Ecological Research Monographs

Tetsu Sato
Ilan Chabay
Jennifer Helgeson *Editors*

Transformations of Social-Ecological Systems

Studies in Co-creating Integrated Knowledge Toward Sustainable Futures

Springer

Ecological Research Monographs

More information about this series at http://www.springer.com/series/8852

Tetsu Sato • Ilan Chabay • Jennifer Helgeson
Editors

Transformations of Social-Ecological Systems

Studies in Co-creating Integrated Knowledge Toward Sustainable Futures

Springer

Editors
Tetsu Sato
Research Institute for Humanity and Nature
Kyoto, Japan

Ehime University
Matsuyama, Japan

Ilan Chabay
Institute for Advanced Sustainability Studies
Potsdam, Germany

Jennifer Helgeson
National Institute of Standards and Technology
Gaithersburg, MD, USA

ISSN 2191-0707 ISSN 2191-0715 (electronic)
Ecological Research Monographs
ISBN 978-981-13-2326-3 ISBN 978-981-13-2327-0 (eBook)
https://doi.org/10.1007/978-981-13-2327-0

Library of Congress Control Number: 2018959135

Cover illustration: *Left*: Pole-top aquaculture of corals in the coast of Onna Village, Okinawa, Japan (Chapter 3); *Top Right*: Rice terraces in Ifugao, the Philippines (Chapter 11); *Bottom Right*: Decision Theater of the Decision Center for a Desert City (DCDC) at Arizona State University, USA (Chapter 18). Photos by Tetsu Sato.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Preface

In the midst of anthropogenic impacts causing a multitude of global environmental problems, we have been observing various initiatives by local communities across the world aimed at tackling such sustainability challenges. It is critically important to scale-up such local actions to achieve societal transformations that are applicable at broader scales. Key to achieving this goal is greater understanding of underlying processes that allow these initiatives to create mutual learning and co-production of knowledge, which support effective, informed decision making and actions to achieve sustainability. Through collaborative processes in communities, transdisciplinary knowledge co-production among diverse stakeholders has been mobilized to establish a shared knowledge base among relevant actors. We denote this as Integrated Local Environmental Knowledge (ILEK), which effectively supports collaborative decision making and actions toward transformations to sustainable societies.

The Research Institute for Humanity and Nature (RIHN), Kyoto, Japan, promotes solution-oriented research addressing complex global environmental problems through transdisciplinary approaches in collaboration with diverse stakeholders in society to critically examine how the interactions between humanity and nature could be. RIHN has created and conducted many inter- and trans-disciplinary research projects in various regions of the world covering a wide range of the targets of Sustainable Development Goals (SDGs) and resonating with the Future Earth initiative, inviting and collaborating with creative researchers in Japan as well as from the world. As a part of this effort, RIHN conducted the research project "Creation and Sustainable Governance of New Commons through Formation of Integrated Local Environmental Knowledge (ILEK project)" for 5 years since April 2012. The ILEK project collaborated with researchers and stakeholders in local communities of the world to explore mechanisms and important factors enabling co-creation of solution-oriented knowledge addressing complex sustainability challenges. Furnished with novel concepts of ILEK as a dynamic and complex knowledge system, as well as important actors of knowledge co-production including "residential researchers" and "bilateral knowledge translators," the project endeavored to understand and promote transdisciplinary processes to facilitate decision making and actions for sustainable futures in each local community and the project as a whole. In collaboration with the project members deeply embedded to local communities and with international research partners, including the Knowledge, Learning and Societal Change Alliance (www.KLASICA.org) at the Institute for Advanced Sustainability Studies (IASS) in Potsdam, Germany, it accumulated case studies of transdisciplinary knowledge co-production at local, as well as at broader or global scales and levels, produced a conceptual model of knowledge-based societal transformations, and facilitated various collaborative actions. These processes also provided ample opportunities for mutual learning among all participating members, which resulted in obtaining important insights and triggered further creative transdisciplinary processes to address complex sustainability challenges.

This book presents a collection of case studies and comparative analyses from communities, which are used to illuminate and clarify processes and factors promoting co-production and utilization of ILEK to support collaborative decision making and actions toward sustainable futures that require societal transformations. This book aims to summarize the theory, approaches, societal impacts and academic implications of such transdisciplinary knowledge co-production, focusing on actors in local communities as the source of knowledge comprising ILEK. All lead authors of the chapters in this book are dedicated members of ILEK project having deep rooted ties with local communities in various areas of the world. They have engaged in transdisciplinary co-production of knowledge throughout the process of the project with numerous opportunities for collective thinking and deliberation, including a series of international symposia and transdisciplinary field researches. Some of them are also active in promoting interactions between local actions and wider or even global initiatives to create scale-up potentials of local practices. Readers will gain a comprehensive picture of this novel aspect of transdisciplinary knowledge co-production as an issue-driven and solution-oriented science, and understand its relationship to the processes of societal transformations toward sustainability. We, the editors, sincerely hope that this book can expand and deepen the readers' understanding of science-society interactions that contribute to collaborative solutions for complex sustainability challenges facing contemporary societies.

In addition to ILEK project and RIHN, we are deeply indebted to diverse institutions, organizations and people to support researches underlying chapters of the book, for whom it is impossible to provide the whole list. A short list of selected names is given at the end of this book to express our gratitude. A significant part of the research in ILEK project was also supported by the Research Institute of Science and Technology for Society, Japan Science and Technology Agency "Transdisciplinary Study of Natural Resource Management under Poverty Conditions Collaborating with Vulnerable Sectors", (Tetsu Sato, feasibility study: 2015, trial: 2016) and Grant-in-Aid for Scientific Research (A), The Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT), "Environmental Governance in Plural Values with Focus on Natural Resource Management and Renewable Energy" (No. 24243054, Taisuke Miyauchi, 2012–2015).

Funding for research in some chapters were provided by various funding agencies including Grant-in-Aid for Scientific Research, MEXT, Nos. 15H04562 (B: Shigeru Yanaka, Chap. 3), 15 K00673 (C: Kenji Kitamura, Chap. 7), and Grant-in-Aid for Young Scientists No. 26740060 (B: Reiko Omoto, Chap. 13), Social Sciences and Humanities Research Council of Canada, Partnership Development Grant (Maureen G. Reed and the Canadian Biosphere Reserves Association, Chap. 10), MEXT Special Education and Research Expenses and JICA Partnership Program for Kanazawa University (Koji Nakamura, Chap. 11), The Mitsui & Co. Environment Fund (Akiko Sakai, Chap. 14), and Institute for Advanced Sustainability Studies (IASS) and International Social Sciences Council under the Transformations to Sustainability Programme (Ilan Chabay, Chap. 21). We express our sincere gratitude for these supports.

And last but not least, we thank all members and many collaborators of ILEK project for enjoying stimulative collective thinking throughout the project, and dedicated administrative staff in RIHN, especially Atsuko Fukushima, for their indispensable participation and support to the project. Publication of this book would never be realized without it.

Kyoto, Japan — Tetsu Sato
Potsdam, Germany — Ilan Chabay
Gaithersburg, Maryland, USA — Jennifer Helgeson

Contents

Chapter 1
Introduction

Tetsu Sato, Ilan Chabay, and Jennifer Helgeson

Global social and ecological problems, including degradation of ecosystem services at multiple scales, pose a major threat to human well-being and long-term survival. To address the various environmental challenges facing human societies at local, as well as global levels, it is critically important to develop an understanding of the opportunities for and consequences of individual and collective actions appropriate to social-ecological systems at the relevant scale(s). Additionally, greater understanding of the interconnections between constituent elements of complex social-ecological systems is vital in maintaining needed ecosystem services.

The degradation of ecosystem services, as well as increasing inequities and poverty are derived from common root causes, including, but not limited to, economic globalization and demographic changes. These global causes fundamentally influence the characteristics and structures of local social-ecological systems. Yet, at the same time, in response to the global causes, various local or regional initiatives have been developed to more sustainably manage ecosystem services and functions in communities around the world. Thus, it is important to develop a deeper understanding of individual and collective actions at multiple spatial scales and governance levels.

T. Sato (✉)
Research Institute for Humanity and Nature, Kyoto, Japan

Ehime University, Matsuyama, Japan
e-mail: tetsu@chikyu.ac.jp

I. Chabay
Institute for Advanced Sustainability Studies, Potsdam, Germany
e-mail: Ilan.Chabay@iass-potsdam.de

J. Helgeson
National Institute of Standards and Technology, Gaithersburg, MD, USA
e-mail: Jennifer.helgeson@nist.gov

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_1

Understanding collective behavior change is also the mission of the knowledge, learning, and societal change research alliance (KLASICA.org), which has benefited from and substantially contributed to the research project entitled "Creation and Sustainable Governance of New Commons through Formation of Integrated Local Environmental Knowledge" (ILEK project) on which this book is based.

This book contains a collection of case studies and comparative analyses, which have been chosen to illuminate processes and factors for co-production and utilization of integrated knowledge in support of collaborative decision making and actions toward societal transformations to sustainable futures. This book aims to summarize the theory, approaches and implications of integrated transdisciplinary knowledge co-production for decision making and actions by local actors in communities. This approach is referred to as Integrated Local Environmental Knowledge (ILEK) in this book (Sato 2014). Chapter authors, both scientists and practitioners, have deep-rooted ties with local communities in various areas of the world and have engaged in transdisciplinary co-production of knowledge. Some of them are also active in promoting interactions between local actions and wider or even global initiatives to expand the impacts of local practices. It is our hope that readers will gain a comprehensive picture of this novel aspect of transdisciplinary knowledge co-production as an issue-driven and solution-oriented science, and understand its relationship to the processes of societal transformations toward sustainability. This book can expand and deepen the readers' thoughts on science-society interactions that contribute to collaborative solutions for a range of social-ecological problems.

In this book, we argue for the importance of collaborative processes of knowledge co-production by stakeholders - including scientists - in local communities, leading to better informed and more effective decision making and associated actions, not only at the local level, but extending to broader scales and levels. The local communities were observed responding dynamically to the challenges they faced and were not defined by static demarcation. Boundaries, geographical areas and participants of communities of practice are highly variable and evolve dynamically, based upon the processes employed to tackle relevant challenges. These local communities are critical components of transformative processes within social-ecological systems to ultimately achieve sustainable futures. They serve as the sources of contextual knowledge contributing to societal transformations, and the locus of collective actions that have the potential to influence decisions and actions at broader scales and multiple levels. On the other hand, local communities are complex systems embedded in and made up of social-ecological systems, in which societal and environmental processes are not separable, but tightly interact with each other in a complex way (Berkes et al. 2003; Folke 2007; Ostrom 2009). Adaptive and collaborative approaches to management and governance are required, involving diverse stakeholders, including scientists, to achieve beneficial transformation of complex social-ecological systems.

Communities are a critical arena for transdisciplinary (TD) knowledge co-production processes, which involve recognition of challenges and creating shared perspectives and visions of solutions and actions. Knowledge co-production through transdisciplinary processes and collective actions among diverse stakeholders are prerequisites to solving complex social-ecological challenges. Therefore, we focus on the development of an integrated knowledge base that in turn supports self-organized and collective decision making and actions among local stakeholders. We refer to this process and the associated outcomes as ILEK.

Various studies have recorded and analyzed characteristics of knowledge systems in local communities; these include: *traditional ecological knowledge* (TEK, Berkes 2008), *local ecological knowledge* (LEK, Olsson and Folke 2001; Houde 2007) and the *knowledge-practice-belief complex* (Berkes et al. 2000). Compared with these previously established concepts of knowledge systems, ILEK is characterized by its transdisciplinary nature and dynamic knowledge co-production, as well as its mandate to address the clear need to find and develop solutions to social-ecological challenges. ILEK is a transdisciplinary blend of heterogeneous knowledge systems from academia and a variety of other actors for responding to complexities of social-ecological challenges. It is issue-driven and solution-oriented knowledge co-production, which is clearly different from discipline-based and primarily curiosity-driven processes in conventional science (including social sciences and the humanities). ILEK is dynamically produced and transformed through collaborative actions among diverse stakeholders and scientists in tackling complex social-ecological challenges. Multiple knowledge systems, including traditional, culturally-specific knowledge, local procedural knowledge acquired in daily life and livelihoods, and scientific knowledge as well, are integrated and blended through transdisciplinary dialogical processes to effectively build a shared knowledge base for decision making and actions. Different societal actors are involved in these co-production processes, including scientists, skilled workers in primary industries, local and broader level governments, companies, NGOs and media. Scientists often assume a new role for themselves in ILEK co-production by integrating and systematizing ILEK to build up knowledge bases for decision making and actions (Fig. 1.1, Kitamura et al. 2018).

The ILEK project ran for five years from April 2012 to March 2017 at the Research Institute for Humanity and Nature in Kyoto, Japan. In this project, we conducted case studies to compare processes that were used to tackle different local social-ecological challenges in various communities of the world. This allows us now to clarify processes and factors promoting creation and effective application of ILEK as a knowledge base and facilitate emergence of broader impacts through interactions among stakeholders across different scales and levels through TD processes. We also examined the interactive processes and mutual learning among knowledge producers and knowledge users to elucidate mechanisms of societal transformations based on dynamic production of knowledge in communities.

In the ILEK project, we identified important actors in the transdisciplinary knowledge co-production process. Residential researchers are defined as scientists and other types of knowledge producers living in a local community with the mission of facilitating and mediating the co-production of knowledge for collaborative decision making and actions to solve environmental problems (Sato 2014). They play a role in bringing scientific knowledge into knowledge co-production processes, but at the same time they may wear multiple hats. They combine different

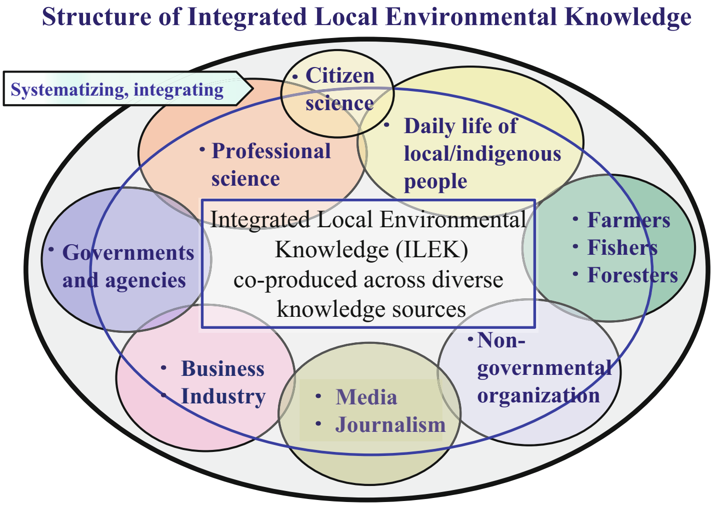


Fig. 1.1 Structure of Integrated Local Environmental Knowledge (ILEK) and diversity of knowledge producers

knowledge sources and types for informing certain actions. They are also residents of the community who understand and often share local value systems, culture, perceptions and governance mechanisms, and participate in community policy formation and implementation as a citizen. Many residential researchers have taken part in transdisciplinary knowledge co-production as a byproduct of the multiple functions they serve in their communities.

These residential researchers are also likely to play a role as bilateral knowledge translators bridging gaps between diverse knowledge systems to develop a basis for sharing knowledge among actors (Kitolelei and Sato 2016). Bilateral knowledge translators are defined as individuals and/or groups able to bridge gaps between heterogeneous sets of knowledge (including specialized know-how) that emerge from different framings of knowledge, by creating new meanings of the knowledge from different perspectives or different epistemic communities and which are rooted in societal challenges (Sato, T., Omoto, R., Kitamura, K., unpublished). They facilitate circulation and sharing of knowledge to promote collaborative decision making and actions among actors for adaptive societal transformation. As shown in Fig. 1.2, their roles are classified into two categories: (1) cross-scale and (2) horizontal translators. The first, cross-scale translators bridge gaps between sets of knowledge/technologies produced at different spatial scales and/or governance levels, by creating their new meanings from the contexts of challenges at other scales and levels. Cross-scale translators may be further categorized by top-down and bottom-up types. Top-down type translators mainly interpret knowledge produced at broader scales/levels from local perspectives. Bottom-up type translators mainly create new meanings of local knowledge from the broader perspectives. Horizontal translators bridge gaps between heterogeneous sets of knowledge,

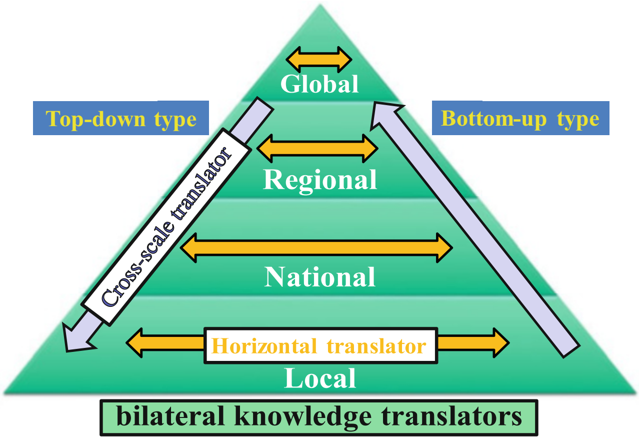


Fig. 1.2 Diverse types of bilateral knowledge translators and their functions

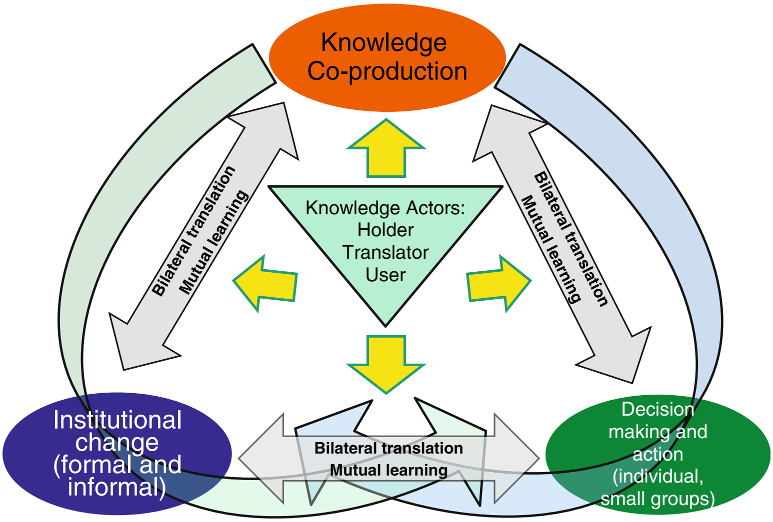


Fig. 1.3 Conceptual model of knowledge-based societal transformation toward sustainable futures (ILEK Triangle)

including those brought by cross scale translators, at a particular spatial scale and/or governance level. They create new meanings of knowledge from contexts at the same scale and level.

The processes and mechanisms of knowledge-based adaptive societal transformation are represented in the ILEK Triangle conceptual model (Fig. 1.3, Kitamura et al. 2018). This model is composed of interactive linkages among three important elements of ILEK-based adaptive transformation: (1) knowledge co-production, (2) decision making and action at individual or small group level, and (3) institutional change (both formal and informal). These elements and the relevant interactions among them are, in turn, mobilized by bilateral knowledge translation and mutual learning among various knowledge actors, including: (1) knowledge holders, (2) knowledge translators and (3) knowledge users. It is important to note that any one individual or group may be a member of more than one actor type with different degrees of commitment; and in some cases, they may change actor types during the knowledge co-production process.

In this model, the co-production of knowledge is hypothesized to lead to dynamic societal transformations toward sustainability through two different pathways. In the first pathway type, change is initiated by alterations in individual decisions and actions that lead to adaptive institutional changes. In the second pathway type, change is initiated by effective alterations in formal and informal institutions that in turn deliver impacts on individual/small group behavior.

We have identified important categories of enablers for knowledge-based adaptive societal transformation toward sustainable futures from various local case studies using the process identified in the ILEK Triangle. Here we introduce five such enabler categories. Firstly, co-produced knowledge can identify and allow collective visualization of new sharable values in local communities that may serve to mobilize collaborative decision making and actions (i.e., *"identify and visualize values"*). Secondly, it may build new linkages among actors within and outside the community, including actors addressing broader issues (i.e., *"build new linkages")*. Thirdly, the co-produced knowledge may expand options and opportunities for sustainable actions among stakeholders and mediates changes in environmental perception (i.e., *"provide options and opportunities"*). The shared knowledge may directly enable and facilitate collective actions, which transform existing local institutions or form new ones (i.e., *"facilitate collective actions"*). And finally, knowledge translators (individuals or institutions), playing their roles at multiple scales and levels, can catalyze all these processes by employing and emphasizing new contextualization of knowledge (i.e., *"encourage multiple translators and viewpoints"*). These different categories of enablers are working in a synergetic way to mobilize collective decision making and action toward societal transformations.

This book is composed of five parts corresponding roughly to the ILEK Triangle model and five categories of enablers. Part 1: "Co-producing knowledge," is composed of four chapters and focuses on the transdisciplinary knowledge co-production and meaning making in relation to the roles played by influential actors, including residential researchers and bilateral knowledge translators. Part 2: "Conceptualizing Values," deals with functions of transdisciplinary processes to identify and visualize new values in three case studies, corresponding to the enabler category of "identify and visualize values" in the ILEK Triangle. Part 3: "Processes of Mobilization," is related to the enabler category of "encourage multiple translators and viewpoints" to promote adaptive processes of societal transformation, focusing social learning, human capacity development and catalyst roles of knowledge translators. Part 4: "Building Linkages," introduces four case examples to transdisciplinary knowledge co-production that established new linkages of actors within and across communities to mobilize decision making and actions. Part 5: "Supporting Decisions and Actions," is composed of five chapters illustrating practical approaches to mobilize transdisciplinary approaches to overcome a variety of limitations and difficulties. Each chapter is based on actual cases of transdisciplinary knowledge co-production in specific local settings that enable conditions for collective action on local social-ecological challenges. Chapters in this book are not abstract theories, but practical guides for producing, sharing and utilizing an integrated knowledge base such as ILEK.

Throughout this book, readers will find detailed pictures from a wide range of case studies of production and utilization of the ILEK. These studies of integrated, issue-driven and solution-oriented transdisciplinary knowledge co-production processes will help to understand the actual processes of societal transformation toward sustainability. This solution-oriented transdisciplinary science should have practical value in the real world. We sincerely hope that the attempt to provide systematic views of the implementation of transdisciplinary knowledge co-production processes will contribute to expanding and deepening the readers' thoughts on science-society interactions and thereby contribute to innovative, collaborative actions in diverse communities towards solutions to complex social-ecological challenges.

References

Berkes F, Colding J, Folke C (2000) Rediscovery of traditional ecological knowledge as adaptive management. Ecol Appl 10(5):1251–1262

Berkes F, Colding J, Folke C (eds) (2003) Navigating social-ecological systems: building resilience for complexity and change. Cambridge University Press, Cambridge

Berkes F (2008) Sacred ecology: traditional ecological knowledge and resource management, 2nd edn. Routledge, New York

Folke C (2007) Social-ecological systems and adaptive governance of the commons. Ecol Res 22:14–15. https://doi.org/10.1007/s11284-006-0074-0

Houde N (2007) The six faces of traditional ecological knowledge: challenges and opportunities for Canadian co-management arrangements. Ecol Soc 12(2):34

Kitamura K, Nakagawa C, Sato T (2018) Formation of a community of practice in the watershed scale, with integrated local environmental knowledge. Sustainability 10(2):404. https://doi.org/10.3390/su10020404

Kitolelei JV, Sato T (2016) Analysis of perceptions and knowledge in managing coastal resources: a case study in Fiji. Front Mar Sci 3:189. https://doi.org/10.3389/fmars.2016.00189

Olsson P, Folke C (2001) Local ecological knowledge and institutional dynamics for ecosystem management: a study of Lake Racken watershed, Sweden. Ecosystems 4:85–104

Ostrom E (2009) A general framework for analyzing sustainability of social-ecological systems. Science 325:419–422. https://doi.org/10.1126/science.1172133

Sato T (2014) Integrated local environmental knowledge supporting adaptive governance of local communities. In: Alvares C (ed) *Multicultural Knowledge and the University*. Multiversity India, Mapusa, pp 268–273

Part I
Co-producing Knowledge

Part I focuses on the characteristics of knowledge production and meaning making in relation to issue-driven, solution-oriented transdisciplinary science. Scientists and experts with long-term, deep commitments to local communities, which include residential researchers, and stakeholders without specific scientific expertise play significant roles in knowledge co-production and integration. The characteristics of integrated knowledge bases and the processes that promote their integration are described from perspectives derived from local case studies.

Chapter 2
Making Meaning of Traditional Agricultural Knowledge: Ground Water Management in Arid Areas of Turkey

Takashi Kume and Erhan Akça

Abstract This chapter introduces a case study focused on the problem of groundwater depletion resulting from the use of modern irrigated agriculture in an arid region that relies on groundwater, along with initiatives that have been made to address the problem. It became apparent, as a result of interaction with a diverse range of stakeholders, that local environmental knowledge possessed by pickling melon farmers and rain fed wheat farmers – groups of people that could be described as the socially vulnerable in the region studied in this chapter – has the potential to open up new markets as well as reduce the pressures on consumption of groundwater resources. The authors discovered that this local environmental knowledge connected with agriculture that is founded on the traditions and cultures of the socially vulnerable could help solve a series of regional issues caused by large scale modern irrigated agriculture which is run by farmers described as the socially privileged. As described in this chapter, the authors utilized a transdisciplinary approach in cooperation with a diverse range of stakeholders to visualize the problems at hand and to uncover and catalog local environmental knowledge, the content of which forms a story for solving local issues and creating a new history.

2.1 The Depletion of Groundwater

2.1.1 Global Situation Surrounding Groundwater

Fresh water makes up only around 2.5% of the world's water, with the remaining 97.5% consisting of salt water (Shiklomanov and Rodda 2003). It is said that of this fresh water, approximately 30% is groundwater, equivalent to somewhere in the

T. Kume (✉)
Ehime University, Matsuyama, Japan
e-mail: kume@ehime-u.ac.jp

E. Akça
Adiyaman University, Adiyaman, Turkey

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_2

region of 0.75% of the total amount of water globally. Around 70% of fresh water resources are used for agricultural purposes.

The world's irrigated agricultural land covers about 300 million ha, of which an estimated 38% is irrigated using groundwater, and that an annually 545 km^3 of groundwater is used for this purpose (Siebert et al. 2010).

Globally speaking, Japan experiences comparatively large volumes of rainfall and has a humid climate, which is why it also has comparatively large volumes of groundwater recharge, in the region of 350–400 mm per year (statistics taken from Editing Committee for the Revised Groundwater Handbook 1980). However, in arid regions, which have very low rainfall volumes of only 300 mm per year, the volumes of groundwater recharge are almost zero.

2.1.2 Irrigated Agriculture and the Problem of Groundwater Depletion

From this perspective, irrigated agriculture, which utilizes groundwater, needs to be conducted in a way which pays extra care to storage volumes and recharge volumes, something which is particularly vital in arid regions. In arid regions, which have plentiful solar radiation and vast land areas, production volumes can easily be increased and farmers are able to enjoy a good livelihood through the introduction of irrigation, heavy machinery and chemical fertilizers. As a result, groundwater supplies are continually under use, pushing these regions ever closer to the threat of groundwater depletion. Arid regions that rely on groundwater can be found around the world. Groundwater depletion is an environmental problem that causes social issues in the form of the transformation and collapse, not only of sustainable agriculture in the area, but also local communities themselves. Also, if groundwater becomes depleted, the vast tracts of land that had once been covered in crops become exposed to the elements; if this situation continues in the long run, it can lead to increased damage from wind erosion (Akça et al. 2015). The end result of this is desertification and the supply of dust particles into the atmosphere like yellow sand, and the various environmental issues which exist in different areas come to symbolize global environmental problems with a reach extending throughout the planet.

This chapter examines the problems associated with groundwater depletion faced by arid regions with large scale irrigated agriculture that rely 100% on groundwater, along with the content of initiatives that have been made to address the problems through dialog with a diverse range of local stakeholders. It describes how two different minor forms of agriculture, the practitioners of which could be described as the socially vulnerable, encountered during this research have the potential to solve these problems. Based on this, it goes on to discuss the knowledge base gained from such forms of agriculture and the utilization of this in an attempt to shift to types of agriculture in arid regions that do not rely on groundwater alone.

2.2 Karapinar's Natural Environment and Agriculture

2.2.1 An Arid Region that Has Successfully Kept Desertification in Check

The area of study in this chapter is Karapinar City, located in Konya Province, the Republic of Turkey. Karapinar has an annual rainfall level of 300 mm, a high temperature of 38 °C in the summer, and a low temperature of −10 °C in the winter, making it a typical cold arid region. It occupies an almost central position in the Anatolian Plateau, is situated at an altitude of somewhere in the region of 1000 m, and has a flat topography.

Karapinar, an arid region, has a history of curbing the effects of desertification since the 1960s, something it has managed to achieve through the planting of trees. The initiatives taken to prevent desertification are known throughout Turkey as a notable success story of what can be achieved through such action. The organization behind these initiatives is the Soil and Water Research Institute of Ministry of Food, Agriculture and Livestock. This research institute is a residential research institute that, in addition to projects seeking to prevent desertification, provides the results of its research endeavors regarding regional irrigated agriculture to farmers in the form of information (Sato 2009).

The environmental problems that this area is currently experiencing include groundwater depletion and the formation of giant sinkholes (Fig. 2.1) thought to

Fig. 2.1 A sinkhole measuring 20 m in diameter with a depth of 40 m that opened up as a result of declining groundwater levels

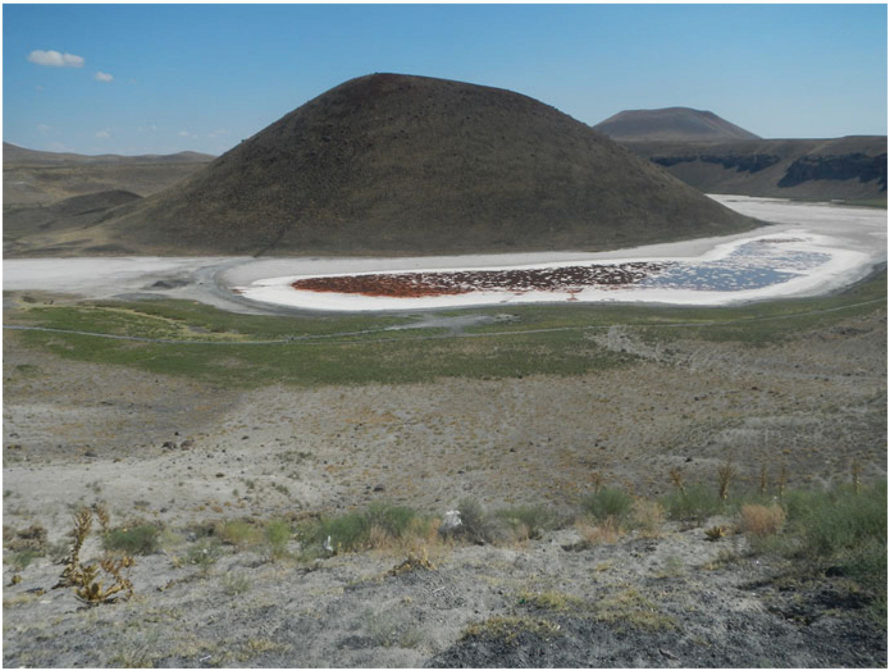


Fig. 2.2 Meke Crater Lake, a local symbol of ongoing exsiccation

be caused by this. The main factor behind groundwater depletion is shifting to irrigated agriculture. It is said that the sinkholes found in neighboring areas are caused by the same mechanisms as ground subsistence, which arises through the pumping-up of waste water (Çelik and Afşin 1998). A total of 33 sinkholes opened-up in the period from 1979 to 2009 (Yılmaz 2010) and three more developed only in 2016. Furthermore, decreasing levels of groundwater in this region have caused the lake water Meke Crater Lake (Fig. 2.2), a local symbol, to recede year by year. At the time of writing, the lake bed is almost completely exposed.

2.2.2 Agriculture in Karapinar

Large scale modern irrigated agriculture which uses groundwater, the main factor behind today's groundwater depletion, began in this area in the year 2000 and has continued (Fig. 2.3). There are many farmers in Karapinar, both large and small. Their operations range in scale from major farmers with center pivot irrigation systems in agricultural land in excess of 100 ha to farmers with only a few hectares of land. All depend 100% on groundwater for irrigating their land.

Karapinar City has a population of roughly 40,000 people, among whom approximately 20,000 people are farmers. Among these agricultural workers, about 18,000

Fig. 2.3 Large scale modern irrigated agriculture which relies on groundwater

people are members of Karapinar Agriculture Chamber, which provides support for all activities relating to agriculture. It is this chamber that has acted as the flagbearer for modern irrigated agriculture in Karapinar. The chamber's main work consists of registering loans related to agriculture, providing information on agricultural technologies, and mediation services for seeds, fertilizers and agricultural chemicals, but it is also a residential research institute equipped with a soil inspection laboratory.

The history of irrigated agriculture in Karapinar is relatively recent, dating back to around 1950, and it was in 1968 that the first well for irrigation was dug. At that time, marshy areas could be found here and groundwater existed at a depth of just a few meters, meaning that there was a high soil moisture content throughout the year and irrigation using wells was small-scale in nature. A series of large drainage canals that were once used to drain excess water in marshy regions still exist.

2.2.3 *Where Does Groundwater in This Area Come From?*

Looking at data on transitions in groundwater levels in Karapinar in recent years, we see that there are some locations in which groundwater levels have dropped by as much as 20 m over the past decade, with an average level of reduction of 1–3 m per year (Doğdu and Sağnak 2008). Our measurements show an annual level of reduction of 3 m in some locations. According to analysis of radioactive dating using the radioactive isotopes of carbon etc., today's groundwater in Karapinar recharged from the Taurus Mountains, 35 km away, around 10,000 years ago (Bayari et al. 2009).

Interviews conducted with multiple farmers in this area suggest that while there is a slight difference in water levels in some places, the current water level is at a depth of around 60–80 m from the ground surface, at its deepest reaching 100–150 m. Water levels are decreasing year by year, and pipes are frequently added to enable water to be pumped up.

Karapinar has a base rock layer at a depth of around 150–200 m; as such, if water decreases to this level, it will result in the destruction of the base rock layer and groundwater will need to be pumped up from underneath. It has been suggested that groundwater in deeper layers may contain dissolved sulfur and heavy metals.

2.3 Shock at Water Intake Restrictions

2.3.1 Sudden Notification from the General Directorate of State Hydraulic Works

During the first year that the authors commenced this research project, some major news broke out. This was the legalization in February 2013 of water intake restrictions for groundwater covering the whole of Turkey, including Karapinar. In accordance with a letter issued by the General Directorate of State Hydraulic Works (DSI), an order was given to reduce water intake volumes of groundwater to 200 mm per year.

In Turkey, Section 167 of the Groundwater Act was drawn up in 1960, which requires the issuance of a certificate of usage upon filing of notification when digging and using wells. While the number of wells in Karapinar alone is unclear, there are in the region of 200,000 wells in the Konya river basin area, which includes Karapinar, of which around 90,000 are illegal – i.e., uncertificated wells for which notification has not been given (Yilmaz 2010). The annual water extraction exceeded 4.5 Billion m^3 which is almost double of the allowed annual level of 2.4 Billion m^3 for Great Konya Basin (Pınarkaya et al. 2013).

As a result of this large number of unlicensed wells having been dug, groundwater levels were confirmed to be dramatically decreasing throughout Turkey. Therefore, the following item was appended to Section 126 Clause 167 of Article 10 of the Law relating to Groundwater, dated December 16, 1960 (Part of this law has been omitted. (The following text was translated from the original Turkish into Japanese by Shizue Miura, a member of the Japan-Turkey Society, Turkish interpreter and archaeologist.).

> Certificates of usage will not be issued in the event that a detection system for groundwater volumes drawn from wells, underground passages, tunnels or their equivalent has not been installed. This detection system is prescribed by law.

In addition, the following provisional clause was appended to Section 127 Clause 167 (partially omitted).

> Provisional Clause 3 – Those individuals who had already established wells, underground passages, tunnels or their equivalent prior to the date of the issuance of this clause and who are already in possession of a certificate of usage are to install the detection system prescribed in Article 10-2 within a period of 2 years. Those who fail to install a detection system within this period will have their certificate of usage revoked by the General Directorate of State Hydraulic Works, and the costs associated with the closing off of (wells etc.) will be borne by the owner.

The detection system mentioned in the above text is a kind of device that stops water intake for that year once the set level has been reached. As the letter states, though, even after this law was revised, there are still many illegal wells etc. for which a detection system has not been installed. As the law implies, if the owners of these wells do not install the system by February 25, 2013, they will have their certificate of usage revoked and even their electricity will be cut off.

2.3.2 Farmers Filing Petitions

Naturally, the changes to this law were met with a backlash from farmers. In Karapinar, where people rely 100% on groundwater to irrigate their crops, these restrictions on water intake represent a matter of life and death. For example, if a farmer who grows crops on a field that requires 600 mm of irrigation water is restricted to 200 mm in water intake, it means that the total area of cultivation will be reduced to 1/3 and his income likewise by 1/3.

Karapinar Agriculture Chamber filed a petition in response to this to the Grand National Assembly of Turkey in October 2012. The content of this stated that a water intake volume of 200 mm was insufficient for agriculture and that, as a result, the area of irrigated land would decrease and the farmers would experience a dramatic drop in their income. Next, it also stated that if the land was no longer covered by cultivated crops, soil run-off due to erosion would occur, leading to the risk of desertification occurring once more in Karapinar, a model area in Turkey for preventing desertification.

Moreover, Karapinar Agriculture Chamber requested that the General Directorate of State Hydraulic Works (DSİ, Devlet Su İşleri) disclose information providing clear scientific evidence of the reasoning behind its decision to set water intake at 200 mm. However, at present no clear answer has been received from the General Directorate of State Hydraulic Works detailing how it arrived at this figure. Perhaps this petition and request for disclosure of information had the desired effect, as the restrictions on water intake have been postponed on two occasions, and have yet to come into effect.

Fig. 2.4 A stakeholder workshop in progress (October 22, 2014)

2.4 Issues and New Light that Have Become Apparent Through Collaboration with Stakeholders

2.4.1 Aims of the Stakeholder Workshops

During the course of the surveys being carried out in Karapinar, which had been plunged into turmoil at the prospect of these restrictions on water intake, the authors held a series of three local workshops (Fig. 2.4) from April 2012 to March 2016 (Tables 2.1 and 2.2). In addition, during a local visit, we were introduced to some farmers and given consent to conduct a series of interviews with them through the mediation of Karapinar Agriculture Chamber. The aim behind these initiatives was to understand how the farmers themselves felt about the restrictions on water intake and the problem of groundwater depletion, and to gain a clearer picture as to what steps should be taken in the future to address the issues at hand.

The workshops proved extremely fruitful for our research. As a result, we could bring the issues facing the region back into focus and gleaned hints that would help shed new light on the content. For the remainder of this section, all quotation marks signify remarks that were made at meetings or during interviews.

Table 2.1 Overview of workshops and main participating organizations (with the exception of farmers)

Workshop	Date	No. of participants	Main participating organizations	Overview (aims)
1st workshop	February 7, 2013	Around 60 people	1	Clarify local issues through free discussion relating to agriculture and water problems
2nd workshop	October 22, 2014	Around 50 people	1, 2, 3, 4, 6, 7, 8	Exchange information on the future of the region with a diverse range of stakeholders, including students and female laborers, with a focus on the issue of groundwater
3rd workshop	January 9, 2016	Around 60 people	1, 4, 5, 7	Discuss what stakeholders can do to contribute to the future of Karapinar

Numbers of main participating organizations correspond to numbers of name of stakeholder in Table 2.2

Table 2.2 Participating individuals and organizations in this research adopting a transdisciplinary approach

Name of stakeholder	Content of work
1. Karapinar Agriculture Chamber	A private organization made up of around 18,000 farmers. It is the biggest stakeholder, contributing to the region's agriculture through the provision of information and technologies, including the provision of technologies to farmers, soil diagnostics, and mediation services for bank loans etc.
2. Mayor of Karapinar City	City mayor
3. District Governor of Karapinar City	Head of Karapinar's municipal government (public sector worker)
4. Soil and Water Research Institute	A governmental research institute that conducts research relating to crops, water, economics, and desertification
5. Konya Central Irrigation Union	An organization which manages and runs irrigation facilities in Konya Province
6. Bahri Dagdas International Agricultural Research Institute	A private agricultural research institute set up by a former Minister for Agriculture
7. Karapinar Trade Association	Karapinar's trade association, providing sales, processing and distribution of crops
8. Media representatives	Karapinar newspaper and journalists from surrounding areas

2.4.2 *Farmers and Groundwater*

The region faces serious problems when it comes to groundwater. "Everyone has known for a while now that the water will disappear if things continue like this." "We need to think carefully about how much water will be left for our children, on whose shoulders the future rests."

Movements among farmers to conserve groundwater had been limited to the bottom up stance of, "We do not waste water." It would seem, though, that people have moved to a passive stance of waiting for the government to unfurl top down policies. "If we had sufficient assistance from the government, we would move away from crops that require large amounts of water." "We would not need assistance for irrigation if we received assistance for rainfed agriculture."

In addition, as Karapinar does not have any rivers or river basins, many were of the opinion that, when it comes to securing alternative sources of water, "If the water disappears, then all we have to do is draw it up from another location."

Nobody appeared to voice remarks that were contrary to opinions such as those above. In other words, at the very least, those who took part in the workshops were almost unanimously of the view that they had already done everything they could, which is why they felt that the government should step in to handle the rest. We can also interpret this as a state of dependence on the government. In addition to the aforementioned kinds of remarks, there were more than a few people who also voiced the following sentiments concerning subsidies from the government: "We will undergo soil inspections for the simple reason that we can receive subsidies from the government. If these subsidies were to be cut off, we would not be inclined to undergo soil inspections."

2.4.3 How Is Irrigation Water Being Used?

"We do not use irrigation water in ways that are wasteful." This was a remark that came up time and time again, which is why the authors decided to ask farmers individually during interviews to clarify how they use irrigation water. This section presents the results of the survey using interviews from 5 randomly selected farmers and remarks made by participants during the workshops.

As Table 2.3 shows, it became apparent that the volumes of irrigation water being used by the farmers in Karapinar who took part in this study were somewhat excessive for corn and sugar beet when compared with the crop water requirements of FAO (Brouwer and Heibloem 1986). The crop water requirements of FAO serve as only guidelines and it is of course the case that they differ according to the soil,

Table 2.3 Irrigation water volumes in Karapinar and the crop water requirements of FAO (1986)

Crop	Water volumes in Karapinar (mm)	Crop water requirements of FAO (mm)
Wheat (irrigated)	450–600	450–650
Corn	950–1400	500–800
Clover	800	800–1600
Sugar beet	900–1400	550–750
Melons (for pickling)	150–200	400–600

farm's location and other conditions. Regarding corn, the state of germination of the crops was not good during the sowing period and that there were some farmers who conducted seeding once more, which is why there was an increase in volumes of irrigation water at present.

Concerning the volumes of irrigation water being used by the farmers, judging from the conditions under which the farms are being operated, while they tended to use too much irrigation water for sugar beet, overall it would be fair to say that, by and large, groundwater in this area is being using appropriately.

On the other hand, the timing and frequency of irrigation along with the volume of irrigation water used each time are decided by watching others and copying what they do. To begin with, a section of farmers learn the irrigation techniques of agricultural technicians at such organizations as the General Directorate of State Hydraulic Works, the Soil and Water Research Institute and Karapinar Agriculture Chamber. Then, other farmers who learn these techniques by watching and copying the farmers who originally learned them make their own improvements and pass them on to others. While this is perhaps not very scientific, one could say that appropriate irrigation management is being carried out based on experience.

2.4.4 Farmers Who Are Being Led Along and Increasingly Unquestioning Stance Toward Modern Irrigated Agriculture

Karapinar is a famous area in Turkey, despite being just one of many provincial cities. The main reasons for this relative fame is its success in tree planting activities as a means of preventing desertification, as well as its success in dramatically improving productivity through modern irrigated agriculture using groundwater, despite being the area with the smallest rainfall amounts in the country.

Success stories such as these have led to a range of projects being initiated in Karapinar. Beginning with the introduction of modern irrigated agriculture at the initiative of the government, several other projects soon followed in its wake, including a tree planting project, the construction of a new industrial park, a solar power generation station project, and an agricultural greenhouse project. Projects were able to get off the ground as long as they contained the name Karapinar, and all kinds of actors made their way to Karapinar to set up projects and then subsequently left, including governmental bodies, researchers, NGOs, and private businesses connected with agriculture.

Every time a new project was launched, local farmers obtained new information and technologies and had no choice by to abandon their old technologies. These farmers, who were being pulled in various directions, repeatedly invested in new facilities for irrigation. As a result, some farmers who fell into debt started abandoning sections of their agricultural land, and other farmers are now barely able to keep their businesses running.

These farmers, who have been led along by all the information they are being fed, related as follows: “The technologies are becoming more and more advanced every year, which is why it is probably best to keep buying new machinery.” Meanwhile, the former head of Karapinar Agriculture Chamber stated that, “Another problem is that income which has been gained through farming has not been invested effectively.” For example, there are more than a few farmers who have used the income they have obtained through farming to replace their family cars on an almost annual basis.

Modern agriculture in Karapinar initially blossomed as a result of bountiful groundwater and modern irrigation facilities. However, during the workshops, several issues surrounding fertilizers and agricultural chemicals were highlighted. The soil has lost its fertility and the ecosystems upon which microorganisms thrived have been destroyed; thus, there is the never-ending issue of agricultural land which is becoming increasingly unsuited to growing crops. This has made it customary for farmers to use without question the fertilizers and agricultural chemicals that were recommended by manufacturers: “We use the agricultural chemicals we are recommended without question.” As a result, it has served to worsen the problem of farmers blindly accepting what they are given and taking an unquestioning stance toward agriculture.

2.4.5 The Beginnings of Cooperation Brought About by Groundwater Depletion and Restrictions on Water Intake

It is said that Karapinar has “reached a golden age” due to modern agriculture. And yet, it is facing the problem of how to deal with groundwater depletion. In fact, by sharing the issues at hand, the region is currently striving to inject stimulus into cooperative activities aimed at social and economic growth to effectuate sustainable agriculture.

With each workshop that was held, it became apparent that those involved were endeavoring to build stances along the following lines: “The problem of restrictions on water intake has enabled a range of different stakeholders, including farmers, to come together under one roof and meet like this.” “Farmers, Karapinar Agriculture Chamber, researchers, KOP (Konya Plain Project), Konya Sugar Factory and the Soil and Water Research Institute will unite to tackle a range issues together.” Concerning individual issues, such as the problem of artificial chemicals and fertilizers, some technicians from the Bahri Dagdas International Agricultural Research Institute made a specific appeal to the farmers for cooperation. “The thing which is lacking most is dialog. We (Bahri Dagdas International Agricultural Research Institute) are ready to listen to what you have to say.”

In addition, the District Governor along with the Director of the Soil and Water Research Institute made the following remarks: “We also need to start holding gatherings such as these which include individuals from a wide range of professions and organizations." "We need gatherings like these in which a range of people and farmers can participate." This suggests that those involved are gradually coming to realize the importance of cooperation and that moves towards facilitation are starting to emerge.

2.4.6 Visualizing the Story in Which Issues Provide a Chance for Change

The biggest problem surrounding the issues discussed in this chapter is that while moves are being made to affect real cooperation between the diverse stakeholders, the fact remains that, at present, water intake volumes have not decreased in the least. Rather, new wells are being dug and registered, and irrigated agriculture continues to spread unchecked. Even though everyone understands the situation, in reality they are moving in the opposite direction to what which is needed.

In Karapinar, large scale and efficient crop cultivation has been made possible through the implementation of modern irrigated agriculture. In fact, methods of irrigated agriculture that have been learned through watching and copying have generated sufficient profits. Given these circumstances, it is not easy to persuade farmers to reduce their water intake volumes. In order to make this happen, it is necessary to visualize and put into practice a new story.

Karapinar is a region with an illustrious history of having halted desertification through the planting of trees. People there continue to take pride in and talk about the achievements they have made through these activities. And the effects of the steps they have taken continue to this day, with the land coverage provided by afforestation and irrigated agriculture giving rise to a synergistic effect that has facilitated astonishing economic growth. The story of how this region overcame desertification and allowed irrigated agriculture to flourish lies here.

And if Karapinar does not need new state of the art irrigation facilities, it equally does not need restrictions on water intake or agricultural subsidies from the government. It is also not enough for groundwater levels simply to recover to their original levels. What is needed is for the visualization and realization of a new story in which the knowledge and technologies which exist in the region are mobilized on a large scale, and for farmers to cooperate in creating technological and social solutions to groundwater management (Maruyama 2009). By taking these steps, Karapinar would be the first in the world to create sustainable forms of agriculture specifically for arid regions.

Therefore, at the same time as surveys on large scale modern irrigated agriculture, the practitioners of which in this case could be called the socially privileged, we also commenced surveys on comparatively small scale farmers who could be called the socially vulnerable, with the aim of mobilizing the region's knowledge. During our surveys, we encountered pickling melon farmers and rain fed wheat farmers. These farmers, the socially vulnerable in this case, hold the potential to bringing new light to the region.

2.5 The Production of Knowledge in Karapinar and Its Distribution

2.5.1 Pickling Melon Cultivation Which Makes Low Volume Irrigation Possible

In Karapinar, pickled melons are served at meal times as a free side dish. These melons are harvested and pickled just before they ripen, when they are around 15 cm in length. They are cultivated about a half an hour's drive from the city center, on arenaceous agricultural land that differs from other areas of Karapinar.

From interviews conducted among farmers, it became apparent that while the cultivation of regular melons necessitates irrigation to be conducted on 6 occasions (400–600 mm), the cultivation of these pickling melons only requires irrigation to be conducted on 2–3 occasions, with irrigation water volumes in the region of only 150–200 mm (see Table 2.3). By a curious coincidence, these water levels are the same as the 200 mm water restriction set by the General Directorate of State Hydraulic Works. Here, there is very little decrease in groundwater levels, just a fluctuation of around 50 cm during the irrigation season.

Melon cultivation in this area began in the 1980s. To begin with, the General Directorate of State Hydraulic Works dug wells for farmers who did not have wells on their agricultural land, and these wells are being used to conduct irrigated agriculture while being managed in cooperation with the Water Management Union.

Surprisingly these melons are extremely lucrative for the farmers. In usual cases, maize (corn) cultivation yields 3030 USD per 1 ha, but in the case of these pickling melons, it soars to 20,300 USD per 1 ha. However, the problem is that, even excluding irrigation, from cultivation to harvesting, growing melons involves many manual procedures, making mass production difficult (Fig. 2.5). While growing melons involves many manual procedures and hard work compared with modern large scale irrigated agriculture, the agricultural labor is concentrated over short periods and farmers are able to leisurely engage in other lines of work during off seasons. The farmers themselves state that they have no intention to give up this way of life.

Each farmer has his or her own original recipe for pickled melons, and producers and consumers who prefer certain tastes often deal with the same farmer over many years. In addition, during the harvesting season, many farmers set up open air stalls along roads to sell their produce directly (Fig. 2.6). In recent years, export traders who have heard about these melons have been visiting the area to purchase melons

Fig. 2.5 Pickling melons that make it possible to limit irrigation volumes through early harvesting

Fig. 2.6 Harvesting pickling melons

for export to the European countriese for use in salads, showing just how booming the melon cultivation industry is in this region.

2.5.2 Rainfed Wheat, a Practice Which Has Continued Since Before the Common Era

Rainfed wheat came to the attention of the authors during the second workshop, when the District Governor asserted the need to put in place rainfed agriculture as a means of conserving groundwater. Considering this comment, we promptly set about searching for rainfed wheat farmers. However, the farmers that we were introduced to by Karapinar Agriculture Chamber stated that they were no longer involved in rainfed agriculture. Furthermore, we were even told that there were no longer any farmers in Karapinar who practice rainfed agriculture. In addition, in an interview, staff involved in research on irrigation management at the Soil and Water Research Institute stated as follows: "Rainfed agriculture is beyond our capabilities."

According to materials from Karapinar Agriculture Chamber, as of 2012 in Karapinar, the area of land under irrigation stood at 65,000 ha, while rainfed agriculture stood at 37,000 ha. Who exactly was using 37,000 ha for rainfed agriculture and where? We drove outside the city center for around 1 h where, before long, we happened upon a farmer who was cultivating rainfed wheat. We interviewed this farmer and found out the reason why we were having so much trouble finding rainfed wheat farmers. This is because rainfed wheat farmers do not belong to Karapinar Agriculture Chamber for various reasons. The rainfed wheat farmers that Karapinar Agriculture Chamber introduced us to had already given up rainfed agriculture and turned to modern irrigated agriculture.

Rainfed wheat cultivation in this area employs a farming method known as the Nadas System, in which fields are left fallow once every 2 years (Fig. 2.7). However, in years with high rainfall amounts, farmers using this system skip the fallow period and continue cultivating the land. The amount of yield of wheat using this method varies dramatically depending on the moisture content of the soil and rainfall volumes, ranging from 1500 kg/ha to 4000 kg/ha, lower than the amount of yield of irrigated wheat (4000–6000 kg/ha).

We asked about when, where and how the Nadas System was developed, but were unable to get to the bottom of it. There is also no mention of this system in a history of Karapinar published by Karapinar City.

It is said that the Central Anatolia region, which includes Karapinar, has one of the longest histories of wheat cultivation (Esin 2002). The evidence of agriculture in Konya Plain may be seen at the Çatalhöyük excavation site dates to Neolithic (9500 CE) where is about 70 km to the southwest of Karapınar (Fairbairnn 2005). While there is no documentary evidence relating to agricultural technologies in the ancient world, as with irrigated agriculture, it would be safe to say that the Nadas

Fig. 2.7 Cultivating rainfed wheat

System, which developed as a form of agriculture suited to arid regions, has been passed down since before the Common Era by watching and learning and through oral tradition.

2.5.3 Oral Tradition in Turkey and the Transmission of Knowledge of Irrigated Agriculture

The Mediterranean and Aegean Sea region have been home to a rich oral tradition, the most famous example being Homer in Ancient Greece. In Turkey, there were wandering minstrels called Âşik (Ashik)or Orak. These individuals compiled the histories of various countries and spread culture via oral tradition. In Turkey, information was not disseminated through writing until 1928, which Mustafa Kemal Atatürk, the founder of the Republic of Turkey, introduced the modern Turkish alphabet (Gencer and Ozel 2000), and the country's oral traditions continue to be passed down to this day. Prior to 1928, with the exception of a select few persons of learning and court scribes, the vast majority of the population could not read or write.

Karapinar is no exception, where this oral culture and historical background continues to flourish. Therefore, although a vast body of agricultural knowledge has been produced in this region, there is an extremely limited range of written documents and records on this subject. In other words, farmers simply learn about agricultural production by watching with their own eyes and listening to what others tell them. They do not keep records on irrigation by themselves. The farmers who were interviewed practice agriculture based on information they have been party to – for example, once the buds appear, the bulbs will open for around 24 h 10 or so days later.

We learned something surprising during an unscheduled interview with a farmer. Apparently, he was a new part-time farmer who was engaging in agriculture as a side business; his main occupation was running a tea shop serving chai, a popular drink in Turkey. He is increasing his income through irrigated agriculture by watching and learning from others as a means of increasing his income through a side business. He states as follows: "When it comes to practicing irrigated agriculture, I have simply rearranged the method of irrigation that I remember from helping out my father as a child." "If I am unsure of anything, I just ask another farmer nearby." In this way, in Karapinar, anyone can easily become involved in agriculture and increase their revenue if they have groundwater and modern irrigation facilities at their disposal.

As is apparent from this example, oral traditions that are rooted in the region have enabled knowledge of irrigation to been passed down correctly, and that this in turn has allowed farmers to learn the techniques and technologies needed for engaging in irrigation, despite slight variations and a lack of a scientific grounding. On the other hand, the fact that little care has been given to systematically obtaining and cataloging this knowledge in written form and disseminating it has not enabled individual farmers put it into application and develop it, thus making them susceptible to blindly accepting what they are told and taking an unquestioning stance toward agriculture. This is where to problem lies for knowledge production and dissemination in Karapinar.

2.6 Moving Towards Sustainable Agriculture Through the Utilization of Local Environmental Knowledge

2.6.1 Problems Inherent in the Various Agricultural Systems

As we have seen so far, irrigation that relies on groundwater in Karapinar has been developed on the initiative of the government, but this continues to cause the problem of groundwater depletion and the continuance of irrigated agriculture is under threat due to restrictions on water intake. Farmers who engage in irrigated agriculture have constructed agricultural systems through effective irrigated agricultural techniques that have accepted without question, but they are bringing ruin upon themselves through these very systems.

Meanwhile, pickling melon farmers and farmers who practice rainfed agriculture are producing new forms of knowledge that inject scientific knowledge into their own preexisting knowledge. The utilization of this fusion of knowledge shows signs of resulting in highly sustainable forms of agriculture that are suited to the region, avoiding the trap of blindly accepting things without question. However, agricultural operations of this kind are facing issues in terms of productivity and scale.

In this section we seek to visualize the issues surrounding modern groundwater irrigated agriculture, farmers who practice rainfed agriculture and pickling melon farmers, and to explore possible methods for promoting moves to sustainable forms of agriculture that will help solve the issues facing the region.

2.6.2 Issues that Have Become Apparent with Modern Irrigated Agriculture

First, farmers engaging in modern groundwater irrigated agriculture face the issue of dealing with groundwater depletion and unenforced water intake restrictions. Research relating to water resource management consists of Integrated Water Resources Management (Hassing et al. 2009) and Participatory Irrigation Management (Groenfeldt et al. 1999), but under these participatory approaches, farmers participate later in systems that have been set by researchers and governmental bodies. In this respect, a gap emerges between policy and those on the ground (Miyauchi 2013) and it becomes difficult for accommodative water resource management to function properly.

Bearing this in mind, prior to developing irrigation, it is perhaps important to take on board the remarks made by participants in the workshops: “What we really want to grow is wheat from which we can make bread.” “If we could gain sufficient support for growing wheat, we would not have to cultivate other crops that use large amounts of irrigation water.” It is likely that the current situation surrounding groundwater could have been avoided if the government had reflected opinions such as these in their policies, set the purchase price and subsidies for rainfed wheat at a high amount at the first stages of planning, and been able to reduce assistance for investment in irrigation.

In addition, if it is the case that “the proceeds gained from irrigated agriculture have not been properly reinvested,” by collecting part of the revenue gained through the use of groundwater, which is a regional shared asset, and investing it for the future as a fund for such things as groundwater conservation and measures to prevent soil erosion, then this revenue would create values which go beyond mere economic value and would contribute to sustainable agriculture, something which is more desirable than purchasing a new car every year.

2.6.3 New Forms of Local Environmental Knowledge in Karapinar

By harvesting crops that are rooted in the region early, irrigation water volumes can be reduced and the crops can be sold with added value. The production of knowledge and action behind this notion is best embodied by pickling melons. In this case, we can say that this knowledge set has created new forms of local environmental knowledge comprising of a range of factors including local culinary culture, the cultivation of crops that are rooted in the region, modern irrigation facilities and cultivation management that is performed through manual labor (Sato 2015).

In the same way, the cultivation of rainfed wheat through the Nadas System, something which has been passed down since before the Common Era, is a form of sustainable agriculture that has been realized through a unique form of local environmental knowledge that blends a diverse range of knowledge spanning centuries and which is rooted in the region. Rainfed wheat farmers have been making gradual improvements to the Nadas System by obtaining information from sources not related to rainfed agriculture, such as agricultural exhibitions and agriculture channels on television.

Farmers who adopt such cultivation methods are in the minority in Karapinar. The problem, then, is how to spread awareness of these methods throughout the region and make them take rood. One effective method would be to turn pickling melons and rainfed wheat into a local brand and begin by raising their profile at the regional level. This needs to start with those farmers who believe that there are no farmers left who practice rainfed agriculture or researchers who believe that rainfed agriculture is not possible. Karapinar's pickling melons and rainfed wheat would make the perfect items for branding; their association with the illustrious area of Karapinar alone would make this possible. But local farmers have yet to realize this.

2.6.4 Shifting Over to a Sustainable Society Through the Creation of a New Story

In Karapinar, the issue of groundwater depletion has created an awareness of the need for the region to cooperate in taking steps to conserve its groundwater resources. And through workshops consisting of a diverse range of stakeholders, issues that the region faces came to the fore and were shared with more force than usual.

If the District Governor had not make the remarks he did during one of these workshops, rainfed agriculture farmers may not have come to our attention. In addition, if we had not eaten pickled melons at a restaurant, we may not have had contact with pickling melon farmers. Interaction between various stakeholders and fortunate encounters served to strengthen the ties between us as scientists and the region.

Here, the most distinctive feature of our research processes, based on the transdisciplinary approach (Hadorn et al. 2008), is that they facilitated cooperation between various stakeholders through workshops, not only those involved in modern large scale irrigated agriculture (the socially privileged) but also traditional rainfed agriculture farmers who do not belong to Karapinar Agriculture Chamber along with comparatively small scale pickling melon farmers (the socially vulnerable).

And what became newly apparent to us through this process is the fact that the environmental knowledge possessed by the socially vulnerable has the potential to serve as a beacon of hope for the region in helping solve the problems and challenges caused by the socially privileged. No doubt, in addition to pickling melon farmers and rainfed agriculture farmers, other groups of socially vulnerable people who possess unique forms of local environmental knowledge exist in Karapinar. There is a need for action to be taken in uncovering these new forms of knowledge and documenting information that has been passed down through oral traditions, and to disseminate and develop this throughout the region.

An effective way for this to happen is for all the actors to cooperate in creating and sharing a story that can resonate across the region. The most acceptable way to achieve this in the region would be to imitate the way in which Karapinar created a history of success in stopping desertification through the planting of trees.

In other words, this new history of Karapinar necessitates the creation of a story in which local environmental knowledge is organized and developed and used by the entire region to act in conserving groundwater, becoming the first in the world to develop sustainable forms of agriculture for arid regions. By doing so, we could expect the production of knowledge and action by pickling melon farmers and rain fed agriculture farmers to be applied as viable methods not only in Karapinar but in other arid regions in the world experiencing similar problems.

The next challenge facing our research group is to continue this transdisciplinary approach to organize and reconstruct local environmental knowledge that has been passed down orally, and to then document it. This would be followed by the construction of a model for groundwater conservation using the local environmental knowledge of the socially vulnerable, which we would use to contribute to the improvement of sustainability in agriculture in other arid regions experiencing similar problems. This is the least that we as researchers can do in return for all we have learned through cooperation with the local stakeholders.

References

Akça E, Kume T, Sato T (2015) Development and success, for whom and where: the central Anatolian case. In: Chabay I, Frick M, Helgeson J (eds) Land restoration: reclaiming landscapes for a sustainable future. Academic Press, London, pp 533–541

Bayari S, Ozyurt N, Kilani S (2009) Radiocarbon age distribution of groundwater in the Konya closed basin, Central Anatolia, Turkey. Hydrogeol J 17:347–365

Brouwer C, Heibloem M (1986) Irrigation water management: irrigation water needs. FAO, Paris

Celik M, Afsin M (1998) The role of hydrogeology in solution-subsidence development and its environmental impacts; a case-study for Sazlıca (Niğde, Turkey). Environ Geol 36(3):335–342

Dogdu MS, Sagnak C (2008) Climate change, drought and over pumping impacts on groundwaters: two examples from Turkey. In: Conference on water observation and information system for decision support. BALWOIS 2008, Ohrid, Republic of Macedonia

Editing Committee for the Revised Groundwater Handbook (ed) (1980) Revised groundwater handbook (改訂地下水ハンドブック). Tokyo, Research Institute of Construction and Economy, Tokyo (in Japanese)

Esin U (2002) ASIKLI HOYUK. ARKEOATLAS-Yasayan Gecmisim Drgisi. D.B.R Istanbul, Istanbul

Fairbairn A (2005) A history of agricultural production at Neolithic Çatalhöyük East, Turkey. World Archaeol 37(2):197–210

Gencer AL, Ozel S (2000) Turk Inkilap Tarihi. DER YAYINLARI, Istanbul

Groenfeldt D, Subramanian A, Salman S, Raby N, Svendsen M, Schaak J (1999) Participatory Irrigation Management (PIM) handbook. World Bank 1(ii):54–91

Hadorn GH, Hoffmann-Riem H, Biber-Klemm S, Grossenbacher-Mansuy W, Joye D, Pohl C, Wiesmann U, Zemp E (2008) Handbook of transdisciplinary research. Springer, Netherland

Hassing J, Ipsen N, Jønch T, Larsen CH, Lindgaard-Jørgensen P (2009) Integrated water resources management in action. United Nations Educational, Scientific and Cultural Organization, Paris

Maruyama Y (2009) Questioning “earth-friendliness” – the narrow path of natural energies and nature conservation (「地球に優しい」を問う-自然エネルギーと自然「保護」の隘路). In: Kito S, Fukunaga M (eds) Environmental ethics. University of Tokyo Press, Tokyo, pp 171–183 (in Japanese)

Miyauchi T (ed) (2013) Why does environmental conservation fail??-(なぜ環境保全はうまくいかないのか). Tokyo, Shinsensha, 348pp (in Japanese)

Pınarkaya M, İnan GA, Şahin M, Bosyancı İ, Vanoğlu M (2013) External water allocation suggestions to KOP region. National KOP regional development symposium, 14–16 November 2013, Konya Turkey

Sato T (2009) From knowledge to wisdom – residential research institutions bringing together indigenous and scientific knowledge (知識から智慧へ-土着的知識と科学的知識をつなぐレジデント型研究機関). In: Kito S, Fukunaga M (eds) Environmental ethics. University of Tokyo Press, Tokyo, pp 211–226 (in Japanese)

Sato T (2015) Theory of sustainability science: solution-oriented production of integrated knowledge (サステイナビリティ学の科学論-課題解決に向けた統合知の生産). Environmental Research Quarterly 177:52–59 (in Japanese)

Shiklomanov IA, Rodda JC (eds) (2003) World water resources at the beginning of the twenty-first century. Cambridge University Press, Cambridge

Siebert S, Burke J, Faures JM, Frenken K, Hoogeveen J, Döll P, Portmann FT (2010) Groundwater use for irrigation – a global inventory. Hydrol Earth Syst Sci 14:1863–1880

Yılmaz M (2010) Karapınar Çevresinde Yeraltı Suyu Seviye Değisimlerinin Yaratmıs Olduğu Çevre Sorunları. Ankara Üniversitesi Çevrebilimleri Dergisi 2(2):145–163

Chapter 3
Knowledge and Technologies Born from Livelihoods: Emergence of Satoumi and Self-Harvesting Forestry in Japan

Shigeru Yanaka

Abstract This chapter discusses knowledge and technologies born from two different livelihoods: fisheries and forestry in Japan. In the case of the former, livelihood technologies, including seaweed aquaculture techniques, have been adapted for coral aquaculture, involving people from different sectors with diverse standpoints and relationships to corals. The Mozuku Seaweed Fund, built up through purchases by consumers, has been used to help fishers engage in coral aquaculture and planting activities. By nurturing healthy coral environments, a cycle has been created in which increased biodiversity and ecosystem services translates into the production of high-quality Mozuku seaweed (*Nemacystus decipiens*). In the case of the latter, through the concept of "self-employed and self-harvesting forestry," the livelihood technologies of "durable forest roads" and "small-scale inexpensive forestry machinery" have become tools for reincorporating forests into the daily lives of people in local communities. Anyone can be involved with forests by taking up forestry as a livelihood, thereby enabling people to make full use of the resources of the forest. From the perspective of governance of the commons, these initiatives are noteworthy because those with these livelihoods often transcend the framework of private rights to generate knowledge and technologies for promoting sustainable use of ecosystem services.

3.1 Knowledge and Technologies Forming Livelihoods

This chapter considers knowledge and technologies born from two different livelihood activities: fisheries and forestry in Japan. Livelihoods can be seen as processes in which people directly or indirectly use natural resources in their daily lives, extracting those resources from ecosystems that enable them to make a living. The livelihood process as such comprise knowledge and technologies along with formal and informal institutions and systems that allow people to enjoy ecosystem services.

S. Yanaka (✉)
Tottori University, Tottori, Japan
e-mail: syanaka@rs.tottori-u.ac.jp

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_3

This chapter focuses on two case studies: (1) fisheries in coral reefs in Okinawa and (2) forestry in hilly and mountainous rural areas throughout Japan. These two cases are extreme contrasts in terms of both the characteristics of the ecosystems and their historical background. However, they also present commonalities.

From 1972, following Okinawa's reversion to Japan, Okinawa's coastal areas have experienced major societal impacts including large-scale development through public works and resort development that took place as part of Japan's rapid modernization and industrialization. As a result, Okinawa's coral reefs are currently under threat (Japanese Coral Reef Society 2011). Globally, around 20% of the world's coral reefs have already been lost; the situation is so critical that another 15% is predicted to disappear in 10–20 years, and a further 20% in 20–40 years (Wilkinson 2008).

Meanwhile, Japan's hilly and mountainous rural areas also went through significant changes in the form of massive postwar afforestation, a drop in wood prices following their peak in 1980, and depopulation/marginalization of rural communities. Although two thirds of Japan's total land area are covered by forests, the third highest proportion of forested land among OECD countries, its self-sufficiency rate for wood is only 28.6% (2013). Forest areas that have been left unattended and in a state of degradation due to a lack of sufficient management are increasing, resulted in part from aging of forestry workers and decrease of younger generations working in this industry to replace them (Forestry Agency 2015).

Under these conditions, the people involved in both cases were inevitably faced with the need to rearrange the existing technologies and systems through which they had been making a living, leading to the creation of knowledge and technologies especially relevant to the perspective of Integrated Local Environmental Knowledge (ILEK).

3.2 Creation of Knowledge and Technologies for Coral Reef Restoration Through "Satoumi"

3.2.1 What Is Satoumi?

In recent years, the term Satoumi has become commonly used in Japan; it refers to "coastal marine areas in which productivity and biodiversity have increased through human intervention" (Yanagi 2010, 2013). One of the reasons for the resurgence in interest in this concept is the fact that managed ecosystems created by livelihood activities of people including Satoyama and Satoumi has been reappraised in recent years. These concepts are defined as the socio-ecological production landscapes (Satoyama) and coastal seascapes (Satoumi) in a dynamic mosaic of habitats and uses of land and sea to improve biodiversity, ecosystem services and well-being of people. In the past it was undisturbed "wilderness" that was regarded as the most valuable nature (Kumar et al. 2012). Now the notion of "conservation while using" has also taken on much importance as an adaptive management perspective, because human resource use activities can provide monitoring functions.

There are many policies and systems aimed at conserving and restoring coastal marine areas in Japan. The concept of Satoumi was discussed in the third National Biodiversity Strategy (2007) and in the Basic Plan on Ocean Policy (2008). Additionally, a Satoumi creation support project was initiated by the Ministry of the Environment (in the 2008–2010 fiscal years). The 2001 Fisheries Basic Act and the 2007 Basic Plan for Fisheries set out provisions concerning the multifunctional roles of fisheries and fishing villages. The Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, has implemented environmental and ecosystem conservation support projects (2009–2012) and fisheries multifunctional roles promotion projects (2013–2015; phase 2, 2016–2020). The conservation and restoration of coastal fishing grounds carried out through these projects, including seaweed beds, tidal flats and coral reefs, have been made possible through collaboration with fishers and members of local communities. These coastal areas are easy to access when the tide is out, and one does not have to be a fisher to engage with activities in such areas. Therefore, the value of Satoumi came about through the multifunctional intervention of people supported by these policies (Yanaka 2012).

3.2.2 *Beginnings of Coral Aquaculture: Application of Seaweed Aquaculture Techniques*

Onna Village Fisheries Cooperative (259 members as of April 2016; the population of Onna Village is 10,921) views "fishing activities as constituting part of ecosystems" (Fig. 3.1) and produces various actions in the creation of Satoumi. Its initiatives can be classified into two distinct areas. The first is coral aquaculture and planting by Onna Village Fisheries Cooperative. The second is the Mozuku Seaweed Fund, which collaborates with the consumer cooperatives and fishery processing and marketing companies that deal with the cultured seaweeds produced by Onna Village Fisheries Cooperative.

In 1998 and 2001extensive bleaching occurred in the coral reefs. Stress resulting from rising sea temperatures (30 °C and above) resulted in the disappearance of the symbiotic zooxanthella, causing bleaching and the widespread die out of corals. While the Youth Division of Onna Village Fisheries Cooperative had already undertaken coral transplanting trials in 1989, it was not until 1998 that full-scale efforts in this field got underway after the bleaching in 1998. In this year, Okinawa Prefecture granted permission to collect corals in specific zones for aquaculture by the fisheries cooperative, and a study group for coral aquaculture was launched within the cooperative in 1999. Following further bleaching that occurred in 2001, consensus was reached in 2002 that the issue should be tackled not only by the fisheries cooperative, but through cooperation between Onna Village Government Office, Onna Village Chamber of Commerce and industries and resort hotels. In

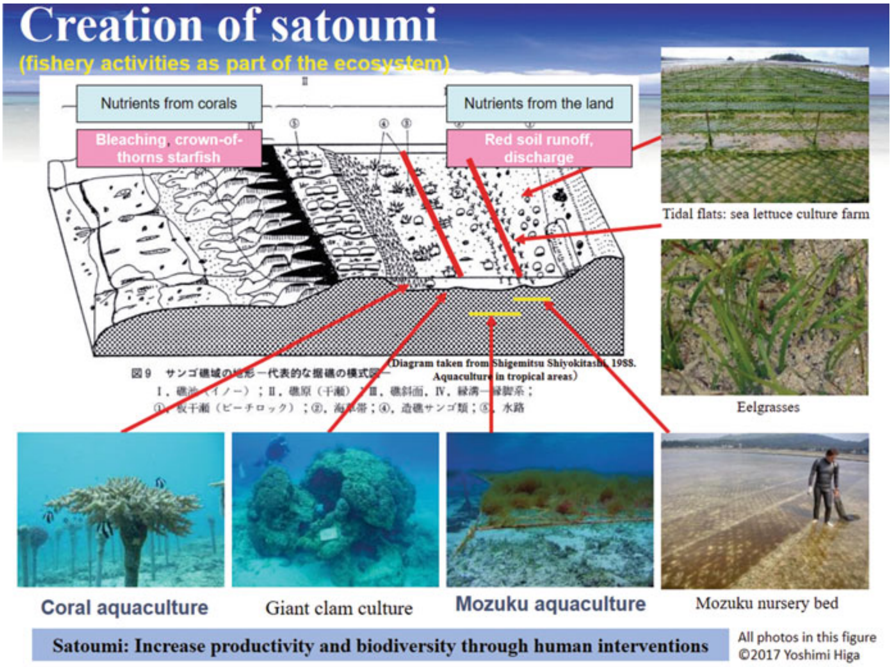


Fig. 3.1 Summary of "Creation of Satoumi" by Onna Village Fisheries Cooperative. (Courtesy of Onna Village Fisheries Cooperative)

2003, an on-land facility for coral aquaculture was set up within the grounds of Onna Village Fisheries Cooperative, marking the beginning of fully fledged efforts to turn "coral planting" into a viable option.

Conventional coral "transplanting" and the "coral planting" developed by Onna Village Fisheries Cooperative differ in many ways, discussed below. While "transplanting" involves collecting pieces of coral and growing them in a different location, "coral planting" entails taking the coral and culturing it in a water tank at the above-mentioned on-land facility. The corals grown on land are then divided into small pieces and planted in the sea, where it continues to grow and propagate. Methods of planting coral pieces on the sea bottom include either planting corals settled onto pins or an artificial board-shaped substrate directly attached to the ocean floor, or by fastening an artificial substrate with corals at the top ends of steel poles that have been embedded in the ocean floor, so-called "pole-top aquaculture." The use of a water tank at the land facility is based on experiences of seed production for Mozuku seaweed and sea grapes (*Caulerpa lentillifera*), another edible seagrass species widely marketed by the cooperative. The pole-top aquaculture method for corals using steel poles represents a technical application of methods for growing Mozuku seaweed (Higa and Omori 2014, Fig. 3.2a).

The repeated coral aquaculture and planting trials resulted in a series of unique discoveries and technological developments. They include keeping corals in a cage

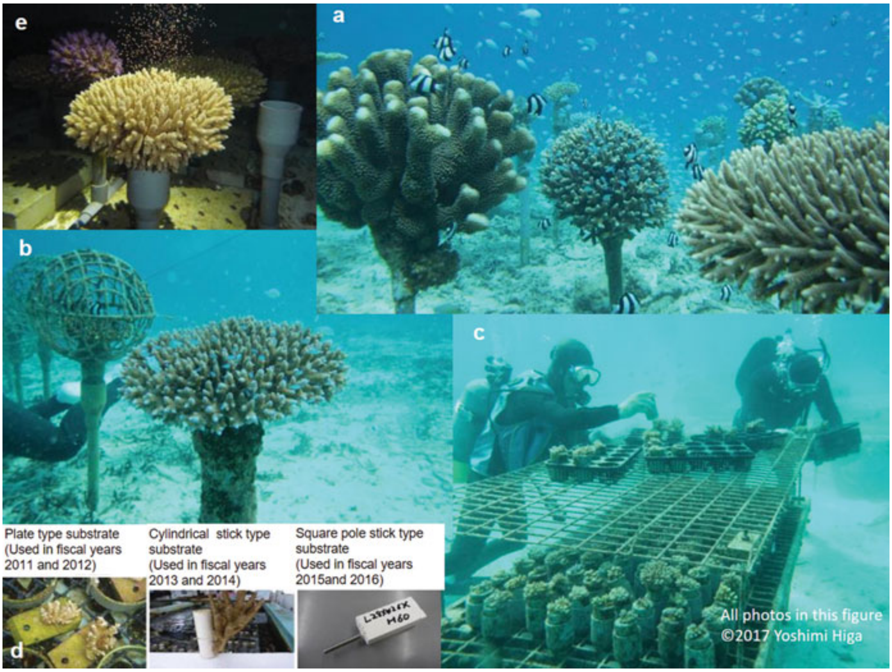


Fig. 3.2 (**a**) Pole-top aquaculture, (**b**) Protective cage, (**c**) Middle stage nurturing, (**d**) Artificial substrate, (**e**) Spawning of cultured coral. (Courtesy of Onna Village Fisheries Cooperative)

to protect them from coral predators such as parrotfish. Once damsel fish begin to make their territory at the planted corals and start defending it, the protective cage can be removed, as there is no risk of predation damage (Fig. 3.2b). Another technique is to attach coral fragments to the artificial substrate in a horizontal orientation rather than a vertical orientation. Methods of planting coral to the ocean floor include: (1) "group planting," in which corals are grouped together in close concentrations or (2) "top planting," in which the corals are planted near large coral colonies.

By growing corals elevated from the ocean floor using the pole-top aquaculture method, it is possible to avoid damages caused by red soil sedimentation washed down from erosion on land. Even in the higher water temperature, the presence of tidal currents helps hinder bleaching. It also helps growth of the corals by sunlight reflecting off the ocean floor. Therefore, it has become apparent that the pole-top aquaculture method is well suited to growing corals. The corals on the steel poles can be repositioned to find optimal locations for corals to thrive, and the corals can be grouped based on their growth rates. In addition, corals cultured at the land facility exhibits even better growth at the later stages if it undergoes "middle stage nurturing" in the sea prior to being attached to the steel poles (Fig. 3.2c).

What is interesting here is the development of an artificial substrate to attach coral fragments. Materials such as concrete and ceramic pieces are not suitable for artificial substrates. Coral stones and travertine (Ryukyu lime stone), a high-quality stone material, were initially tested, but the rate of coral settlement increased dramatically when the material was changed to mug white, a soil hardening agent used as a substrate in giant clam aquaculture. Improvements were made every two years, such as by altering the shape of the artificial substrate from board shaped to cylindrical and then prismatic, each change in geometry resulting in better results (Fig. 3.2d).

These coral aquaculture and planting technologies employ a series of technologies developed by Onna Village Fisheries Cooperative for Mozuku seaweed, sea grape and Tridacna clam (Tridacnidae) aquacultures, and were based on experiences and observations of individual fishers. Onna Village Fisheries Cooperative was the first in Okinawa to successfully culture Sea lettuce (*Monostroma nitidum*), an edible green algae (1976), to develop the pole-top aquaculture method for Mozuku seaweed (1977), to successfully culture Ito-Mozuku (a variety of Mozuku), and to successfully culture sea grapes on land (1994). These experiences and incentives to develop and improve new technologies effectively promoted various actions by the members of Onna Village Fisheries Cooperative. The superiority of the livelihood technologies possessed by the cooperative is shown by the fact that the cooperative accounts for 60% share of the production of Ito-Mozuku (which is difficult to culture) in Okinawa Prefecture. The "Onna Mozuku" seaweed brand, a product which comes under the Mozuku Seaweed Fund (see below), was the first brown algae to be registered as a new variety (2007).

3.2.3 "Mozuku Seaweed Fund": A Collaborative Project to Nurture Coral Reefs

Since 1987, the Onna Village Fisheries Cooperative has been promoting sustainable management of fisheries resources. It has developed the Onna Village Fisheries Cooperative Local Fishing Vitalization Plan "Churaumi (beautiful seas)" as a comprehensive plan for fisheries in this village. This plan, has been consistently revised to improve the societal, as well as economic positions of the association members under the banner of the creation of Satoumi. It advocates active cooperation with administrative bodies, local communities and other industries. Around two million tourists visit Onna Village each year, a major marine resort and destination attracting visitors to Okinawa Prefecture. Therefore, the association interprets the creation of Satoumi to be an issue involving the village as a whole. It is carrying out its activities involving a wide range of stakeholders including tourism sectors.

A coral planting project that began in 2003 developed in 2004 into "Team Churasango (beautiful corals)," an initiative involving 18 companies from Okinawa Prefecture and nation-wide to conduct coral planting tours by mainly volunteer divers. An initiative of this scale, which could not have been achieved by Onna Village Fisheries Cooperative alone, came into being through collaboration transcending diverse industries with different relationships with corals and the sea. And it was the Mozuku Seaweed Fund which enabled the dramatic spread of these Satoumi creation activities. As a collaborative project to nurture coral reefs, a council was launched through collaborations of Onna Village Fisheries Cooperative (producer), consumer cooperatives (consumers), Igeta Takeuchi Co., Ltd. (a fishery processing and marketing company with headquarters in Sakaiminato City, Tottori Prefecture), and Onna Village Government Office. Under this project, they saved part of the profit from sales of cultured Mozuku seaweed for the fund to supply resources for coral planting projects (Fig. 3.3).

In November 2009, in collaboration with the Pal System Consumers' Co-operative Union (1,898,000 members as of April 2016), they established Onna Village Churaumi Direct Delivery Committee. In April 2010, they entered collaborative agreements on support for the coral reef restoration project with the Association of Consumer Cooperatives Chugoku Shikoku Region (COOP CS Net) (members: 1,232,155), and with the Association in Tokai Region (members: 849,019) in June. In March 2012, the COOP Coral Forest Liaison Committee was formed, generating increased interaction between fisheries cooperative and consumer cooperative members, and deepened shared understanding of the importance of the conservation of coral reef ecosystems and sustainable fisheries activities. These activities are now spreading to cooperatives in the Kinki, Hokuriku and Kyushu areas.

Behind these developments was a crisis in the production and distribution of Mozuku seaweed in Okinawa. In general, distributors tend to approach Mozuku producers from the perspective of their own interests to procure Mozuku seaweed at the lowest possible cost. Okinawa's Mozuku aquaculture was locked in a vicious cycle of stagnating prices and erratic quality. From the period around 2005–2006 onward, the price of Mozuku seaweed particularly continued to drop, mainly at large scale suppliers like supermarkets. While the production and marketing cost was said to be 100 yen per kilogram, in many cases the price was a lot lower, falling to 80 or even 50 yen. In 2009, a rally was staged by Chinen and Katsuren Fishery Cooperatives in protest at this situation. There were even some consumer cooperatives that were on the verge of coming to loggerheads with the large-scale suppliers over the falling prices. Amidst this sense of crisis, the Mozuku Seaweed Fund was proposed as a means of delivering messages to the consumer cooperative members. The message was on the background of their Mozuku products through the long-term efforts by Onna Village Fisheries Cooperative to work on coral reef conservation by preventing red-soil runoff and control of crown-of-thorns starfish (*Acanthaster plancias*) (Yanaka 2000). It also aimed to encourage consumers themselves to become more than just consumers and get involved with the creation of Satoumi through purchasing Mozuku to establish recycling and reproductive supply chain systems, creating values that went beyond the simple production of commodities.

Under the fund set up by the COOP Coral Forest Liaison Committee, one yen from the sale of applicable four pack products and two yen from the sale of applicable six pack products goes directly to the fund. To date, over 13,000,000 packs have been sold under this scheme, and the resulting fund has helped planting

Fig. 3.3 Leaflet of the "Mozuku Seaweed Fund". (Courtesy of COOP CS Net)

12,000 corals (as of the end of the 2015 fiscal year). They are on the verge of reaching 20,000 corals when totaling up the planting done by Onna Village Fisheries Cooperative on its own along with the planting performed by other cooperatives outside the liaison committee. The corals planted so far belong to 11 families, 15 genera and 54 species. All of them were derived from indigenous corals in the seas around Onna Village to avoid genetic disturbances. In May 2013, the first spawning of planted coral was confirmed, demonstrating that corals cultured and planted using the pole-top aquaculture method would grow into spawning colonies within 3 years (Fig. 3.2e). Around 120,000 coral larvae are estimated to be released from a single colony on a pole, nurturing approximately 20,000 parent corals, which is expected to produce significant impacts on corral restorations. In 2015, efforts for sexual reproduction of corals have launched in addition to asexual reproduction by planting (Nature Protection and Greening Promotion Division, Environment Department, Prefecture of Okinawa 2015).

The area of planted corals has reached 3 ha in 2017, the largest in the world with a high survival rate. One can get a good idea of the scale when comparing it to the 0.5 ha that the Ministry of the Environment has planted over 12 years in Sekisei Lagoon, located between Ishigaki and Iriomote Islands. Close examination of 30 cultured coral colonies on the poles revealed 841 individuals of coral-dwelling fishes from 8 families and more than 33 species inhabiting in the colonies. This means that an average of 28 individual fishes had lived on each colony on a pole; taken together with the number of planted corals, this gives a total of around 530,000 individuals. Truly, the human intervention has produced increased biodiversity.

Through a "Collaborative Project Nurturing Coral Reefs," Onna Village Fisheries Cooperative successfully fostered diverse relationships and linkages for creation of Satoumi by working together with the tourist industry such as resort hotels and diving shops, material suppliers for coral aquaculture, elementary and junior high schools in the form of training courses, practical sessions for technical colleges, and broader educational institutions through school meal projects, as well as with consumer cooperatives and urban consumers from outside Okinawa Prefecture (Fig. 3.4).

3.3 Creation of Knowledge and Technologies for Restoring Forests and Forestry Through Self-Employed and Self-Harvesting

3.3.1 "An Evening Drink with C Timber!": Re-creating Forest Commons Through Community Currency

In 2006, a revolutionary new scheme began in the Niyodogawa River basin of Kochi Prefecture, Japan. Small timbers and logging residues produced through forest thinning have usually been abandoned in forest lands in Japan, because there is no use for such small wood fragments. Under this new scheme, these forest land residues can be exchanged for equivalent of 6000 yen in "community currency" per ton when sent to an experimental wood biomass power plant. Wood destined for use as construction materials is categorized as class A timber, wood used for

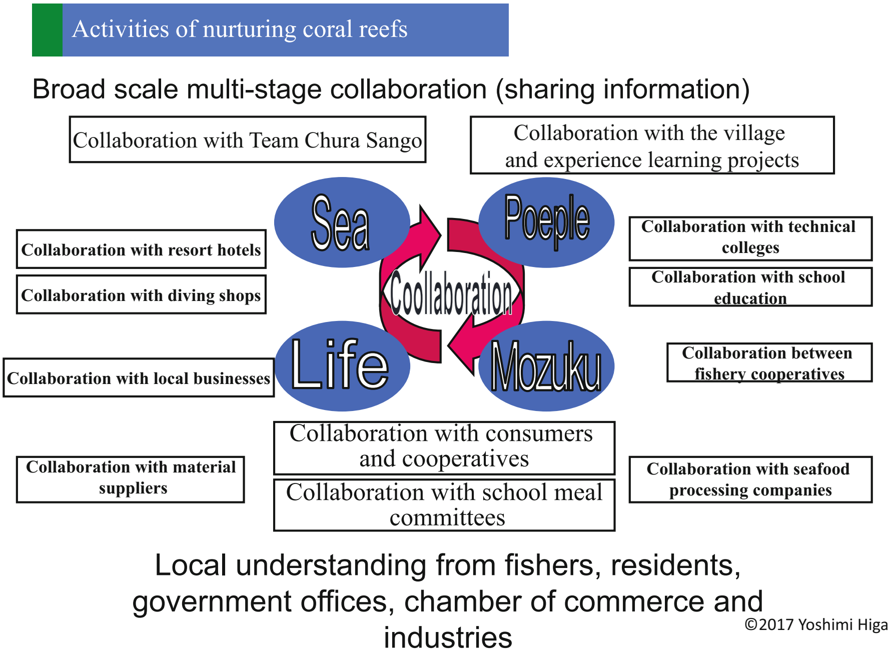


Fig. 3.4 Satoumi creation involving diverse stakeholders. (Courtesy of Onna village fisheries cooperative)

plywood and laminated lumber as class B, and wood without any use as class C. This led to the initiative with the name "An Evening Drink with C Timber!". This catch phrase succinctly expressed the spirit of the scheme. While nobody would get rich from it, just two light trucks' worth of residues would provide enough money for a few drinks in the evening. What drew most attention to this scheme was the fact that, instead of cash, compensation was provided in the form of community currency. Community currency, named "Mori-ken (forest notes)," is issued in denominations of 1000 yen and can be used in exchange for products at designated shops, as well as to pay for meals at restaurants or purchase gasoline. In other words, this system created a mechanism to re-create value for forests as commons by introducing community currency obtained through forest managements that is circulated and used within the community (Nakajima 2012; Yanaka 2014b, Fig. 3.5).

This groundbreaking system was devised by the NPO Tosa-no-mori (forests of Tosa area) Rescue Team. At the time, a New Energy and Industrial Technology Development Organization (NEDO) project was underway titled "Project to construct Self-Supply Systems for Energy in the Niyodogawa River Basin of Kochi Prefecture" which took place from December 2005 – March 2009. A plan was put in place for three types of forestry operators – large-scale, medium-scale and small-

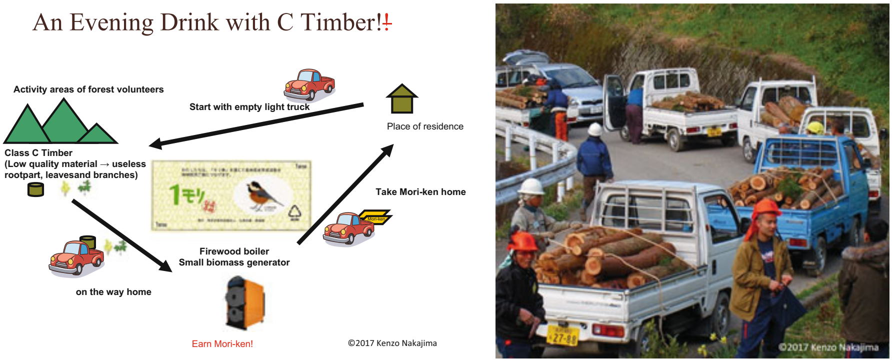


Fig. 3.5 "An Evening Drink with C Timber!" schematic representation of actions underway in Niyodogawa River basin area. (Courtesy of NPO Tosa-no-mori Rescue Team)

scale – to collect forest land residues as part of the project. The large-scale operator was the biggest raw material producer (log production) in Kochi Prefecture, conducting a large-scale clear-cutting and cable yarding. The medium-scale operators were the forestry cooperatives and raw material producers who have been commissioned to undertake large-scale intensive forestry work in the form of the thinning of forests using high performance forestry machinery, the current type of forestry being promoted under forestry policies in Japan. And the small-scale operators are those general participants enlisted by Tosa-no-mori Rescue Team.

One of the factors behind the groundbreaking success of "An Evening Drink with C Timber!" is that the Tosa-no-mori Rescue Team did not limit the scope of enlistment for participants, but opened it up to all residents of the Niyodogawa river basin area. At first, there were major expectations surrounding the roles of the large-scale and medium-scale operators in the project; however, the costs of transporting forest land residues did not fit within their profit margins, and they soon withdrew from the scheme. On the other hand, when it came to the small-scale operators, at least with a light truck and a chain saw that majority of people living in hilly and mountainous rural areas possess, they could take the residues out from the forests. This resulted in a dramatic increase in participants, and the amount of wood they supplied alone met the volumes required under the project. Furthermore, in addition to forest land residues to be used for wood biomass, the production of raw materials (logs) destined for lumber markets also continued to increase, more than doubling the raw material production volumes of Niyodogawa Forestry Cooperative. This is the proof that the goals of mass production and a stable supply of woods can be achieved with totally different approaches with the participation of many small-scale self-employed and self-harvesting foresters without introducing high performance forestry machineries. The self-employment and self-harvesting forestry (hereafter referred to as "SE-SH" forestry and foresters) allows diverse forms of participation; as such, it has also given rise to a new phenomenon of younger

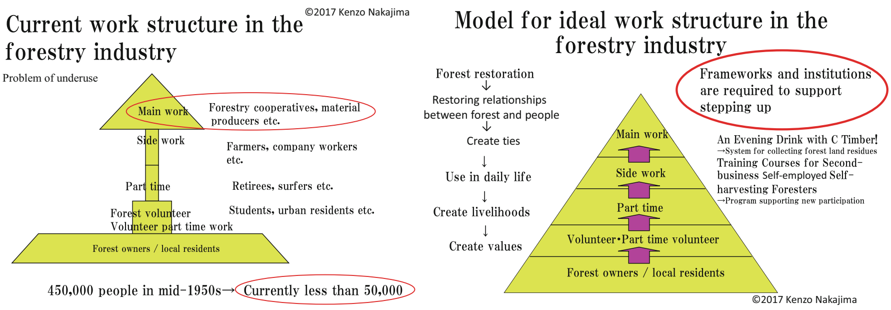
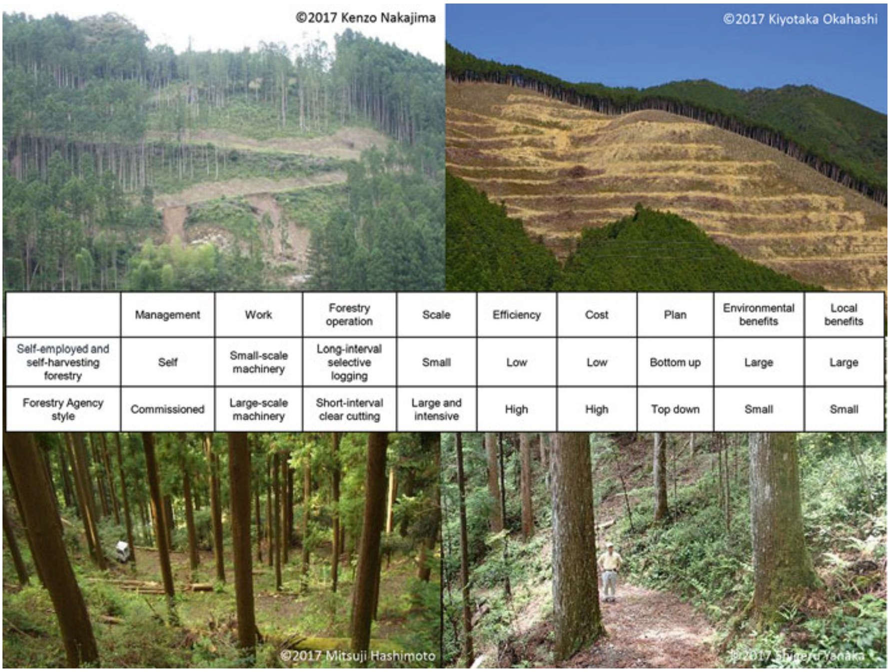


Fig. 3.6 Work structure in the forestry industry and frameworks for providing support for stepping up. (Courtesy of Kenzo Nakajima)

generations moving back to their hometowns or relocating to the countryside from cities to be involved in forestry for the first time. The "An Evening Drink with C Timber!" scheme has quickly spread throughout Japan under different names, such as "An Evening Drink with a Light Truck and Chainsaw" or "Wood Depot."

The "An Evening Drink with C Timber!" scheme created a new lens to view the forest owners in hilly and mountainous rural areas as having wishes and interests to manage and utilize their own local forests with appropriate assistance and opportunities, contrary to labeling them to have "lost the will to engage in forestry", a common perception among existing forestry policies and mainstream researchers. "An Evening Drink with C Timber!" successfully mobilized latent potential of the silent majority by listening to their voices hoping to keep the forests well-managed that had been passed down over generations in their communities.

What sets the Tosa-no-mori Rescue Team apart from other conventional forest volunteers and NPOs is that they did not put in place "barriers" between forest conservation activities and forestry as a livelihood. Instead, it built up a system for local residents and forest owners not to participate as volunteers or part-time workers, but to establish a side business or even full-time business (Fig. 3.6). "An Evening Drink with C Timber!" is just one of the methods for local residents to achieve this. The organization has been initiating nationwide actions promoting participation in SE-SH forestry, such as a series of training courses for Second-business Self-Employed and Self-Harvesting Foresters (2009-Present) or livelihood creation initiatives in areas affected by the tsunami in the Great East Japan Earthquake. In June 2014, it established an incorporated NPO "Association for the Promotion of Self-Employed and Self-Harvesting Sustainable Forestry in Harmony with Environment". Through these activities, it has sought to break away completely from Japan's current forms of forestry promoted by forestry policies, putting in place a systematic framework for livelihood technologies of self-harvesting forestry which strike a balance between the environmental conservation of forests and sustainable forestry management.



	Management	Work	Forestry operation	Scale	Efficiency	Cost	Plan	Environmental benefits	Local benefits
Self-employed and self-harvesting forestry	Self	Small-scale machinery	Long-interval selective logging	Small	Low	Low	Bottom up	Large	Large
Forestry Agency style	Commissioned	Large-scale machinery	Short-interval clear cutting	Large and intensive	High	High	Top down	Small	Small

Fig. 3.7 Comparison of current forestry (Forestry agency method) and the self-employed and self-harvesting forestry. (Photo courtesy of Kiyotaka Okahashi, Mitsuji Hashimoto, Kenzo Nakajima)

3.3.2 Self-Employed and Self-Harvesting Forestry as Appropriate Technologies

The methods of SE-SH forestry systematized by Tosa-no-mori Rescue Team comprise of the following three main elements: (1) Durable forest roads (narrow and high-density forest-road networks); (2) Small-scale inexpensive forestry machinery; and (3) Long-interval selective logging (Fig. 3.7).

The idea of "durable forest roads" was originally conceived by Keizaburo Ohashi (Ohashi 2001) and was continued by Mitsuji Hashimoto, Kiyochika Okahashi and Kiyotaka Okahashi. This concept is currently gaining ground among new participants in SE-SH forestry through training provided by the Association for the Promotion of Self-Employed and Self-Harvesting Sustainable Forestry. Mr. Hashimoto, a SE-SH forester from Naka Town, Tokushima Prefecture, has built 30 km of forest roads in his 100 ha forest. Likewise, Mr. Okahashi, a self-harvesting forester from Yoshino, Nara Prefecture, has built 90 km of forest-roads in the 1900 ha of forest in his possession (Hashimoto 2013; Okahashi 2014).

In the case of Mr. Ohashi's method of forest roads, the roads are designed based on detailed observations on the topography and vegetation of the forest and the water flow paths, and constructed utilizing stable terrain, such as the ridge lines and shelves

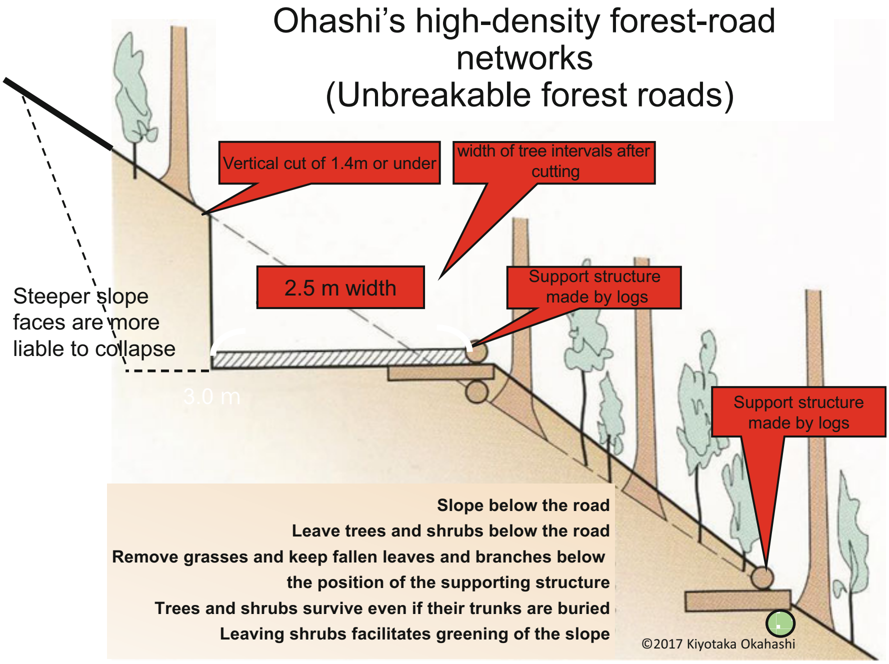


Fig. 3.8 "Durable roads". (Courtesy of Kiyotaka Okahashi)

of mountains. The width of the roads is set at 2–2.5 m, while the height of mountain slopes to be scraped off to construct roads (height of cutting slope) is below 1.4 m. If the mountain roads are any wider or if excavation of greater than 1.4 m is done, then they are liable to collapse. By minimizing alterations to the topography caused by the roads, the terrain becomes stable and the amount of soil to be removed is reduced, thus, cutting work volumes and costs decreased. It is also possible to avoid unnecessary felling of trees. It is an intelligent way of developing forest roads (Fig. 3.8).

These narrow roads are laid down in the form of a high-density network. When 100–300 m of forest roads are constructed in an area of 1 ha, a gap of 20–30 m is left between the roads. This means that when trees are cut down, they fall across one of the forest roads, making work much more efficient and safe. Forest roads that are established to form a series of terraces in this way are also effective at controlling erosion and increase stability of the soil. There is a fundamental difference in the concepts of forest roads between today's forestry industry and SE-SH forestry: in the case of the former, roads are used temporarily during logging operations, while in the case of the latter, they are used repeatedly in forest thinning for sustainable and long-term management of the forest.

"Small-scale inexpensive forestry machinery" refers to a combination of the absolute minimum amount of small forestry machineries needed for SE-SH operations, including a 3 t hydraulic excavator for constructing forest roads and a 2 t four-wheel drive truck or a 1–3 t forestry work vehicle for transporting timber. The costs of purchasing these are in the range of 2–three million yen each, completely different to large-scale intensive forestry requiring 3–4 high performance forestry machines costing several tens of millions of yen. This is a low-cost livelihood technology that anyone can become involved in, even if maintenance costs are included. Such low-cost systems become more important as the lumber prices have dropped by 1/5 to 1/7 in recent years compared to the past.

Today's forestry industry is geared solely towards logging through forest thinning or clear-cutting, roaming and utilizing around forests under logging permissions without commitments to long-term nurturing of forests. A large-scale logging using high performance forestry machineries inflicts major damage on forests, and the forest roads to accommodate large machines bring about the collapse of mountains partly due to the rough ways of road constructions. In recent years, feeding of Sika deer has been producing significant damages to the forests, and it becomes virtually impossible to plant tree seedlings for reforestation after clear-cutting. As the result, there is also the problem of abandoning reforestation attempts following excessive thinning or clear-cutting. SE-SH forestry, in contrast, is undertaken in forests under personal ownership or of another owner in the community, resulting in long-interval selective logging to nurture the forests on a long-term basis while yielding continual gains.

Then, why has SE-SH forestry come into the spotlight now and what are its significance for the forestry policies in Japan?

3.3.3 Regeneration of Rural Areas Through Livelihood Creation by Self-Employed and Self-Harvesting Forestry

There have been two occasions in the past when SE-SH forestry and family run forestry came under the spotlight in Japan's forestry policies. First, there was a period from the latter half of the 1950s until the beginning of the 1970s when families subsisting both on farming and forestry (farming forestry) were regarded as an excellent system of expanding silviculture, and a great deal of attention was given to agriculture-forestry mixed management through family labor. Second, there was a period from the 1980s until the beginning of the 1990s when trees in forests planted after the Second World War had grown and entered the thinning stage, and the forest owners conducted thinning and carried out woods using forestry work vehicles by themselves (Kohroki 2014). However, SE-SH forestry activities in these periods were limited to certain areas of Japan and did not change the entire direction of forestry in Japan. Majority of mainstream forestry policy researchers were of the opinion that generation transitions were difficult among SE-SH foresters, and they would disappear with Japan's declining rural population (Sato 2015). While the 1964 Basic Law on Forestry included family run forestry, forestry cooperatives and large-scale forest owners in parallel, the course of subsequent forestry policies has emphasized only forestry cooperatives (Izumi 2014).

The 2009 Forest and Forestry Restoration Plan clearly judged that "The forest owners have lost interest in forestry and do not have capabilities to manage forests" and specified large-scale forestry operators and forestry cooperatives as the important agents for forestry works in Japan. Forest management plans and reforestation subsidies systems were changed to conform with this. In this way, small-scale foresters were excluded from the scope of forestry policies and subsidy schemes, and forests became even more distant from the lives of community members living in hilly and mountainous rural areas (Sato 2013, 2016b). While conservation and management have formed the crux of international policies surrounding forests and forestry, Japan's forestry policies have continued to remain centered on productivity (Shiga 2015).

Then suddenly, new forestry participants began to emerge from the sectors that forestry policies and mainstream researchers never envisaged through initiatives of Tosa-no-mori Rescue Team's "An Evening Drink with C Timber!" or "Training courses for Second-business Self-Employed and Self-Harvesting Foresters" (Izumi 2014; Sato 2015; Nakajima 2015). These people mainly from younger generations are seeking to create new lifestyles based on forests. It implies a transition from the quantity-emphasized forestry spearheaded by the government to the "enjoyable and rewarding forestry" through creation of independent and self-employed livelihoods (Sato 2016a).

Focusing on these trends, many municipalities throughout Japan have interpreted SE-SH forestry as a "trump card" for the regeneration of hilly and mountainous rural areas. Using the Ministry of Internal Affairs and Communications' "Community-Reactivating Cooperator Squad" project aiming to encourage people to relocate and settle in disadvantaged local communities, these municipalities have solicited for new participants in SE-SH forestry and have commissioned the Association for the Promotion of Self-Employed and Self-Harvesting Sustainable Forestry in Harmony with Environment to hold training sessions for such individuals. (Examples of these municipalities include Sakawa Town and Motoyama Town in Kochi Prefecture, Chizu Town in Tottori Prefecture, Tsuwano Town and Masuda City in Shimane Prefecture, Nagahama City and Maibara City in Shiga Prefecture, Yoshino Town in Nara Prefecture, Rikuzentakata City in Iwate Prefecture, Kesennuma City Miyagi Prefecture, Minakami Town in Gunma Prefecture, and Atami City in Shizuoka Prefecture.) In this way, diverse movements have sprung up in Japan which seek to restore and reconstruct community functions in rural areas by reintroducing forestry as a livelihood.

3.4 Emergence of Value Creating Commons Transcending Private Rights Frameworks

This chapter has examined case studies on knowledge and technologies emerging from livelihoods in fisheries and forestry. In the case of the process of creating Satoumi, seaweed aquaculture techniques that had been built up over many years were adeptly applied to coral aquaculture. Full play was given to the abilities of observation and skillfulness in hand work, which people had cultivated through the livelihood of fisheries. Running concurrent with these livelihood technologies was a process in which people from diverse sectors with different relations with corals became involved through the Mozuku Seaweed Fund. This fund has been built up by the consumer cooperative members purchasing cultured Mozuku seaweed and is used to help Onna Village Fisheries Cooperative members - the producers - to promote coral aquaculture and planting activities by nurturing healthy corals and increased biodiversity that translates into the production of high-quality Mozuku seaweed. This scheme paved a way for the urban consumers to be involved as an actor to create values, not simply purchasing products, by collaborating with fishers for Satoumi restoration (Yanaka 2014a; Higa et al. 2018).

In the case of SE-SH forestry, too, appropriate technologies in the form of durable forest roads and small-scale inexpensive forestry machinery have been devised by forestry workers independently from national forestry policies and experts. While current forestry policies in Japan set out a single nation-wide standard for forestry operations, SE-SH forestry has created ties between people and forests corresponding to the specific natural and social conditions of each area, providing the tools needed to incorporate forests within the daily lives of people living in local communities (Yanaka 2016). As it costs relatively little for people to become involved in forestry as a part of side businesses, it is quickly gaining ground among members of younger generations who are pursuing new lifestyles. It is beginning to function as a livelihood technology for facilitating decision making and action for people to effectively utilize forests by allowing everyone to become involved with forests through forestry as a livelihood (Fig. 3.9).

In conclusion, we try to interpret knowledge and technologies born from these livelihoods from the perspective of governing the commons. In general, fishing rights and common rights systems are deemed to be typical examples of traditional commons (Ostrom 1990; McKean 1992; Makino 2011; Murota and Takeshita 2013; Suga 2015), but they also possess the nature of exclusive private rights. However, the creation of Satoumi requires diverse forms of involvement for people from diverse sectors. While transcending the frameworks of private commons and resource management based on fishing rights, Satoumi develops into a system to enable people to continually enjoy the benefits of ecosystem services. SE-SH forestry goes beyond interests in the form of profiting from forests as a private property to generate a sense of awareness among participants and forest owners of protecting and nurturing local forests (Sato 2014). This process presents a stark

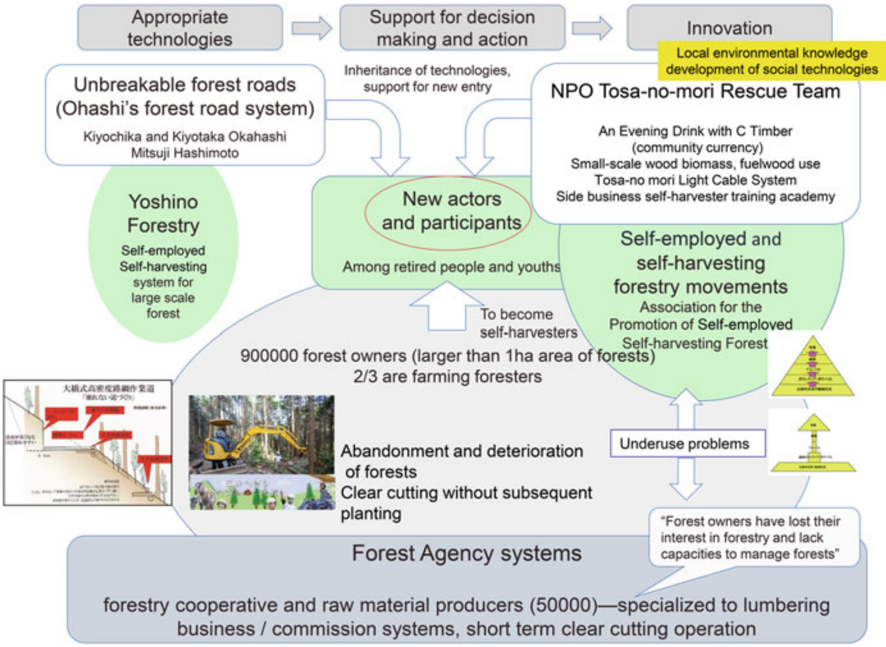


Fig. 3.9 Livelihood technologies and self-employed and self-harvesting forestry supporting decision making and action

qualitative difference to the current forms of outsourcing forestry and commissioned forestry, which pursue efficiency and productivity to maximize private benefits.

According to Hiramatsu (1999) studying processes of establishment of commons in the United Kingdom, commons can be regarded as a development processes from the traditional rights for private benefits to the public rights of benefits for people to enjoy public open spaces. In other words, people succeeded in maintaining the benefits from commons while resisting enclosures. While Japan and the United Kingdom have different historical trajectories, it is noteworthy to recognize that people can be responsible for livelihoods that produce knowledge and technologies for continually enjoying the shared benefits of ecosystem services in open forms beyond the frameworks of exclusive private rights.

This perception is clearly different from existing "new commons theory" which does not imply the perspective of production (Yanaka 2018). In this case, production has been reinterpreted from the perspective of creating values. In order to deal with decrease of labor forces for productions in fisheries or forestry due to depopulation and aging, the new commons theory is proposed to maintain the public values of forests by establishing broad networks, including residents of urban areas and forest volunteers as represented in the practices of collaborative watershed management. However, "it is meaningless to restore commons as the target of another form of 'consumption'" (Miyauchi 2001), without the perspectives of people responsible for use and production of these resources in their daily lives. Apparently, we can no longer rely on twentieth century-style prioritization of productivity. Value does not reside merely in the large quantity of material production. The cases presented in this chapter indicate the need to go beyond existing frameworks to reinterpret the meaning of “production” within the perspective of creative endeavors to generate new knowledge, technologies and institutions (Koizumi 2016) to create a new way to use and manage commons.

References

Forestry Agency, Ministry of Agriculture, Forestry and Fisheries, Japan (2015) Annual report on forest and forestry in Japan fiscal year 2014 (Summary)

Hashimoto M (2013) Working to keep mountains pristine – three pillars of management gained from self-harvesting type forestry (美しい山づくり—自伐林家として実践から得た経営の三本柱). Modern Forestry, May Issue, 54–58 (in Japanese)

Higa Y, Omori M (2014) Production of coral colonies for outplanting using a unique rearing method of donor colonies at Onna Village, Okinawa, Japan. Galaxea 16:19–20

Higa Y, Takeuchi A, Yanaka S (2018) Connecting rural areas and cities with Muzuku aquaculture and coral restoration: Onna Village, Okinawa prefecture (モズク養殖とサンゴ礁再生で地方と都市をつなぐ—沖縄県恩納村). In: Kakuma S, Yanagi T, Sato T (eds) Introduction to satoumi science: new linkages between humanity and ocean. Bensei Publishing, Tokyo, pp 237–271 (in Japanese)

Hiramatsu H (1999) Commoners tale of green Briton – another natural environment history (イギリス緑の庶民物語—もうひとつの自然環境史). Akashi Shoten, Tokyo (in Japanese)

Izumi E (2014) Listening to the symposium (シンポジウムを聴いて). People and Forest 128:27–30 (in Japanese)

Japanese Coral Reef Society (2011) In: Suzuki Y, Ohba H, Tsuchiya M (eds) Coral reef science-Invitation to an unknown world (サンゴ礁学—未知なる世界への招待). Tokai University Press, Kanagawa (in Japanese)

Kohroki K (2014) Frequent burning of debates on self-harvesting type forestry – historic characteristics of self-harvesting forestry families and evaluation of their roles (再々燃する自伐林家論—自伐林家の歴史的性格と担い手としての評価). In: Sato N, Kohroki K, Yanaka S (eds) New era in forestry – future of agricultural and forestry households through “self-harvesting”. Rural Culture Association Japan, Tokyo, pp 85–127 (in Japanese)

Koizumi M (2016) Governance with a creative citizenry: art projects for convivial society in Japanese Cities. Springer, Tokyo

Kumar DA, Nakamura K, Takeuchi K, Watanabe M, Nishi M (eds) (2012) Satoyama–Satoumi ecosystems and human Well-being: socio-ecological production landscapes of Japan. United Nations University Press, Tokyo

Makino M (2011) Fisheries management in Japan: its institutional features and case studies. Springer, Tokyo

McKean M (1992) Management of traditional common lands (Iriaichi) in Japan. In: Bromley DW (ed) Making the commons work. ICS Press, San Francisco, pp 63–98

Miyauchi T (2001) The sociology of commons – possessing, using and managing the natural environment (コモンズの社会学—自然環境の所有・利用・管理をめぐって). In: Torigoe H (ed) Natural environment and environmental culture. Yuhikaku, Tokyo, pp 25–46 (in Japanese)

Murota T, Takeshita K (eds) (2013) Local commons and democratic environmental governance. United Nations University Press, Tokyo

Nakajima K (ed) (2012) Starting a side business in self-harvesting forestry from the proceeds of biomass material (バイオマス材収入から始める副業的自伐林業). Tokyo, Zenrinkyou (in Japanese)
Nakajima K (ed) (2015) Recommendations for new self-harvesting type forestry (New自伐型林業のすすめ). Zenrinkyou, Tokyo (in Japanese)
Nature Protection and Greening Promotion Division, Environment Department, Prefecture of Okinawa (2015) FY 2015 report on project for verifying coral community revitalization in Onna-village waters (平成27年度恩納村海域サンゴ群集再生実証事業報告書). Okinawa (in Japanese)
Ohashi K (2001) Keizaburo Ohashi's compendium of forestry work road construction (大橋慶三郎道づくりのすべて). National Society for the Improvement of Forestry, Tokyo (in Japanese)
Okahashi K (2014) Site illustrations – Forestry work road construction technology (現場図解 道づくりの施工技術). National Society for the Improvement of Forestry, Tokyo (in Japanese)
Ostrom E (1990) Governing the commons: the evolution of institutions for collective action. Cambridge University Press, Cambridge
Sato N (2013) Position of mountainous area issues on the process of policy making and the implementation of "Forest and forestry revitalization plan" (「森林・林業再生プラン」の政策形成・実行段階に山村の位置づけ). J For Econ 59:15–26 (in Japanese)
Sato N (2014) Discussion on "self-harvesting type forestry" for regional revitalization (地域再生のための「自伐林業」論). In: Sato N, Kohroki K, Yanaka S (eds) New era in forestry – future of agricultural and forestry households through "self-harvesting". Rural Culture Association Japan, Tokyo, pp 11–84 (in Japanese)
Sato N (2015) Revitalization of forests and forestry management in Japan – the spread and significance of "self-harvesting type forestry"(日本の森林再生と林業経営—「自伐林業」の広がりとその意味). Linking Rural Villages and Cities 762:8–14 (in Japanese)
Sato N (2016a) Journey in pursuit of self-harvesting type forestry series: Chizu edition (the latter part) on administration & community support to nurture self-harvesting capability as a livelihood (「自伐林業」探求の旅シリーズ:智頭編(後編)生業としての自伐力を育てる—行政,地域の支援). Modern Forestry 606:38–45 (in Japanese)
Sato N (2016b) Mountain villages and forest/forestry policy from 2000s onward – centering around Forest planning institution (2000年代以降の森林・林業政策と山村—森林計画制度を中心に). In: Fujimura M (ed) The way to reactivate human-mountain relations in modern Japanese society. Rural Culture Association Japan, Tokyo, pp 31–58 (in Japanese)
Shiga K (2015) Basic understanding of forest management and forest policy research (森林管理の基礎理解と林政研究). In: Mochida H, Kusao E (eds) Research of problems with forestry structuring. Japan Forestry Investigation Committee, Tokyo, pp 55–80 (in Japanese)
Suga Y (2015) Historical changes in communal fisheries in Japan. In: Yanagisawa H (ed) Commons and natural resource management in Asia. NUS Press, Singapore, pp 113–136
Wilkinson C (2008) Status of coral reefs of the world: 2008. Global Coral Reef Monitoring Network and Reef and Rainforest Research Centre, Townsville
Yanagi T (2010) Satoumi creation (里海創生論). Kouseisha-kouseikaku Corporation, Tokyo (in Japanese)
Yanagi T (2013) Japanese commons in the coastal seas: how the satoumi concept harmonizes human activity in coastal seas with high productivity and diversity. Springer, Tokyo
Yanaka S (2000) Process and background of public opinion formation for environmental problems — from the case of initiatives to prevent red soil runoff by Onna-village fishery cooperative in Okinawa prefecture (環境問題における公論形成の場の創出過程—沖縄県恩納村漁協による赤土流出防止の取り組みから). J Rural Stud 7(1):9–20 (in Japanese)
Yanaka S (2012) Multifaceted involvement in and functionality of satoumi – from practical experience of Onna-village fishery cooperative in Okinawa prefecture (里海の多面的関与と多機能性—沖縄県恩納村漁協の実践から). In: Matsui T (ed) Subsistence activities and production structures in ethnographic perspective. Iwata Shoin, Tokyo, pp 89–121 (in Japanese)

Yanaka S (2014a) Satoumi and power of local community – emerging commons (里海と地域の力—生成するコモンズ). In: Akimichi T (ed) The thought of commons in Japan. Iwanami Shoten, Tokyo, pp 67–88 (in Japanese)

Yanaka S (2014b) Self-harvesting type forestry as a movement – toward responsible forestry in relation to local communities, forest ecosystems, past and future (運動としての自伐林業—地域社会・森林生態系・過去と未来に対する「責任ある林業」へ). In: Sato N, Kohroki K, Yanaka S (eds) New era in forestry – future of agricultural and forestry households through "self-harvesting". Rural Culture Association Japan, Tokyo, pp 153–292 (in Japanese)

Yanaka S (2016) Trends of self-harvesting type forestry emerging after the earthquake disaster – Otsuchi-town and Tono-city in Iwate prefecture, Kesennuma-city in Miyagi prefecture (震災を機に立ち上がった'自伐型林業'の動き—岩手県大槌町,遠野市,宮城県気仙沼市). In: Year book of forest and environment 2016. The Forest Culture Association, Tokyo, pp 94–105 (in Japanese)

Yanaka S (2018) Reviewing forests and forestry from the perspectives of residents – ownership theory approach to under-use problems (森林・林業を居住者の視点から捉え直す—アンダーユースの環境問題への所有論的アプローチ). In: Torigoe H, Adachi S, Kanebishi K (eds) Community analysis by life-environmentalism. Kyoto, Minerva Shobo (in Japanese)

Chapter 4
Drawing Plans of a House That Already Stands: Knowledge Systems of the Shiretoko Region, a World Heritage Site of Japan

Hiroyuki Matsuda, Mitsutaku Makino, and Eirini Ioanna Vlachopoulou

Abstract In the context of the process in which Shiretoko was selected as a World Natural Heritage Site, we discuss the functions of bilateral knowledge translators as buffers to resist external pressure. We explore a process that encourages reconfiguration of the international framework represented by World Natural Heritage Site. In the Shiretoko region, through the interaction between fishers and visiting researchers, knowledge systems that contribute to the international value of World Natural Heritage Sites are reorganized to fit local realities. The mechanisms utilized and the value derived from local fisher practices can spread widely via the language of science.

4.1 Producing Knowledge That Is Useful to the Area

4.1.1 Shiretoko World Heritage Site and Its Scientific Council

A remote peninsula on the island of Hokkaido, Shiretoko has an ecosystem that combines nutrients from land and sea, with plankton from the Sea of Okhotsk arriving in the seasonal sea ice -the lowest latitude for sea ice in the northern hemisphere- and salmon returning upstream, which become prey for local brown bears. The site is also habitat for rare species like the Steller's sea eagle (*Haliaeetus pelagicus*) and the endangered Steller sea lion (*Eumetopias jubatus*), making Shiretoko a hotspot for biodiversity.

H. Matsuda (✉)
Yokohama National University, Yokohama, Japan
e-mail: matsuda-hiroyuki-vj@ynu.ac.jp

M. Makino
Japan Fisheries Research and Education Agency, Yokohama, Japan

E. I. Vlachopoulou
University of the Aegean, Mytilene, Greece

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_4

Shiretoko was inscribed as a World Natural Heritage Site in 2005, but the selection process went through several rough points. The marine areas essential to the natural value of Shiretoko were locations of set-net and gill-net fishing; one of their main target species is walleye pollock (*Theragra chalcogramma*), which is also a staple food source for the Steller's sea lion. As clusters of wilderness, World Heritage Sites often restrict human activity, especially compared to other nature conservation sites. However, the rivers of Shiretoko are dammed in several dozen places, which prevents the upstream return of salmon that is a vital element of the Shiretoko ecosystem.

As highly demanding requirements were expected for the designation of Shiretoko in comparison to the processes for the selection of Yakushima and Shirakami-Sanchi, Japan's first World Natural Heritage Sites inscribed in 1996, the Japanese Ministry of the Environment established a scientific council to provide scientific advice pertaining to the selection and management processes.

As the scientific council contributed immensely in the selection process and the management work that followed, and helped the site to remain conversant with the World Heritage system, without trying to force global standards on the site. The Ministry of the Environment, encouraged by its success, formed scientific councils also for Yakushima, Shirakami-Sanchi, and Ogasawara, all of which are registered as World Heritage sites. This chapter aims at examining the effect of the establishment of the scientific council on the Shiretoko World Heritage Site as well as propose a set of roles that local environmentalists can take to support World Heritage processes.

4.1.2 The Roles of Scientists in the Decision-Making Process of Environmental Policy

Scientific expertise is necessary not just for management and selection of World Heritage Sites but also for management of nature reserves (parks). The expertise of scientists is the basis for ascertaining issues, such as the species present, case-specific measures to maximize natural value outputs and identify threats to biodiversity. The primary function of ecology is to observe and study nature, rather than focusing on human-led change. Yet, anthropogenic global environmental change, particularly climate change, poses the largest threat to the value of sites, even if its effects might not be immediate, direct, or obvious, as in the case of untouched wilderness. Thus, issues, such as how to preserve the remaining ecosystems and how to restore lost ecosystems, are central objectives in fields related to ecology, in order for scientists to be able to inform the basis for sustainable use of local natural resources. We call the holistic management of land, water and biotic resources the "ecosystem approach".

This ecosystem approach cannot be labeled as just an ecological method for observing nature. In the "12 Principles of the Ecosystem Approach" agreed upon at

Table 4.1 Abstract from the 12 principles of the ecosystem approach (Conference of the Parties to the Convention on Biological Diversity 2000)

1. The objectives of management of land, water and living resources are a matter of societal choices
2. Management should be decentralized to the lowest appropriate level
3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems
4. Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:
(a) Reduce those market distortions that adversely affect biological diversity;
(b) Align incentives to promote biodiversity conservation and sustainable use;
(c) Internalize costs and benefits in the given ecosystem to the extent feasible
5. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach
6. Ecosystem must be managed within the limits of their functioning
7. The ecosystem approach should be undertaken at the appropriate spatial and temporal scales
8. Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term
9. Management must recognize the change is inevitable
10. The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity
11. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices
12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines

the 5th meeting of the Convention on Biological Diversity in 2000, a series of principles that go beyond conventional ecology were adopted (Table 4.1), which can be seen as guidelines for the roles and precautions to be taken by scientists when preserving and restoring ecosystems.

The role of scientists in working groups such as the aforementioned scientific council is not to assert one's own thoughts and beliefs, but to take an advisory stance in the form of a neutral, third party. As the "12 Principles of the Ecosystem Approach" state, "The objectives of management of land, water and living resources are a matter of societal choices" (Convention on Biological Diversity 2000). For example, scientists cannot be alone in deciding how to deal with sika deer (*Cervus nippon*), once in dramatic decline but now with a population in excess), which are causing severe damage to agriculture and forestry. In many prefectures, deer are regarded as pests, with attempts being made to reduce populations, while in Hokkaido they are seen as a resource and deer meat consumption is promoted. However, there are some prefectures, like Kanagawa, that do not include the sustainable use of deer meat in their conservation management plans, as the decision to use deer meat or not is a societal choice. An even clearer example would be the case of the Japanese macaque (*Macaca fuscata*). Approximately 50 years ago, Japanese macaque populations were also in steep decline, but with several of the regional populations having recovered in recent years, they are affecting negatively the local agriculture. In an attempt to reduce the damage, macaques are captured and killed in many regions in Japan, yet hardly any monkey carcasses are used as food. Interestingly enough, in the past, monkeys were traditionally utilized as a food source in several Japanese regions. Considering also that even today some nations consume monkey meat, despite the potential risks from the transmission of zoonotic diseases from monkey meat consumption may present an increased risk compared to, for example, deer meat. Ultimately, consumption ethics are societal choice; society alone decides whether deer or monkeys should be eaten, not the scientific community.

Nevertheless, scientists can and should be involved in the process of realizing societal objectives, as they can offer advice on measures to achieve those objectives and ways to validate the measures (Matsuda 2007). Yet, local stakeholders should make the final decision on the adoption of the scientists' suggestions. In other words, the local community and scientists should engage in an exchange of ideas throughout the process until a common understanding or shared vision has been developed in the decision-making process for the management plan.

Beyond entrusting matters to societal choices, scientists should remain impartial, introducing the available scientific knowledge and established theories shared among the relevant disciplines to the community concerned. In that sense, scientists from the same field should ideally be supporting similar ideas. Nevertheless, complete impartiality is impossible to achieve, and there will be differences depending on the scientists' personalities. Still, established theory and relevant validated empirical data should be the scientists' compass. Above that, in order to exercise ingenuity, knowledge dependent on the genius of the individual making a proposal that goes beyond the established theory can be provided. In such cases, it should be explained that such ingenuity is not an established theory but a new proposal.

Another role of scientists concerns arranging the discourses based on local wisdom in the context of science, and universally translating them in a format that even non-locals can understand. This is evident in Principle 11 of Table 4.1. Nowadays, this corresponds to a transdisciplinary approach. The role of the "translator" differs from those of the local leaders and elders. Yet, in some cases, there may be the same people who handle all these roles.

Even if the act of writing a paper is to have it appraised in the discipline concerned on a valuation basis set by professional researchers, this process and the change that can actually take place in a community are separate, with the latter being an important role of scientists with relation to local communities. Offering access to knowledge, both novel ideas and established knowledge, is the role of the scientist as a translator. Doubtless, there needs to be a setup that will appraise such a role of scientists from a viewpoint that is different from conventional science.

Naturally, if something of real benefit can be done for the region in question, the ideas behind it may have scientific impacts. If experts can act as consultants or advisors providing useful information to the society concerned, then there should be good opportunities for obtaining new results that are valuable in scientific communities. Achieving such results, regardless of whatever the appraisal is in the conventional discipline or not, is a vital gift for the expert as a scientist. Having the ability and passion to challenge new and unknown domains is an essential element of a scientist and, as a result, the specialty of a scientist working in a local environment will often transform or broaden as the years roll by.

So, in writing a treatise, words should be used to express matters in such a way as to offer a vicarious experience to people who have not seen the site concerned, changing the meaning for them. In other words, scientific knowledge is essentially universal. Appraisal from academics mainly takes place according to research results that are connected to peer-review. In the course of announcing research results as treatises, works are critiqued by experts in the same field, with only those that are worthy for publication in scientific journals being deemed worthy of citation and use in further work. Indeed, the norm is for papers to be rejected in the review process or demands made for sweeping revisions. Writing a scientific article on the scientific validity of local knowledge is, however, the business of scientists. Although there are increasingly interdisciplinary and transdisciplinary opportunities to work, a scientist acknowledged in a certain field may still have difficulties to produce a paper in a different field for peer-review. Evidence acceptable in one field is often not accepted in others. Hence, a rational way out is often sought, in which a scientist will consult experts in a field where their contribution is needed, either entrusting the work to those experts or doing collaborative research with them. Consequently, introducing experts from other fields is yet another important role of a researcher involved in a local area. This is probably very similar to how a doctor in a general practice might refer a serious case to a specialist.

There are many cases where scientists who live in the areas where they are conducting work fulfill immense roles. They are the residential researchers discussed in this book (see Introduction). Yet, experts from outside can also give opinions on problems in a local area. Either way, what is important is that scientists take the role of translator to make the most of global standards in the area under examination, and, conversely, raise awareness in the world about how that local area is tackling issues.

To summarize the above, we would like to say that the following three roles should be taken by scientists involved in management of World Heritage Sites: (1) The role of explaining to local stakeholders in a readily understandable manner the approach and background to the global standard, (2) The role of elucidating in a scientific context to local stakeholders the natural value of and the local approach (along with its problems) to protected areas, and (3) The role of proposing to the on-site community the arguments and methods for solving on-site problems that cannot be resolved by generalities as well as proposing to the world a new approach to be taken by the on-site community that will contribute back to the global standard.

4.1.3 Roles of Scientists at Shiretoko World Heritage Site

As will be described later, the Shiretoko World Heritage Scientific Council has fulfilled the role of translator in making the most of the World Heritage global standard in the approach to the Shiretoko area while also raising awareness in the world about the approach taken locally. Many of the scientists in the Shiretoko scientific council do not live in Shiretoko. In that sense, they are visiting researchers. Yet, up to FY2014, there were scientific council researchers also living in Shiretoko (Sharicho, Rausucho). They are not natives of Shiretoko, but have spent many years residing in their place of work. The Ministry of the Environment has acknowledged the importance of these residential researchers as mentioned in this chapter, and is adding a small number of them belonging to local prefectures (Ogasawaramura municipality in the case of Ogasawara) in scientific councils for Yakushima and Shirakami-Sanchi, as well as Ogasawara, which started World Heritage work after Shiretoko. These residential researchers have taken root locally, so the intention does seem to be adding experts who know the daily life of local areas.

Another feature of the Shiretoko World Heritage Site is the Shiretoko Foundation, spearheaded by the town of Sharicho. With the addition of a park ranger dispatched by the Ministry of the Environment, the foundation comprises a large number of its own rangers, who take responsibility for managing the park. These rangers fulfill the role of residential researchers who know the local area very well, with some of them even being Ph.D. holders. The Shiretoko Foundation has cleaved to a massive expectation in the working of the scientific council from the outset of its creation. That expectation is built around the hope that the scientific council can present an independent opinion to the authorities, so that “the local community can take the initiative in moving forward rather than the authorities having hegemony” (Fujiwara 2005).

World Heritage has ten selection criteria related to matters such as “natural beauty”, “topography and geological features”, “ecological process” and “biodiversity”. At least one of these criteria has to be fulfilled to enable selection. The evaluation results for these selection criteria and past matters must fulfill the global standard to achieve World Heritage status. Yet, even though it is a global standard, it does not necessarily mean that these results are in line with the societal objectives of the local community. Doubtlessly, scientists think that the global standard brandishes some gravitas, but it should not be the expedient for forcing ideas incongruous to the locality on to the local community. Namely, assuming World Heritage selection is the goal, yet it is not justification enough for making excessive demands of the local area in order to attain the goal.

However,

1. it may be feasible to persuade local communities if reasons for establishing the global standard are explained clearly in locally relevant term.
2. It may be feasible to clarify the universality and significance of an approach that has been compared to the approaches of other local areas when working to sustainably protect nature, using scientific context to extract the special features. In a sense, this could be an exemplar of the approach taken by another area.
3. It is important to be creative with the original local area approach. Because, if things can be achieved by getting the local area to accept demands by gradually fulfilling the global standard, then the mediation provided by the translator who proposed such creativity will be extremely important.

Table 4.2 Shiretoko World Heritage Site Scientific Council

	2005	2016
Vegetation	Yukio Ishikawa, Gaku Kudo, Hideki Takahashi	Yukio Ishikawa[a], Gaku Kudo
Forestry ecosystem	Kenkichi Ishigaki, Tsuneo Igarashi	
Mammals	Noriyuki Otaishi, Koichi Kaji	Koichi Kaji[a]
Birds	Gen Nakagawa[b]	Yutaka Watanuki
Fish	Eishige Komiyama	Kentaro Morita
Erosion control & River ecology	Futoshi Nakamura	Futoshi Nakamura
Ocean ecology & marine products	Yasunori Sakurai, Tsutomu Sano, Mari Kobayashi	Yasunori Sakurai, Osamu Shida
Oceanology	Hiroshi Hattori	Keiichiro Oshima
Ecology (GIS, bioresource)	Hiroyuki Matsuda[a], Masami Kaneko	Masami Kaneko, Tetsuya Aiko
Fisheries policy		Mitsutaku Makino[a]
Tourism		Asami Shikida[a]

Note: Classification is per this chapter
[a]Denotes residence outside of Hokkaido; [b]Denotes residence in Sharicho or Rausucho

These points agree with the three roles of scientists laid out in the previous section. We introduce these three roles of a translator in the case of Shiretoko.

4.2 Shiretoko World Heritage Selection and the Advice Given by the Scientific Council

4.2.1 Scientific Council's Independent Recommendations

As mentioned earlier, Shiretoko was the first World Heritage Site in Japan to have a scientific council established by the Ministry of the Environment, specializing in the local area of the site. At first, the council was staffed by mostly natural scientists. However, nowadays, the number of social scientists has risen (Table 4.2), and, upon reflection, the understanding of the Ministry of the Environment has changed as well.

In the World Heritage selection process, sites undergo domestic scrutiny before the national government submits its recommendations to UNESCO for consideration. In the case of World Natural Heritage, the International Union for Conservation of Nature and Natural Resources (IUCN) does the evaluating (International Council on Monuments and Sites [ICOMOS] in the case of cultural heritage), and makes recommendations: "inscribe", "referral", "deferral" or "not to inscribe". Based on the recommendation, the World Heritage Committee, consisting of representatives from governments, votes whether to adopt the recommendation. If the recommendation is "referral", and the conditions imposed by IUCN are fulfilled by the time the World Heritage Committee meets, then the prospect of selection is good. If a recommendation of “deferral” is made, then selection in that year is difficult, so another attempt should be made in the following year or later. However, a “not to inscribe” recommendation will mean that future selection in general will be difficult.

In the case of Shiretoko, David Sheppard of IUCN came to Japan in the summer of 2004 to evaluate the site. He wrote an informal letter asking for improvements to dams that blocked the path of salmon swimming upstream and enhancement of conservation levels in marine areas. Yet, even though the scientific council had been formed, the informal letter was not made available to the council, which found out about it via the media. The scientific council chair asked the Ministry of the Environment for permission to summon the council in order to discuss countermeasures, but was turned down by the ministry.

The only way of understanding this reaction is to realize that many of the councils summoned by the government are mouthpiece bodies that simply echo government policies. Moreover, there had been behind-the-scenes discussions between relevant ministries and agencies, making it difficult for the Ministry of the Environment to talk to the scientific council without the consent of other ministries and agencies. Additionally, while the removal of dams would not run contrary to the interests of the Ministry of the Environment, there probably were other ministries and agencies that would have been concerned. Also, it is possible that the Fisheries Agency might have been affected due to issues of regulation governing marine areas. It seems that the scientific council was being cautioned about voicing its opinion.

However, despite being told by the Ministry of the Environment not to call for a meeting, the chair of the scientific council at that time composed an email including the council’s points and compiled an independent proposal to deal with the content of the informal letter from IUCN. The proposal added a marine area working group (WG from here on) and a river structure WG to the pre-existing deer WG (tasked with dealing with the increased deer population). In this way, the scientific council went beyond the government view, establishing its own independent working stance, which has probably become the springboard for launching various new values.

The government refused the proposal, sending a letter to IUCN to tell them that the additional conservation measures were not necessary. From the view of accepted practice by scientists, this rebuttal to the site evaluator mid-evaluation was a highly unusual one. In peer-reviewing practice, the opinion of the evaluator has significant impact on whether or not a paper will be published, so much so that unless there is some kind of technicality issue, anonymous evaluators are adhered to fully or ostensibly adhered to while the author works to win his/her point (Sakai 2007). The government’s response at that time was a long way from the accepted practice.

Fortunately, however, IUCN did not reject the government’s letter, and instead another letter came to Japan. In this second missive, matters were made clearer, with specific demands, such as expansion of the marine areas to be inscribed. At this point, a meeting of the scientific council was at last held, and advice on how to implement countermeasures given.

As described earlier, the marine areas of Shiretoko are fishing grounds where set-net fishing is employed. The Ministry of the Environment and Hokkaido promised the three Fisheries Cooperative Associations (FCAs) involved that there would be no new regulations brought in with achieving World Heritage status. Conversely, IUCN demanded bolstering of the conservation levels for marine areas. Thus, satisfying both sides simultaneously appeared to be impossible.

In an attempt to meet the IUCN demands and keep the promise to the fishers, the scientific council proposed that the FCAs themselves enhance their conservation levels. Japanese fishers everywhere – not just in Shiretoko – are strongly resisting government regulations. So, in Japan, fishing is legally performed even in marine parks (equivalent to special protection areas in terrestrial national parks). For coastal fisheries, that does not mean that everyone can freely catch fish; only local fishers are given the right to use marine resources in what is known as common fishery rights. In international terms, this is one form of Territorial Use Rights for Fisheries (TURFs, Tsurita et al. 2018). In many Western countries, fisheries resources are openly accessed and managed by the governmental authorities in order to avoid the tragedy of the commons (Hardin 1960). This is based on the Public Trust Doctrine. The TURFs are different way to avoid the tragedy of the commons. The proposal of Shiretoko World Heritage was a good opportunity to introduce the Japanese fisheries co-management framework to Western countries promoting a World Heritage system context reflecting the logic fronted by Christianity (UNESCO World Heritage Centre 1994). In the Japanese framework, local fishers maintain their resource usage rights while also taking responsibility for sustainably maintaining the resource. As a result, under the common fishery rights, it is not just the government but also the FCAs that take the role of fulfilling the requests of IUCN.

4.2.2 Rausu Fisheries Cooperative Association Decision

As a result, the Rausu FCA autonomously expanded the seasonal fishing ban area for walleye pollock (Fig. 4.1). This satisfied the IUCN's requirement to increase the marine conservation level and contributed towards Shiretoko being selected as a World Heritage Site (Makino et al. 2009).

Walleye pollock is one of major target species in the Japanese fishing industry, with more than two million tons caught in the 1980s. After that peak in catches, the resource declined sharply, and catches decreased accordingly. The number of fishing boats targeting walleye pollock with the Rausu FCA decreased gradually, falling to half their original number from 1995 to 2005. Despite the limited international precedent of a fishers' association compensating retiring members instead of the government, the fishers who quit the walleye pollock fishery were offered compensation by the FCAs. Furthermore, since 1995, a part of the spawning ground has been closed to fishing during a part of the spawning season, as an effort to protect fish (Makino et al. 2009).

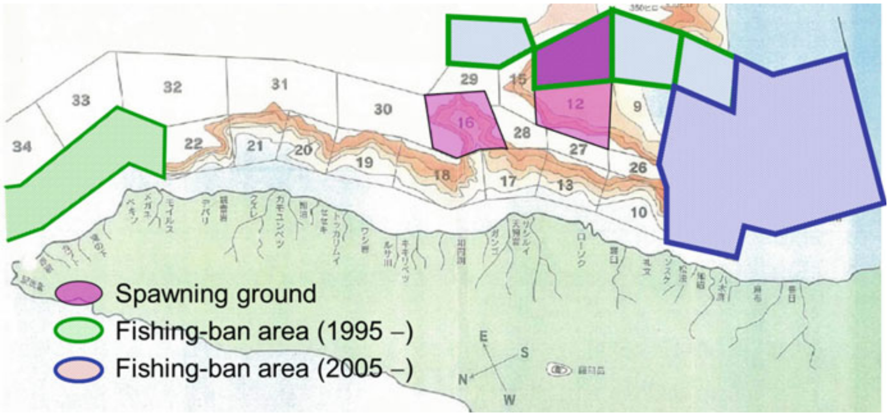


Fig. 4.1 Walleye pollock grounds and seasonal fishing-ban areas on east side of Shiretoko World Heritage Site. (Source: Revised data from Rausu Fisheries Cooperative Association)

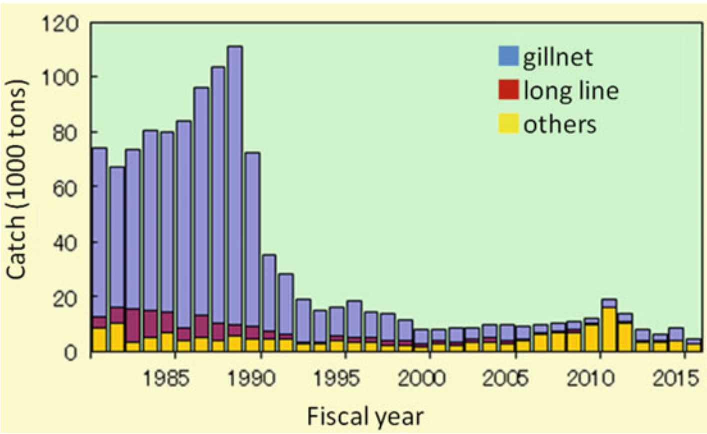


Fig. 4.2 Catch volumes for Nemuro shoal of Walleye pollock. (Source: Revised data from Rausu Fisheries Cooperative Association)

As Fig. 4.2 shows, the walleye pollock resource decline started in the 1990s. Yet, asking for further catch reductions would not necessarily be greeted with approval for a range of reasons. The resource fished by Rausu belongs to the Nemuro stock, which is also utilized by Russia. Even though Japan imposes limits on trawler catches, Russia is said to make massive trawler catches. Thus, getting just the Japanese side to implement catch limitations was not going to elicit agreement from the FCAs.

Instead, in the second letter from IUCN, there was a request for expansion of the marine areas to be inscribed. In the proposal put forward by Japan, the World Heritage marine areas were to extend offshore by 1 km. In fact, "excluding the special exemption law for the Inland Sea of Japan, the distance of one kilometer from shoreline to offshore boundary" was laid down in the scope for national park planning revised in 2003. Therefore, amendments to that ruling would be necessary in order to register the larger marine areas in the national park. The scientific council said it would be appropriate to make the marine areas part of the continental shelf, and proposed an expansion to three kilometers offshore.

Even if the marine areas for selection were expanded, it was not going to result in regulated fishing. So, it was no wonder that increasingly more fishers became suspicious, asking why there was the need for such an expansion. They were also suspicious that there might be some kind of additional demand made after the site was inscribed. In response, the scientific council requested direct dialogue with the fishers, but the government fearing that the scientific council would act rashly, made no attempt to arrange any meetings, at least at first. Yet, after some forceful requests, permission for a meeting in Kushiro was granted. Despite additional complications in the internal affairs of the FCAs, in the end, the association chairs made the wise decision to cooperate in the efforts to aim for selection as a World Heritage Site.

4.2.3 The Role Fulfilled by Shiretoko Scientific Council

Undoubtedly, the scientific council played a major role in the site selection process. To start with, the council persuaded the local communities that the global standard is necessary for assuring the international community that sustainability was being addressed and to pave thus the way for selection as a World Heritage Site. Secondly, the council introduced to the world the self-management framework that was already an established practice among local fishers. Lastly, the council demonstrated an actual example of how IUCN requests could be met by an as-yet-unknown expedient; the strengthening of self-management rather than introduction of government regulations. Yet, all the scientific council did was put forward ideas to resolve issues; it was the fisheries cooperative associations that made the decision to actually implement these solutions. In this way, instead of the government taking responsibility to preserve nature in line with the conventional World Heritage Site management system, the scientific council showed the world a new World Heritage model. The Ministry of the Environment acknowledged the success of the scientific council's role, calling it the "Shiretoko Approach" (Makino et al. 2009; Matsuda 2016), and from there on the ministry established scientific councils for the existing World Heritage Sites of Yakushima, Shirakami-Sanchi and Ogasawara.

In 2010, the International Association for the Study of the Commons selected this case under the title of "Co-management of Coastal Fisheries in Japan" to be one of its global impact stories. It is a case of inclusive co-management, where not just the government but also stakeholder parties are included in autonomous management (Matsuda 2016).

4.3 Documentation of Shiretoko Marine Areas Management Plan Based on Local Knowledge

4.3.1 Swift Establishment of Marine Areas Management Plan

For the selection of Shiretoko as a World Heritage Site, a marine areas management plan had to be developed that would allow the World Heritage Site of Shiretoko to run a fishing industry. Even in the government's reply to the first letter from IUCN in November 2004, it was explained, as mentioned above, that the fishers have made several efforts to counter the walleye pollock stock decline. They expanded the already established fishing closure areas in order to protect spawning fish, and reduced the number of fishing boats. The FCAs themselves already compensated fishers who quit fishing, and restricted the allowed types of fishing gear. The reply also explained that the objective over the next 5–10 years was to form a multipurpose integrated marine areas management plan (marine areas management plan from here on). Yet, even though the reply denied the need for new regulation, IUCN was not convinced; while highly praising the self-implemented expansion of seasonal fishing closure areas for walleye pollock, IUCN also requested that the marine areas management plan be established swiftly and that an inquiry commission be invited within 2 years. IUCN had conceived the possibility that establishing the marine areas management plan contradicted the desire not to establish new regulations.

However, the strategy of the scientific council was clear from the time of inscription. In the hearings conducted with the FCAs, the scientific council found out that up to that point in time, the FCAs had been involved in various approaches that had not been documented in writing, and least in English. If those approaches were to be included in the marine areas management plan, there would be no need to establish new regulations. Such a thing would not be too difficult to do, and was likened to "Drawing Plans of a House that Already Stands". As mentioned earlier, the number of social scientists in the scientific council was small, but the need for a specialist in the fishing industry system was noted, so one of the co-authors of this chapter, Mitsutaku Makino, became a member of the marine areas WG. Having a specialist who can deal with local issues is always a vital addition, especially as many of Japan's fisheries economists tend not to write papers in English. Yet papers in English get the best results when it comes to World Heritage issues. This truly epitomizes the second role of the translator mentioned earlier.

Furthermore, TURFs are used by other countries, and are being implemented elsewhere in Japan as well. In the case of Shiretoko, we proceeded by explaining the following autonomous fisheries management practices implemented by the fishermen themselves based on the advice of the scientific council, as stated in the reply from the Japanese government to IUCN in February 2005.

The reply mentioned that, to establish a marine areas management plan with the aim of maintaining stable fisheries while preserving marine life and marine ecosystems in a compatible format, the science council will "compile all advice necessary to prepare a draft of the Plan, including current fishery restrictions and putting the voluntary restrictions enforced by fishermen and fisheries organizations in the statutory form" (Onodera 2005). Based on this advice and in collaboration between the relevant government agencies and fisheries related organizations, research institutions including universities and fisheries experimental station, a marine areas management plan that will be the keynote to fishing related rules could be agreed upon. To achieve that, it was promised that within 3 years the advice of the scientific council would be obtained while building consensus via public participation in stages of the process, such as holding briefing sessions for local stakeholders including fishers, and by implementing opportunities to enable provision of opinions.

Thus the basic policy of the marine areas management plan was made clear:

1. The aim is to maintain a stable fishing business while preserving marine life and marine ecosystems in a compatible manner.
2. Gradually implemented fishing self-management rules enforced by fishers and fishing bodies in the marine areas will be set as the key rules. As the self-management rules already in place at present have been judged to be good, they will continue to be used as the base while the scientific council will describe matters related to the overall preservation of ecosystems.

In the "marine areas management plan" formulated in December 2007, the "objective to compatibly manage the preservation of ocean ecosystems in the marine areas within the World Heritage Site together with the stable fishing business practices that sustainably use marine resources" was clearly described, which assisted in reducing the fishers' apprehension about new fishing regulations being assigned for World Heritage selection. The basic policy was to make the keystone points of the plan be the legal regulations governing preservation and fishing in ocean environments and ocean ecosystems with the self-managed rules related to ocean recreation, as well as the fishers' autonomous management of the fishing industry. These terms were added to express the current legal regulations and autonomous management related to recreation in marine areas.

An important element of the marine areas management plan is its approach to the marine food web. In the food web diagram included below are mapped the sea eagles and brown bears, as well as the fishing industry, to clearly describe how the existence of the fishing industry was linked to both land and sea at the Shiretoko site. Additionally, emphasis is put on the importance of fishing-data-derived information that shows the change in ecosystems by selecting indicator species featured in ocean ecosystems at Shiretoko, including salmon and walleye pollock, sea lion, seal, spectacled guillemot and sea eagle, along with fishing information such as volumes and prices from fish catches in Shari and Rausu from monitoring observation statistics dating back to 1935,.

While the sea lion is an endangered species it also causes an extreme amount of damage to the fishing industry via actions such as destroying set-nets and eating the salmon stock inside. The Fisheries Agency has set culling limits to prevent populations in Hokkaido and Aomori from decreasing. At time of World Heritage selection in 2005, the number of migrating sea lions arriving in Shiretoko was too small to cause serious conflicts. However, the sea lion's main visiting sites change over time. Therefore, in readiness for the future, the interested parties pledged to maintain the nationwide cull limit. Nevertheless, as eating of sea lions is not an accepted or tolerated practice, despite the existence of establishments offering sea lion cuisine, the carcasses go to waste. UNESCO and IUCN argued that use of the carcasses could lead to overhunting, thus a precautionary approach should be followed; as a result, sea lion eateries could not be in the process of Shiretoko getting selected as a World Heritage Site.

The process explained earlier resulted in an agreement to fulfill the promised requirements in 3 years. Nevertheless, by putting matters into the statutory form, some burden would have to be shouldered if changes could not be made easily when desired at a later date. Yet, what had been achieved did not involve new regulations. Shiretoko would become a World Heritage Site while the opportunity to responsibly explain to the world the issues and advantages of allowing fishers to do their daily work had been earned.

4.3.2 The Relationship with Russia

The fishers had another reason for putting their hope in the scientific council: the need to cooperate with Russia in relation to the walleye pollock stock. As described earlier, if only Japan was involved in the management of the resource, its recovery would be unlikely. Absence of Russian data would prevent an evaluation of which side, Japan or Russia, was having the greatest impact on the resource. In other words, a quantitative comparison would be impossible. The policy of the scientific council is to first build a trusting relationship between Japanese and Russian experts, in order to mutually share information on an informal basis. Then it would propose to both countries an effective resource management scheme to cover all aspects. However, formal sharing of information and implementation of co-management on an inter-government basis will probably not happen in the near future. After all, the Japanese government will never condone Russian fishing around the Kuril Islands. When Shiretoko was being selected as a World Heritage Site, the IUCN recommendation document pointed out that nearby islands shared a similar ecosystem to that of Shiretoko, with even a proposal going as far as saying that the selected area could be expanded in the future to encompass those nearby islands in order to create a "world peace park". UNESCO recommended selections of World Heritage Sites that span international borders in the hope of promoting peace and friendship. Fortunately, Shiretoko was selected ahead of such proposals, so Japan has the initiative rights on whether to expand or not in the future. At present, there is no indication that the Japanese government is ready to use this trump card. Yet, for the noble cause of nature conservation, it is possible that a government proposal on nature conservation including the Kuril Islands might be put forward. Such a move though could bring the threat of a new problem concerning the Kuril Islands separation from the question of territorial possession (Honma 2005).

In relation to this, Japanese, Chinese and Russian researchers, led by Professor Takayuki Shiraiwa of Hokkaido University, formed the "Amur-Okhotsk

Consortium" in 2011. While there are various restrictions placed on field trips in Russia and China, real progress is being made in establishing mutual trust among the researchers in their joint efforts. Indeed, the Ministry of the Environment and the Ministry of Foreign Affairs frequently hold workshops on cooperation in preserving ecosystems in areas adjacent to Japan and Russia. These workshops possibly give hope to the scientists involved with the fishers mentioned above.

4.4 Approaches in Shiretoko Area

4.4.1 Rausu Fisheries Cooperative Association's Approach to the Prevention of Overfishing

Fishers are fully aware of what fishing grounds mean for their own economic activities, and continuously monitor environmental aspects such as water temperature. Yet, as the Fisheries Agency does not necessarily evaluate resources like the main fish species status, there is no hard evidence that truly sustainable fishing is being implemented. Hence, a method was worked out, in which the monitoring and basic research implemented by the Ministry of the Environment, the Ministry of Agriculture, Forestry and Fisheries, Hokkaido, and research bodies have been pooled together in order for the FCAs to implement an unaccompanied study to ascertain the state of sustainability.

In Fig.4.3, the circles represent the life forms utilized by humans, and statistics for catches of finfish, shellfish and marine mammals denote certain points. The sea eagle, for example, is not utilized by humans, but the number of eagles discovered to

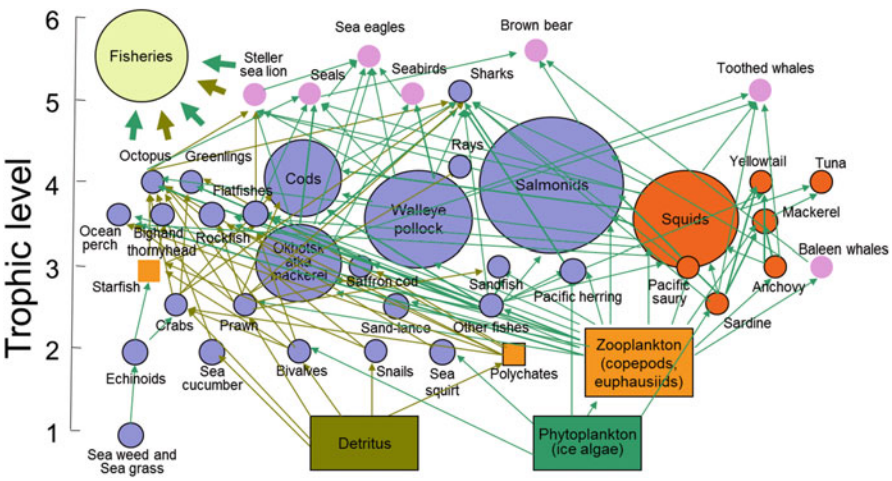


Fig. 4.3 Food web in Shiretoko marine areas. (Source: Shiretoko World Heritage marine areas management plan)

have died by lead poisoning or other accidents is known. As the majority of life forms in the ecosystems of the marine areas are utilized by humans, ecosystem information from fish catch statistics can be obtained. Nonetheless, the volume of fish catches alone will not provide adequate results regarding sustainability. Maintaining fish catch volumes even if the resource becomes depleted will invite a crisis to the resource. The FCAs have tabulated the fish catch prices per fish species and, if the fish caught become smaller because of overfishing, the price per ton of landed fish will drop. Therefore, if fish catch weight and fish catch prices are written into the management plan, and become the subject of monitoring, fish species undergoing unusual events can be identified. Not all of the fish species exhibiting significant reductions in terms of catch volume or those getting lower prices per unit of weight (lower catch prices) will suffer overfishing, yet their circumstances can be given additional study time to explore potential causal relations and perhaps to assure sustainability.

4.4.2 Tourism and Nature Conservation: Opposition and Co-benefit

Tourism and nature conservation often stand in opposition to each other and Shiretoko is not an exception. It is designated as one of the 13 areas across Japan in the Ministry of the Environment's "model for promoting ecotourism", with the "Shiretoko Eco-Tourism Association" (eco-association from here on) being formed in July 2004. After its selection as a World Heritage Site, a proper usage/ecotourism WG was established within the World Heritage scientific council in 2010, and now links up with the eco-association to promote ecotourism.

There is no general definition of ecotourism (Fennell 2001), but it is regarded as tourism that takes into consideration the conservation of nature and contributes to education (Donohoe and Needham 2006). For the eco-association, the aim is for a stay-type (instead of pass-through-type) sightseeing as ecotourism in Shiretoko, with a structure that links to the development of local industries, such as agriculture and fishing. Within this configuration, the aim is for tourism that also enables tourists to experience regional history and culture along with sightseeing. Here, we introduce several ways in which sightseeing in Shiretoko displays the above problem concerning opposition and co-benefit in nature conservation.

From 2011 the Shiretoko Goko Lakes area was designated as a regulated utilization area system as per the natural park act. The period from 10 May to 20 October is set as the season each year when tourists are required to attend a lecture and be accompanied by a guide on tours around the lakes to minimize bear-human encounters and protect vegetation. Moreover, an elevated pathway has been installed and opened to visitors so that they can enjoy the area without coming into direct contact with wildlife.

Fig. 4.4 Tourists photographing a bear at very close quarters. (Source: Shiretoko Foundation)

However, the locations where use can be regulated in ways similar to those above are limited. Unlike national parks in countries like the USA, Japanese national parks involve private land, so tourists cannot be prohibited from entering. At Iwaobetsugawa River, more and more tourists are taking photos of brown bears (*Ursus arctos*) from close quarters, which has led to brown bears becoming familiar with human presence to the extent that they no longer run away, and, instead, have taken to entering urban districts, a behavior that often results in their extermination. With Shiretoko being a World Heritage Site, the prevalent policy is to scare off brown bears without catching and killing them, yet scaring off is ineffective, and the number of brown bears accustomed to humans is continuing to increase. Hokkaido's ordinances on biodiversity prohibit the feeding of brown bears but there is no legal basis for banning photo shoots. In 2013, the scientific council issued an emergency statement alerting visitors to the problem, but this too was ineffective, and photo shoots continue (Fig. 4.4). Sadly, as of February 2016, there still seems to be no solution to the problem in sight.

In the vicinity of Shiretoko World Heritage Site, food is being put out for the nocturnal Blakiston's fish owl (*Ketupa blakistoni*), an endangered species, at a guesthouse in Rausu, with spotlighted photo opportunities proving very popular with lodgers (Fig. 4.5). This spectacle was highlighted in a national newspaper in December 2015, but the issue became a big problem when the Ministry of the Environment commented favorably about it. There are only 140 Blakiston's fish owls in the whole of Hokkaido, making them an endangered species. The Ministry of the Environment is involved in a protection propagation program, which is feeding

Fig. 4.5 River where food is left for Blakiston's fish owl and the guesthouse that arranges viewings of such feeding. (Photo: Matsuda)

them in areas other than Shiretoko. Yet, even though effort is being made to keep the Shiretoko owls as wild as possible and free of dependency on feeding, they are being fed for the benefit of guesthouse lodgers. Furthermore, the lodgers are only informed that photo lighting is appropriate to reduce the burden on the birds, so the guesthouse actions are not part of any reintroduction scheme for the Blakiston's fish owl. As might be expected, even the Ministry of the Environment had to take the matter seriously, and is now considering ordering a review on the state of tourism while having given instructions for the feeding to be stopped. However, the person who put forward the lighting technology was no other than a residential researcher affiliated to the tourist association and employed on a part-time basis in Rausucho, having left a university position because his technical skills in lighting were in demand.

In the Utoro area, sightseeing boats are maneuvering close to the nests of the spectacled guillemot (*Cepphus carbo*), another endangered species, a practice that interferes with nesting (Fukuda 2008). The population had dropped to 93 birds in 2011 and concern had been voiced from the scientific council. In response, the Ministry of the Environment spent 3 years from 2011 studying the protection of sea birds and sustainable use of marine areas in the Utoro marine area of the Shiretoko national park, during which time the sightseeing boat operators learned to deem the spectacled guillemot as a tourism resource, and even took to explaining to passengers the actual actions being taken to protect the bird. As a result, the population is on the way to recovering. By getting the tourism industry and nature conservation groups to acknowledge that protected species are valuable tourism resources by sightseeing operators, the relationship between both parties started to shift from an opposition one to co-benefit one. From the point of view that both sides have succeeded in coexisting through the process of mutual understanding, this can be claimed a success story that can be taken as a model for other areas.

4.4.3 Conversancy in the System for Shiretoko World Heritage

Differing from the Man and the Biosphere Programme (MAB) and Ramsar Convention (see Chap. 14), World Natural Heritage primarily aims at protecting nature rather than reconciling protection with use. In as far as World Natural Heritage protection goes, use is neither excluded nor encouraged. Like the case of the sea lion described earlier, there is reluctance to allow uses of wildlife that require trapping.

At the time of Shiretoko being selected as a World Heritage Site, along with the sea lion and fishing industry relationship issue, the problem of river dams was also on the agenda. It goes without saying that dams impede the salmon run. The IUCN salmon specialists who visited Shiretoko during the World Heritage candidacy period said that "we wanted to see Shiretoko become the conservation template for river environments in Japan." This message found its way into the press (15 June 2005 edition of Yomiuri Shimbun newspaper); a message scenario dreaded by dam stakeholders in Japan. IUCN specialists were free to say that the dams in the Shiretoko area were not appropriate for a World Heritage Site, but the above message meant they were using the World Heritage setup as a means to interfere with the domestic affairs of Japan. The scientific council instead claimed that Shiretoko was a special case, and if, for example, Shiretoko's dams were improved for reasons related to World Heritage, it would not have an influence on the overarching policy of the government of Japan. It was likely however, that if such improvements really did turn out to be an effective measure, they would spill over across Japan of their own accord. Looking back at that message finding its way into the press, we can only say that it caused a lot of trouble.

At a meeting of the World Heritage Committee in 2012, it looked like a claim to remove a certain dam on the Rushagawa River would be raised (Fig. 4.6). Downstream of the dam in question was a road that led to a salmon and trout hatchery and fishers' lodge. If a disaster was to happen at those downstream facilities after the dam was removed, the government was sure to lose any court cases. From the time of inscription, the scientific council felt that it would be a good idea to consider removing the downstream facilities prior to the removing the dam and the hatchery has already been removed.

Fig. 4.6 Deliberation on Shiretoko at the 36th session of the World Heritage Committee. (Date: 29/06/2012, Source: Ministry of the Environment)

Similarly, wishes to use the World Heritage system in order to promote mild use of areas exist, and sometimes the pursued objectives are distanced from the spirit of the World Heritage concept. It is important thus to gauge whether the advantages of achieving World Heritage Site status exceed the burdens caused by losing sight of that real aim. The next thing to do is to think about what can be done to alleviate that burden as much as possible, namely to promote "local conversancy of international systems". Abandoning fishing and removing facilities without the consent of the local community in order to achieve World Heritage Site status will inevitably cause serious conflicts.

In saying that protecting nature is the international standard, we have to remember that the international standard really is diverse. We have explained that conservation differs from protection in that the former includes sustainable usage, and, likewise, the standard for World Natural Heritage differs greatly from the standard for UNESCO's MAB programme. As with the above case, if the intentions and driving force of the review body are understood, it is possible to work out a feasible solution for the area under examination. Moreover, getting that solution published in an international academic journal as a research output is a useful way of realizing the proposal concerned and helping it become a universal solution. The scientific council fulfills an important role as a translator that links the local area to global standards and such a council or committee will also doubtless be helpful in mediating between stakeholders in the locality. For those reasons, it is important for scientific council members to travel to and spend time in a candidacy/selected area, getting to know the real circumstances of the area and listening to the opinions of stakeholders while at the same time getting to know specialists from various fields who may someday be of help as well as developing friendly and trusting relationships with the international community.

References

Convention on Biological Diversity (2000) Decisions adopted by the conference of the parties to the convention on biological diversity at its fifth meeting, Nairobi, 15–26 May 2000, UNEP/CBD/COP/5/23

Donohoe HM, Needham RD (2006) Ecotourism: The evolving contemporary definition. *Journal of Ecotourism* 5:192–210

Fennell DA (2001) A content analysis of ecotourism definitions. *Current Issues in Tourism* 4:403–421

Fujiwara C (2005) Shiretoko World Natural Heritage Proposed Site Scientific Committee and local community – The start of talks between researchers and local citizens (知床世界自然遺産候補地科学委員会と地域社会—研究者と地域住民の対話のはじまり). *Agriculture and Economy* 6:65–70 (in Japanese)

Fukuda Y (2008) The status of Spectacled Guillemot *Cepphus carbo* and the impact of sightseeing boats on the species. *Strix* 26:169–175 (in Japanese with English abstract)

Hardin G (1960) The tragedy of the commons. Science 162:1243–1248

Honma H (2005) How the four northern islands can be conserved: Expansion of the World Natural Heritage as an alternative (北方四島をどう保全するか-世界自然遺産の拡張という選択肢). In: Matsunaga S (ed) *Environment: The design approach*. Toshindo, Tokyo, pp 81–127 (in Japanese)

Makino M, Matsuda H, Sakurai Y (2009) Expanding fisheries co-management to ecosystem-based management: A case in the Shiretoko World Natural Heritage area, Japan. *Marine Policy* 33:207–214

Matsuda H (2007) Basic steps of risk management (リスクマネジメントの基本手順). In: Urano K, Matsuda H (eds) *Principles and methods for ecosystem risk management*. Tokyo, Ohmsha (in Japanese)

Matsuda H (2016) Local message and global view: From case study on Shiretoko World Heritage (地域からの発信と世界の目-知床世界遺産の事例から). In: Omoto R, Sato T, Naito D (eds) *International certification for sustainable resource management: Ecolabels linking the global and the local*. University of Tokyo Press, Tokyo, pp 96–107 (in Japanese)

Onodera (2005) Response to the letter from the world conservation union (IUCN) concerning Shiretoko (Japan). Letter of march 30, 2005, Shiretoko World Heritage Center http://shiretoko-whc.com/data/process/200503/letter2_ree.pdf

Sakai S (2007) *For the youth starting to write reports/dissertations* (これからレポート・卒論を書く若者のために). Kyoritsu Shuppan, Tokyo (in Japanese)

Tsurita I, Hori J, Kunieda T, Hori M, Makino M (2018) Marine protected areas, Satoumi, and territorial use rights for fisheries: A case study from hinase, Japan. *Marine Policy* 91:41–48

UNESCO World Heritage Centre (1994) Global strategy for a balanced, representative, and credible world heritage list. http://whc.unesco.org/en/globalstrategy/

Chapter 5
Community-Based Scallop Restoration: A Model for Knowledge Circulation Theory

Michael P. Crosby, Barbara Lausche, and Jim Culter

Abstract The transdisciplinary (TD) approach is a key tool for knowledge translation and circulation among various communities of knowledge, including scientists from different disciplines and non-academic stakeholders from diverse backgrounds, participating collaboratively to address local social-ecological challenges. This chapter analyzes the transdisciplinary approach used by Mote Marine Laboratory, a Florida residential research institute, to achieve collaboration among scientists and local stakeholders for restoring fisheries' resources and a local environmental icon, the bay scallop. These activities generated knowledge production and integration among stakeholders with different values, interests, and knowledge contributions. The mechanisms of knowledge-based collaboration among diverse stakeholders are discussed along with key strategies used to promote effective interactions and mutual learning among all knowledge holders, from traditional to formal science practitioners.

5.1 Introduction

The overall health of the marine environment has been deteriorating for decades as a result of a variety of anthropogenic activities on land and sea (Norse 1993). One manifestation of poor management of natural resources is the loss of biological diversity (see Norse 1993; Eichbaum et al. 1996; Maragos et al. 1996). The problem of biodiversity loss and ineffective management of natural resources has many aspects: social, economic, cultural, managerial and scientific (Solbrig 1991).

The need for sustainable management of marine resources and ecosystems has been recognized and reinforced internationally many times, most recently and notably through United Nations Sustainable Development Goals adopted by countries in 2015, Goal 14 to "conserve and sustainably use the oceans, seas and marine resources for sustainable development" (UNSDG 2015). Some of the greatest threats

M. P. Crosby (✉) · B. Lausche · J. Culter
Mote Marine Laboratory, Sarasota, FL, USA
e-mail: mcrosby@mote.org

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_5

to the resiliency and sustainable use of marine and coastal biodiversity in both developed and developing countries are the over exploitation of living marine resources by such anthropogenic activities as commercial fishing (Safina 1995), the degradation of coastal habitats by increased occurrence of harmful algal blooms (Cosper et al. 1987; Hallegraeff 1993), introduction of non-indigenous species (Bjergo et al. 1995), and nonpoint source pollution and upland runoff (White 1996). All of these actions can individually and synergistically alter finely tuned ecological relationships that directly and indirectly lead to loss of biodiversity at the genetic, species, and habitat levels. Although efforts are being made to address these threats, there is growing evidence that future stresses on marine resources from global environmental change will be significant, constraining future options for human use and limiting resiliency of the marine biome.

In years past, marine habitats and resources were exploited without a sense of limits; it was assumed that if one habitat became degraded or a particular fisheries resource depleted, there always would be another to replace it. As Ludwig et al. (1993) observed " . . .there is remarkable consistency in the history of resource exploitation: resources are inevitably over-exploited, often to the point of collapse or extinction." A number of reasons were given for this consistency, including wealth or the prospect of wealth generating power, the difficulty in reaching a consensus on scientific understanding, and the enormous complexity and natural variability of natural marine and coastal systems.

At the close of the twentieth Century, humankind began to grasp the concepts needed to manage relations between people and the oceans (Kelleher and Kenchington 1992; Crosby 1994; Kelleher et al. 1995; Eichbaum et al. 1996). Achieving sustainable human use of natural marine resources is a complex process of balancing competing human needs with various natural resource management goals at all spatial and temporal scales (Crosby 1997). Among the most important of these goals are: promoting sustainable economic production; sustaining cultural values that are intimately linked with the marine environment; providing basic information to understand the condition of the marine environment; and conserving natural marine resources and biodiversity.

At its XXVII Session (Paris, July 1994), the Intergovernmental Oceanographic Commission (IOC) Executive Council, in partnership with the U.S. National Oceanic and Atmospheric Administration (NOAA), called for an "'*ad hoc* Consultation on Marine Biodiversity,'" which was held in Paris in May 1995. The general recommendation of the Consultation was that IOC should re-evaluate its existing programs and activities with a view of enhancing marine biodiversity as an IOC activity. They further called for the integration of scientific research activities with community level education, low-technology methods for monitoring, and comprehensive management for sustainable use and conservation of marine biodiversity.

Crosby (1997) identified three core challenges for achieving these recommended goals for improving interactions between scientists, the public and resource managers:

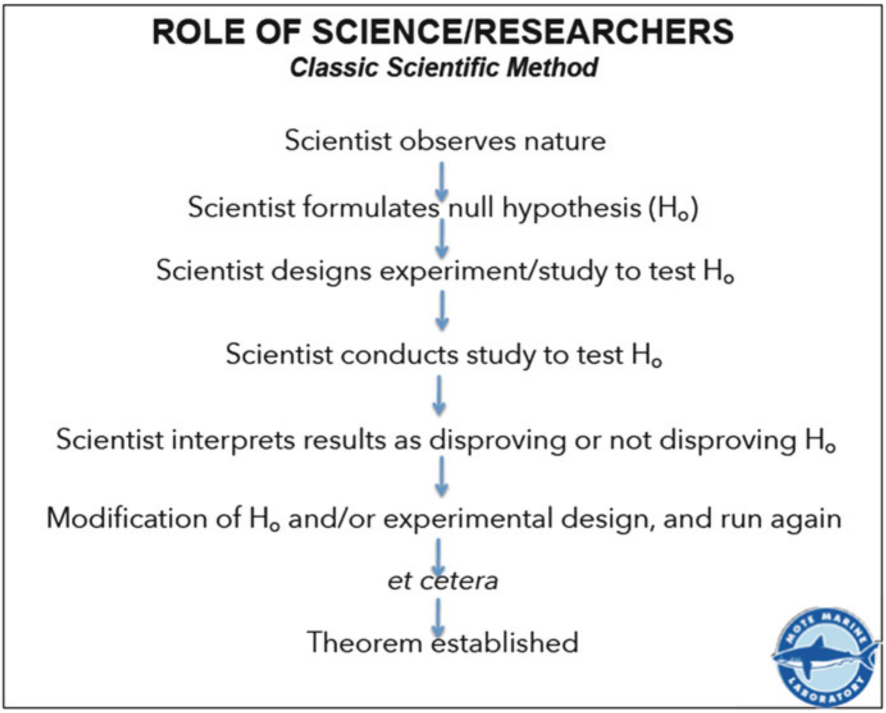


Fig. 5.1 Illustration of the role of scientists in conducting the classic 'scientific method'

- Poor and/or tenuous linkages between managers, scientists & stakeholder communities.
- Scarcity of truly management-oriented science to address local community issues.
- Political goals & poorly informed public pressure driving priorities of science support & resource management policy

The evolution of the classic 'scientific method' (Fig. 5.1) over the past millennium led to a culture within the scientific community that sought objectivity to avoid any 'outside' influence that may bias experimental design and results. A perspective developed within the scientific community that management/environmental policy-oriented science was influenced by public pressures and politics more than by scientific considerations (NRC 1995; Brooks et al. 1996), resulting in a dogma within the scientific research community (until fairly recently) that 'real researchers' do not do monitoring, assessment work, or management-oriented science.

In considering the very basic classic scientific method illustrated in Fig. 5.1, it is clear that the classic approach lacks mechanisms for data and information exchange between scientists, the public, and other interest groups. In addition, contrasting perspectives (see Crosby 1997) between scientists, managers and policy makers in

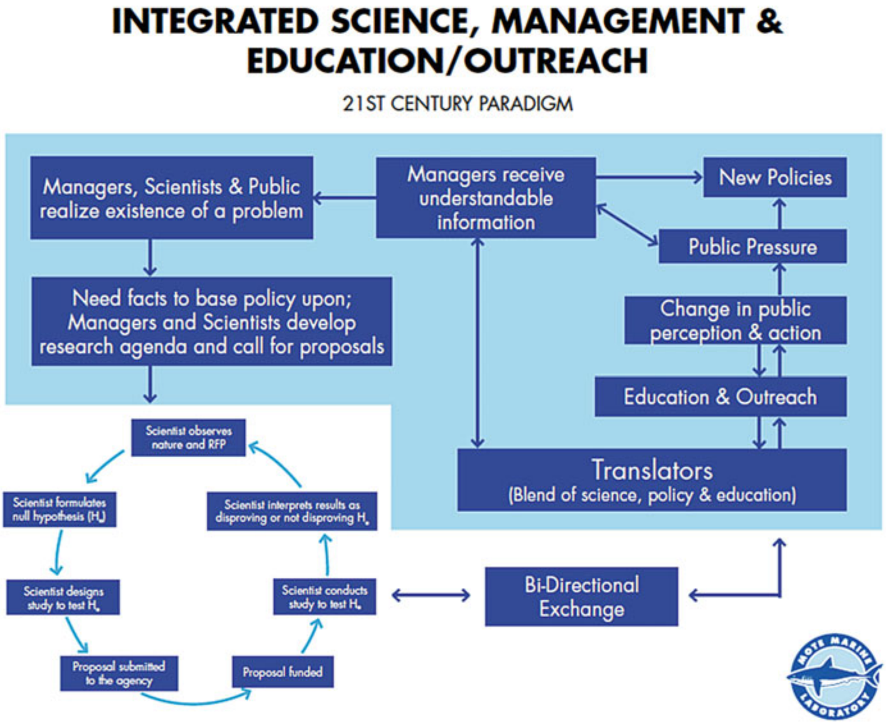


Fig. 5.2 Illustration of a new paradigm for the interaction and role of integrated, multi-disciplinary science, management and education/outreach efforts. (Modified from Crosby 1997)

how they view and deal with similar parameters is a likely reason for this barrier to meaningful information exchange being difficult to overcome.

To facilitate the incorporation and sharing of new and existing knowledge between scientists and various stakeholder groups, a new paradigm for the interaction and role of integrated, multi-disciplinary science, management and education/outreach efforts has been developed (Fig. 5.2 modified from Crosby 1997). Implementing this new paradigm requires that scientists and the public work together to identify and understand ecological, economic and social driving forces behind losses of marine biodiversity and destruction of marine and coastal ecosystems.

The process in which scientists and all interested groups participate in making decisions and coordinating management of natural resources is often referred to as *community-based decision making* (Gilman 1997). This involves a transdisciplinary research approach that brings together societal practice and scientific practice (see Lang et al. 2012). A full spectrum of data and information required to better understand marine biodiversity and ecosystem processes needs to be available and accessible to scientists, decision makers, and the public. Moreover, it is essential that information be user-friendly, and that validated analytical models be available and

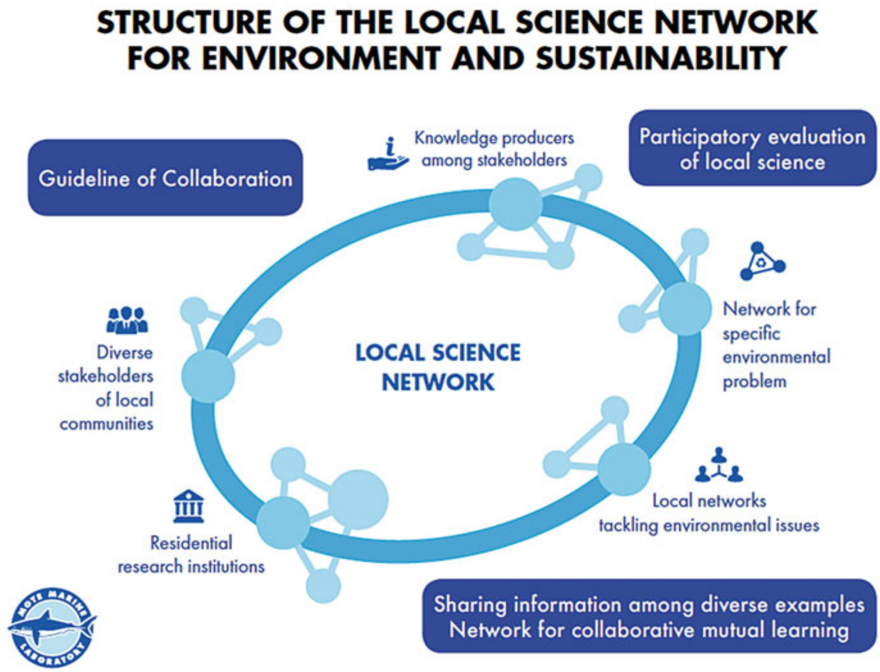


Fig. 5.3 Illustration of the role of local science networks for environmental sustainability in information translation and transfer among and between scientists, the public and multiple stakeholder groups. (Modified from the Local Science Network web site)

used to explore possible consequences of alternative management and policy decisions. Hence, scientists must become more involved with other stakeholders to integrate various types of knowledge and be part of the bilateral process of translation and transfer of technical as well as empirical knowledge.

One of the key recommendations put forth by Ludwig et al. (1993) for future natural resource management principles was to include human motivation and responses as part of the system to be studied and managed. We should seek to avoid the "tragedy of the commons" (Hardin 1966) in our utilization of marine and coastal resources. Yet, local communities remain hesitant to adopt scientifically valid ideas and tools for management of the local environment due to a lack of user-friendly knowledge applicable to local value systems and decision making processes. A critical need exists for the formation of *integrated local environmental knowledge* (ILEK) through improved translation and transfer of information among and between scientists, the public and resource managers. Key to success in achieving this goal is to establish and expand networks of scientists and other stakeholders to strengthen bi-directional exchanges among science and society, including the public and social sciences. An example of the structure of such local science network is illustrated in Fig. 5.3, and built upon here:

- Residential research institutions in collaboration with local communities;
- Value and incorporate various types of knowledge in communities including traditional and local knowledge;
- Long-term sustainable support provided by partnership of local and national government, NGOs, and business and volunteers;
- Establish an international network of local science networks.

The following section introduces a case study with Mote Marine Laboratory, a residential research institution in Florida, whose scientists work with diverse community stakeholders to co-produce and apply knowledge for restoring a local shellfish population which plays a critical role in the health of the local marine and estuary environment.

5.2 ILEK Case Study: Community-Based Scallop Restoration in Sarasota Bay

A model for implementing ILEK was launched in 2012 when a unique residential research institution, Mote Marine Laboratory, part of the local community for over 60 years, implemented a novel shellfish initiative for Sarasota Bay, Florida, USA. This initiative involved international and local research institutions and community-based environmental organizations, and became one of ILEK's 11 case-study sites in its worldwide project led by Japan's RIHN. Mote's innovative partnership in Community-based Scallop Restoration in Sarasota Bay directly engages participation of existing local organizations with world-class scientific researchers to restore bay scallop populations in the Sarasota Bay estuary system, on the central Florida Gulf coast (Fig. 5.4).

5.2.1 Role of Scallops and Their Changing Status

Scallops are an important component of sub-tropical biodiversity and critical for maintaining healthy coastal ecosystems (Fig. 5.5). Scallops filter water at a more rapid rate than many other shellfish including oysters, transferring energy from primary production of plankton into the food chain, maintaining overall water quality, and increasing water clarity.

Scallops have long been recognized as a local environmental icon in marine and estuarine environments that provides valuable ecosystem services (NAS 2010). The Bay Scallop was commercially harvested in Florida until the mid 1960s when many local populations were reduced to a remnant of this once abundant resource due to a combination of anthropogenic impacts including dredge and fill habitat destruction,

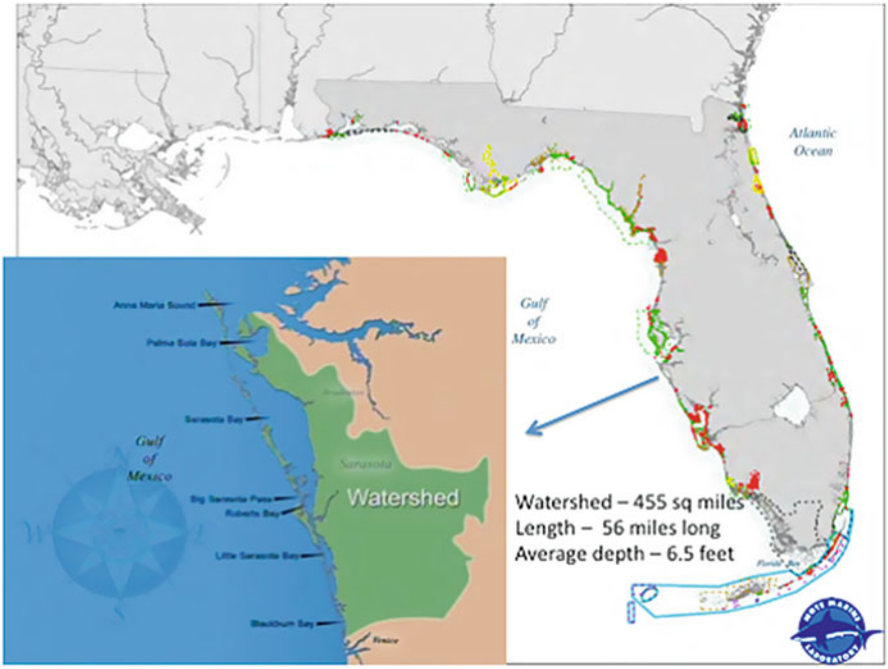


Fig. 5.4 The Sarasota Bay location for the Mote Community-based Scallop Restoration Program

decline in water quality, extreme red tide events, destruction of sea grass and overharvesting (see Fig. 5.6). This led to an end to commercial harvesting of scallops in the early 1990s.

Seasonal recreational harvest is permitted in certain areas north of the Homosassa River on the west coast of Florida (Fig. 5.7), and can have positive local economic benefits. For example, a single season (2003) of recreational scallop harvest in Citrus County, Florida generated over $1.6 million tourist dollars for the local economy (Stevens et al. 2004).

The Bay Scallop (*Argopecten irradians*) was historically prominent in Sarasota Bay, but relative abundance data for scallops are sparse and mostly predate 1990. The most comprehensive molluscan survey for Sarasota Bay was conducted by Mote scientists in 1986 (Estevez and Bruzek 1986). Shellfish landings in Manatee and Sarasota Counties fell to zero after 1971 for oysters and hard clams, and zero after 1964 for the Bay Scallop. As a result, there is no longer any commercial or recreational harvesting of scallops in the Bay.

Although water quality is good and seagrass beds are expanding, scallop populations have yet to recover in Central Florida areas south of Tampa Bay. Lack of recovery may be due to lack of sufficient larval recruitment and periodic harmful

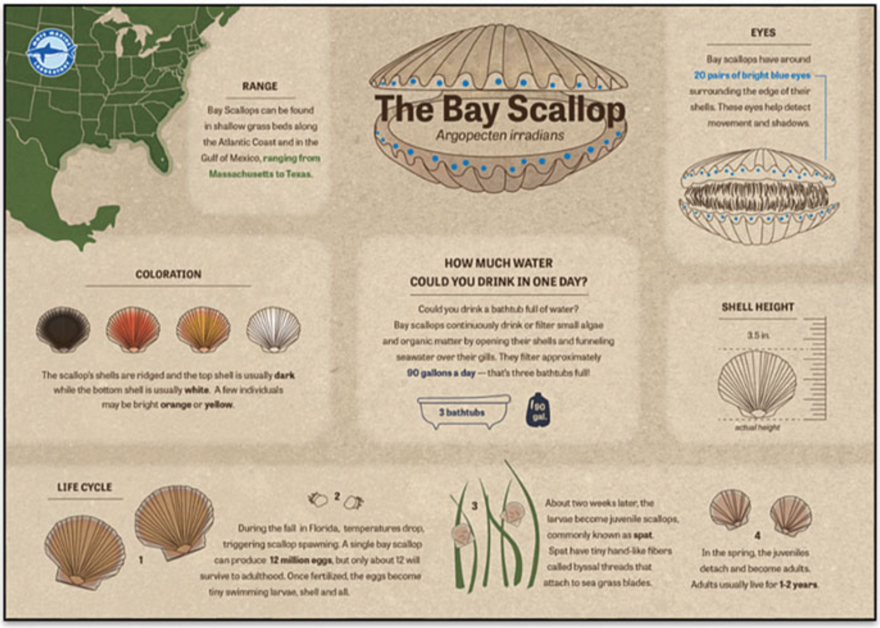


Fig. 5.5 Bay Scallops are found in a variety of places in the Atlantic Ocean and the Gulf of Mexico and vary in size and color

algae blooms (HABs) (*Karenia brevis*) (commonly known as red tide). Changes in Sarasota Bay circulation patterns, trophic dynamics (i.e., shark-ray-scallop) and pest/disease interactions are also still poorly understood as related to scallop population dynamics. As broadcast spawners, wild scallop populations require a threshold population density of reproductive adults for successful fertilization of eggs.

In recent years, there has been a growing interest in restoring scallop populations in Sarasota Bay due to their history as a previously thriving keystone species providing local tourism incentives, commercial benefit and contributing to the overall health of Sarasota Bay by serving as water filtration organisms that contribute to a balanced ecosystem and a food source for animals.

There have been relatively few Sarasota Bay shellfish restoration efforts in recent decades. For the most part, these minor efforts, although well intentioned, were built on a limited science-base approach. More recently, Mote initiated a new paradigm for integration of local grassroots community engagement directly into a scallop research, restoration and monitoring program. The program integrates grassroots engagement in the research, restoration, monitoring program, and adaptive management through co-ownership with the community in processes and outcomes.

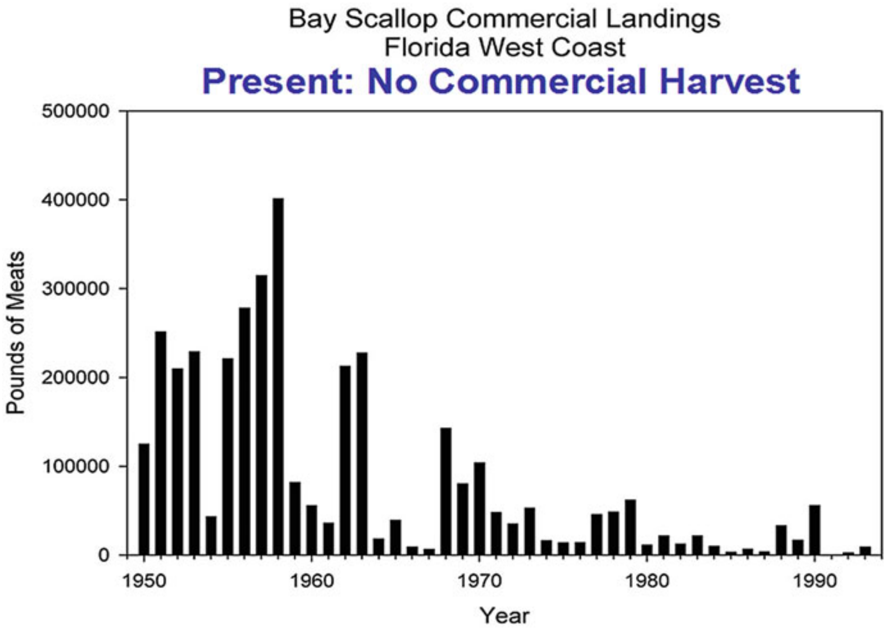


Fig. 5.6 Harvest of Bay Scallops on the west coast of Florida during a time when the harvest in this area was still legal. Beginning in the early 1970s, the graph demonstrates a rapid decline of scallop harvests due in large part to overfishing of the commercial product. (Arnold 2009)

5.2.2 Strategies and Outcomes

The strategy for the Mote Program consists of assembling a community-based consortium to be directly engaged in and to implement science-based restoration and monitoring of the Bay Scallop that will result in long-term self-sustaining populations in Sarasota Bay. The Program draws on local stakeholders and common interests of existing organizations including Mote Marine Laboratory, Sarasota Bay Estuary Program (SBEP), Sarasota Bay Watch (SBW), Bay Shellfish Company, Inc., Sarasota County, New College, University of South Florida-Sarasota/Manatee, University of Florida, Research Institute for Humanity and Nature, Japan, the Florida Fish and Wildlife Conservation Commission (FWCC), and NOAA.

The strategy also builds on past research that demonstrated feasibility of Bay Scallop restoration in small-scale projects conducted in Florida (Leverone et al. 2010; Arnold et al. 2005). The consortium identified the “small scale” and inadequacy of detailed site-suitability information as the primary culprits in failing to jump start scallop populations on a larger regional scale.

Technical expertise for retrofitting aquaculture systems for scallop production and successful collection, spawning, larval rearing, and nursery feeding and release of juveniles is being provided by Mote scientists with assistance from local Bay

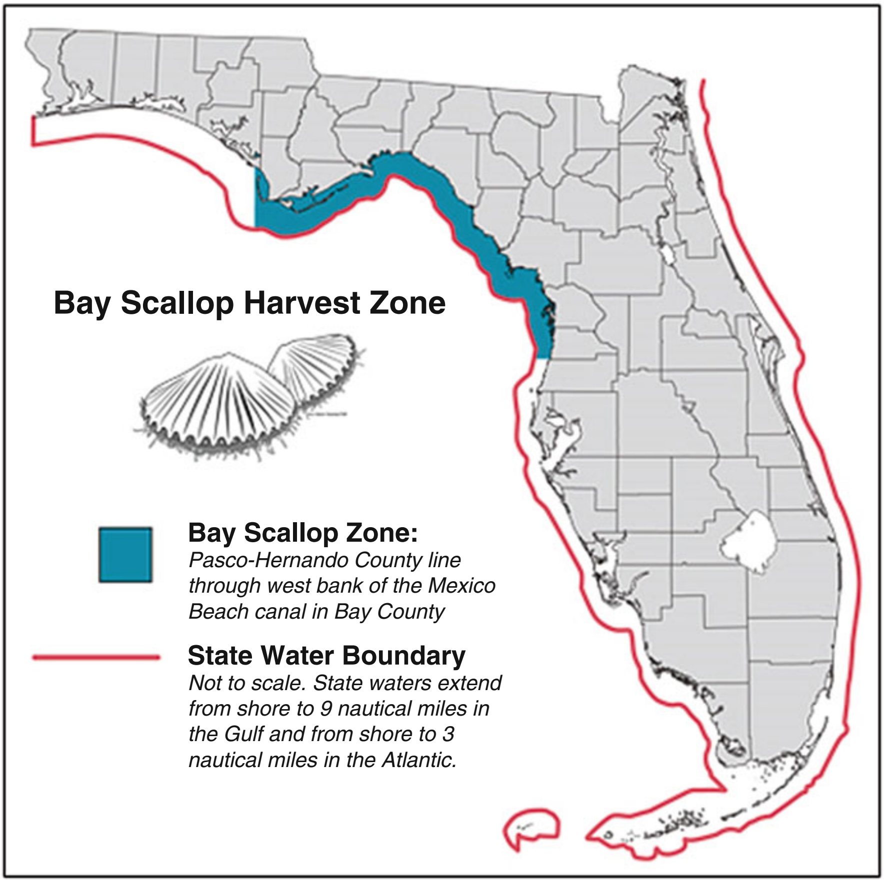


Fig. 5.7 Scallop Fishery is closed from Homosassa River South, but populations are under increasing recreational harvest pressure to the north. (Image at Florida Fish and Wildlife Commission web site)

Shellfish Company. The program is also coordinated with the FWCC Wildlife Research Institute's (FWRI) Shellfish Research Program. Training of citizen-scientists for participation in hatchery operations and maintenance, techniques of field monitoring and data quality assurance was conducted by Mote scientists in cooperation with other participating NGOs.

The partnership of local organizations with volunteers and trained citizen-scientists pursued all aspects of strategy design, collection of spawning stock, release of stock and monitoring under the oversight of professional Mote scientists and input of the FWCC. To facilitate close coordination, representatives from Mote, SBW, SBEP and FWCC met regularly over the course of 2 years. Mote also organized two special workshops on essential elements for innovative science-based scallop restoration in Sarasota Bay with representatives from its local partners and invited experts

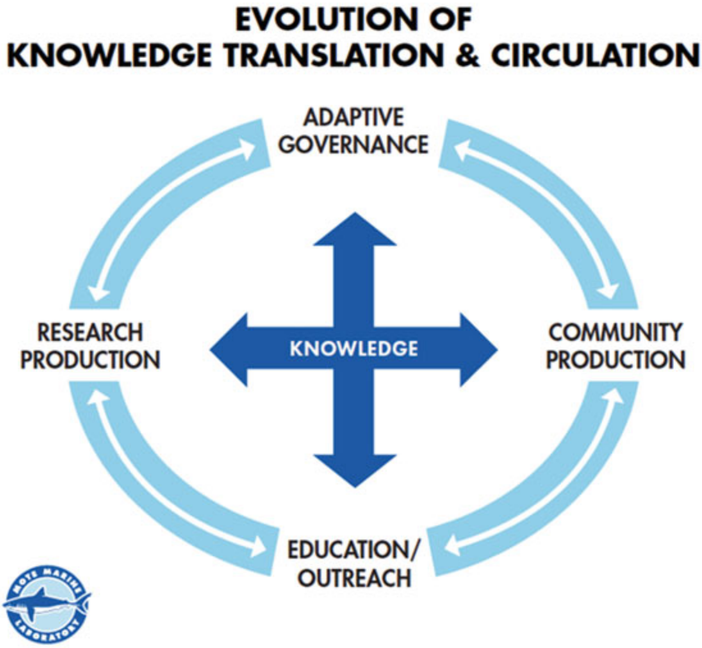


Fig. 5.8 The evolution of knowledge translation and circulation between and amongst traditional knowledge and formal scientific research stakeholders

from around the U.S. Those workshops led to a consensus strategy entitled "Coordinated Strategy for a Sarasota Bay Scallop (Argopecten irradians) Restoration Initiative".

The purpose of the consensus strategy is to serve as a general coordination guide for interested parties to use in development and implementation of a scientifically defensible restoration strategy for the Bay Scallop. It is recognized by Mote, SBW, SBEP and FWCC that partnerships and positive leveraging of capabilities, expertise and resources is the most effective and efficient approach for achieving restoration of Sarasota Bay scallop populations. The guiding principle is to strategically coordinate efforts for employing the best scientific methodology available, selecting restoration sites with a high probability of success, and utilizing quantitative monitoring tools capable of defining successful restoration.

Progress is measured by the increased level of understanding and awareness of the value of knowledge translation and circulation between and among diverse stakeholders, including those with traditional knowledge and formal scientific researchers with different types of knowledge. This knowledge translation and circulation is illustrated in Fig. 5.8.

Important elements employed for facilitating knowledge circulation and for developing integrated local environmental knowledge included:

- implementation of stakeholder workshops involving scientists and community interests;
- organization, education and training of citizen-scientists;
- engagement of citizen-scientists in spawning and release of scallops, guided by the formal science researchers;
- working in scientist/volunteer teams, field monitoring of scallop settlement, growth and survival to assess the effectiveness of stocking strategies and the level of success in restoring scallops locally;
- collection of relevant environmental field data by citizen-scientists working with formal researchers;
- production by interns of training manuals, videos, informational handouts and presentations for local schools;
- compiling and analyzing data with Mote scientists working along side volunteers on each step;
- developing and administering surveys to track changing perceptions of all participants about the problem and what they were learning about solutions.

An important community engagement component of the Program drew together a large pool of dedicated volunteer citizen-scientists in the Bradenton, Sarasota, and Venice communities. Volunteers were recruited for all aspects of the initiative. This had three-fold upfront benefits: (1) inherent labor costs were markedly reduced, (2) community interest and involvement in a popular restoration effort were heighted and increased, and (3) increased public literacy on ecological connectivity and the role of scallops in Sarasota Bay. Strong community support in the Central Florida region is shown by annual scallop searches that are the hallmark of Mote's partner, the Sarasota Bay Watch, which draws large numbers of participants.

Volunteers, consisting of high school students, teachers and adults supervised by Mote scientists, also established a scallop nursery area at a Mote facility. The nursery is used to grow seed to sub-adults for placement in natural habitats in protective cages. Mortality rates in larval scallops are much higher than later stages in the life cycle. Raising scallop seed to reproductive stage reduces early life-stage losses. Mote scientists and staff also trained high school students to build spat and juvenile scallop collectors to monitor scallops settling in Sarasota Bay. Students built dozens of spat and juvenile scallop collectors using donated mesh citrus bags and other materials (Fig. 5.9). These collectors were then deployed in restoration sites, allowing Mote scientists to monitor the success of released scallop larvae and spat to transition to the next phase of their life cycle.

5.2.3 Mote Community Forum

As part of this Program, international scientists, fisheries representatives and nearly 100 members of the local community gathered at Mote Marine Laboratory for a public forum (see Fig. 5.10). This forum focused on how communities around the

Fig. 5.9 Supervised by Mote Scientist, Jim Culter, students are building scallop spat and juvenile collectors

Fig. 5.10 May 8, 2013 Mote Marine Laboratory Sato-Umi Public Forum panelists (left to right): Dr. G. Macho, Universidade de Vigo, Spain; Dr. M.P. Crosby, Mote Marine Laboratory; Ed Chiles, The Chiles Group, Anna Maria, FL.; Dr. T. Yanagi, Kyushu University, Japan; Ippei Yanagida of NPO INO, Japan; Dr. T. Sato, Research Institute for Humanity and Nature, Japan

world are conducting science-based conservation, with a highlight on 'Sato-Umi' — a concept that originated in Japan and gaining interest around the world. The concept relates to achieving harmony between human communities and the productivity and biodiversity of marine ecosystems, especially as applied to coastal areas and sustainable fisheries management.

Drawing upon Mote's Community-based Scallop Restoration Initiative and cases from Japan and Spain, the forum discussion included how Sato-Umi is being put into practice as new paradigms for environmental restoration and sustainable use of natural resources are being created around the world, leading to tangible conservation benefits.

Sarasota Bay is a promising site for implementing 'Sato-Umi'. World-class scientists at Mote work closely with successful grassroots efforts and have strong connections with local fishing communities. Mote's institutional philosophy is that scientists have much to learn from those who live and work in the natural environment and that knowledge circulation and sharing are essential among all stakeholders. A clear consensus of the forum was that many parts of the world could benefit from Sato-Umi practices by developing ways to share and exchange scientific and traditional or local knowledge.

5.2.4 Tracking Knowledge Circulation

A critical component of the Mote Program was an examination of knowledge circulation theory of multi-directional translation and transfer of research data and traditional knowledge between and among diverse stakeholders, as illustrated in Fig. 5.8 above. Surveys of knowledge being shared and transferred between scientists and participants were employed to track changing perceptions and awareness building about actions needed to improve the Bay's environmental quality. Surveys were conducted via community outreach, recruitment of volunteers, and data analyses. Baseline surveys of participants' views before they became involved in the project were followed by surveys once they began participating. These two aspects helped track potential changing perceptions of the participants once involved in the program (Muzyczka 2015).

The baseline survey consisted of two questions:

- From your general knowledge and experience, how would you rate the general environmental quality of the Sarasota Bay?
- From your general knowledge and experience, how much of a threat do you think each of the following issues is to restoring scallops in Sarasota Bay?

Each baseline question contained multiple choices for the survey taker to choose from. For example, question one answer choices were: *Healthy*, *Improving*, *Fair, Poor* or *Can't Decide.*

The follow-up survey included the two baseline survey questions with slight modifications as indicated by the bolded words, again with similar choices from which to select an answer:

- From your participation in the Scallop Program, how would you rate the general environmental quality of the Sarasota Bay?
- From your experience with the Scallop Program, how much of a threat do you think each of the following issues is to restoring scallops in Sarasota Bay?

The follow up survey was more detailed than the baseline survey with thirteen additional questions relating to demographics of participants, training received, previous involvement in the Program, and specific views about its value.

Different recruitment strategies were used to build the survey sample. Mote survey team members attended a variety of local public environment awareness events, explaining the Program and encouraging participation. If interested, they were invited to take the baseline survey. This approach was disappointing in that it resulted in very few who actually participated.

That result was in contrast to the significant success recruiting volunteers, interns and staff already associated with Mote Marine Laboratory, Sarasota Bay Watch, or Sarasota Bay Estuary Program. In addition, local high schools were visited by Mote scientists and many students joined the Program as volunteers due to their ongoing interest in marine science and participation in the marine club at their school. Their participation also helped fulfill their high school graduation requirement to participate in community service. Twenty volunteers, interns, staff and students were part of both the baseline and follow-up surveys. All participants were given detailed advance briefings on the Program and a training session.

Social media also was used to recruit and support volunteers, and to reach a broader, more diverse audience than the two methods above. In particular, a Facebook page was set up by Mote, specifically for disseminating and updating information and building a network of "friends" and participants for the Program.

Analyses of the matching baseline and follow-up surveys generated some noteworthy findings, a few of which are useful to highlight here.

Importantly, a sense of increased general knowledge about the environmental quality of the Bay seems to have occurred among participants. Ten percent of respondents who took the baseline could not decide on the environmental quality of Sarasota Bay. However, after participating, all participants had views about that issue.

Questions on the baseline and the follow-up survey that asked for opinions about threats to restoring scallops in the Bay showed a shift in perception. These parallel questions listed multiple issues that might be considered threats and ask survey respondents to rate them by degree of threat, with a range of five choices (severe threat, moderate threat, small threat, not a threat, can't decide).

To highlight changing perceptions about threats to scallop restoration, 30% of baseline respondents described red tide as a "severe threat"; this grew to 60% in the follow-up survey. Red tide had been an issue discussed in training and its possible linkage to scallop survival. Using boating as another threat, 5% of baseline respondents did not see boating as a threat at all and 5% saw it as a "severe" threat; in the follow-up survey 30% felt that boating was a "severe" threat, and all respondents felt that boating was some threat. Boating particularly in or near seagrass had been discussed in training and propeller damage was visible in seagrass beds when participants were in the water. More broadly, 90% of the participants felt the program had either a "strong" or "moderate" impact on informing them about factors affecting the environmental quality of the Bay.

When asked how important a number of Mote community activities were for restoring scallops to Sarasota Bay, every participant answered "very important" or "important" for each of four options: (l) educate the community about the role of scallops in maintaining the environmental quality of the Bay, (2) increase community collaboration to improve environmental quality of the Bay, (3) increase public/private partnerships to restore and protect the Bay, (4) provide scientific and technical information and training to help strengthen local policies to restore and protect the Bay. No participants selected ‘somewhat important’, ‘not important’, or ‘can’t decide’. Furthermore, 95% of the participants ‘strongly agreed’ with the statement that ‘scientific knowledge is important’ and 45% ‘strongly agreed’ that “the community has useful knowledge.” No respondent selected ‘not important’ or ‘can’t decide’ on these points.

5.3 Partnering in Production and Sharing of Knowledge at Mote Marine Laboratory

Mote Marine Laboratory’s Community-based Scallop Restoration Initiative serves as a model for how a residential research institute embedded as part of the local community for 60 years can serve as a vehicle for community knowledge-sharing and solution-building on a local socio-ecological problem. As a fundamentally community-based ecosystem management partnership, this case study is a demonstration of the evolution of knowledge translation and circulation between, and among, traditional knowledge holders, diverse stakeholders, and formal scientific researchers, including scientists with different types of knowledge. Key components for effectiveness, in addition to outreach and interaction with the community through a series of workshops with recognized experts, were the formation of science-based and socially acceptable procedures for culturing, releasing and monitoring of scallop stocks in Sarasota Bay, along with development and implementation of an assessment of changes in perception among participants over time. All these were conducted with volunteers, interns and various stakeholders, both within and outside the community, who were all engaged in these activities and assessments, which in turn strengthened linkages and collaborations among all parties involved to facilitate circulation and sharing of knowledge related to the importance of scallops as a local cultural and environmental icon in the environment of Sarasota Bay. The strong networking and mutual trust between various local community stakeholder groups and Mote, intersecting with recognized significant Mote scientific knowledge of ecosystem dynamics (i.e., circulation, life-cycle dynamics, predator-prey interactions) were expanded and strengthened through this scallop restoration program. As a result, the community has increased confidence in Mote Marine Laboratory as a unique model of a residential research institute that will continue to support joint production and sharing of transdisciplinary knowledge contributing to solutions for local social-ecological challenges in the future.

References

Arnold WS (2009) The bay scallop, *Argopecten irradians*, in Florida coastal waters. Mar Fish Rev 71(3):1–7

Arnold WS, Blake NJ, Harrison MM, Marelli DC, Parker ML, Peters SC, Sweat DE (2005) Restoration of bay scallop (*Argopecten irradians*) (Lamarck) populations in Florida coastal waters: planting techniques and the growth, mortality and reproductive development of planted scallops. J Shellfish Res 24(4):883–904

Bjergo C, Boydston C, Crosby MP, Kokkanakis S, Sayer R Jr (1995) Non-native aquatic species in the United States and coastal waters. In: LaRoe ET, Farris GS, Puckett CE, Doran PD, Mac MJ (eds) Our living resources – A report to the Nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. U.S. Dept. of Interior- National Biological Service, Washington, DC, pp 428–431

Brooks A, Bell WH, Greer J (1996) Our coastal seas: what is their future?: the environmental management of enclosed Coastal Seas: summary of an international conference. Maryland Sea Grant College, College Park, 180pp

Cosper EM, Dennison WC, Carpenter EJ, Bricelj VM, Mitchell JG, Kuenstner SH, Colflesh DC, Dewey M (1987) Recurrent and persistent ‘brown tide’ blooms perturb coastal marine ecosystems. Estuaries 10:284–290

Crosby MP (1994) A proposed approach for studying ecological and socio-economic impacts of alternative access management strategies in marine protected areas. In: Brunkhorst DJ (ed) Marine protected areas and biosphere reserves: ‘Towards a new paradigm’. Australian Nature Conservation Agency, Canberra, pp 45–65

Crosby MP (1997) Moving towards a new paradigm for interactions among scientists, managers and the public in marine and coastal protected areas. In: Crosby MP, Laffoley D, Mondor C, O’Sullivan G, Geenen K (eds) Proceeding of the Second International Symposium and Workshop on Marine and Coastal Protected Areas, July, 1995. Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration, Silver Spring, pp 10–24 247 pp

Eichbaum WM, Crosby MP, Agardy MT, Laskin SA (1996) The role of marine and coastal protected areas in the conservation and sustainable use of biological diversity. Oceanography 9:60–70

Estevez ED, Bruzek DA (1986) Survey of mollusks in southern Sarasota Bay, Florida, emphasizing edible species. Mote Marine Laboratory Technical Report, 102. https://dspace.mote.org/bitstream/2075/15/1/102.pdf. Accessed 6 May 2018

Florida Fish and Wildlife Commission web site. http://myfwc.com/fishing/saltwater/recreational/bay-scallops/. Accessed 12 Dec 2016

Gilman EL (1997) Community based and multiple purpose protected areas: a model to select and manage protected areas with lessons from the Pacific Islands. Coast Manag 25:59–91

Hallegraeff GM (1993) A review of harmful algal blooms and their apparent global increase. Phycologia 32(2):79–99

Hardin G (1966) Biology: its principles and implications, 2nd edn. W.H. Freeman & Co., San Francisco

Kelleher G, Kenchington R (1992) Guidelines for establishing marine protected areas. A marine Comservation and development report. IUCN, Gland, 79 pp

Kelleher G, Bleakley C, Wells S (1995) A global representative system of marine protected areas. The World Bank, Washington, DC

Lang DJ, Wiek A, Bergmann N, Stauffacher M, Martens P, Moll P, Swilling M, Thomas CJ (2012) Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustainable Science 7(1):25–43. https://doi.org/10.1007/s11625-011-0149-x

Leverone JR, Geiger SP, Stephenson SP, Arnold WS (2010) Increase in bay scallop (*Argopecten irradians*) populations following releases of competent larvae in two West Florida estuaries. J Shellfish Res 29(2):395–406

Local Science Network for Environment and Sustainability web site. http://lsnes.org/english/aboutus/outline/. Accessed 27 Dec 2017
Ludwig D, Helborn R, Walters C (1993) Uncertainty, resource exploitation, and conservation: lessons from history. Science 260:17–36
Maragos JE, Crosby MP, McManus J (1996) Coral reefs and biodiversity: a critical and threatened relationship. Oceanography 9:83–99
Muzyczka Z (2015) Synopsis and Progress Report on Survey Work for the Mote Community Partnership: Scallop Restoration Initiative (Mote intern and 4th year university student) (Mote Technical Report 1897)
National Academy of Sciences (NAS) (2010) Ecosystem concepts for sustainable bivalve Mariculture. National Academies Press, Washington, DC, 180 pp
National Research Council (NRC) (1995) S*cience, Policy, and the Coast: improving decision making*. National Academy Press, Washington, DC
Norse EA (1993) Global marine biological diversity: a strategy for building conservation into decision making. Island Press, Washington, DC, 383 pp
Safina C (1995) The World's imperiled fish. Sci Am 273(5):46–53
Solbrig O (1991) *From genes to ecosystems: A research agenda for biodiversity*. International Union for Biological Sciences (IUBS), Paris, 124pp
Stevens T, Adams C, Hodges A, Mulkey D (2004) Economic impact on the re-opened scalloping area for citrus County, Florida – 2003. Gainesville: University of Florida. EDIS Document FE493. http://edis.ifas.ufl.edu/pdffiles/FE/FE49300.pdf. Accessed 6 May 2018
United Nations Sustainable Development Goals (UNSDG) (2015). https://sustainabledevelopment.un.org/?menu=1300. Accessed 6 May 2018
White NM (1996) Spatial analysis of local coliform bacteria fate and transport. Ph.D. Dissertation, North Carolina State University, Raleigh, 145pp

Part II
Conceptualizing Values

Transdisciplinary (TD) processes characterized by intensive collaborations among scientists, experts, and other stakeholders have been capable of conceptualizing sharable values for collaborative decision making and actions to instantiate such values. Part II analyzes various processes of identifying and visualizing shared values through the co-production of knowledge, resulting in emergence of collaborative actions among diverse stakeholders with different values and interests. The processes and mechanisms of knowledge production that seeks to establish shared values and visions are discussed from the viewpoint of facilitating collaborative actions.

Chapter 6
Co-creation of Local Values: Reintroduction of Oriental White Storks into the Wild

Naoki Kikuchi

Abstract In the Tajima region of Hyogo Prefecture, Japan, an initiative is currently underway to reconnect people and nature, which centers on the oriental white stork, a bird traditionaly revered in Japanese communities with close cultural, as well as psychological ties with human life. This project seeks to reintroduce oriental white storks into the wild. In this chapter, the author draws on his experiences in helping reintroduce oriental white storks into the wild as a researcher at Hyogo Park of the Oriental White Stork. The chapter attempts to analyze the processes by which multifaceted initiatives developed in a relaxed cooperation between a diverse range of actors through the sharing of the "story" of coexistence with the oriental white stork. The fact that the story of the reintroduction of the oriental white stork is ambiguous enables different values to coexist that are at first glance contradictory, thereby increasing the potential for diverse initiatives, which are not bound to the same single value to occur on a simultaneous and frequent basis. However, the fact that the story is a simplification of reality has led to various kinds of discordance. The author believes that multiple values can be acknowledged by connecting the story of the oriental white stork to local life, a process by which it is given greater relevance to local communities.

6.1 The Story of the Reintroduction of Oriental White Storks

The photo pictured in Fig. 6.1 was taken in 2008 in the Tajima region of Hyogo Prefecture, Japan. It shows a single large bird standing in a rice field. It is an oriental white stork. There are what appears to be three other birds in the background, but the images are actually of three farmers at work.

N. Kikuchi (✉)
Kanazawa University, Kanazawa, Japan

Research Institute for Humanity and Nature, Kyoto, Japan
e-mail: nkikuchi@staff.kanazawa-u.ac.jp

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_6

Fig. 6.1 The habitats of oriental white stork are within the human living spheres. The livable environments for oriental white storks should also be the good environments for humans. (Photo by Hideko Nishimura)

Oriental white storks once fed from rice fields that were cultivated by farmers, and made their nests in pine trees in the nearby satoyama. Satoyama is an area consisting of villages and their surrounding secondary forests, agricultural land, ponds, and meadows that has been established and maintained by agriculture, forestry, and other human activities. Satoyama is not only a habitat for living beings, but is also an important place in terms of providing natural resources such as food and lumber, offering excellent scenery, and preserving culture (Satoyama Initiative 2018). This environment, which was created through human intervention was the white storks' habitat. This photograph tells us that oriental white storks are birds of the human living sphere; that is, they live near people. The oriental white stork became extinct in the wild in 1971. The extinction of this bird that co-existed in the human living sphere is an event symbolizing major changes that took place in people's connections with their immediate natural environments since that time. At present, in the Tajima region – the last place that oriental white storks are found in the wild in Japan – a project is underway to reintroduce the oriental white stork into the wild. Under this project, the oriental white storks are bred and raised in captivity and then released into the human living sphere. The photograph in Fig. 6.2 shows an oriental white stork that has been reintroduced into the wild.

To reintroduce the oriental white stork into the wild, it is necessary to increase the number of oriental white storks that are bred and raised in captivity. A source of birds bred in captivity is required before they can be released into the wild. And even

Fig. 6.2 Oriental white stork. (Photo by Naoki Kikuchi)

if they are released into the wild, they will die off unless a habitable environment is put in place for them. This necessitates the restoration of their natural habitat. The natural habitat of the oriental white stork consists of diverse connections with humans in the form of rice fields and satoyama. It is both a living space for people and a natural environment maintained through the intervention of local communities. As such, the restoration of their habitat rests on the restoration of the ties between humans and nature. However, rural districts are suffering from declining vitality with an aging and diminishing population, thus people can no longer maintain their rice fields as in the past, and areas of satoyama are becoming increasingly difficult to maintain. In order to manage rice fields and satoyama, it is essential to maintain the vitality of rural communities. By turning the oriental white stork into a symbol of the area's ecosystems, the project seeks to restore the diverse connections between humans and nature. If this is to happen, the most important thing is to take a united stance in tackling the issues at hand (Naito and Ikeda 2007; Naito et al. 2014; Roberge and Angelstam 2004).

This initiative seeks to reintroduce oriental white storks into the wild and aims to create "livable environments for oriental white storks that are also pleasant and beneficial environments for humans" (Kikuchi 2006). This easy to understand story has generated widespread empathy and interest among people for the efforts to reintroduce the oriental white stork into the wild. Toyooka City has come up with policies that aim to strike harmony between the environment and the economy, and we are witnessing the development of an increasing number of farming methods aiming to create a sustainable environment. The oriental white stork has come to possess value as a tourist resource, capturing the hearts of many people. These efforts to reintroduce the oriental white stork into the wild, which are being initiated through multiple perspectives, have garnered high praise as a successful example of nature restoration and regional development.

There is no denying the fact that “livable environments for the oriental white storks are also pleasant and beneficial environments for humans.” However, as someone who has been directly involved in efforts to reintroduce the oriental white stork into the wild for many years, I have come to feel that something is wrong with the picture-perfect story that is being presented. It goes without saying, but not everybody is necessarily sympathetic to the notion of reintroducing oriental white storks into the wild. Some people may think that oriental white storks are a potential asset for revitalizing the local economy. Others may be convinced that protecting them takes precedence over all other concerns. However, others may take a more skeptical line, believing that the welfare of humans is a more pressing matter. Oriental white storks have multiple values, and efforts to reintroduce oriental white storks into the wild continue despite contradictory views related to the importance of this reintroduction effort. This is the realization I have come to over the many years I have been involved in the project.

So, when it comes to reintroducing oriental white storks into the wild, is it possible to create initiatives that are founded on multifaceted perspectives, while maintaining differing perspectives, even if the values that people hold are different? In this chapter, I consider this question, while reflecting on my own experiences.

6.2 Oriental White Storks and the History of Their Conservation

6.2.1 Oriental White Storks

Oriental white storks are a large bird, with a total height measuring in the region of 110 cm, a wing span of around 2 m and a weight of 4–5 kg (Fig. 6.2). They have a white body with black flight feathers and beak acting as contrast. They resemble cranes, such as the red-crowned crane, but in terms of taxonomy are closer to herons or the crested ibis. They are carnivorous, with their diet consisting of fish, such as loaches and crucian carp, along with small creatures like frogs and grasshoppers. When raised in captivity, they eat vast quantities of food, in excess of 500 g a day, thus requiring rich food resources. They build large nests with a diameter of 1–1.5 m in trees, such as big pine trees.

Their main breeding grounds are located in wetland areas, from Amur in eastern Siberia to Ussuri. They migrate for the winter to the Yangtze River and Poyang Lake areas of China, Taiwan, Korea and Japan. While they are in principle migratory birds, they adapted to Japan’s rural environment including rivers, rice paddies and satoyama and formed breeding populations as resident birds. Including Russia, China and other areas, there are estimated to be about 3000 birds left in the wild, and are classified as an endangered species (En) under the International Union for Conservation of Nature (IUCN)'s Red List.

6.2.2 From the Conservation of Oriental White Storks in Captivity to Their Reintroduction into the Wild

During the late Edo period (first half of the 19th century), oriental white storks could be found throughout Japan, but populations dropped dramatically during the Meiji period (1868–1912) due to hunting. To redress this, conservation measures were put in place, such as by setting up hunting prohibition areas, as a result of which populations recovered. However, populations dropped dramatically once more during the Second World War, due among other things to the large-scale felling of pine trees, the nesting places of oriental white storks. In 1955, conservation movements began involving united action by the government and members of the general public, and from 1965 an artificial rearing program started up. However, by 1971, oriental white storks were already extinct in the wild. The likely reasons for its extinction are as follows: (1) Reduction in area of distribution due to overhunting during the Meiji period; (2) Loss of habitat in the form of the disappearance of wetlands that were the birds' feeding grounds due to agricultural field improvement along with the drop in the number of pine trees that were their nesting places; (3) Pollution resulting from toxic substances like agricultural chemicals; and (4) Decreasing genetic diversity at stages when populations started to drop. In all cases, these were the direct result of changes to the relationship between humans and nature.

The original reason for capturing the last remaining wild oriental white stork was to conduct artificial breeding and to establish a population of birds. Artificial breeding proved to be extremely difficult, but a turning point came in 1985 when a gift of six young birds was received from Khabarovsk (in the then Soviet Union). Pairs were formed from these six, from which the first chicks were born in 1989. From that point forward, breeding in captivity took on a sense of "plain sailing." Plans to reintroduce oriental white storks into the wild gained pace, and in 1999, the Hyogo Park of the Oriental White Stork opened as a center for these activities. In 2002, the number of oriental white storks in captivity exceeded 100 individuals, and training exercises began in anticipation of reintroducing them into the wild (Kikuchi and Ikeda 2006).

Then, on September 24, 2005, five oriental white storks were released into the wild. It had been 34 years since their extinction in the wild in Japan. This shows just how long it takes to reintroduce extinct species into the wild. In 2007, the released birds successfully bred in the wild, and in 2012, the third generation of birds was born in the wild.

6.3 Reintroduction of Oriental White Storks into the Wild Through Collaboration Between Researchers and Administrative Bodies

6.3.1 Hyogo Park of the Oriental White Stork as a Facility for Residential Research

The Hyogo Park of the Oriental White Stork is a facility with an aim is to reintroduce oriental white storks into the wild. It boasts a diverse team of staff members, not only breeding staff and veterinary surgeons, but also researchers and environmental education staff. The facility's work includes the preservation and genetic management of species, scientific research and experiments aimed at reintroducing oriental white storks into the wild, and educational and public awareness activities seeking to create local environment in which both people and nature can coexist. I worked at this facility from 1999 until 2013 as a researcher in the field of environmental sociology.

The late Hiroshi Ikeda, who was the first director of the Research Department at the park, was a researcher who gave his all to the cause of reintroducing oriental white storks into the wild, having previously worked as an ecologist studying raccoon dogs and as an investigator for the Agency for Cultural Affairs. Ikeda appealed for the need to "bring together all kinds of academic disciplines in the fight to reintroduce oriental white storks into the wild" (Ikeda 1999). This is because the reintroduction of oriental white storks into the wild is a complex issue that cannot be approached through the field of ecology alone. Ikeda sought to position the oriental white stork as a symbol for recreating the ties between people and nature in the region.

As a research facility, the Hyogo Park of the Oriental White Stork is characterized firstly by multidisciplinary cooperation between researchers in the fields of conservation ecology, avian ethology, landscape ecology and environmental sociology, along with diverse experts including breeding staff and veterinary surgeons. Second, researchers at this facility conduct activities using two separate business cards: as faculty members of the University of Hyogo and as researchers at Hyogo Park of the Oriental White Stork. They do not conduct research simply for the sake of research. Rather, research conducted at the institute forms an integral part of its practical pursuits. Third, the researchers have relocated to Toyooka City and become part of the local community to conduct practical research activities aimed at resolving the issue of the reintroduction of oriental white storks into the wild (Kikuchi 2015b).

Researchers are experts; because of this, they tend to become preoccupied with perspectives in their own field of specialization. By putting in place conditions and facilities that facilitate the interplay of multiple perspectives, it is possible to fuse diverse perspectives from administrative bodies, researchers, and local communities.

This opens up the possibility for engaging in practical research that is oriented toward solving problems, relativizing the ways in which researchers perceive their areas of study, and allowing them to perceive the gaps which exist between the problems that they investigate in their research and problems concerning society (Kikuchi 2015a). In the kinds of initiatives that are being undertaken at the Hyogo Park of the Oriental White Stork, it is possible to witness the germination of pioneering ideas in terms of residential research and transdisciplinary research.

6.3.2 The Development of Oriental White Stork-Centered Administrative Policies

Toyooka City also started to develop policies that positioned the oriental white stork as a symbol. Setsuo Satake, who has long been involved in oriental white stork-centered administrative policies, states that an important aspect of reintroducing them into the wild is putting in place suitable habitats and knowing about one's own town. He says that oriental white storks are an indicator of "the richness of agriculture" and that they serve to help us question the ways in which human beings live (Satake 1997). In 2002, the Oriental White Stork Coexistence Promotion Division was set up within Toyooka City Planning Department (currently the Oriental White Stork Coexistence Department). It appears that this was the first administrative organization in Japan to be named after a living creature. In the same year, the Oriental White Stork Project team was launched within the Hyogo Prefecture Bureau for Residents of Tajima. From fiscal year 2003, both Hyogo Prefecture and Toyooka City designated rice paddies as habitat for wildlife and, with the aim of having them function as feeding grounds for oriental white storks, implemented the Rice Field Nature Restoration Project for Coexistence with Oriental White Storks. These are expenses for which the commission fund paid farmers that includes the necessary expenses for managing their land as a biotope along with compensation for a loss of income as a result of not carrying out rice cropping. As I will discuss later, initiatives aiming to establish farming methods to create a sustainable environment have also been underway. In addition, a series of administrative plans relating to the reintroduction of oriental white storks into the wild have also been drawn up based on community participation, such as the Toyooka City Basic Concept (2002), Oriental White Stork Environmental Ordinance (2002), Toyooka City Basic Environmental Plan (2002), Toyooka City Environmental Action Plan (2003), and the Strategic Committee for the Environment and Economy (2004). This shows just how much oriental white storks have become incorporated within administrative policy.

6.3.3 Drawing Up Plans to Reintroduce Oriental White Storks into the Wild

In 2003, the Plan to Promote the Reintroduction of Oriental White Storks into the Wild, the first action plan in Japan concerning this issue, was drawn up through cooperation between administrative bodies and researchers (Committee for the Promotion of the Reintroduction of Oriental White Storks into the Wild 2003). The plan makes the following declaration: "This plan seeks to promote the reintroduction of oriental white storks into the wild and create a region in which people and nature coexist by revising the construction of a range of social systems that until now have overly emphasized economic growth, with the recognition that an environment in which humans can coexist with oriental white storks is also a rich environment in which people can live in safety and security."

Also in 2003, the Liaison Council for the Promotion of the Reintroduction of Oriental White Storks into the Wild was set-up. Based on the idea that reintroducing oriental white storks into the wild is something that should be done with the cooperation of a diverse range of concerned parties in local society, the council is made up of numerous organizations and individuals, including administrative bodies such as Hyogo Prefectural Government and Toyooka City, Japan Agricultural Cooperatives and fishery cooperatives, ward mayor councils and agricultural associations, representatives from schools, NPOs connected with environmental conservation and other fields, and researchers. Based on the awareness that the return of wildlife is an issue tied to the future of the area, the Liaison Council has called for participation from a variety of sectors in society, recognizing the importance and value of the participation of each in this endeavor. What is most striking about this Liaison Council is that its existing membership consists mainly of local organizations (Table 6.1). A range of nature restoration projects based on directions set-out in the aforementioned plans are being moved forward as administrative policy. Initiatives aimed at reintroducing oriental white storks into the wild spearheaded by various individuals are spreading, including the establishment of farming methods to create a sustainable environment.

The existence of the Hyogo Park of the Oriental White Stork on the frontline of activities and the Oriental White Stork Coexistence Department within Toyooka City Hall has played a defining part in helping draw-up plans and push forward with initiatives. This is because researchers and administrative workers can engage in close communication in physically close quarters and learn from each other. As a researcher, myself, I was able to clarify the connections between people and the oriental white stork and engage in research on such matters as the regeneration of agriculture, the potential to turn the oriental white stork into a tourist resource and the facilitation of communication between a range of related parties. As this research progressed, it became possible to bring together local issues and research activities (Kikuchi 2015a).

Table. 6.1 Structure of the Council for promotion of the reintroduction of oriental white storks into the wild

		Research	Preservation and breeding	Community development	Education	Commerce	Primary industry	Nature restoration
National Government	Ministry of Land, Infrastructure, Transport and Tourism							●
Hyogo Prefecture	Hyogo Park of Oriental White Stork	●	●	●	●			
	Bureau for Residents of Tajima			●			●	●
	Local Education Office				●			
Toyooka City	Municipal Government			●	●		●	
	Agricultural Affairs Committee						●	
	Council of Land Improvement						●	●
	Council of Certificated Farmers						●	●
Local organizations	Warm-hearted Beautiful Tajima Promotion Meeting			●				
	Tajima Dream Table			●				
	Association of Ward Headman			●				
	Tajima Council of Consumer Organizations			●				
	Tajima Cultural Association			●	●			
	Toyooka Chamber of Commerce			●		●		
	Tajima Council of Commerce and Industry			●		●		
	Japan Agricultural Cooperative in Tajima			●			●	●
	Maruyama River Fishery Cooperative						●	●
	North Tajima Forest Owner's Cooperative						●	●

(continued)

Table. 6.1 (continued)

		Research	Preservation and breeding	Community development	Education	Commerce	Primary industry	Nature restoration
	Association of Schoolmasters in Tajima				●			
NPO	Green Netwok in Tajima			●				
	Citizen's Research Institute on Oriental White Stork	●			●			●
Reseacher	Agricultural Scientist	●		●			●	
	River Engineering	●						●
	Conservation Ecologist	●	●	●	●			●

6.3.4 Making a Story Out of the Reintroduction of Oriental White Storks into the Wild

The story was created mainly through collaboration between researchers and administrative bodies. The story is very case-specific; as such, those not connected with it, especially those from outside the region, will likely find it hard to understand. By combining the region's specific forms of knowledge and culture with scientific knowledge, the story has been changed in ways that make it comprehensible to those outside the area. By incorporating research perspectives, the area's particularities have been rendered from universal perspectives, thus increasing the potential for it to create meaning and value, both within the community and outside communities which may gain from learning of the story and experiences of the Oriental White Stork.

I refer to this process as "making a story" out of the oriental white stork's past and present. This takes the form of a narrative, which relates the events from beginning to end. The creation of a story in this manner makes it possible to appeal to and elicit a empathetic response from urban consumers, helping acquire appreciation of the story and creating a new economic base for rural agricultural and fishing villages. The story of "livable environments for oriental white storks are also pleasant and beneficial environments for humans" follows the following sequence of events: 1. Oriental white storks are a bird of the human living sphere, such as rice fields. → 2. Environments in which oriental white storks can live are also beneficial environments for human beings. → 3. Farmers are the ones who put environments of this kind in place through their sustainable practices. By creating the story in this way, it resonates with people from all corners of life and creates brand value for the oriental white stork, but more generally, for rice as a product associated with the stork. While the story appeals to those outside the area, at the same time local people can also share in the story while engaging with the project to share the story (Kikuchi 2016a).

6.4 The Development of Multifaceted Projects Which Share the Story of the Reintroduction of Oriental White Storks into the Wild

6.4.1 The Development of Agriculture with the Oriental White Stork as a Symbol

Before this story came into being, other related initiatives existed in the field of agriculture. I refer here to a method of farming which proposed a technological system that would enable the production of high added-value rice at the same time as putting in place habitat for aquatic animals for the oriental white storks to feed

(Nishimura 2006). The idea behind this farming method was to give high added-value to agricultural products by contributing to the creation of environments in which oriental white storks could live, and at the same time sustain agriculture by branding strategies connecting to environment-friendly products with sustainable, organic, or reduced chemical productions. Tha Tajima branch of Japan Agricultural Cooperatives (JA Tajima) sets a purchase price of 6000 yen per 30 kg when rice is cultivated using conventional methods. In the case of the farming method friendly to oriental white storks with reduced chemicals and various techniques to improve biodiversity of rice field as a food source of the oriental white stork, though, it is a lot higher: 8600 yen in the case of methods using reduced levels of agricultural chemicals and 10,800 yen in the case of organic rice. This high added value will provide an incentive to farmers and realize agricultural sustainability. Urban consumers who place a particular emphasis on food safety will find value in the story of storks returning to the wild. The issue of the reintroduction of oriental white storks into the wild has gained widespread attention and sales of rice have been favorable. As of 2014 the total area of fields being cultivated under this scheme has increased to 340 ha. This is a successful example of how a diverse range of actors, including farmers, administrative bodies, JA Tajima and Toyooka Agricultural Extension Center have cooperated in using the oriental white stork as a symbol for widespread benefits.

6.4.2 Turning Oriental White Storks into Tourist Resources

Since the release of oriental white storks into the wild in 2005, the Hyogo Park of the Oriental White Stork has attracted around 300,000 people annually. It is initiating trials in regional development by turning local natural environments and culture into regional assets, channeling the profits gained from tourism back into the area and finding ways to promote the sustainable use of local resources (Shikida et al. 2009). In order to gauge the economic effects of the release of oriental white storks, we conducted a questionnaire survey of visitors to Hyogo Park of the Oriental White Stork. The survey was conducted three times from November 2008 to July 2009, with responses obtained from a total of 1564 people.The fact that 90% of visitors stated that they were satisfied with their visit and would consider coming again highlights the degree to which the oriental white stork has become an important local resource in the field of tourism (Kikuchi 2012a). Onuma and Yamamoto (2009) calculated that the annual economic ripple effect for Toyooka City in terms of oriental white stork tourism is worth around 1 billion yen, stating that it has made a contribution to the local economy. The fact that there are many repeat visitors suggests that this effect is highly likely to continue, from which we can say that it is a successful example of what can happen when a balance is struck between the conservation of biodiversity and the economy.

Channeling the profits from tourism back into the agricultural sector and wetland restoration initiatives is somewhat challenging. Sustainable use of these habitats for oriental white stork should become possible as the bird add values of local environments (Kikuchi 2012a).

6.4.3 The Restoration of Habitat by Citizens

There are an increasing number of citizens becoming involved in the "custodianship" of oriental white storks, engaging in activities that include surveys on their ecology, diet, and feeding environments, as well as helping develop environments that are suitable as sustained habitat. In order to protect natural environments in the vicinity of local communities, the idea of environmental monitoring by citizens is something that has been advocated (Washitani and Kito 2007). The fact that scientific knowledge emphasizes consistency within the scientific community, but does not generally reflect societal perspectives and values, makes the knowledge somewhat limited in relevance when dealing with problems of a specific practical nature, such as the reintroduction of oriental white storks into the wild. In order to deal with problems of this kind, surveys and research need to be conducted from the perspective of citizens. The series of activities came about as a direct result of efforts to reintroduce oriental white storks into the wild, symbolizing the dynamism that exists in the relationship between human beings and nature. What is also noteworthy is the fact that the involvement of a diverse range of actors has facilitated the reintroduction of oriental white storks into the wild in a way that is multilayered and broad in scope.

In 2007, NPO Oriental White Stork Wetland Net was set up with the aim of contributing to the creation of a society in which people and nature coexist. This NPO has been putting in place wetlands suitable as habitats for oriental white storks through a process of trial and error. For example, at Toyooka City Hachigoro's Toshiima Wetland, which is under the NPO's management, oriental white storks have been observed breeding every year since 2008.

6.5 The Ambiguity of the Story

As the story of the reintroduction of oriental white storks into the wild has been shared, it has given rise to multidirectional initiatives and generated responses across multiple value systems (Fig. 6.3).

However, the fact that this story is shared does not necessarily mean that each individual related initiatives are necessarily mutually connected. It would be fair to say that initiatives in the areas of agriculture and tourism have been conducted separately. This is also the case with initiatives related to agriculture and civilian activities. The initiatives may be loosely connected, but this by no means suggests

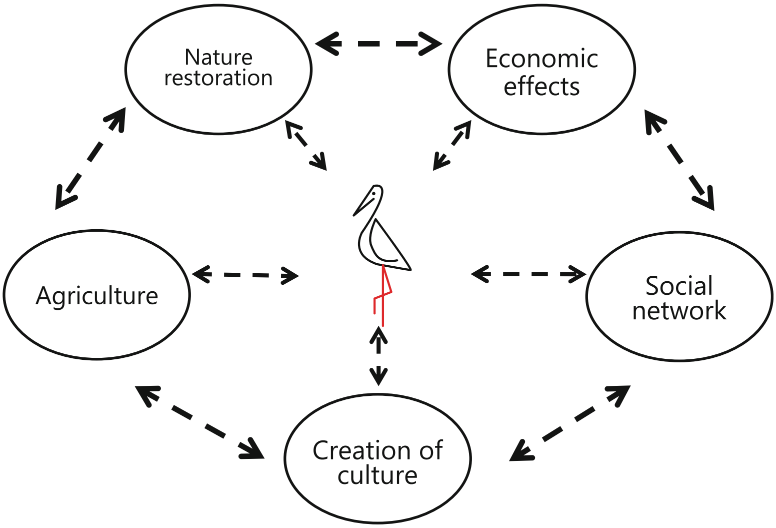


Fig. 6.3 Reintroduction of oriental white storks resulted in creation of multiple values centering oriental white stork

that they are moving in the same direction. The question that arises here, then, is why do such initiatives emerge frequently and at the same time reflect different values, even if they are not necessarily moving in the same direction?

The story that "livable environments for oriental white storks are also pleasant and beneficial environments for humans" is ambiguous. One cannot simply say that livable environments for oriental white storks are also pleasant and beneficial environments for humans. For example, wetlands, the habitat of oriental white storks, are environments which are susceptible to flooding. They are contradictory environments in terms of providing a healthy and liveable area for humans versus oriental white storks. The notion of what constitutes a pleasant and beneficial environment for humans is in itself ambiguous. Could not environments with many divergent characteristics be described as such?

What I wish to explore here is whether it is the story's very ambiguity that has made it possible for multifaceted initiatives that maintain differences to exist. The story is ambiguous; therefore, it is open to various interpretations. It is this that has enabled different values that are at first glance contradictory to exist side by side, and that has made it possible for the various actors to link their own initiatives to the reintroduction of oriental white storks into the wild. By maintaining different values, it serves to increase the potential for relaxed cooperation between diverse individuals, encompassing researchers, members of administrative bodies and citizens.

In contrast, if there were a strong emphasis on conforming to a single value in terms of the value in the field of biology, it would mean that everyone except for researchers would be positioned as mere actors acting out a story set by the researchers themselves. This would result in an increased risk of conflict occurring surrounding values and would reduce the potential for diverse initiatives to emerge.

6.6 What Is Meant by the Term "Wild?"

6.6.1 Issues Surrounding Feeding

In July 2007, the first oriental white stork nest was confirmed following their reintroduction into the wild. As a researcher at the Hyogo Park of the Oriental White Stork who witnessed this nest firsthand, I could not help but feel a sense of incongruity. This is because the nest was built by a pair of birds who were reliant on feeding by humans. When exactly does a bird reach a point when it can be labeled as "wild" legitimately be called wild? Did the fact that they were reliant on feeding with the goal of settling into the wild mean that this nest was also under human management? Can one really call an oriental white stork that is reliant on feeding a wild bird?

In principle, the Hyogo Park of the Oriental White Stork adopted a policy of not conducting feeding, as this does not encourage the birds to become "wild." The fundamental idea here is that "feeding wild animals harms their inherent wildness." However, the park conducted temporary feeding for scientific and policy-based objectives in the sense that it enables wild storks to settle in Toyooka City and increases the likelihood that they will breed there. On the other hand, there were some citizen-led groups that took it upon themselves to feed the birds on an independent basis. The opinion of these groups was that sufficient habitats for oriental white storks had yet to be put in place, and that by feeding the birds, they could provide a source of support until such time the proper environments were in place. This was also a form of assistance for breeding. This is the idea that "it is mere sophistry to extol the conservation of wild animals in an abstract way without considering the protection of animals struggling to survive before our very eyes, and that feeding is a form of conservation."

Opinions were divided between stakeholders as to the nature of human involvement with oriental white storks. It would seem that people's attitudes to feeding differed according to their perspective on what is meant by "wild." It may be the case that the word "wild" means completely different things to different individuals and groups associated with the regeneration of the oriental white stork population.

These conflicts over values manifested in a range of settings (Kikuchi 2016b). Oriental white storks settled in the area surrounding the Hyogo Park of the Oriental White Stork, where they became reliant on food provided to other oriental white storks that were being raised in open cages for display purposes. The park judged that if the birds were to be reintroduced into the wild, they would need to be allowed to find their own feet outside the park and not be dependent on the park for their survival. Consequnetly, the park set about taking in those oriental white storks that were being raised in open-air cages for display purposes and took steps to ensure that the oriental white storks which had been released into the wild could not eat their food. Citizens and Toyooka City officers voiced the opinion that feeding was only natural based on the reason that their protection and recovery of habitat were still insufficient. The park decided to hold off taking action on the grounds that efforts to reintroduce oriental white storks into the wild would be hampered if they damaged their relationships of trust with other concerned parties. Later on, the park gradually weaned the birds off feeding in line with the idea of "independence" based on scientific perspectives (at present, the park is not conducting feeding). The citizen-led groups judged whether or not feeding was appropriate according to the situation and at present are not feeding the birds. What do we mean by "wild" when seeking to reintroduce oriental white storks into the wild? In the course of my work, I was forced to confront this question.

6.6.2 Ambiguity and Its Potentials

The Hyogo Park of the Oriental White Stork considered "wild" to be a state without human involvement. "It is important that the oriental white storks themselves evaluate their environment. This is why we do not provide them with food. Environments in which they can live independently are also good environments for human beings" (Kikuchi 2008). For the citizen-led groups, it was a state in which humans became involved with oriental white storks based on protective custody. "It is possible to engage in efforts to restore nature by having oriental white storks live there. By doing this, environments can be created that are also good for human beings." Both cases are expressions of values in accordance with the story of the reintroduction of oriental white storks into the wild and the nature of human involvement. Despite using the same word "wild," there were major differences between researchers and citizens in how they conceived the nature of these values and human involvement. The story is one of ambiguity, in which contradictory initiatives exist side by side; as such, human involvement is established in many forms, leading to the coexistence of contradictory initiatives.

The reintroduction of oriental white storks into the wild is in some aspects contradictory. It needs to be based on science while presupposing uncertainty. It requires the achievement of scientific goals, but needs to elicit the participation of a wide range of citizens. Oriental white storks possess academic values, at the same time creating emotional values. Human involvement is either increased or decreased under the name of "wild." The qualitative description of wildness, as the eventual goal of the process of reintroducing the oriental white stork, is an ambiguous term which is subject to constant change. I have endeavored to question the concept of "wild" in the reintroduction of oriental white storks into the wild through the means of a diagram (Figs. 6.3 and 6.4).

Despite the presence of conflict, the fact is that all parties were able to build a relationship of relaxed cooperation while sharing the story of the reintroduction of oriental white storks into the wild. Both Hyogo Park of the Oriental White Stork and

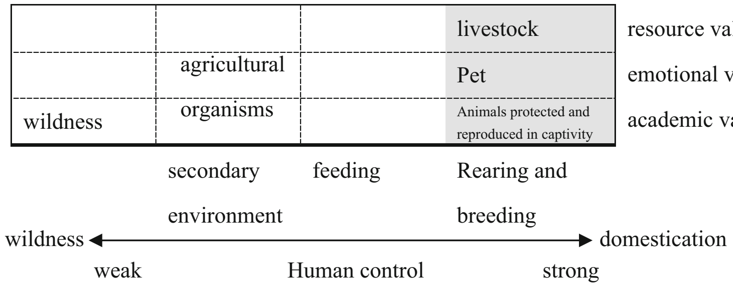


Fig. 6.4 Domestication-wildness relationships. "Wildness" is constructed by multiple values and degree of human control

the citizen-led groups were united in working to restore the habitats for the birds. And they also made it possible to turn the oriental white stork into a brand through the use of the word "wild." It is this word that enables the initiatives to "make sense." The word "wild" invites conflict as a result of its ambiguity, but even if people disagree at the personal level, the many diverse actors are able to link the initiatives to oriental white storks in line with their own logic. This results in generating multiple values.

The relationship between nature and humans have always been fraught with ambiguity, with the common ground between them constantly liable to change. Contradictions of perceptions and values in the relationship between nature and society are unavoidable when it comes to reintroducing oriental white storks into the wild. In an interview-based survey I carried out, it became apparent that oriental white storks have always been birds that inspire contradictions for humans, at one point being considered harmful birds or auspicious birds, but at other times just "ordinary" birds. Therefore, oriental white storks are multifaceted birds whose significance differs per the ways in which people engage with them. Coexistence with oriental white storks means to come to terms with the inherent contradiction in oriental white storks and nature. This suggests that a practical issue for when reintroducing them into the wild is to restore the multifaceted ties with oriental white storks in ways that minimize these inherent contradictions (Kikuchi 2006).

Considered in this way, conflict and contradictions are not things which need to be solved; rather, they serve to add a sense of nervous momentum in the ongoing struggle to tackle real issues. If attempts were made to unify values and eradicate contradictions, it would increase the risk of values coming into conflict and hamper the emergence of a broad spectrum of activities. The fact that the term "wild" is ambiguous allows it to function as a polysemous concept that unites a range of actors and activities. It is the term's ambiguity and contradictory nature – i.e. that there is no right or wrong answer – that provides opportunities for people to mutually accept different values, set several goals, and learn from one another (Miyauchi 2013). Rather, by accepting the term "wild" as an ambiguous and polysemous concept, it increases the potential for cooperation that maintains differences by a diverse range of actors who do not adhere to a single shared value, including administrative bodies and researchers. In addition to reducing the risk of conflicts breaking out over values, the presence of ambiguity increases the potential for restoring diverse ties that make it possible to translate multiple values into reality.

6.7 Moves to Connect the Story to Local Life

The story should be ambiguous. However, to function properly, it also requires a measure of balance. The story must indicate major directions for people to follow. And it is vital for the story to be accessible and comprehensible to anyone, eliciting the empathy of as many different people as possible. It also needs to be based on local particularities, but include sharable values. The story's simplicity helps it spread and capture the hearts of people. The problem is that if the story diverges from its original intention, the gaps between story and reality will widen and make it difficult to connect the story to practices for solutions of particular issues. As a result, it will lower the potential for the emergence of diverse initiatives.

What is important here is a process by which the story is linked once more with local life, what I call "connecting the story to local life" (Kikuchi 2017). As shown in Table 6.1, the Committee for the Promotion of the Reintroduction of Oriental White Storks into the Wild comprises of many existing local organizations. Efforts to reintroduce oriental white storks into the wild have made ground because the logic of the oriental white stork has been incorporated within the logic of each organization. The involvement of the logic of the oriental white stork served to override the activities of each organization to a small degree. To get a more concrete understanding of what this entails, let us listen to the testimonies of the farmers that have incorporated the farming method which improve the habitats of oriental white storks (Kikuchi 2012b). One farmer relates as follows. "I incorporated this farming method because I can relate to the principle of reintroducing oriental white storks into the wild." Not all the farmers say the same thing. Another farmer states that, "This farming method represents the origins of our village," thus linking it to the maintenance of the village's existence. Another farmer expresses the following hope: "I would be happy to see our children return to the rice paddies (which are teeming with life)." Thus, oriental white storks are finding their way back into people's daily lives. Farmers are connecting the story to local life through their own logic.

When connecting the story of the reintroduction of oriental white storks into the wild to local life, the values which are created through the story become established in the area. Connecting the story to local life is a process of avoiding the divergence of the story from its original intention. During this process, the ambiguities and equivocalness become incorporated within the story once again, increasing the potential for relaxed cooperation that maintains differences, and helping turn multiple values into reality. The reason why this ambiguity occurs is because daily life itself is by nature both an ambiguous and equivocal practice. The issues surrounding

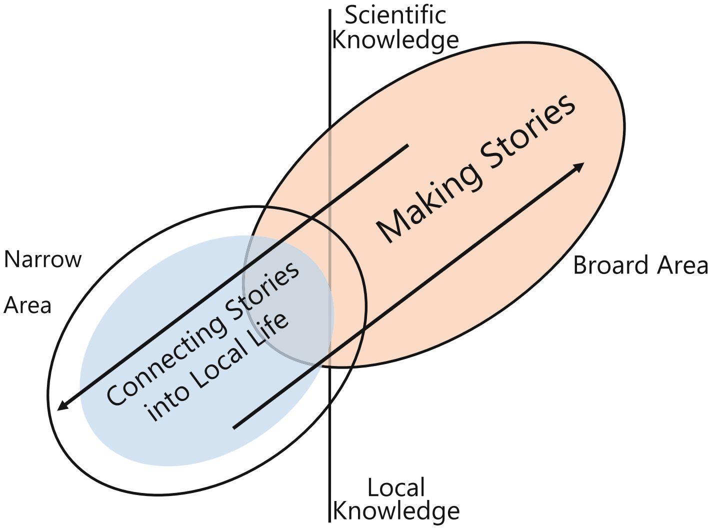


Fig. 6.5 Making stories and connecting stories into local life. Making stories is a process of translating local knowledge to spread to broader areas. Connecting stories into local life is a process of re-translating stories into local knowledge

what is meant by "wild" involve people endeavoring to simplify a story which includes ambiguity.

In summary, when it comes to the reintroduction of oriental white storks into the wild, which reflects local peculiarities, it is difficult to directly elicit widespread empathy. By blending the issues with scientific knowledge and turning it into a story, it becomes possible to elicit empathy also among people outside the region with the story of the reintroduction of oriental white storks into the wild. Turning the reintroduction of oriental white storks into the wild into a story makes it possible to convey local peculiarities to a wider audience. But it is not simply a matter of the story eliciting empathy and stopping at that, because the act of making story to generate empathy widens the gap between reality and story. When this happens, farmers and local communities are reduced to mere objects acting out a story. This is why there is a need for a process to link the story within the context of local life once more. This is what I call connecting the story to local life. By doing this, it increases the potential for generating values in local life from different perspectives than before.

Spatially speaking, the act of making a story from the reintroduction of oriental white storks into the wild takes things in broader directions. Meanwhile, the act of connecting the story to local life brings it back to a narrower area (Fig. 6.5). In this process, local peculiarities are made into a story, and this story is then connected to local life. Is it not the case that integrated local environmental knowledge is created through this coming and going of ideas? In order for integrated local environmental knowledge to form a foundation of knowledge that encourages cooperation of a kind which maintains differences, the existence of ambiguity that makes diverse interpretations possible is the key.

I believe that the mobilization of this process helps people come to terms with and compromise on a range of contradictions, increasing the possibility of cooperation of a kind which maintains differences and turning multiple values into reality. In which case, how are we to design this ambiguity as a process of cooperation? This practical issue is the next challenge which needs addressing.

References

Council for Promotion of Reintroducing Oriental White Storks to the Wild (2003) Plan for promotion of reintroducing oriental white storks to the wild (コウノトリ野生復帰推進計画) (in Japanese)

Ikeda H (1999) Weaving “environmental conservation studies” – throwing all the academic disciplines into the melting pot (「環境保全学」を織りだす—すべての学問を坩堝に). Ecosophia 4:62–65 (in Japanese)

Kikuchi N (2006) Reviving the oriental white stork: a reintroduction project for local community sustainability (蘇るコウノトリ:野生復帰から地域再生へ). University of Tokyo Press, Tokyo (in Japanese)

Kikuchi N (2008) Ambiguous “wild” in the case of the reintroduction project of the oriental white stork (コウノトリの野生復帰における「野生」). J Environ Sociol 14:86–99 (in Japanese)

Kikuchi N (2012a) Oriental white stork tourism and its issues from perspective of building up wild population (コウノトリの野生復帰を軸にした観光資源化とその課題). Wetland Research 2:3–14 (in Japanese)

Kikuchi N (2012b) Report on survey of farmers using agricultural methods to encourage oriental white stork population in Toyooka, Hyogo prefecture (兵庫県豊岡市における「コウノトリ育む農法」に取り組む農業者に対する聞き取り調査報告). Reintroduction 2:107–119 (in Japanese)

Kikuchi N (2015a) Residential research as a methodology (方法論としてのレジデント型研究). Jpn J Qual Psychol 14:75–88 (in Japanese)

Kikuchi N (2015b) Return to the wild case study – oriental white stork homeland activities (野生復帰事例:コウノトリの郷の活動). Biological Science Heredity 69(6):493–497 (in Japanese)

Kikuchi N (2016a) The multiple roles of the residential researcher: toward the creation of sustainable rural communities (持続可能な地域づくりとレジデント型研究:その多面的役割に関する試論的考察). Environ Res Q 180:80–88 (in Japanese)

Kikuchi N (2016b) Fudged relationship between fed birds and wild birds – sketched out thoughts from the site where oriental white storks are returning to the wild (給餌と「野生」のあいまいな関係:コウノトリの野生復帰の現場から考える給餌を位置づける見取り図). In: Kojima N, Takahashi M (eds) Wildlife feeding: noble deed or an ignorant mischief? Ecosystem rebellion, bird & wildlife damage, infectious diseases, damage to livelihoods. Chijin Shokan, Tokyo, pp 207–226 (in Japanese)

Kikuchi N (2017) Nature restoration studies beginning because the birds cannot be left alone – At the site where oriental white storks are being reintroduced to the wild (「ほっとけない」からの自然再生学:コウノトリ野性復帰の現場). Kyoto University Press, Kyoto (in Japanese)

Kikuchi N, Ikeda H (2006) Tajima’s oriental white stork (但馬のこうのとり). Tajima Bunka Kyokai, Toyooka (in Japanese)

Miyauchi T (2013) Why doesn’t environmental conservation work well? – thinking about the feasibility of adaptive governance (なぜ環境保全はうまくいかないのか:順応的ガバナン

スの可能性). In: Miyauchi T (ed) Why doesn't environmental conservation work well? – Thinking about the feasibility of adaptive governance from an on-site perspective. Shinsensha, Tokyo, pp 14–28 (in Japanese)
Naito K, Ikeda H (2007) Habitat restoration for the reintroduction of the oriental white storks. Glob Environ Res 11:217–221
Naito K, Kikuchi N, Ohsako Y (2014) Role of the oriental white stork in maintaining the cultural landscape in the Toyooka Basin, Japan. In: Hong SK, Qingwen Min JB (eds) Biocultural landscapes. Springer, Tokyo, pp 34–44
Nishimura I (2006) Agricultural methods that encourage oriental white stork (コウノトリ育む農法). In: Washitani I (ed) Communities and ecosystems bringing back by restoration of paddy field. Ie-no-Hikari Association, Tokyo, pp 125–146 (in Japanese)
Onuma A, Yamamoto M (2009) Economic analysis of returning the white storks to the wild in Toyooka City, Hyogo Prefecture: economic rationale for adopting white stork friendly farming method and the effect of returning the white storks to the wild on the local economy (兵庫県豊岡市におけるコウノトリ野生復帰をめぐる経済分析:コウノトリ育む農法の経済的背景とコウノトリの野生復帰がもたらす地域経済への効果). Mita J Econ 102(2):3–23 (in Japanese)
Roberge J-M, Angelstam P (2004) Usefulness of the umbrella species concept as a conservation tool. Conserv Biol 18:76–85
Satake S (1997) Toyooka City (豊岡市). In: Japan Eco-life Center, Dentsu EYE (eds) Beginner's book on environmental communication. Nikkei Inc, Tokyo, pp 147–155 (in Japanese)
Satoyama Initiative (2018). http://satoyama-initiative.org/about/#1. Accessed 25 Mar 2018
Shikida A, Uchiyama J, Morishige M (eds) (2009) Regional branding for tourism (観光の地域ブランディング). Gakugei Shuppan sha, Kyoto (in Japanese)
Washitani I, Kito S (2007) Biodiversity monitoring: collaboration to build capacity for ecosystem management (自然再生のための生物多様性モニタリング). University of Tokyo Press, Tokyo (in Japanese)

Chapter 7
Future Visions for Fundamental Livelihoods: Collaborative Actions in the Nishibetsu Watershed in Japan

Kenji Kitamura and Katsuhiko Ohashi

Abstract Nishibetsu River flows in the eastern part of Hokkaido, located in the northernmost area of Japan. In this watershed, local people spearhead activities with the objective of reviving and maintaining the watershed environment as a continuing habitat for the Blackiston's fish owl. A parent body leading these activities is called Nijibetsu Kor Kamuy Society, which is a totally voluntary and non-profitable organization. The Society's efforts to revive the natural environment have gone on for more than 20 years, producing opportunities for cooperation that go beyond administrative boundaries and differences in interests. The Blakiston's fish owl is a species worshipped as Kotan kor kamuy (protective spirit of the village) from ancient times by the Ainu, an indigenous people in Hokkaido, and the activities of the Nijibetsu Kor Kamuy Society are consistent with this in that they direct their attention to the Blakiston's fish owl. The local residents have made ingenious use of tools, knowledge and techniques they have in their livelihoods. And, the success of the Blakiston's fish owl indicates not only a good/adequate watershed environment, but indicates that the Nishibetsu watershed is in a condition to continue to sustain cornerstone industries in the region, such as dairy farming and fishing. The watershed's value has been widely shared through a series of activities. In this chapter, we will look back in specific ways at that process.

7.1 Nishibetsu River and Its Watershed

Totaling some 80 kilometers in length, the Nishibetsu River flows through the eastern part of Hokkaido, Japan. The river starts with water soaking into the land from Lake Mashu in Teshikaga Town, emerging as the source at Nijibetsu in

K. Kitamura (✉)
Kanazawa University, Suzu, Japan

Research Institute for Humanity and Nature, Kyoto, Japan
e-mail: kenjikm@staff.kanazawa-u.ac.jp

K. Ohashi
Nijibetsu Kor Kamuy Society, Hokkaido, Japan

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_7

Fig. 7.1 Source of Nishibetsu River (foreground of photo) southeast of Lake Mashu (center of photo) © 2015 Kenji Kitamura

Shibecha Town, and flowing east to Betsukai Town where it feeds into Nemuro Bay. Once a watershed area dotted with Ainu hamlets, settlers from other parts of Japan colonized this area in the first half of the 20th century, creating the foundation for the present area (Nijibetsu development's 50th anniversary celebration executive committee 1979). Note that in this chapter, the authors refer to the Nishibetsu River watershed as inclusive of the water source at Lake Mashu (Fig. 7.1).

The key industry continues to be fishing in the watershed given the salmon and trout in the Nishibetsu River. In 1890, a salmon and trout hatchery was built near the source of the River in Nijibetsu (Akiba and Suetake 1984; Nijibetsu shigai neighborhood association 1992), and still runs today, following restoration and changing ownership. The other key industry in the area is dairy farming. In the Nemuro and Kushiro regions, including the Nishibetsu River watershed, dairy farming has been greatly expanded under national policy, with a project of land development using heavy machinery in the Nemuro and Kushiro districts undertaken for 10 years from 1954, as well as a project of establishing a new dairy farming community undertaken for another decade from 1973. Along with this change in land use, forests were felled on a massive scale and polluted wastewater flowed into rivers, adversely affecting Nishibetsu River's water quality. Moreover, a declining birthrate and aging population have brought uncertainty to the future sustainability of dairy farming and fishing as the region's fundamental industries.

With worries about deterioration in river environment in the background, a couple of grassroots surveys were conducted in 1973 by rubber dinghies from the source to the river mouth to measure water quality as they drifted down the river (Watanabe 1973; Yaginuma 1999). One of this chapter's authors, Katsuhiko Ohashi, took part in one of these studies. Looking at the entire Hokkaido region, based on the theory that deforestation was the cause of dramatic decline in size of herring catches, a move was made in 1988 by the Fisheries Cooperative Association's Women's Group in Hokkaido to "plant trees to increase the number of fish". The catchphrase for this activity translates as "taking 100 years to restore the shore to its condition 100 years ago" (Yaginuma 1999).

Amidst these actions in Hokkaido and related to improving and maintaining the watershed, the Nijibetsu Kor Kamuy Society commenced activities, with the restoration of Blakiston's fish owl habitat as its central target (Sato 2016). This chapter introduces the process in which the values of protecting the entire watershed have been shared, with particular attention to the functions of knowledge and skills embedded in local livelihoods that facilitate various activities of the Society.

7.2 Owl: The Start of the Nijibetsu Kor Kamuy Society

As noted above, the Nijibetsu Kor Kamuy Society emerged against a background of various trends developing from the 1970s onward in Hokkaido and around the watershed, but the most tangible reason was an encounter with Blakiston's fish owl. This owl is endemic to the Northeast Asia region, encompassing areas such as the far east of Russia, the northeastern area of China and Hokkaido. And, with the loss of riparian forests and development of river surroundings, the owl's population has dropped dramatically, putting it in danger of extinction (BirdLife International 2001). Growing to a full height of about 70 centimeters and with a wingspan of 180 centimeters, the Blakiston's fish owl is the largest owl in Japan, and is designated as a Natural Monument (Fig. 7.2). The two habitats are old trees with large hollows and rivers that do not freeze over in winter (Slaght and Surmach 2008). The former is necessary for nesting during the breeding season and the latter for supply of a fish food source that is available throughout the year. However, land-use changes in the past led to a dramatic drop in this owl's population, to the point where it is now in the"Critically Endangered" category of the Ministry of the Environment's Red List of endangered species, with only about 140 individuals currently existing, mainly in the eastern part of Hokkaido (Ministry of the Environment n.d.). From long ago, the Ainu called Blakiston's fish owl the "Kotan kor kamuy", or the spirit (kamuy) that protects (kor) the village (kotan) (Kameda 2011).

An initial encounter with the rare Blakiston's fish owl took place in 1993. The Ohashi family business involves fixed net fishing of salmon at the river mouth of Nishibetsu River and the family home is on the seashore of Betsukai Town. However, from the 1980s, the Ohashi business became strongly interested in the Donaldson trout (a member of the rainbow trout family), and built a dedicated

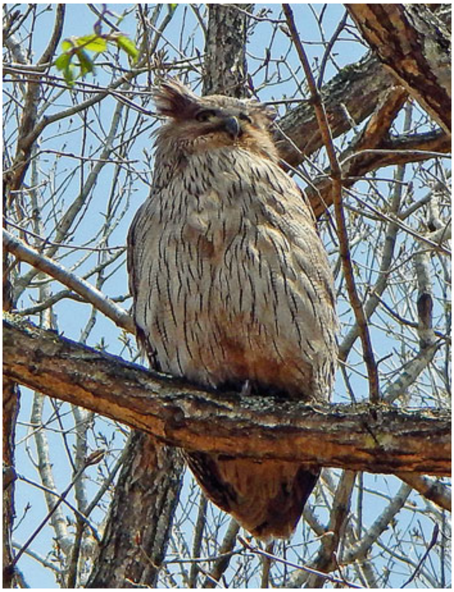


Fig. 7.2 Blakiston's fish owl © 2014 Kenji Kitamura

hatchery in Nijibetsu, close to the source of the Nishibetsu River. And, it was here that the Blakiston's fish owl made an appearance. Ohashi invited colleague from Nijibetsu to view the owl together. They had known about this owl species but never seen it in reality. The sightings of Blakiston's fish owl moved them deeply, leaving them in agreement that they wanted to improve the entire watershed to turn it into an environment where the Blakiston's fish owl could continue to live.

To establish a parent body to conduct activities, Ohashi and his colleagues gained prior approval from the Ainu people to use *kor kamuy* in the group's name: Nijibetsu Kor Kamuy Society. This was because the Ainu had long worshiped the Blakiston's fish owl as a spirit. So, the Society was formed in April 1994, with the Ainu term for "protecting spirit" in their name,

7.3 Making Use of Livelihood Tools and Techniques

In 1993, even before Nijibetsu Kor Kamuy Society was formally established, the group started building and setting out nesting boxes for the Blakiston's fish owl. As previously mentioned, the owls tend to build nests in hollows in large-diameter broadleaf trees close to rivers, but such suitable trees for nesting had decreased because of timber harvesting and clearing. For this reason, since 1984, the Ministry of the Environment has been procuring and setting out nesting boxes as part of a protection and propagation program (Ministry of the Environment n.d.).

Local residents in the area realized that there were several different materials of similar shape and size compared to those being set out by the Ministry of the

Fig. 7.3 Blakiston's fish owl's nesting box © 2015 Kenji Kitamura

Environment. These 200-liter plastic containers (the same size as a common metal drum) are for formic acid, which is used to preserve grazing pasture, and they are very common in dairy farming in the Nishibetsu watershed area. So the Nijibetsu Kor Kamuy Society collected empty and unwanted plastic containers and in turn its members skillfully turned them into nesting boxes (Fig. 7.3). There is a co-benefit of this arrangement: dairy farmers in the area are pleased to hand over their containers, as they would normally have to pay to have them disposed of as industrial waste.

In fact, there is an earlier example of how these containers had been put to good practical use in the watershed. The fixed-net salmon fishing season is limited to just several months from summer to autumn when the salmon return to the river; hence, the nets are stored away on the shore during the off season. The formic acid containers are used as a podium to hold the nets in storage during this period (Fig. 7.4). One reason for this practice is to prevent the nets from being buried in snow during winter. A second reason is to protect the nets from mice damage. Mice burrow into the mass of netting, biting through the mesh to create tunnel nests. The raised podium provided by the containers offers off-the-ground storage for the nets and the plastic surfaces of the containers are difficult for mice to climb. It is an example of how people will make use of close-at-hand tools to ingeniously put them to work for purposes other than they were intended and therefore, do the desired job without incurring expenses.

Moreover, when making the nesting boxes for the Blakiston's fish owl, the locals need to attach a wooden frame around the entrance to the container and stuff the inside with wood chips, with all the materials used for these tasks being found locally. There are no labor costs involved since the nest builders are all volunteers. Thus, in essence, nests are made, set and maintained free of charge.

Fig. 7.4 Formic acid containers being reused for fishing net storage © 2015 Kenji Kitamura

There was a concern that the handmade nesting boxes would not function sufficiently. This concern proved to be false. The nests installed by the Nijibetsu Kor Kamuy Society have almost the same occupancy rate as nests set up by the Ministry of the Environment, with a total of nearly 30 young owls leaving the Society's nests, according to the monitoring jointly continued by the Ministry of the Environment and the Nijibetsu Kor Kamuy Society.

In 1994 when the Nijibetsu Kor Kamuy Society was initially formed another major event also occurred. A decision was made by a local government to deforest an area in the Nijibetsu district to build a snow station for parking snow clearing vehicles. In response, the Nijibetsu Kor Kamuy Society said that it would replant all of the threatened trees in another area – in other words, move an entire forest. The Society's membership included many dairy farmers, fishers and civil servants but there was no professional forester represented in the Society. Nonetheless, with their own trailers and excavators and volunteer labor, the members completed the task – they shifted a forest for just the cost of machinery fuel, tens of thousands of yen. The work was completed in June 1994, almost directly after the Society was formed. This shows that the willingness of the local people to work together for the watershed environment had already been high by the time the Society was established. This project turned out to be a suitable opportunity for them to start concrete collaborative actions.

The area used for replanting the trees had been a waste disposal site, and the waste had just been covered with 30 or 40 centimeters of top soil. It was a poor site for tree growth, and a study several years later showed that the percentage of seedlings that

Fig. 7.5 Tree planting festival for the 100 year project of creating forests for the Blakiston's fish owl © 2016 Kenji Kitamura

took root was not high; however, at least replanting had taken place according to the initial plan. The Society members then put learning from that experience to good use in their future decision-making for seriously attempting to reforest riverbanks for the Blakiston's fish owl to live on in the area. The Society named this task the "100-year project of creating forests for the Blakiston's fish owl," and every May the members hold a tree planting festival (Fig. 7.5).

The Society designed it as a century-long project, borrowing the idea of the Hokkaido Fisheries Cooperative Association's Women's Group, which was mentioned earlier in this chapter. The difference between the two efforts is obvious in that the tree planting festival hosted by the Women's Group is for herring while the Society's festival is for Blakiston's fish owl. In the case of herring, the planting activities have a strong link to a specific livelihood – namely, fishing. To the contrary, Blakiston's fish owl has no direct use as a given resource, making it easier to get a broader participation in the planting festival beyond the differences in livelihoods and standpoints. The tree planting festival has already taken place annually 23 times, every year up to May 2016, with some 75,000 trees in total being planted across those years. Planting sites are selected each year, with some being on town-owned land and others on private land. From 2014, based on an agreement with the Town of Shibecha, the Society started to plant trees on that town's land. Here, the move coincided with Shibecha wanting to fell some Japanese larch trees that had been commercially planted 50 or 60 years ago, so the Society's idea is to restore that deforested area to one of broadleaf trees. This is an example of how the Society has specifically linked up with a local administration to achieve projects.

Annual participation in the festival varies from 200 to 300 people, making it the most well attended event that Nijibetsu Kor Kamuy Society hosts, with several dozen members also participating. The other participants mainly come from the administrations in the three towns in the watershed (Teshikaga, Shibecha and Betsukai), with a customarily good turnout of council employees, ranging from senior to junior staff. Staff from the Ministry of the Environment, the Hokkaido Regional Development Bureau and the Hokkaido Government also participate. Moreover, the festival also draws participants from primary and secondary schools at all levels in Shibecha Town, many of these being students engaged in outdoor education. So, even though the Society does not assertively advertise the event, every year many participants gather to offer their labor free of charge. Thanks to that, more than 3000 trees are planted in about a single hour.

Another custom that has taken hold over the years is the distribution of local milk during the break taken during mid-planting. When the planting site is in Betsukai Town, the milk comes from Betsukai, and when the event is in Shibecha Town, it is Shibecha milk. This gives participants a chance to think about the dairy farming, which is so integral to the area, while drinking the milk. Furthermore, when the planting is finished, participants are rewarded with barbeque lunch with seafood and other locally produced foods. This gives meanings to their action that the forest and sea are connected and people benefit from the services from the ecosystem.

Native tree species are planted. At the May 23, 2016 event, some 3300 trees of nine species were planted, including Japanese oak, Sargent cherry, walnut and willow. Half of the saplings were donated by the Mitsubishi UFJ Environment Foundation, which purchases them from the local forestry association. This donation has been taking place since the fifth Festival, and has turned into an ongoing, long-term donation. Nijibetsu Kor Kamuy Society procures the remaining half of the saplings, with one particular member taking on the important role of growing saplings for the event. Here, the aim is to restore the Blakiston's fish owl's original habitat using broadleaf trees raised from saplings grown locally as well as to provide the participants the opportunity to think about how the local environment should be.

Another feature of this planting event is that the members of the Nijibetsu Kor Kamuy Society do everything themselves for the event; this goes from organizing the detailed preparations for planting to running the social elements of the event. to running the social gathering. So, every year, operations that would typically be undertaken by professional event organizers in the urban setting, the Society's members can be seen doing many practical tasks, such as swiftly unloading portable toilets from a crane-mounted truck before the event and then removing them after the event. With more than 20 years of experience under their collective belt, the members do not wait for orders, but instead just unassumingly get on with the tasks. This brings us to another key feature of this planting festival: there is no clear distinction between organizing staff and participants. So, apart from the town council's employees and Society's members, the participants also have made it a custom to get on with various tasks, to complete the work smoothly and swiftly. They find out where hands are needed, and move flexibly to work together. Another group of integral stakeholders is the families of the Society's members. Some 20 women prepare and lay out food for the participants. These women neither wear official armbands of the Nijibetsu Kor Kamuy Society nor get counted in participant numbers but instead make a big contribution behind the scenes.

The Society's members also look after the forests as they grow throughout the year(s). As the grass needs to be mowed for several years until saplings reach a certain size, the members volunteer to do this mowing, which keeps costs down to just the expense of fuel for the grass cutting equipment. This forest regeneration work really is a DIY affair for the Society.

7.4 Contriving to Bring People Together

As a follow-on to setting nesting boxes and planting trees, the Nijibetsu Kor Kamuy Society next set out to plan and host events that bring people together. In specific terms there are three main events that the Society organizes which fall into this category. The first is a concert that was held in which the singer-songwriter Michiyo Shirai, who is an acquaintance of the Society's president Sadayoshi Tate, came and played in Nijibetsu in September 1995, with this "Nishibetsu Headwater Concert" receiving some funding from the subsidy for cultural promotion by the Town of Shibecha, but other than that being basically a self-managed DIY event.

The local residents of Betsukai Town who participated in this concert said that they would like to see the same concert held at the river mouth, which evolved into the idea of playing a series of concerts at districts along the course of the river. Thus, from the following year, 1996, with Nijibetsu Kor Kamuy Society taking on the central organizing role, five concerts were held over a week from the upstream source to the downstream mouth. The concert title was changed so that "Headwaters" became "Watershed" in the "Nishibetsu Watershed Concerts". This concert series was held every year for 10 years until 2005 (Fig. 7.6).

Holding the same concert in five districts demonstrated how the approach to managing the concert in each district varied. A lesson learnt is that even on the same watershed there are people with various ideas, and things would not go well if just one idea was pushed ahead. At its meetings, therefore, the Society has made it a custom to listen to every participant's voice about her/his life in general as well as opinions about the activities.

The second event was the "Meeting of the Fame in the Mashu Water System and the Nishibetsu Watershed," which first occurred in the summer of 2001 as a gathering of the town mayors from Teshikaga Town, Shibecha Town and Betsukai Town together with the Nijibetsu Kor Kamuy Society. This meeting has carried on since, and after the first five or six gatherings, not only the mayors, but also the councils' employees started to participate. At that point it was decided that the

Fig. 7.6 Nishibetsu Watershed Concert © 1998 Nijibetsu Kor Kamuy Society

"meeting of the fame" in the original title may make it difficult for many people to participate, so the title was changed in 2010 to "Neighborhood Meeting in the Mashu Water System and the Nishibetsu Watershed," with representatives from farming, forestry, fisheries, commerce, and industry participating from then onwards. Moreover, from 2014, an invitation has been extended to the neighboring district of Nakashibetsu Town, further broadening the circle of discussion and participation.

The third event is the "Forum on Lake Mashu, Water and the Environment". Since 2002, the three watershed towns have taken turns to host this Forum, which is given a theme based on an important issue for the watershed each year, with experts being invited to lecture on the chosen theme. Possible themes are proposed by the secretariat of the Society, discussed within the Society and also with municipal offices, and then finalized. Thus, the forum functions as a venue where people come together to learn about problems inherent to the Nishibetsu watershed, taking river and environment as its axis. The Forum also has the objective of increasing manpower that can make calm decisions and turn them into activities that counter problems arising in the region.

Through these three events, a diverse range of people living in the watershed have the opportunity to meet one another beyond town boundaries. It is not easy to break into the hierarchy of administration, but with the president of the Nijibetsu Kor Kamuy Society hailing from an administrative post, there is no doubt that his connections and trusted relationships with people in administration have helped move forward the Society's cause. Furthermore, as the Society has had no intention

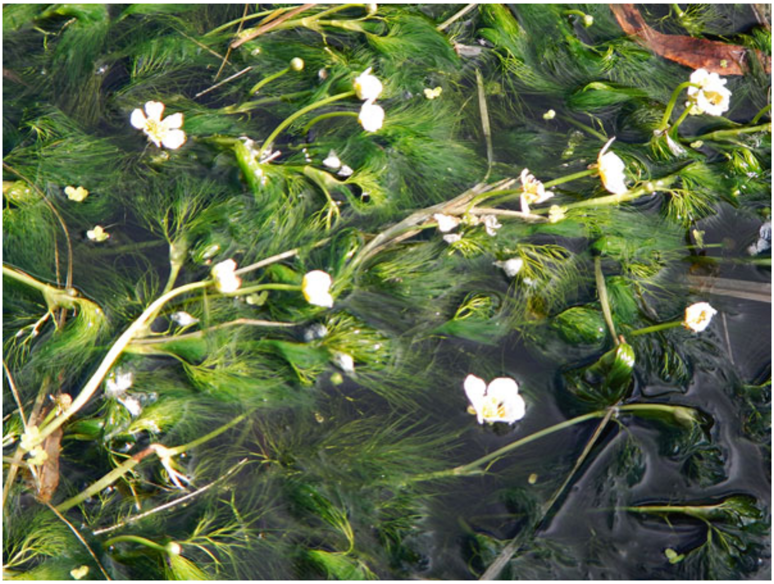


Fig. 7.7 Water crowfoot © 2014 Kenji Kitamura

to ask for funding from administrations; the Society has built up a working environment that is conducive to relaxed participation from administrative officials.

7.5 Network on Water Grass

Through the 20 or so years since establishment, a sense of stability can be seen in the activities maintained by Nijibetsu Kor Kamuy Society. In addition in recent years the Society has taken yet another direction, it is seeking to protect the water crowfoot, which is a type of water grass, and is written in Chinese characters as “ume flower algae” for its Japanese name of *baikamo*, a name that is apt as it produces a small flower (one centimeter in diameter) that looks like an ume blossom (Fig. 7.7).

Lake Mashu’s underground water is the source of Nishibetsu River, so the water temperature is always constant, which means the upstream area of the watershed never freezes over even in winter, which is uncharacteristic compared to nearby rivers. Even when everything is blanketed under white snow, the river keeps flowing, with the swirling green of the water crowfoot reassuringly visible to all the locals. Furthermore, the water crowfoot eases the pace of the river flow, causing undulations on the riverbed, which become environments suitable for fish to live. The Nishibetsu River is home to yamame trout and white-spotted char, with their young living among the water crowfoot. Insects like the caddisfly are a source of food for those fish; the fish in turn are food for brown bears and birds of prey, including the Blakiston's fish owl. Thus, if a river has an abundant spread of water crowfoot, both water quality and ecosystem food chains will be in better relative shape/health.

However, in recent years, the presence of water crowfoot is decreasing, and the greatest contributing factor to this reduction is that waterfowl and yezo sika deer are increasingly turning to eating water crowfoot as they cannot obtain other sources of nutrition. In particular, there are concerns that the population of the yezo sika deer is on the increase, and that they take even the rhizomes of the water crowfoot from the riverbed, making it harder for the water crowfoot to grow and recover during the spring and summer months.

Here, stakeholders, clustered around members of Nijibetsu Kor Kamuy Society, have come up with the idea of placing a net over the river, slightly above the water, to prevent deer, swans and ducks from eating the water crowfoot, and have started to cooperate in a study on such a method. Here too, local knowledge that allows these local tools to be put into practical use is prominently evident. To start with, the netting to cover the river is none other than the nets used locally in fixed-net fishing. And, to prevent the nets from draping into the water, plenty of floats are used; these floats are the plastic formic acid containers—they are also used to build nesting boxes for Blakiston's fish owl. A precedent actually existed at Ohashi's hatchery, where part of the water surface is covered in netting. Note that only a portion of the hatchery is covered, not all of it, to let wild animals have a small portion to eat. Here, the needs of mankind and the needs of wild animals are both being accommodated to a suitable degree based on the local beliefs. So, the method used at the hatchery was employed as the method for protecting the water crowfoot in the river.

Again, the metal fittings for securing the ends of the nets are the same anchors that are used on fixed nets for salmon fishing (Fig. 7.8). These are examples of creatively making maximum use on a daily basis of equipment designed for fishing and farming, but applicable to other uses. Such application of local materials and knowledge also helps reduce the cost of actions, which consequently reduces actual and potential risks of budget to be wasted in vain.

From 2015 and over the winter of 2016, some three seasons have passed since we started experimenting with methods for spreading the water crowfoot protection nets, building up the knowledge base by making slight improvements in areas such as the seasonal timings for setting and removing the nets, positioning of the floats and the order in which work should be done (Fig. 7.9). Here, a gem of local livelihood technology can be seen in how the net is spread out. There is no blueprint drawn on paper, but in reality, the settings are highly systemized, so that with each setting the know-how gained from the previous attempt is integrated into the new setting. And, what is more, the configuration of the nets is achieved thanks to well-experienced hands.

The activities of the water crowfoot protection initiative are creating new forms of cooperation among various groups of people. As stated at the beginning of this section, the nets are being spread in a salmon and trout hatchery, so acquiring the cooperation of the hatchery is a major factor. Furthermore, cooperation from various stakeholders is needed for the initiative to be viable. Examples of such stakeholder

Fig. 7.8 Anchors for fixed nets © 2015 Kenji Kitamura

Fig. 7.9 Water crowfoot protection net © 2015 Kenji Kitamura

include the three town councils in the Nishibetsu watershed as well as anglers, underwater photographers and birdwatchers, all of who come to the river to pursue their individual interests. Hence, regardless of whether they have a direct interest in the restoration of the water crowfoot or not, stakeholders' typical activities are affected temporarily during the periods when the protective nets are spread. Yet, even for those people not directly engaged in order to help the water crowfoot thrive, over the long-term they come to appreciate the value by seeing the water crowfoot increase and river environment gradually restored, the action being taken on the river is a desirable one. And, thanks to thoughtful and careful efforts in explaining the situation to various people, to date there has not been any opposition noted/recorded. This may be a partial consequence of the study being conducted for over 10 years on the water crowfoot by Shun-ichi Kikuchi, a researcher from the Faculty of Agriculture, Yamagata University. Thanks to his ongoing study, the Society is able to obtain a continuous supply of scientific data, which is referred to when considering the status and ecology of the river with regard to the changes in growing conditions of water crowfoot. While not wanting to rush to conclusions about the actual efficacy toward protection of water crowfoot, Kikuchi is almost certain that net spreading in Nijibetsu has thus far proved to be beneficial to the overall ecosystem; he continues to validate this claim. This is an example of integrated local environmental knowledge, which connects science with on-site matters and promotes action.

7.6 Vision for Fundamental Livelihoods in the Entire Watershed

A key feature of the case study highlighted in this chapter is that knowledge and skills that exist in the watershed area have been put to multiple uses in every stage of activities. For instance, there already has been analytical research on indigenous people that has established a worldview that shows them to have livelihood technology cored around hunting and harvesting as well as a natural environment and human society that is integral to each other (Omura 2012). Whereas, in the case examples provided in this chapter, the special feature is how livelihood technology is put to practical use in new approaches to restoring the natural environment in a modern local community where there are no traditional models for acts such as sharing out the catch of a hunt. And, here, the meaning of livelihood technology also includes the knowledge and ingenuity to put dairy farming and fishing tools to wide-ranging uses as well as social skills, based on administrative experience, to harness people of various capacities as well as make use of human networking (Heller 1997).

By keeping activities close to those that are typical in the daily lives of local residents, where not just the frugal approach to expenses but also the creation of an atmosphere that makes participation an easy-going affair, good results have been achieved. Thus, a sense of fulfillment in contributing comes to the fore even when participating just one time, because in that participation there is collaboration with like-minded people, and it may lead to the desire to participate again. A good illustration of this would be the tree planting festival, which sees not just Nijibetsu Kor Kamuy Society members but also many other participants returning again and again to help. Even people who have moved out of the watershed area can be seen returning at their own expenses of traveling to participate in the tree planting festival.

While contributing a major effort to the creation of forests for Blakiston's fish owl, the Nijibetsu Kor Kamuy Society also constantly works to simultaneously implement multiple types of activities. Each has its own objective, which creates synergistic effects when combined with each other. Among these, the Forum on Lake Mashu, Water and Environment shows the strongest element of thinking about watershed problems while integrating in scientific wisdom. And, if administrations and researchers took the initiative, activities such as the forum would be the first ones to be planned. However, Nijibetsu Kor Kamuy Society took the lead to introduce familiar activities with strong elements of physical cooperation, making sure that the foundations were sufficiently strong in areas such as human interrelations and shared principles before setting up the forum. And, as to the question of order and timing in implementing multiple types of activities, the decisions can be made based on social skills and interpretations.

Apart from the activities of the Nijibetsu Kor Kamuy Society, there are various other moves unfolding in order to solve problems in the watershed. One such example is the production of biogas using cattle manure. Here, the idea is to collect manure instead of letting it flow into rivers, so that it takes the role of being a source of energy. And, if this helps reduce poor water quality and eutrophication in rivers and coastal waters, then it also will have a positive impact on fishing. In another move, some dairy farms are switching over to dent corn fields for fodder. A dairy farming cycle that starts with the production of fodder is one of the future choices that could be made to tie everything together in the watershed. The background to this kind of new move is the worry being shown about the future of fundamental livelihoods in the area. Amidst the industry changes that come with increasing economic globalization, the population of the watershed area is decreasing and aging. There are even fears that there are too few youngsters of the next generation to keep things going. And, thinking in terms of just one industry, such as dairy farming only or fishing only, will no longer lead to a solution to the problem. Therefore, it is important to bolster the foundations of local industries while mutually helping each other in various livelihood activities.

In thinking about the vision for the future of local industries, the watershed becomes an appropriate unit. Fundamentally, the watershed, which in the geographical scope is cut up by dividing mountains, is connected in its entirety by the essential resource water. A watershed with a healthy environment provides ecosystem services in such forms as stable water flow, tourism and recreation opportunities, which also serve as a basis for farming, forestry and fishing (Brauman et al. 2007; Postel et al. 2005). And, as the upstream area has an impact on environments of the downstream area and coastal area, it is vital that consideration is shown to problems and countermeasures in terms of the watershed as a unit (Millennium Ecosystem Assessment 2005). A watershed also is significant as a geographical scope suited to self-implemented initiatives for problem solving that go beyond conventional administrative frameworks (Lubell et al. 2002).

We can interpret the activities undertaken by the Nijibetsu Kor Kamuy Society up to now as the process of building and strengthening a collaborative platform based on the unit of this watershed. And, on this platform, participants are able to pull together as they aim for a common goal regardless of relationship in status and beyond the boundaries of administrations. Thus, through cooperation, both: (1) the local economy made up largely of dairy production and fishing, and (2) the natural environment that underpins that local economy acquire sustainable statuses, which has value that becomes shared with the geographical expanse of the watershed (Kitamura et al. 2018).

In essence, the Nijibetsu Kor Kamuy Society was founded back in 1994 with just the aim of "relentlessly working to save the Blakiston's fish owl". Add to that the sentiment of "wanting to hand down Japan's best salmon and milk to the grandchild generation by keeping the river flowing" as symbolized by the Nishibetsu Watershed Concerts, talking about future visions for the fundamental livelihoods. Thus, without being too abstract and without being too concrete, this vision expresses a sentiment that can easily be shared by the people living in the watershed. In this way, the sense of value achieved through Nijibetsu Kor Kamuy Society efforts to share are now being reflected in administrative policy. The following is from the preamble to the "ordinance on river environment conservation and healthy use of rivers" (Betsukai Town ordinance 21) adopted and enacted by the Town of Betsukai on the downstream side on April 1, 2014.

> In Betsukai Town, rivers starting with Nishibetsu River, with its source at the foot of Mt. Nishibetsu-, and other rivers, such as Furen River, Tokotan River, Shunbetsu River and Tohoro River, flow into Lake Furen and then Notsuke Bay and Nemuro Bay, blessing us who live in this lush vast land and watershed with many bounties and supporting us with abundant fishing resources.
>
> However, the burden on our river environment in no small way is coming from increasing industrial activity, so that if matters remain this way, the impact will doubtless move from the natural environment to our foundation industries, farming and fishing.
>
> Thus, we enact this ordinance to protect these irreplaceable rivers with the resolve to hand on to future generations the many blessings that come from the abundance of nature in those rivers that flow through the vast heathland of Betsukai by working to protect and improve the river environments for our children, our grandchildren and all people who visit the watershed.

Through articles such as household wastewater (Article 10), detergent (Article 11), agrochemicals (Article 12), sediment runoff (Article 13), industrial wastewater (Article 14) and waste disposal (Article 15), the ordinance demands effort to reduce the load on the river environments (Town of Betsukai 2014). Yet, fundamentally, the ordinance is not designed to punish violators through the use of regulations. This has a lot in common with activity policy of the Nijibetsu Kor Kamuy Society, which encourages cooperation beyond viewpoint and differences in opinions rather than seeking out the wrongdoers.

For some time now, people with various viewpoints have been putting forward their opinions about the future of the watershed, but the environmental icon represented by the Blakiston's fish owl (Sato 2008) can help those viewpoints converge. And now, in recent years, a new environmental icon in the form of water crowfoot has emerged to give even more gravitas to the cause. This too is an ecological symbol for the entire watershed that will ultimately tie into the efforts for the Blakiston's fish owl. Thus, the Nishibetsu River watershed case examples show that various bodies, regardless of livelihood differences and administrative boundaries, can cooperate and develop activities via local residents who are able to self-coordinate tasks while also sharing future visions of the watershed on a scale that accommodates underpinning industries.

References

Akiba T, Suetake T (1984) Salmon & trout of Nemuro – Development of hatchery projects (根室の鮭鱒——ふ化事業の発展). Hokkaido Sake/Masu Tomo no Kai, Sapporo (in Japanese)

Betsukai Town (2014) Municipal ordinance of Betsukai Town on environmental conservation and sound use of rivers (別海町河川環境の保全及び河川の健全利用に関する条例). http://betsukai.jp/d1w_reiki/426901010021000000MH/426901010021000000MH/426901010021000000MH.html. Accessed 31 May 2016 (in Japanese)

BirdLife International (2001) Threatened birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge

Brauman KA, Daily GC, Duarte T K'e, Mooney HA (2007) The nature and value of ecosystem services: an overview highlighting hydrologic services. Annu Rev Environ Resour 32(1):67–98

Executive committee for commemorative events to mark the 50th anniversary of Nijibetsu (1979) Fifty years of Nijibetsu (虹別五十年) (in Japanese)

Heller F (1997) Sociotechnology and the environment. Hum Relat 50(5):605–624

Kameda Y (2011) Aspects of the ainu spiritual belief systems: an examination of the literary and artistic representations of the owl god. A thesis submitted in partial fulfillment of the requirements for the degree of master of arts in the department of pacific and Asian studies, University of Victoria, Canada

Kitamura K, Nakagawa C, Sato T (2018) Formation of a community of practice in the watershed scale, with integrated local environmental knowledge. Sustainability 10(2):404

Lubell M, Schneider M, Scholz JT, Mete M, (2002) Watershed partnerships and the emergence of collective action institutions. Am J Polit Sci 46(1):148

Millennium Ecosystem Assessment (2005) Ecosystems and human well-being: current state and trends: findings of the condition and trends working group. Island Press, Washington

Ministry of the Environment (n.d.) Blakiston's fish owl (シマフクロウ). https://www.env.go.jp/nature/kisho/hogozoushoku/shimafukuro.html. Accessed 31 May 2016 (in Japanese)

Nijibetsu Shigai Neighborhood Association (1992) Nijibetsu Shigai neighborhood association 25th anniversary commemorative publication: “Niji-no-Ayumi” (虹別市街町内会25周年記念誌『虹の歩み』) (in Japanese)
Omura K (2012) The ontology of technology: considering the potentiality of natural-cultural anthropology through an analysis of the Inuit Technological-Complex System (技術のオントロギー:イヌイトの技術複合システムを通してみる自然=文化人類学の可能性). Jpn J Cult Anthropol 77(1):105–127 (in Japanese)
Postel SL, Thompson BH, (2005) Watershed protection: capturing the benefits of nature’s water supply services. Nat Res Forum 29(2):98–108
Sato T (2008) Wildlife as an environmental icon and local communities: formation processes of environmental icons and the roles of science of ecosystem services (環境アイコンとしての野生生物と地域社会-アイコン化のプロセスと生態系サービスに関する科学の役割). J Environ Sociol 14:70–85 (in Japanese)
Sato T (2016) Field Scientist: the perspective of Integrated Local Environment Studies (フィールドサイエンティスト:地域環境学という発想). University of Tokyo Press, Tokyo, 235pp (in Japanese)
Slaght JC, Surmach SG (2008) Biology and Conservation of Blakiston’s Fish-Owls (Ketupa blakistoni) in Russia: a Review of the Primary Literature and an Assessment of the Secondary Literature. J Raptor Res 42(1):29–37
Watanabe Y (1973) Returning North (北帰行). Yama-kei Publishers, Tokyo (in Japanese)
Yaginuma T (1999) Entire forest encourages fish breeding (森はすべて魚つき林). Hokuto Shuppan, Tokyo (in Japanese)

Chapter 8
Innovation Emerging from Livelihoods: Natural Resource Management in Lake Malawi

Tetsu Sato, Dylo Pemba, and Chigusa Nakagawa

Abstract The eradication of poverty is an urgent global challenge. However, the solution to this issue is difficult, especially given uncertainty of the behavior of complex social-ecological systems. This chapter considers the nature of transdisciplinary (TD) research that is necessary to deal with such complex and wicked problems. Through collaborative TD research conducted with the socially vulnerable people, in this case people living in poverty in Lake Malawi riparian communities in East Africa, it became apparent that various autonomous innovations (tools) were emerging which contribute to the improvement of well-being and sustainable management of natural resources among people living in poverty who have been regarded as the targets of aid. Through the construction of a toolbox that promotes societal transformation toward sustainability, this chapter proposes a new approach of TD research conducted with socially vulnerable people to visualize values of knowledge and technologies that promote autonomous natural resource management and pluriactivity in livelihoods to improve well-being of these people and achieve natural resource sustainability.

8.1 Challenges Facing the Least Developed Countries

8.1.1 Realities and Issues Surrounding Poverty

Poverty continues to cast a dark shadow over sustainability and well-being of human societies. As of 2015, 14% of the world's population was living in a state of extreme

T. Sato (✉)
Research Institute for Humanity and Nature, Kyoto, Japan

Ehime University, Matsuyama, Japan
e-mail: tetsu@chikyu.ac.jp

D. Pemba
University of Malawi, Chancellor College, Zomba, Malawi

C. Nakagawa
Ryukoku University, Otsu, Japan

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_8

poverty, subsiding on an income of less than 1.25 USD per day (World Bank 2015). People living in poverty are often subjected to extreme limitations of employment opportunities and economic activities. In many cases their main livelihoods revolve around the use of natural resources through agriculture, forestry, and fishery, and their well-being is heavily dependent on natural resources. In turn, their day-to-day needs exert major pressure upon the natural resources on which they depend. Further, basic services such as medical services and opportunities for primary education typically do not reach people in such communities. In turn, this produces various challenges connected with basic human rights, such as drop in the school attendance rate and rise in infant mortality. In this sense, people living in poverty are the socially vulnerable. In the least developed countries, concentrating on those in Africa in particular, improvements to the well-being of the socially vulnerable living in poverty who make up the large proportion of the population in these countries and sustainable development of local communities are one of the most urgent international challenges (United Nations Development Programme 2013). Sustainable development Goals (SDGs), which were set down during the United Nations General Assembly of September 2015, include the following goals: “No Poverty – End poverty in all its forms everywhere.” (Goal 1) and “Zero Hunger – End hunger, achieve food security and improved nutrition and promote sustainable agriculture” (Goal 2). The sustainable use of agricultural and aquatic resources along with improvements to the resilience of communities in developing countries are challenges which need to be resolved with the highest priority (United Nations General Assembly 2015).

In the Republic of Malawi, a landlocked country in East Africa, diverse ecosystem services from Lake Malawi (a UNESCO Natural World Heritage Site) include fisheries and tourism resources that the lake environment provides, agricultural resources that are supported by vast tracts of fertile land (including water resources) and forestry resources that are vital for energy resources. These all also support the daily lives of people in the lake region. These resources have the potential to provide the foundations for improvements of well-being of people and to promote sustainable development of communities living in the lake region (Government of Malawi 2002). However, 50% of the country’s population lives in a state of poverty, with 25% of people living in extreme poverty (Government of Malawi 2012a, c). Factors such as rapid economic development and climate change have led to dynamic and unpredictable changes to local social-ecological systems, generating a series of challenges that are now putting pressure on the lives of those who live in the riparian communities.

8.1.2 Lake Malawi Riparian Communities

From the situation surrounding a range of natural resources that support the lives of those who live in the riparian communities of Lake Malawi, it is possible to catch a glimpse of scientific uncertainty of complex social-ecological systems and the nature

Fig. 8.1 Fishers on their dugout canoe coming back from fishing. Most of fishers in Lake Malawi are small-scale operators under poverty

of difficult challenges which arise from this complexity (Biggs et al. 2015). The majority of people in these riparian communities live in poverty, and their main livelihoods include small-scale fishery or the small-scale trade of fishery products (Fig. 8.1), combined with subsistence agriculture. In Malawi, small-scale fishers produce over 90% of the country's fishery products. These small-scale fisheries along with the supply of fisheries-related products provided by small-scale traders support the economies of riparian communities and provide people in these communities with animal protein at a low cost. According to the 2012 "Malawi National Fisheries Policy," the fishery industry accounted for 4% of the country's gross national production; and fisheries and related industries created employment for 14% of the population of Lake Malawi riparian regions (200,000 people). Fishery products made up 70% of the nation's dietary intake of animal protein, providing 40% of their overall protein intake. Participation in fishery and related industries is easy and provides precious employment opportunities to people in riparian communities (Government of Malawi 2012b). Cheap fishery products like Usipa (*Engraulicypris sardella*, Cyprinidae) and Utaka (*Copadichromis* spp., Cichlidae) can be caught year-round and play an important role in providing vital animal protein to people living in poverty (Fig. 8.2). However, in Lake Malawi and other water bodies in the country, there are over exploitation and stock decline in some fish species. The distribution of fishery products has suffered from inadequate post-harvest management in supply chains, resulting in as much as 40% of fishery products deteriorating and subsequently being disposed of before they can be

Fig. 8.2 Usipa and other small fish species are either sun-dried or smoked and supplied to remote markets, providing affordable animal protein resources for people

consumed. Cheap fishery products like Usipa and Utaka are mainly sun-dried or smoked and then traded over a broad area; however, the quality control during the processing and distribution stages is difficult, which leads to a severe deterioration and loss. Moreover, there is a major demand for firewood resources required for smoking fishery products, and this combined with an increase in demand for firewood resources for fuel in urban areas has exacerbated depletion of forestry resources.

While these riparian communities are blessed with an abundance of water resources courtesy of Lake Malawi and its catchments, small-scale irrigation systems that people living in poverty can use are not widespread, and rain-fed agriculture during the rainy season is the first to suffer from the impacts of climate change (Government of Malawi 2012c). In order to supplement unstable agricultural

Fig. 8.3 Colorful cichlid fishes (Mbuna) schooling on rocky bottoms at shallow littoral areas are valuable resources for snorkeling tourism

production at risk from drought and flooding, the Government of Malawi Department of Fisheries is endeavoring to encourage people in rural communities to take up small-scale aquaculture. However, while the annual catch of fish from Lake Malawi stands at approximately 70,000 tons, the annual production of aquaculture remains at only 2500 tons (Government of Malawi 2012b). In order to improve the quality of life for people living in poverty while continuing to secure sources of vital animal protein, there is a need to promote the sustainable management of aquatic resources, reduce post-harvest losses, and improve sustainable agricultural production. In addition, rich natural environments such as Lake Malawi National Park which has been inscribed as a UNESCO World Natural Heritage Site, possess a large potential value as a tourism resource (Fig. 8.3). Tourism in riparian areas of Lake Malawi continued to grow, and in 2013, the annual number of overseas tourists from outside Malawi reached 800,000 people. In recent years, there is also increasing potential concerning domestic tourism targeting wealthy classes from urban areas. Creation of community-based tourism and provision of new livelihood opportunities may be the key to triggering improvements of well-being of people living in riparian communities.

Complex social-ecological systems in local communities change dynamically through a complex entwinement of problems and opportunities for their solution, with a large degree of uncertainty for the plausible futures. Given the complexities of challenges and the extreme difficulty of predicting futures, pluriactivity in livelihoods in which households living in poverty possess multiple livelihood options and can flexibly select from a handful of options according to the need at hand is thought to be the most effective means of providing households with stability, improved well-being and resilience compared to relying on a single occupation (Salmi 2005). Households in poverty would no doubt benefit greatly by having plural livelihood options at their disposal, because in addition to an increase in income resulting from the addition of new means of earning a living, they would be able to secure alternative means of coping with the event that a specific livelihood became no longer viable due to changes in resources and social conditions. From the perspective of people living in vulnerable riparian communities under the dynamic changes of social-ecological systems, achievement of pluriactivity in livelihoods and sustainable management of natural resources contributing to and enabling pluriactivity would not only contribute to improve people's well-being but would also surely contribute to solving the international challenges of ending poverty and disparities, as set out in the SDGs.

8.1.3 The Significance of Transdisciplinary Science

In the least developed countries, initiatives which aim to improve well-being of the socially vulnerable through sustainable use of natural resources have been conducted in various forms by governmental and private organizations including NGOs. However, these efforts have generally tended to take a top-down structure, such that aid organizations, government agencies or researchers specify issues and the design and implement systems and frameworks for tackling the identified issues. There have been insufficient efforts to incorporate the perspective of the vulnerable people into designs of actions that explicitly explore the nature of the real challenges in their daily lives, the barriers to reaching a solution to these challenges, and various autonomous actions that the socially vulnerable are taking in an attempt to solve the challenges by themselves. In order to solve the overarching challenge to end poverty, it is necessary to trust in the multifaceted knowledge sets of the socially vulnerable themselves along with their potential to solve the issues by themselves, and to create frameworks that enable effective supports for autonomous actions by the socially vulnerable. A new approach of transdisciplinary (TD) research to promote co-creation of knowledge with the socially vulnerable people living in poverty would be an effective way of improving their well-being through the sustainable and effective use of the natural resources on which they depend heavily. There is a desperate need to visualize diverse challenges that the socially vulnerable face in their actual daily lives, and to come up with theories and methodologies on co-design of solution-oriented research, co-production of feasible knowledge and tool sets, and dissemination of research outcomes in collaboration with stakeholders (Mauser et al. 2013). Furthermore, constructing TD research that can be applied to the difficult circumstances in the least developed countries can contribute to developing solution-oriented science that deals with complex and wicked problems at the global level.

We have been conducting TD research in close collaboration with diverse stakeholders among people living in Lake Malawi riparian communities, including fishers and fishery product traders, to establish the foundations for collaboration with stakeholders living in poverty in the least developed countries. We have constructed methodologies of TD research with vulnerable people in riparian communities to visualize the challenges faced by these people and demonstrated that innovations of livelihoods (tools) emerged from innovators among people living in poverty in different local communities. If many different tools that are known to be effective in a specific community are accumulated, some of those tools may also function in other communities under similar conditions. Judging which tool will prove of use in a particular community is not easy. Therefore, we came up with the idea of bringing together several viable options through TD research collaborating with vulnerable people to increase the chances that one of these would prove effective in other communities. Innovators in riparian communities as the developers and users of a diverse tools and scientists supporting their activities adopt a TD approach to promote development of appropriate tools. It is the individuals living in poverty and the scientists who co-create and visualize diverse options the community can select and utilize by themselves for pluriactivity. This approach is expected to promote further emergence of autonomous innovations among the socially vulnerable to improve their own well-being.

8.2 Transdisciplinary Research Collaborating with Vulnerable People

8.2.1 Methodologies for Dialogue and Deliberation

What is the nature of TD research that is conducted in close collaboration with the socially vulnerable, especially people living in poverty, to contribute solutions of the challenges faced by people living in local communities for their sustainable livelihoods and better quality of life? TD research based on partnerships with people living in poverty is greatly hindered by the power disparity and paternalism of scientists/experts. Science supporting policies and approaches of government agencies and aid organizations has manifested before the eyes of people living in poverty clad in the garments of external hegemony, encouraging unilateral regulations and management. Dispelling the mistrust of the socially vulnerable toward scientists and experts is not an easy task. This mistrust has originated in the power disparity and paternalism of scientists and experts, who often view stakeholders in local communities as the targets of aid and indoctrination. Their experiences of having met with coercion and having their hopes betrayed by these scientists and experts have caused this deep-seated mistrust to take root. In some cases, habituation to the repeated guidance and aid has encouraged them to adopt a passive attitude of simply waiting for assistance to arrive. The general attitude in dissemination or outreach of scientific knowledge and technologies into such communities has been to view the socially vulnerable as lacking scientific knowledge and literacy. This deep-rooted deficit model held by some scientists and experts has strengthened the attitude of scientists that their role is to guide and educate local stakeholders. In some cases, we also see a similar deficit model among the socially vulnerable, who view the scientists and experts who come to their communities from the outside as knowing nothing about the local situation. It is extremely difficult to overcome the deficit models of both sides and foster mutual trust between scientists/experts on the one hand and the socially vulnerable on the other, facilitating collaboration as equal partners. The deficit models of both sides give rise to significant gaps between the framing of science and the knowledge bases, prioritized values and decision-making systems of local communities. It is also no small feat to fill these gaps and co-create and utilize integrated local environmental knowledge (ILEK) as the basis of decision making by respecting each other's diverse knowledge sets that have been classified variously as scientific, local and daily-life knowledge (Sato 2014a, b, 2016). Furthermore, even if scientifically and socially valid solutions can be found, local communities face a range of social, economic and cultural constraints in translating these into reality. Decision making and actions by the socially vulnerable living in poverty involves particularly strong constraints, and there is a large degree of uncertainty surrounding the effectiveness of solutions in complex social-ecological systems.

Based on our experiences collaborating with the socially vulnerable in Malawi from 2014, we have established a set of theories and methodologies of TD research to visualize innovative tools emerging from the socially vulnerable themselves and challenges facing them through dialogue and deliberation while overcoming above mentioned factors that have impeded TD research in the past. We refer to this methodology as Dialogic Deliberation in Living Spheres (DIDLIS). DIDLIS is a method by which scientists clad in power disparity and paternalism engage in dialogue with the socially vulnerable in an equal partnership, deliberating together from a perspective extremely close to that of the real lives of the vulnerable. The goal is to visualize imminent and important challenges and co-design TD research to contribute to the solution of these challenges. DIDLIS is not simply advocating methods or procedures, but a proposal of a new lens for the scientists endeavoring to collaborate with the socially vulnerable to have a renewed framing of perception without skewed views or biases toward these people. TD scientists are required to hold an attitude that allows them to view the socially vulnerable as a partner of TD research, not the target of aid, as well as understand and respect the values of diverse knowledge and experiences accumulated through their daily lives. Scientists are also needed to understand and trust various autonomous innovations emerging from these people and their potentials to create effective and workable options for solutions to complex challenges. This trust could in turn serve as the basis upon which scientists are convinced that many solutions to diverse global environmental problems may be uncovered not in the laboratory but in the societal practices of people as the main actors. It is also important for scientists to be convinced about the potential of academic innovation created through learning from diverse stakeholders in society and to enjoy such learning processes.

DIDLIS is characterized by such a lens of TD scientists and a range of methods and procedures that alleviate the impact of the power disparity and paternalism of scientists/experts and foster mutual trust. In turn, this change in direction will result in abandonment of deficit models to promote the integration of diverse knowledge systems into ILEK and overcoming the constraints on decision making for the socially vulnerable along with the uncertainty surrounding complex social-ecological systems. First, in order to alleviate the impact of the power disparity and paternalism, dialogue and deliberation is facilitated by having scientists visit to the sites of the livelihood activities of the socially vulnerable in their daily living sphere. Residential researchers and bilateral knowledge translators who are trusted by local stakeholders play important roles by participating and acting as intermediaries in dialogue (Sato 2009, 2014a, 2016). Scientists engaged with local communities in the past wearing a hat of power or hegemony, such as being a part of government missions or enforcement practices of regulations, take special care not to become involved in the dialogue during its initial stages. In order to address the gap brought about by deficit models, scientists and experts make fundamental changes to their attitudes to guide people based on their own knowledge and technologies, and engage in informal dialogue relating to the real challenges faced by the socially vulnerable along with opportunities for solving these. It is important to mobilize adaptive dialogue without a scenario that follows the framing of the stakeholders, and scientists must adopt open-minded and humble attitudes to listen and learn. Iterations of dialogues are essential to foster mutual trust over the long run. Scientists and experts introduce new scientific concepts, ideas, knowledge and technologies into the deliberations in caution while learning from discourses of the socially vulnerable. In order to deal with constraints on the behavioral changes of the socially vulnerable and scientific uncertainty, scientists adopt an approach to collect a diverse range of tools that have already been utilized by the socially vulnerable living in poverty in particular communities with a feasibility for other communities in similar situations, and summarize and visualize these tools in the form of a "Sustainable Development Toolbox" (this approach will be discussed in more detail later). Here, it is also important to demonstrate the values and impacts of individual tools that vulnerable people have already utilized as scientifically as possible from the perspective of the impacts of tools in improving well-being of the socially vulnerable people.

8.2.2 Visualizing Innovations and Challenges

The concept and methodology of DIDLIS came to fruition during trials of TD research in four areas along Lake Malawi (Fig. 8.4). In this preliminary research, we extracted essential challenges for people living in poverty corresponding to the specific circumstances of each community. We also successfully visualized various tools with the potential to improve the quality of life of people living in poverty through pluriactivity in livelihoods and to contribute to the sustainable use of natural

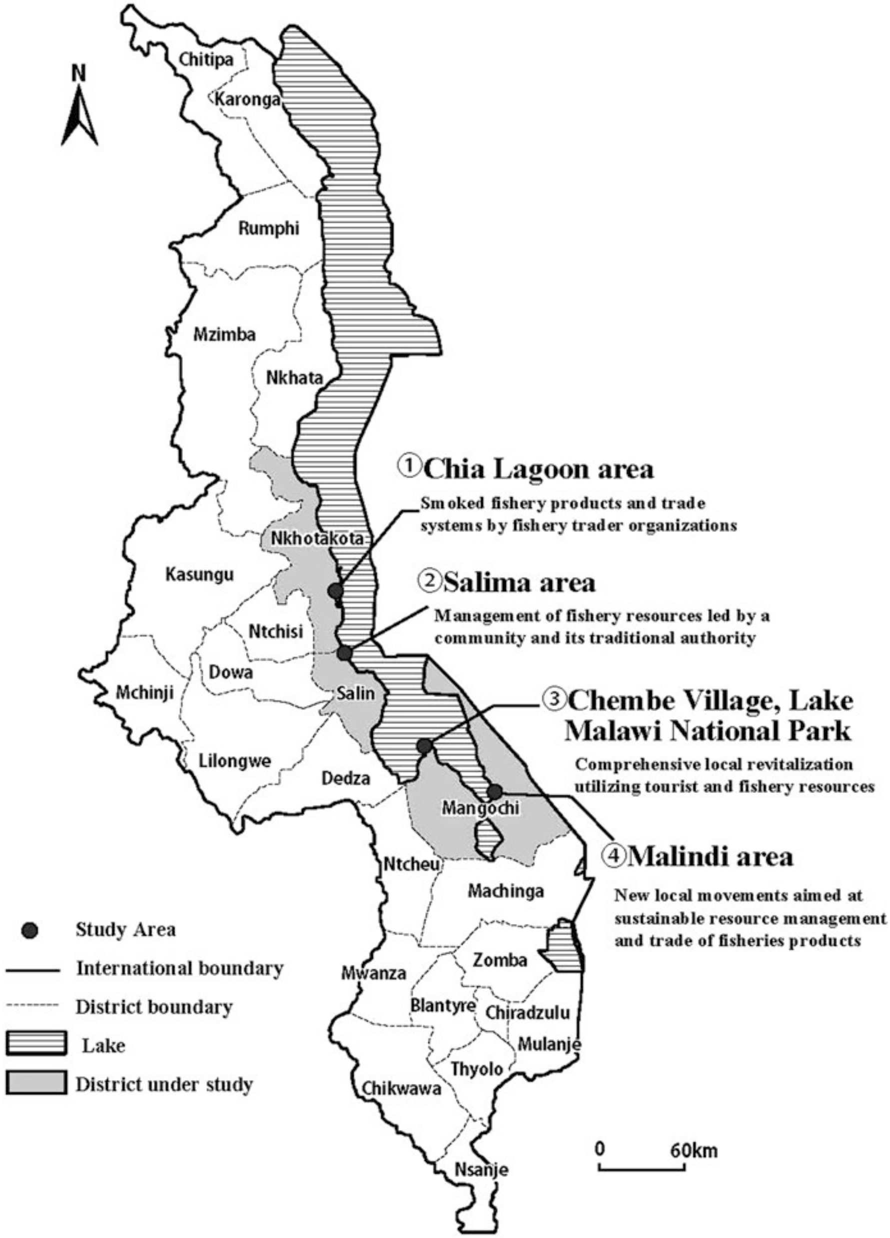


Fig. 8.4 TD research using DIDLIS was conducted at four riparian localities of Lake Malawi. (Original map provided by Azusa Iguchi, modified with permission)

resources. We were also able to locate innovators among the socially vulnerable from whom a variety of innovative tools has emerged. We successfully uncovered a surprising amount of creative and innovative tools among those who had been viewed as vulnerable people in need of aid. In many cases, these innovators acquire the ideas and skills needed to come up with the tools through their own personal networks. Therefore, it became apparent that there is a need to expand these networks of mutual learning with the participation of TD researchers.

In Lake Malawi riparian communities, diverse tools have emerged that help improve well-being of people through the autonomous management of natural resources and pluriactivity in livelihoods. These tools include methods and ideas relevant to the sustainable and effective use of fishery and forest resources, small-scale irrigation for agriculture, small-scale aquaculture and the value-added supply of fisheries products. In the Chia Lagoon area of Nkhotakota district (Fig. 8.4: ①), a fisheries trader association producing high added value smoked fishes using traditional smoking technologies has successfully been running on a continual basis a sales hub called Chia Fish Market. Individual traders have their own customer networks and have successfully put in place "face-to-face supply chains" to provide customers with products according to their preferences through marketing using mobile phones. Also, an enterprising farmer had established a form of pluriactivity in livelihoods that combines small-scale aquaculture with other diverse agricultural products (Fig. 8.5). However, there are challenges regarding sustainable management of fisheries' resources by the fishers themselves, branding with added values to fishery products, and the sustainability of firewood resources for smoking. In Salima area (②), under the leadership of traditional authorities extending over three generations from the 1950s, a system of autonomous fishery resource management led by fishers has been conducted. They have succeeded in maintaining resource stocks by enforcing a seasonal ban of fishing in the vicinity of Mbenji Island, the fishing and

Fig. 8.5 In Nkhotakota area near Chia Lagoon, a small-scale farmer created an innovative approach of pluriactivity combining small-scale aquaculture and production of diverse crops and fruits

spawning ground of Utaka (Scholz and Chimatiro 2004). One challenge is to increase the incentives for resource management through development of value-added processing systems and supply chains linking the efforts for resource management to sustainable development of local communities. In Chembe Village (③) located within Lake Malawi National Park, an autonomous local tour guide association by young villagers has been involved in a range of activities aimed at improving the value within communities of being a tour guide as an occupation based on close collaboration with tourist lodges. Initiatives by a local farmer has been on track to develop technologies of small-scale irrigation using lake water to cultivate commercial crops. Their challenges include putting in place autonomous fishery and forestry resource management systems that coexist with protected areas of the national park and resolving conflicts between the tourism and fishery industries in the village. In the Malindi area (④), an alternating livelihood pattern has emerged under the leadership of traditional authorities in which fishing is conducted during dry season and agriculture in rainy season, reducing fishing pressure during spawning season (rainy season) for the major fisheries resources. Afforestation activities have been carried out with the aim of preventing the degradation of agricultural land and coastal fishing ground by preventing soil erosion. The challenge here is to improve sustainable fisheries resource management by achieving traditional authorities gestate ideas of setting the spawning grounds of the major fisheries species as autonomous underwater protected areas, and to reduce post-harvest losses of local fisheries and agricultural products in the processing and distribution and create added value.

8.2.3 Sustainable Development Toolbox

In order to utilize diverse tools emerging from people living in poverty and apply them to the solution of challenges faced by local communities, it is essential to construct systems that summarize the challenges faced by each individual community, potential impacts that each tool can produce to solve these challenges, and the conditions for these tools to emerge and function. Through such systems, people can choose and use appropriate tools in decision making and actions under their own specific circumstances of each community. Recognizing the effectiveness of a diverse range of methods for managing fisheries resources utilized by fishers in Japan, and taking hints from the "Fisheries Management Toolbox" that was developed to encourage their use in various fishing communities in Japan (Makino et al. 2011), we designed a "Sustainable Development Toolbox" (hereafter, "Toolbox") that can be applied to the immediate challenges in the least developed countries (Fig. 8.6).

This Toolbox organizes the tools that have emerged and are functioning in communities in four localities along Lake Malawi from the perspectives of contributing to the sustainable management of natural resources and pluriactivity in livelihoods, and of improving the quality of life and well-being of people living in

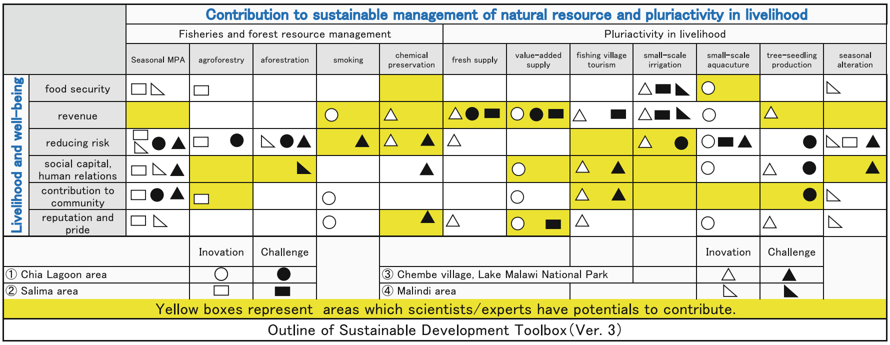


Fig. 8.6 Sustainable development toolbox is created by collecting and organizing innovative tools emerging from people living in poverty to be utilized to deliver effective solutions

poverty. The horizontal axis classifies the qualities of the tools collected so far based on their effects on the resource management and pluriactivity, while the vertical axis organizes their effects upon various aspects of daily life and well-being for people living in poverty. The communities in the four locations are expressed by symbols such as ○ or □, with blank symbols (such as ○) representing tools, and filled symbols (such as ●) representing challenges. The shadowed sections signify the areas for which there is a possibility of proposing potential tools from the perspective of scientists who undertake TD research. With this structure of the toolbox, it is possible to clarify the challenges the people of the riparian communities face along with the nature and location of tools that could be used to solve these challenges.

For example, in the Salima area (marked as □ in Fig. 8.6), remarkably effective and well-managed fishery resource management systems by local fishers are in place, which are improving various aspects of human well-being such as securing food sources, reducing risks, and improving human relations and social capital in the community. However, while a huge amount of effort has been expended in ensuring the sustainable management of fishery resources, a challenge exists that the incentives for doing this are not being fully felt by community members. Possible solutions to this include systems for the fresh supply of fishery products, or to provide added value to fishery products that are produced with appropriate resource management (■). Looking at the Toolbox, we can see that the systems of providing incentives have already been put in place in Chembe Village in Lake Malawi National Park (Δ), and in the Chia Lagoon area (○). The socioeconomic conditions and cultural climates in the latter two localities resemble those of the Salima area. Therefore, by improving some of these tools from other localities, there is a high possibility that they will work well in the Salima area, too. If such value-added supply systems were to gain acceptance and become more widespread, the opportunities of pluriactivity in livelihoods would increase for both communities and households in the Salima area. By using the Toolbox in this way, it should be possible to improve the sustainable management of natural resources and well-being of people through the emergence and utilization of new forms of livelihoods in each area. Current scientist version of the Toolbox described here mainly serves as a database for scientists and experts to examine the nature of tools and the conditions for their effective use. In order for the socially vulnerable people living in poverty on the ground in local communities to use the Toolbox, it would be necessary to distill it into more easily usable/accessible and communicable formats.

8.3 The Impacts of Transdisciplinary Research

8.3.1 Towards the Solution of Societal Challenges

We have endeavored to construct a "Sustainable Development Toolbox" that brings together viable solutions to different challenges facing people living in poverty by collecting and analyzing diverse autonomous innovations in Lake Malawi riparian communities. If this Toolbox can be shared and utilized widely among stakeholders, including the users of natural resources, members of riparian communities, local organizations, government agencies, and NGOs, it would provide important insights not only for the eradication of poverty in Malawi but also for solutions to urgent challenges at the global level. In order to achieve such a broader scale impacts, there is a need to put in place networks connecting people who develop and utilize effective tools, enabling them to mutually exchange ideas and learn (Sato 2015). Scientists and experts who undertake TD research based on trust relationships with the socially vulnerable people would also be important members of such networks. The Toolbox is a "boundary object" that brings together a range of knowledge and technologies, and in order to utilize this device effectively, networks are required to fulfill the role of a "platform" in bringing together relevant parties. Important challenges ahead are to effectively utilize such networks to provide long term support for sustainable development in riparian communities, and to test the Toolbox and accumulated tools, verify their effectiveness, and make improvements to ensure that they become easier to use and more effective.

Endeavors to promote autonomous emergence of tools by people living in poverty in the least developed countries and to achieve sustainable management of natural resources and improvement of wellbeing among people can provide new frameworks for resource management and community development to other least developed countries along with emerging nations that are experiencing widening disparities in wealth. It may be possible to utilize existing organizations and networks as platforms to produce a ripple effect at the international level rooted on the results of our TD research. For example, the World Forum of Fish Harvesters & Fish Workers is currently promoting exchanges and mutual learning with the participation of domestic organizations of small-scale fishers and fishery operators mainly in Asian and African countries. Also, the Farmers' Forum (FAFO) of the International Fund for Agricultural Development (IFAD) is making efforts to facilitate collaboration, exchanges and mutual learning with the participation of national organizations of small-scale farmers and agricultural producers in various countries. If connected with these existing frameworks, it will open up a window to apply the outcomes of our research at the global scale. This will in turn likely mobilize activities emerging from the socially vulnerable people living in poverty at the global level to eradicate poverty and create sustainable societies.

8.3.2 The Academic Impact of Solution-Oriented TD Research

TD research is also a process to bring about innovations in academia along with social impacts (Lang et al. 2012). TD research employing DIDLIS has also given us a range of perspectives and ideas for opening up new horizons in sustainability science. For example, from dialog with stakeholders in the Salima area, it became apparent that the seasonal bans on fishing was originally more to do with safety management over the risks to the lives of fishers due to lightning striking the island, rather than the management of fishery resources. When considering solutions to the challenge related to the sustainable management of natural resources, this finding provides a new insight that the approaches to achieve resource management as a result or a by-product of measures targeting more pressing and urgent issues for local stakeholders (in this case, the safety of fishers) are more feasible and easily acceptable to stakeholders. In another case, Lake Malawi National Park, a World Natural Heritage site, possesses underwater protected areas without effective enforcement mechanisms, and it has been regarded as an example of failure of management of protected areas, a so-called paper park (Abbot and Mace 1999). However, from close dialogue with fishers and detailed analysis of their operating patterns, it became evident that fishers had an unforced fishing pattern that respects the rules and regulations of the national park as much as possible, and that this attitude had been influenced by the less strict enforcement of the rules and regulations resulting in coexistence between the underwater protected areas and fishers (Sato et al. 2008; Sato 2008). The National Park Office seemed to avoid strict enforcement of regulations and gave consideration to avoiding conflicts with fishers, leading to emergence of unforced control of fishing patterns among fishers associated with changes of their perception on the value of the lake and its resources and the attitude of the traditional authority to support coexistence between local communities and the national park (Kada et al. 2002; Sato 2016). Rather than traditional fences and fines regulation and enforcement, this observation proposes new mechanisms of protected area management in which effective management is achieved through social and psychological mechanisms promoting spontaneous behavioral changes among fishers. The last example is the case of an innovator who created and managed innovative supply systems of fresh fish targeting customers from major cities within the country. His first customer had visited the area before as a tourist. Through close dialogue with him, we gained insights into the linkages (nexus) between value-added supply of fisheries products, management and effective use of fishery resources, and domestic tourism. It is likely that a potentially important mechanism is working here as follows. First, tourists from major cities in the country visit this village and recognize the values of fresh fishery products as delicious food. This generates new systems for value-added supply and the prevention of the post-harvest loss of fishery products in the form of the fresh supply of particular fishery products of the customer's favorite based on human networks between villagers and the customers, which in turn improves the purchase price of fish and reduces pressure on fishery resources. This observation opened a potential for highly creative research that sheds light on the synergy between and trade-off in the nexus of the value-added supply of fisheries products, fisheries resource management and domestic tourism.

Through the development of the Toolbox, we have created a framework of TD research to overcome two methodological challenges in sustainability science: scientific uncertainty arising from complex social-ecological systems, and the diverse and complex constraints which emerge when new sustainable options become available for vulnerable people living in poverty to improve their well-being. The processes of developing and improving the Toolbox themselves embody the notion of "science for society" (UNESCO 1999). The points of departure of this process are identification of autonomously emerging tools toward sustainable society improving the livelihoods and quality of life among vulnerable people and extraction of fundamental and solvable challenges facing them through the trust-based dialogue and deliberations (co-design). Then an overall analysis of the scientific and social validity of these autonomous tools summarized in the Toolbox are conducted in collaboration with the innovators among the socially vulnerable, and the mechanisms and conditions for each tool to generate impacts are clarified. At the same time, the research identifies possible (or currently occurring) trade-offs (for example, application of a tool may benefit some stakeholders but at the same time create new socially vulnerable people) and examines measures to mitigate these negative impacts. Amid scientific uncertainty arising from complex social-ecological systems and constraints faced by the socially vulnerable, it is difficult to pinpoint which of the tools will contribute to the solution of challenges in other localities. Therefore, we decided to organize plausible impacts of each tool in terms of resource management and improvement of people's well-being into the format of a Toolbox. This Toolbox is used as a devise for collaboration among diverse stakeholders and scientists to create viable options that are tailored to the conditions of each locality (co-production). The contents of the Toolbox are improved through an adaptive process in which specific actions are designed and trialed in collaboration with people living in poverty and the results monitored and evaluated (dissemination). The iteration of this process helps uncover new tools and challenges, elicits the participation of new innovators and expands the range of applicable tools in riparian communities to allow new forms of actions to emerge. Through the adaptive processes of TD research, trust is fostered between scientists/experts and diverse stakeholders in local communities to promote mutual learning, resulting in emergence of local actions to confront profound and wicked societal challenges.

8.4 Evolution of TD Sciences Collaborating with the Socially Vulnerable

When seeking to confront the complexity of local social-ecological systems, it is clear that there are limitations to solutions based on knowledge and technologies produced in the conventional sciences disconnected from local communities. The solutions with scientific and technological validity are often ineffective for dealing with the complexity of local communities and diverse constraints facing people. However, during the course of TD research in Malawi, we were able to show that it is possible to extract a range of autonomous and innovative tools with a demonstrable impact on the solution of local challenges by adopting an open attitude to the ideas and actions emerging from those who have been regarded as the socially vulnerable. Through this experience, we could reaffirm that people categorized as socially vulnerable are not simply the weak, but with rich knowledge and experience for repelling such labels. We also recognized the importance of scientists being cautious about existence of even more unprivileged people without access to such opportunities to produce innovations for various reasons. The socially vulnerable have been, and will be continuously reproduced.

TD research collaborating with the socially vulnerable provides new paradigms of science aiming to contribute to the solution of diverse contemporary societal challenges with complex structures and backgrounds, for which the conditions and processes to bring about solutions cannot be defined definitively. The forefront of science and technology relating to complex social-ecological systems resides not in laboratories but at the real world of local practices. The most creative and innovative aspects of our TD research are the process to identify those tools demonstrating tangible impacts in communities, clarify the conditions and systems to bring about these impacts in collaboration with local stakeholders, and elaborate these into sharable knowledge by describing them in the universal language of science. In Chap. 4 of this book, such research process is likened to “Drawing a Plan of an Already Built House” using the example of the registration process for Shiretoko World Heritage Site in Japan (Matsuda et al. 2018). With regards to innovations already working in societies (e.g., already built houses), the ideas behind designs, specific contrivances and the conditions for running of systems are examined in collaboration with innovators (e.g., the people who built these houses) and the knowledge is co-produced and shared amongst a broad audience, giving rise to scientific innovations (e.g., new approaches to build houses) together with societal impacts of providing solutions to the challenges (Makino et al. 2009).

TD research carried out in collaboration with the socially vulnerable is bringing about a paradigm shift of science with a potential to contribute to solutions of difficult challenges to eradicate poverty. This was a transformative process to shake up our conceptions and perspectives as scientists and experts. First, we could arrive at a perspective that the socially vulnerable as represented by people living in poverty are understood as equal partners in research and practice rather than the targets of aid and indoctrination. This transformation of perception helped us to foster mutual trust through deep dialogue and sincere deliberation, resulted in fruitful collaboration toward solution of challenges. The TD research collaborating with the socially vulnerable greatly expanded the perspectives of all those who participated, and significantly broaden our horizons for TD research. It also strongly stimulated our scientific curiosity, enabling us as scientists to thoroughly enjoy the process of TD research. The process of TD research that is carried out in collaboration with the socially vulnerable people living in poverty provides unparalleled opportunities for learning and personal development for the scientists endeavoring to be a transdisciplinarian.

References

Abbot JIO, Mace R (1999) Managing protected woodland: fuelwood collection and law enforcement in Lake Malawi National Park. Conserv Biol 13:418–421

Biggs R, Rhode C, Archibald S, Kunene LM, Mutanga SS, Nkuna N, Ocholla PO, Phadima LJ (2015) Strategies for managing complex social-ecological systems in the face of uncertainty: examples from South Africa and beyond. Ecol Soc 20(1):52. https://doi.org/10.5751/ES-07380-200152

Government of Malawi (2002) Malawi state of the environment report. Department of Environmental Affairs, Lilongwe

Government of Malawi (2012a) Malawi growth and development strategy II (MGDS II) 2011–2016. Government of Malawi, Lilongwe

Government of Malawi (2012b) National fisheries policy 2012–2017. Ministry of Agriculture and Food Security, Lilongwe

Government of Malawi (2012c) Integrated household survey 2010–2011. National Statistical Office, Zomba

Kada Y, Nakayama S, Malekano L (2002) Are you sure Mbuna don't taste good? Fish eating culture and environmental problems of Lake Malawi (ムブナはおいしくない?-アフリカ,マラウィ湖の魚食文化と環境問題). In: Miyamoto M, Matsuda M (eds) Social changes in modern Africa – observations on dynamics of language and culture. Jimbun Shoin, Kyoto, pp 260–283 (in Japanese)

Lang DJ, Wiek A, Bergmann M, Stauffacher M, Martens M, Moll P, Swilling M, Thomas CJ (2012) Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustain Sci 7(suppl. 1):25–43. https://doi.org/10.1007/s11625-011-0149-x

Makino M, Matsuda H, Sakurai Y (2009) Expanding fisheries co-management to ecosystem management: a case in the Shiretoko world natural heritage area, Japan. Fishery Policy 33:207–214

Makino M, Hirota M, Machiguchi Y (2011) Study on coastal fishing management using management toolbox – for sea cucumber fishing (管理ツール・ボックスを用いた沿岸漁業管理の考察-ナマコ漁業の場合). Fish Biol Oceanogr Kuroshio 12:25–39 (in Japanese)

Matsuda H, Makino M, Vlachopoulou IE (2018) Drawing plans of a house that already stands: the wisdom of the Shiretoko region, a world heritage site of Japan. Chapter 4 of this volume

Mauser W, Klepper G, Rice M, Schmalzbauer BS, Hackmann H, Leemans R, Moore H (2013) Transdisciplinary global change research: the co-creation of knowledge for sustainability. Curr Opin Environ Sustain 5:420–431. https://doi.org/10.1016/j.cosust.2013.07.001

Salmi P (2005) Rural pluriactivity in livelihoods as a coping strategy in small-scale fisheries. Sociol Rural 45:22–36. https://doi.org/10.1111/j.1467-9523.2005.00288.x

Sato T (2008) Science and society over the local environment-connection between outside knowledge and indigenous knowledge (地域環境をめぐる科学と社会-外来の知識と土着的知識

体系のかかわり). In: Matsunaga S (ed) Environment – culture and policy. Toshindo, Tokyo, pp 159–184 (in Japanese)
Sato T (2009) From knowledge to wisdom – residential research institutions bringing together indigenous and scientific knowledge (知識から智慧へ-土着的知識と科学的知識をつなぐレジデント型研究機関). In: Kito S, Fukunaga M (eds) Environmental ethics. University of Tokyo Press, Tokyo, pp 211–226 (in Japanese)
Sato T (2014a) Integrated local environmental knowledge supporting adaptive governance of local communities. In: Alvares C (ed) Multicultural knowledge and the university. Multiversity India, Mapusa, pp 268–273
Sato T (2014b) Knowledge-generating commons: production, distribution and use of integrated local environmental knowledge (知識を生み出すコモンズ:地域環境知の生産・流通・活用). In: Akimichi T (ed) The thought of commons in Japan. Iwanami Shoten, Tokyo, pp 196–212 (in Japanese)
Sato T (2015) Theory of sustainability science: solution-oriented production of integrated knowledge (サステイナビリティ学の科学論-課題解決に向けた統合知の生産). Environ Res Q 177:52–59 (in Japanese)
Sato T (2016) Field Scientist: the perspective of integrated local environment studies (フィールドサイエンティスト-地域環境学という発想). University of Tokyo Press, Tokyo, 235 pp (in Japanese)
Sato T, Makimoto N, Mwafulirwa D, Mizoiri S (2008) Unforced control of fishing activities as a result of coexistence with underwater protected areas in Lake Malawi National Park, East Africa. Tropics 17:335–342
Scholz U, Chimatiro S (2004) Institutionalizing traditional community-based natural resource management. IK Notes 64:1–4
UNESCO (1999) Declaration on science and the use of scientific knowledge. http://www.unesco.org/science/wcs/eng/declaration_e.htm. Accessed 19 Mar 2017
United Nations Development Programme (2013) Human Development Report 2013. http://www.jp.undp.org/content/dam/tokyo/docs/Publications/HDR/2013/UNDP_Tok_HDR2013Contents_20150603.pdf. Accessed 19 Mar 2017
United Nations General Assembly (2015) Transforming our world: the 2030 Agenda for Sustainable Development. http://www.un.org/ga/search/view_doc.asp?symbol=A/70/L.1. Accessed 19 Mar 2017
World Bank (2015) Poverty overview. http://www.worldbank.org/en/topic/poverty/overview. Accessed 19 Mar 2017

Part III
Processes of Mobilization

Scientific uncertainty and unpredictability surrounding the behavior of complex social-ecological systems make it difficult to set fixed goals and future visions for collaborative actions in local communities. In order to build pathways with shared values to achieve sustainability of local social-ecological systems, we should not assume simple linear processes toward fixed visions of and goals for the future. Instead, we need to assume multiplicities and uncertainties of potential futures in order to design adaptive processes through process of trial and error and mutual learning. Part III examines designs and approaches to achieve adaptive governance of local communities through mutual learning in collaborative processes.

Chapter 9
Adaptive Process Management: Dynamic Actions Toward Sustainable Societies

Taisuke Miyauchi

Abstract As we saw in the previous chapters, in order to create a sustainable local environment, scientists and local citizens need to be interactively involved in solution-orientated knowledge production; furthermore, it is important that they are able to visualize sharable values. Yet, the difficulty is that nature and society are both laden with uncertainties – so, from the outset, answers are not clear to questions such as how to create knowledge and how to create social institutions. Fixed institutions and fixed values may seem to work well for a while, but will, eventually fail to do so. At that point, the dynamics of nature and society need to be recognized, requiring changing to a method that places importance on a process that is constantly on the move. The following five points are the keys to handling such a process: (1) recognize plural values, (2) avoid setting a single goal (prepare multiple goals and multiple institutions), (3) aim for a multifaceted dynamic consensus building (not one where the stakeholders are merely brought together to confirm the unification of opinion), (4) learn collaboratively, and (5) achieve interactive support in an adaptive manner.

9.1 Moving from Institutional Design to Process Design

9.1.1 What Kind of Consultation Method?

I would like to take a suburban forest as an example. Let us suppose that local residents, the local government and a conservation group have decided to take action to restore a forest that is falling into ruin. (The following is a hypothetical case amalgamated from several actual cases that I researched and several actual cases that have been documented). Nearby forest land is already destroyed. Not only have trees been felled, but also the hillside soil has been excavated to create an industrial site. The local government could do nothing but give permission for the work to go ahead

T. Miyauchi (✉)
Hokkaido University, Sapporo, Japan
e-mail: miyauchi@let.hokudai.ac.jp

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_9

(they had several institutions that could suppress such destructive actions but they failed to apply them due to the legal limitation). Needless to say, if the work continued in this way, it was highly likely that the entire forest would be lost. Thus, local residents who sensed the danger decided to protect the forest. Naturally, not all the residents were in agreement, and so, in particular, the core participants who formed a "forest protection group" were those living closest to the forest, within 5 min walking distance. The neighborhood association backed this move, and spoke to the remaining forest landowners (some living locally and others living far away in different towns). Among the members of the forest protection group, one is a semi-expert from the world of forestry, so workshops centered around that person were held to learn about forest conservation and usage. And, from this activity, collaboration with outside conservation groups was made possible, so that the members also got to learn about birds and plants. The environment bureau of the local authority deemed these moves to be good ones, and made it known that the bureau would be prepared to support activities. Some of the forest landowners living locally – hence, also residents – gave permission for their forest parcels to be used by the conservationists. Thus, the bureau came to the conclusion that it would be a good idea to use activity support funds to implement restoration and conservation of the forest together with the forest protection group and the conservation organization. The authorities felt it was desirable to form a council including members from the forest protection group, the conservation group, landowners and neighborhood associations as well as schools and other bodies, to deal with all the forests in the local area. And, to that end, they proposed that they would like to also provide financial assistance to that council. The members of the forest protection group also thought that bringing a diverse range of stakeholders together to restore and conserve the forest was a hugely significant step, so they agreed, and the council was formed. With the founding of the council, restoration and conservation of the local forests were set as the objectives, and the contributing roles of all the different stakeholders were decided.

Up to this point, everything reflected the attributes of an ideal forest conservation scheme as well as cooperative action scheme. And, at the outset, everything did go smoothly. However, it gradually proceeded to take on/reflect problematic aspects.

Firstly, participation by local residents in the forest protection group began to gradually dwindle, leaving the group largely occupied by outsiders who had been drafted in via the conservation organization. Hence, more and more, the actual locals would watch from a distance as these outsiders arrived by car to work enthusiastically to restore the forest. From the outset of the restoration and conservation efforts, there always had been different levels of conviction about participating in the forest protection group among the local residents, so, perhaps, this was to be expected because there was no uniform or shared motive for participating. Some just wanted the forest as a scenic view, others as a place to walk, and yet others who had little interest in the forest but wanted a reason to be involved in a community project, or make friends, etc. The local residents who were truly interested in restoring the forest continued to be active in the group but the rest gradually drifted away.

Meanwhile, the authorities stuck to the council system, and, still further, wanted to see the concrete outcomes, leading to a push for a symposium to be held to publicize the conservation work as a model form of community-based forest restoration. To this point, at some of the council meetings, the authorities guided discussions purely toward how the symposium could be made a success.

The conservation organization had centered its objectives around biodiversity recovery. Yet, the ideas within the conservation organization were not uniform, either. Even within the consensus on biodiversity, there was variation, with some people who placed focus on species, others on ecosystem services, such as the production of firewood, and still others who focused on wildlife.

As for the neighborhood associations, they deemed participation in forest restoration to be good because doing so would help maintain the organizational structure of their associations; however, with the passing of time, they gradually withdrew from activities. The landowners had no real intention of using the land themselves; thus, they were just making the land available free of charge for the local community. In this way, they thought the forest restoration would be good because the wooded areas would be managed. The other stakeholders added to the council (e.g., schools and other such bodies), in the end, did nothing, other than merely attend council gatherings. That concludes the hypothetical case study. But what can we learn from it?

9.1.2 Social Complexities

Bringing various stakeholders to a council table to push ahead with conservation through cooperative efforts is not a bad model. All the principles that led to local residents participating were valid or accepted ones.

So, why would good practice principles and methods fail in this case?

Everyone agreed on the point of forest restoration and conservation. Yet, what do we actually mean by forest restoration? What do we need to bring to the effort in order to do that restoration work? The answers here varied greatly among the stakeholders. More than being differences, we could say that stakeholders emphasized different parts of the issues. So that even when talking about forest restoration, the specifically supposable content will differ, whether it be the utmost desire to put trees first, or to put biodiversity first, or to put the link between forest and people first, or the bonds between human beings.

Yet, that is why a council needs to be formed, and the varied foci will be consulted and discussed. The assumption from the outset was that some stakeholders would have a different focus or emphasis.

The problem was that the council did not reflect the dynamics and opinions in real society. A fixed mechanism like a council has trouble reflecting society. Authorities tend to think that they must treat all citizens fairly. Hence, they formed a council that brought stakeholders together in an atmosphere that was constructed with the assumption that no single group should benefit from the process. Within this, a simplified perspective of society is being reflected. Therefore, the idea of just reaching an agreement in a council as being good is veering toward a simplified way of regarding the tangible elements of society.

How do the simplified image of society and real society differ from one another? Firstly, a simplified society has a clear boundary, within which individuals are gathered as units to make up society or, should I say, within all that, the individuals are divided up into several groups. Whereas, real society is far more complex and is multilayered, where people exist as individuals, but also are in groups, with some groups being clearly defined, while some are informal or obscure groups or networks – in other words, a complex system. One person as an individual may belong to multiple groups and networks (indeed, affiliation or non-affiliation is often vague), and the relationships between groups is complicated as well.

Secondly, the simplified society holds one value, or several values that can be clearly described; whereas, real society is made up from a truly diverse range of values, including some that are fuzzy when it comes to clearly defining them. Thus, so that all sorts of imprecisely or loosely expressed, but multilayered values exist. Multiple values even coexist within each person.

Thirdly, although the simplified society is static, real society is constantly changing. Even though fixed institutions may not change, the opposing small societies made up of all sorts of things are changing daily. The values change as well.

Fourthly, simplified society is assumed to be totally comprehensible whereas real society is uncertain. The society visible to one person may be different from the society as perceived by another person. Comprehending society in its entirety, such as who is connected to who or what kinds of values are in action, is impossible in such a complex system of systems.

Moreover, the formation of a council tends to be a top-down process, and the content it addresses in it is often limited, rather than being generated by or emerging from discussion among the participants.

Research on the nature restoration project at Lake Kasumigaura showed how an established council became ineffective (Tomita 2014). A council was set up for nature restoration in a certain area, and many councilors were openly recruited from among residents. Residents participated in the council because they were deeply concerned about the water environment quality of nearby Lake Kasumigaura. However, discussions in the council were limited to just the project itself – so, for example, issues that the local residents had a strong interest in, such as the problem of water quality for the entire lake or the manipulation of the water level and its relationship to water quality, were deemed to be outside the scope of discussions, and were consequently not raised. This led to the local residents gradually drifting away from the council.

In a case study on nature restoration in Sapporo, Hokkaido, an agreement appeared to have been reached only for it to be overturned at a later date (Hirakawa 2005). In a nature restoration project on the Toyohira River course in Sapporo, the method employed to establish the project was a well thought out one that involved the participation of local citizens. Nevertheless, at the stage where the project plan was agreed, a protest was received from the chair of a nearby neighborhood association, saying that the chair had not been informed about the council. Moreover, after the project was decided, the citizens engaged in the project continued their nature restoration activities, but, amidst those activities, there was an "incident" where a person not participating in the activities was deemed to be "arbitrarily" planting seedlings. Then again, residents of an apartment block next to the river asked for the riverbanks to be mown. Thus, even though it was thought that an agreement had been reached with the open participation of citizens, ultimately deeds by people who were not involved in the agreement managed to overturn the agreement.

9.1.3 Attaching Importance to the Process

Society is complicated and changing dynamically. So, what is required for conservation is not to create a fixed mechanism, such as a council, but, instead, to acknowledge dynamism, and switch over to a method where importance is attached to a constantly fluid process.

What importance can we attach to the process? Firstly, the important issue is not the creation of institutions but, rather, that action should be taken under the assumption that the situation will change. Here, the important thing is to take a flexible stance that will enable us to adjust our mechanisms when the situation changes. Secondly, there are many aspects of society and nature that are incomprehensible, so we must make it a premise of our work that however hard we try we will not be able to comprehend everything (Holling 1978). Thus, we need to be prepared to change the system if an unseen issue emerges. Thirdly, we should guarantee the scope for trial and error. Avoid fixed mechanisms that do not allow for trial and error. To deal with changes in uncertainty, we must prepare mechanisms and environments that enable us to change whenever we have to.

In this way, attaching importance to the process is about emphasizing the course of how change is accommodated. Moreover, it also is about ensuring the adaptability of the process (Folke et al. 2005; Olsson et al. 2006; Miyauchi ed. 2013). So, more than designing institutions, what is required is a changeover to the idea that the process needs to be designed. And, as we are acknowledging that the process will change, we are unable to design such a process in advance. Thus, designing the process is to handle the process skillfully. That said, what are the key points for allowing a process to be handled in that way? Also, what is required to ensure adaptability?

9.2 Five Key Points to Adaptive Process Management

9.2.1 Accept Plural Values

To begin with, the first requirement for adaptively handling the process is maintaining a focus on values.

In terms of the forest case study mentioned at the beginning of this chapter, various values were discernable in forest restoration. These included: value on biodiversity, value on the scenic beauty, value on one's health that is enhanced through the act of restoring the forest, and value on social relations via work on the forest. These kinds of values will sometimes overlap and at times clash.

Values are reflective of society, as well as of the individual. All sorts of things are reflected to form variations of value, including the social position, social class, history, age and gender etc. If we are not aware of these multiple values, they will tend to bring forward conflict. We would be surprised at the difference and try to persuade each other that our value is the correct one. Yet, if we can realize that there exist differences in value and that there are multiple values, then we can respect the mutual differences. To expand further on this, I would say that it is a good idea to assume that each of the values themselves will change. Neither individual values nor overall social values will remain unchanged. Values held by individuals are often numerous. Also it is a good idea to be aware that on occasion certain values come to the fore and then on a different occasion other values come to the fore. The question is whether there is a common purpose that exists or emerges despite a plurality of values.

9.2.2 Multiple Goals and Multiple Institutions

Environmental conservation inherently comes with a bundle of mixed values. So, it is wise to avoid setting a single goal for measures and activities in conservation. For instance, let us say that at the outset all the stakeholders are brought together to discuss the goal of "enhancing the local biodiversity", and to do that they establish a 5-year plan. However, having come together and launched into the plan, some of the stakeholders start to take different issues more seriously – for example, some place more importance on restoring agriculture and others place importance on restoring community relations. If that is the case, then do not attempt to get rid of those factional activities, but instead reset the goal to be multiple goals. A good way to approach this is to find feasible ways to restore the community and restore nature in a broad-speaking and overall manner, including all the factional goals. Hence, set multiple goals to accommodate multiple values. And it does not matter if those goals seem to be mutually contradicting each other.

Likewise, do not force all the responsibilities onto one stakeholder. If there are multiple goals, then have multiple groups take responsibility for them. It is okay for groups to work independent of each other, or, if they want to, to work together. Taking a flexible approach is the important thing.

Having multiple institutions to accommodate such multiple values and multiple goals is also effective. It is often the case that multiple institutions will coexist in the work on conservation. Yamamoto and Tsuka (2013) showed the effectiveness of multiple institutions from a case study of the Tanesashi coastline of Hachinohe in Aomori prefecture. This location found itself overlapped by two institutions, one being a prefectural natural park institution and the other being national scenic spot institution. When it came to restoring the Tanesashi coastline, there was a problem of whether to restore the scenic view of natural grassland and meadows derived from olden times when horses were grazed there, or to restore the Japanese black pine groves that were planted from the 1950s onward. There was no way of saying which form of restoration was correct, but based on several local reasons, the plan to restore grasslands and meadows was adopted. And, at that time, as the institution for that restoration, it was decided to selectively use the national scenic spot one rather than the prefectural natural park one. This is hardly surprising, because, in taking the restoration route locally, the national scenic spot institution was appropriate than the prefectural natural park institution, which would have been dominantly steered by experts. With just a single institution, variable and multiple values are difficult to accommodate. The coexistence of multiple institutions may encourage adaptability.

9.2.3 Adaptive Consensus Building

Amidst the existence of diverse values, there is no correct answer at the outset on what should be done. The only way to move ahead is to discuss what makes good sense within society and then decide. Having discussed and agreed upon what points are appropriate, those “points” are held to be correct (although, provisionally).

Consensus building is a necessary and central process for conservation within plural values. Yet, you should note that consensus building is never a “unification of opinion”. Neither nature nor society is simple enough for a unification of opinion. Indeed, rushing to a majority decision to conclude things is hardly something that can be called consensus building, either. Instead, what is needed is deliberation with shared information (Shinohara 2004).

However, consensus building is not merely a discussion. Consensus building means to discuss ideas to the extent where people mutually consent. Yet, consent is not derived from mere discussion. Trust is also an important factor. For example, an often-seen phenomenon is that if multiple stakeholders, who hold incompatible opinions, are brought together to do some kind of joint task, mutual trust will develop, resulting in concessions on all sides, and the gaining of consensus. Consensus building does not take shape by just finding opportunities to merely talk. It does not emerge from formal discussion. It comes from communication and the physical sharing of experiences. Consensus building is a multi-tiered process undertaken in various situations.

Moreover, I will say that "settling on one opinion" is not on its own a way of consensus building. Matters cannot always be settled with one opinion. It may be that awareness of the problems needs to be spread via multi-tiered communication, so that both those in agreement and those who disagree will increase, which, in fact, is one variation of consensus building (Kuroda 2005). Here, unification of opinion is not visible, but far more interest is being shown in the problem, which in itself makes promotion of the consensus process visible.

Still further, we often see a matter that has been agreed upon being revised again at a later date (Hirakawa 2005). Consensus is really only a consensus at that particular juncture, it can be turned over at a later date – yet again, and further consensus building may be attempted. And, that kind of process of agreement and non-agreement is, in fact, consensus building.

The failed council formation, I raised at the beginning of this chapter, lacks such a dynamic and multifaceted dimension that consensus building ought to fundamentally have. The true essence of consensus building is a process of acceptance based on daily and diverse communication.

9.2.4 Learning

Learning is essential in order to handle the process of conservation. And picking up knowledge from external sources is not the learning I am talking about. Instead, the important thing is for each stakeholder to tackle "learning" on their own. Within the management of the adaptability process, stakeholders must be thinking of the next step to take amidst ongoing changes. Therefore, learning is essential, in order to adapt to change, and, in so doing, find suitable methods and ideas to accommodate those changes.

With regard to this, what should people learn and how should they learn it in order to manage the process? Firstly, stakeholders must start by availing ourselves of a diverse range of knowledge. They are required to learn about scientific facts such as biodiversity, about the institutions and government policies. The pursuit of this learning is not just about gaining knowledge from external sources, it is about reinterpreting and mastering that external knowledge.

Secondly, it is not enough to just focus on external knowledge, more than half of the learning should be focused within the community. Learn about the history of nature in the community, about what relationship people have had with nature in the community, and about the status of environmental capacity in the community. Get some help from experts, walk around the local area, and undertake field studies, hearings and other data collating activities to reexamine what is happening and what has happened in the community. There exist many undiscovered resources in the community. To start with, stakeholders must unearth them, in order to apply the reources to sustainable conservation and activities for the environment. Resources can be nature itself and half-forgotten local knowledge. With such learning, people become capable of sustainably handling the process for conserving the environment.

Thirdly, I cannot emphasize enough just how important it is to use the above kind of learning to build up social networks. The benefits of learning are not merely the contents to be learned, but also the relationships that will form through the learning process. Once stakeholders start conserving the environment, they must realize that entering into various relationships with other stakeholders is a necessity. Likewise, meeting stakeholders with different knowledge and different viewpoints is an opportunity to learn about those differences. Furthermore, they also must recognize that they have to learn about the institutions and mechanisms that will apply to the problems in question.

Learning is something social in essence. It also involves learning about society, and it enables us to rebuild society anew. Social learning is a way of rebuilding new collective memories. It will help us link global values with local values, people with people, and stories with stories.

9.2.5 Support in an Adaptive Way

Various forms of support are needed to carry along the conservation process successfully. Indeed, experience truly shows that support is effective. And, that support can come from offers of specialist knowledge, from external volunteers and from financial backing. Also, it often comes from coordinating support that helps to organize activities and create networks for conservation.

Nevertheless, conversely, it is often reported that support sometimes does not have the intended effect, and may even have a reverse effect. The supporting side may take control of matters in terms of knowledge and methodology, perhaps appropriating the autonomy of the people concerned, with the support side heading in a direction that does not suit the stakeholders, which, in turn, can lead to conflict.

What kind of support is suitable for adaptive process management? There is no set formula that shows the necessary forms of support. What is important is to keep support adaptively changing it as needs require.

The following are some examples of support: (1) provision of knowledge, (2) provision of manpower, (3) support that addresses needs as necessary, (4) support in the shape of introductions that bring people and organizations together, and (5) financial support. Within the adaptive process for conservation, these forms of support will change in accordance with process status and stage. To know what kind of support is necessary at any given time, both supporters and supported must assess the situation, and think carefully about what kind of support suits the situation.

One thing we must be careful about with support is to make sure that it should not be one sided. Experience has taught us that effective support is the kind that is interactive. Teaching global values such as biodiversity is not a form of support. The knowledge and values held by experts should be matched with knowledge and values held in the local community to form Integrated Local Environmental Knowledge, with both sides mutually learning from the other side, and, in some cases, fusing together the values of both sides. And, that kind of reciprocal distribution is the kind of support required in adaptive conservation processes.

For the above to happen, a person or persons who can act as a hub to reciprocally distribute such knowledge is useful. A researcher with the right kind of expertise who lives in the community ("residential researcher") is usually a good candidate for fulfilling this role. The existence of people who can mediate support in an interactive form is the key. And, such people can include visiting researcher, local government officials and members of local community groups.

References

Folke C, Hahn T, Olsson P, Norberg J (2005) Adaptive governance of social-ecological systems. Annu Rev Environ Resour 30:441–473

Hirakawa Z (2005) Preservation of publicness over time within a Citizens's movement: the activities of the Horohira Midori Kaigi and the Horohira Midori Zukuri Group (継続的な市民参加における公共性の担保-ホロヒラみどり会議・ホロヒラみどりづくりの会の6年). J Environ Social 11:160–173 (in Japanese)

Holling CS (ed) (1978) Adaptive environmental assessment and management. Wiley, Chichester

Kuroda S (2005) Consensus building from a disagreement on a river improvement project: the environmental improvement project of Nishino River, Sapporo (河川改修をめぐる不合意からの合意形成--札幌市西野川環境整備事業にかかわるコミュニケーションから). J Environ Sociol 13:158–172 (in Japanese)

Miyauchi T (ed) (2013) Why does environmental conservation fail?(なぜ環境保全はうまくいかないのか). Shinsensha, Tokyo, 348pp (in Japanese)

Olsson P, Gunderson LH, Carpenter SR, Ryan P, Lebel L, Folke C, Holling CS (2006) Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. Ecol Soc 11 (1):18

Shinohara H (2004) Political science for citizens: what is deliberative democracy? (市民の政治学-討議デモクラシーとは何か). Iwanami Shoten, Tokyo, p 210 in Japanese

Tomita R (2014) Environmental ethics for nature regeneration: toward regeneration from restoration (自然再生の環境倫理—復元から再生へ). Showado, Kyoto, p 236 (in Japanese)

Yamamoto S, Tsuka K (2013) Major pillars for deciding and conserving "desirable landscape": Tanesashikaigan in Aomori prefecture as a overlapped "protected area" (「望ましい景観」の決定と保全の主体をめぐって:重複する「保護地域」としての青森県種差海岸). In: Miyauchi T (ed) Why does environmental conservation fail? Shinsensha, Tokyo, pp 122–146

Chapter 10
Social Learning Driven by Collaboration in the Canadian Network of UNESCO Biosphere Reserves

Maureen G. Reed and Paivi Abernethy

Abstract Learning has become a means for achieving adaptive governance and sustainability; however, relatively little attention has been given to learning partnerships of groups spanning spatial scales, governance responsibilities and scales of influence. This chapter documents a multi-scale partnership involving academics, practitioners, and governing bodies associated with Canadian biosphere reserves. Together they worked to improve their sustainability practices through networking and social learning strategies. Initiated in 2011, the partnership involved individual practitioners of 15 biosphere reserves, academic researchers, and the national-level governing bodies of the Man and the Biosphere (MAB) Programme of UNESCO – the Canadian-MAB committee, and the Canadian Commission for UNESCO. We demonstrate how single, double and triple loop learning outcomes were achieved in this multi-level partnership through a platform structured around a social learning and action cycle using highly skilled facilitation. We paid particular attention to three questions: (1) who learns?; (2) what is to be learned?; and (3) how can social learning be accomplished? Over time, experience and trust gained through the partnership encouraged biosphere reserve practitioners, governing agencies, academic researchers and Indigenous partners to engage in peer learning and deepen learning outcomes in favour of sustainability and adaptive governance.

10.1 Introduction

> Building the capacity of individuals, organizations and societies to collaboratively learn through change and uncertainty is fundamental to environment and resource management and sustainability science. (Armitage et al. 2008: 87)

M. G. Reed (✉)
University of Saskatchewan, Saskatoon, SK, Canada
e-mail: m.reed@usask.ca

P. Abernethy
Royal Roads University, Victoria, BC, Canada
e-mail: pkaberne@uwaterloo.ca

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_10

Sustainability challenges are complex, difficult to understand, predict and address. They require adaptive forms of intervention that facilitate dialogue and collaboration among a range of social groups (Berkes 2009). Such intentions are most likely to succeed where opportunities are created for information exchange that help foster shared understandings (Diduck 2010a) and mutual learning (Plummer and Armitage 2010; Crona and Parker 2012). Indeed, deliberation, dialogue and systematic learning through reflection, evaluation and feedback now appear to be significant attributes of good governance for sustainability (Cundill 2010; Wildemeersch 2007; Plummer and Armitage 2010; Berkes 2010; Diduck 2010a). And yet, while learning is valued as a normative goal, much about learning for adaptive governance and sustainability remains poorly understood, particularly as we consider different scales at which social learning might apply.

To date, documented cases of learning in sustainability have focused on smaller-scale case studies, with relatively little attention to partnerships in which social groups span spatial scales, governance responsibilities and scales of influence (for examples, see Armitage et al. 2008). The purpose of this chapter is to document our experience in developing a multi-scale partnership involving academics, practitioners, and governing bodies associated with Canadian biosphere reserves aimed at improving their sustainability practices through networking and social learning strategies. Initiated in 2011, the partnership involved individual practitioners of then 15 biosphere reserves, academic researchers, and the national-level governing bodies of the Man and the Biosphere (MAB) Programme of UNESCO – the Canadian-MAB committee, and the Canadian Commission for UNESCO. Biosphere reserve organizations are dedicated to conservation of biodiversity, sustainable development, and supporting learning on these topics at regional levels and as part of national and international networks.

This chapter begins by explaining questions researchers have addressed with respect to who learns, what is learned, and how social learning can be accomplished (Sect. 10.2). We briefly describe theoretical frameworks from transformative and organizational learning theories we used as lenses by which to understand the extent and depth of social learning observed throughout the study. Key characteristics of the UNESCO biosphere reserve program and the Canadian Biosphere Reserve network are then described (Sect. 10.3). The social learning and action platform we developed in collaboration with the network is presented, with a brief description of specific activities at each stage (Sect. 10.4). We then discuss selected learning outcomes (Sect. 10.5) and draw conclusions about the benefits of the partnership for those participating (Sect. 10.6).

10.2 Key Questions About Multi-level Social Learning

Facilitated platforms for multi-level learning must address three questions: (1) who learns?; (2) what is to be learned?; and (3) how can social learning be accomplished? We provide a selective review of literature that influenced us in developing the partnership structured around these three questions.

10.2.1 Who Learns?

Although researchers still debate whether transformative learning is undertaken by individuals or groups (Wildemeersch 2007; Diduck 2010b; Crona and Parker 2012), Diduck (2010b) has suggested that governance institutions that are adaptive and effective are able to demonstrate learning *at and across* multiple levels of social organizations in order to address conflict, build trust, reconcile diverse views and interests, and develop solutions to problems. Further, he identified five learning levels from the individual to society. We have adapted his classification and considered how these levels and processes apply in our particular case (Table 10.1).

While it is widely agreed that learning can take place at and across all levels, researchers caution about the challenges of setting up platforms for large, heterogeneous groups. For example, Reed et al. (2010) argued that social learning is more likely to occur if groups share similar epistemological beliefs, suggesting a practical limitation on the size of groups. However, limiting mutual learning to specific epistemic communities is not a realistic option if we want to address complex social-ecological issues in an effective and meaningful manner (Brown 2008). Other authors have discussed tensions related to power, interests and attitudes noting that partners within networks have different stakes and the benefits of social learning may not be equally distributed (Wildemeersch 2007; Glasser 2007; Armitage et al. 2008; Cundill 2010). Hence, attention needs to be paid to the various challenges in epistemologically diverse, complex social learning processes. Consequently, in this partnership, we sought to create a deliberate platform for learning with mechanisms to address unequal stakes and power relations among participants.

10.2.2 What Is Social Learning?

We adopted a definition of social learning advanced by Keen et al. (2005: 4) as: “the collective action and reflection that occurs among different individuals and groups as they work to improve the management of human and environmental interrelations.” Educational and organizational theorists have long considered different “depths of learning” referring to whether learning refers to mastering new skills, tasks and procedures (e.g., instrumental or single loop learning), whether it promotes changes in governance and modes of communication (double loop learning) or whether learning leads to a deeper understanding of one’s values or worldview and supports reflection on power dynamics leading to personal or collective empowerment (triple loop learning). We summarize key concepts from transformative and organizational theories we used to help understand the different depths of social learning that might take place in connection with our research partnership (Table 10.2).

The focus on ‘depths of learning,’ as highlighted by the theories mentioned above, and concern for power relations as described earlier suggest that skillful facilitation may be required to guide collaborative processes to ensure that ‘what is

Table 10.1 Learning levels and processes

Learning level	Processes	Application
Individual	Processes through which a person's knowledge, skills, beliefs or behaviours are changed as a result of experience	Individual participants including biosphere reserve practitioners, students, academics, government representatives
Action group *Cohesive, but relatively informal, association of individuals focused on specific objectives and tasks, often with a short lifespan*	Processes by which individual learning outcomes become part of a web of distributed and mutual outcomes in a collection of individuals	The "partnership" which was formed as a community of practice. This included participants listed above
Organization *Like an action group but often with a longer lifespan and more complex mandate, and usually framed by formal membership and institutions*	Processes by which individual or action group learning outcomes are stored in and brought forth from organizational memory, such as routines, practices, procedures, and cultures in the organization	Canadian Biosphere Reserves Association Canadian-MAB committee and the Canadian Commission for UNESCO are separate organizations involved in and influenced by the work of the partnership
Network *An association of organizations that share political, social, economic, environmental and/or cultural interests. May or may not have formal membership and institutional rules*	Processes through which organizational learning outcomes become part of a web of distributed and mutual outcomes on a collection of organizations (and thus effect change in network-level properties)	Canadian Biosphere Reserves Association, Canadian-MAB Committee, Canadian Commission for UNESCO, Academic research partners, Government agencies
Society *Community of people living in a particular region or country having shared customs, organizations, and laws*	Processes by which core societal institutions are modified in response to social and environmental change	Beyond the time frame and scope of this project

Source: Adapted from Diduck (2010b: 202)

being learned' takes place in an equitable manner and to help participants raise more fundamental questions about their values and assumptions in an effort to make transformative change to support sustainability.

10.2.3 How Can Social Learning Be Accomplished?

How, then, might one establish a platform that seeks to pull together participants of different knowledge cultures across multiple levels to foster a broad depth of learning outcomes? Researchers have described "communities of practice" as a concrete approach to facilitate collective or social learning (e.g., Wenger 2003; Brown and Lambert 2013). Learning in a community of practice is not limited to

Table 10.2 Learning theories and learning depths

Theory	Learning "Depths"		
Transformative theory Founding author (s) Mezirow (1994) Examples in Environmental Management: Sinclair et al. (2008)	*Instrumental* provides competence in coping through technical control	*Communicative* helps people negotiate their own meanings, intensions and values	*Emancipatory* provides personal empowerment, enabling critique of inequitable resource sharing and frees the learner from oppressive social relations
Organizational theory Founding author (s) Argyris, and Schon (1978) Examples in Environmental Management: Pahl-Wostl (2009), Plummer and Armitage (2010)	*Single loop* Seeks to improve efficacy through improved skills, actions, strategies, and practices	*Double loop* involves evaluation of, and changes to both instrumental means and more fundamental governing variables. Helps clarify values, question assumptions and improve practice in communications	*Triple-loop* asks if power structures act too much in support of selected and privileged groups or norms. Includes more fundamental questioning of values, knowledge systems, and worldviews. Supports individual and collective empowerment

novices. The practice of a community is dynamic and involves a continuous, reflexive learning process by all participants.

Several researchers have sought to identify the steps by which a community of practice for social learning might be established and evaluated (e.g., Wildemeersch 2007; Cundill 2010). A practical guide to developing a community of practice (Bacsu and Smith 2011) provided the following list of attributes:

1. provide opportunities for regular interaction;
2. allow participation to vary over time;
3. provide public and private spaces to interact;
4. document activities, goals and outputs;
5. enlist a technology champion; and
6. identify the value of the community itself, through structured reflection and evaluation.

We used these ideas to shape the design and discussion of our learning platform.

10.3 The UNESCO Biosphere Program and the Network of Canadian Biosphere Reserves

First established in the mid-1970s under the Man and the Biosphere (MAB) program of the United Nations Education, Scientific, and Cultural Organization (UNESCO), biosphere reserves carry out three functions: promote the conservation of biological and cultural diversity; advance the aims of sustainable development; and provide logistical support for research, learning, and public education (UNESCO 2000). Biosphere reserves contain a core area typically protected under national or sub–national legislation. The core area forms part of a set of zones marking a gradual intensification of resource use as a means to foster understanding of human impacts on ecological and cultural systems. Since their inception, biosphere reserves have been promoted as "living laboratories" or "learning sites" that can help scientists, managers, and more recently, local communities better understand how to achieve conservation of biodiversity and sustainable development (e.g., Batisse 1982; Schultz and Lundholm 2010). They have long been described as representative sites wherein relevant environmental change can be monitored, policies or practices can be tested, and lessons can be learned to inform environmental policy and management practice (Batisse 1982; UNESCO 2007).

Biosphere reserves are also nested within national and international networks. For example, a UNESCO (2005: 2) publication provided the following description:

> Biosphere reserves constitute innovative approaches to governance at multiple levels. Locally, biosphere reserves are a potent tool for social empowerment and planning; nationally, they serve as hubs of learning for replication elsewhere in the country; internationally they provide a means of cooperation with other countries.

Additionally, biosphere reserves are required to address international priorities of the Man and the Biosphere (MAB) program of UNESCO under which they are designated. At present, they are guided by the Seville Strategy and Statutory Framework (1996) and a strategic plan established by MAB approximately once every 10 years. At the time of the partnership, the Madrid Action Plan (2008–2013) was the guiding plan. It stated an intention to "improve capacity of the World Network of Biosphere Reserves (WNBR) with the aim of building strong learning organizations." Additionally, since the Statutory Framework was established, biosphere reserves must be evaluated through a periodic review once every 10 years. However, while metrics for assessing the conservation and sustainable development functions have been established in templates for periodic review, similar metrics for assessing the learning function have not been as clearly articulated (Reed and Egunyu 2013). Furthermore, mechanisms for learning from one biosphere reserve to another or across a network of biosphere reserves have not been formally established.

In Canada, biosphere reserves refer to both geographic areas and to convener organizations. They are designated because of the expressed desire of local communities to work toward sustainability. Residents seeking biosphere reserve status for their region must have it nominated at the local level, endorsed by provincial and national governments, and finally recognized by UNESCO. The Canadian Commission for UNESCO is responsible for administering UN programs in Canada and is advised in its work by the Canadian-MAB committee which is responsible for reviewing nominations for new biosphere reserves, applying the Statutory Framework, overseeing the periodic review process and interpreting higher order directives for delivery by individual biosphere reserves. Locally, biosphere reserves are

Fig. 10.1 The location and designation dates of Canadian BRs 2016

'managed' by community committees or boards responsible for obtaining funds to undertake educational and demonstration projects and provide logistical support for scientific and community-based research. These committees lack regulatory authority and direct management and decision-making powers, but must operate within provincial and federal legislative frameworks and/or work with relevant government agencies in cooperative decision-making forums. Individual reserves typically include several municipalities and interests that extend beyond the boundaries of local jurisdiction.

At the time of the funding application, there were 15 biosphere reserves in Canada (Fig. 10.1). A 16th biosphere reserve joined the network shortly after the work of the partnership began. Funding and staffing levels varied considerably among the biosphere reserves; however, between 2009 and 2012, the federal government provided funds for a staff person in each biosphere reserve and a national Chief Executive Officer and a part-time financial officer. Depending on their respective local context, biosphere reserve practitioners may be directly involved in a range of different kinds of projects, such as protecting forest corridors; helping local businesses introduce sustainable practices; encouraging sustainable food and tourism networks; establishing demonstration projects such as community gardens; introducing curriculum into public schools; serving as field sites for post-secondary courses; helping producers introduce more sustainable farming practices; preparing for and mitigating flooding; developing canoeing, hiking or cycling trails;

developing public education modules relating to local environmental or cultural heritage; providing facilitation for publicly-contentious local issues; supporting or even undertaking research related to conservation, climate change, or social-ecological dynamics. Many activities share commonalities, yet the large distances (over 6,000 km from west to east coast), uneven funding levels, and ecological and cultural differences (including language barriers) have historically impeded the ability of biosphere reserve practitioners to seek help, network, or learn from their counterparts in other parts of the country.

10.4 The Learning and Action Platform

The partnership was launched with a workshop in June 2011. Here, we summarize the process; more details and evaluation information are available in Reed et al. (2014). Although the steps and participants are presented as a table below (Table 10.3), we conceived the process as a collective learning *cycle* as opposed to a linear progression. The cycle we describe *begins* (and ends) with a process of reflection. Reflecting and evaluating the status quo by a practitioner in the field was essential in identifying the need for the project and determining its overall objectives. Each step was driven by a facilitator who provided the necessary mortar to solidify the work of the individual parties throughout the course of the partnership and to address inevitable differences and power dynamics that we anticipated. We used literature in social learning to inform the description of each action step.

10.4.1 Reflecting and Evaluating

Prior to the partnership, the then-CEO realized that like other non-governmental organizations, biosphere reserves were often caught up in a rush to complete project after project, simply to retain funding. He expressed frustration that there was no mechanism to share good practices when successful innovations are introduced or to encourage more widespread adoption. One of his observations was that lessons are not shared, and each biosphere reserve ends up recreating the wheel. Consequently, an opportunity for capacity enhancement across the network is lost, and the ability for biosphere reserves to learn how to be more effective achieving the goals of conservation, sustainable development and public education is diminished. The "learning function," as articulated through the MAB program was severely restricted. It was his critical reflection and 'bird's eye' view of the network as a whole that sparked the desire to secure funds to encourage biosphere reserves to function more as a network than as a series of isolated units. He sought out an academic researcher who had worked in biosphere reserves and served with him on the Canadian-MAB committee.

Table 10.3 The social learning and action cycle

Actions[a]	Partnership actions	Participants and *knowledge cultures/holders* of the partnership
Reflecting and evaluating	Determining the desire for a partnership	Practitioner with *individual* and *local* knowledge
Problem definition Situating and engaging. Identifying key actors and issues. Identifying and accepting different points of view	Write the proposal, set the purpose and objectives	Key Practitioners and researchers with *individual*, *local*, and *specialized* knowledge
Participating in an action	Undertake an Inventory of projects	All practitioners and facilitator with *individual*, *organizational,* and *specialized* knowledge
Translating ideas into action steps. Testing them out.	Determine clusters of activity	
Sharing and communicating Raising awareness, engaging in enquiry and deconstruction. Recognizing, clarifying and challenging worldviews and frames of reference	Articulating and sharing good practices	Practitioners, facilitator, researchers, and policy advisors with *individual*, *local*, *specialized*, and *organizational* knowledge
Integrating and co-creating Developing shared frames of reference	Creating and using a common template for reviewing and showcasing good practices	All participants at all levels, generating *holistic* knowledge
Negotiating and deciding Taking action	Completing professional documentation. Determining what and how to showcase to and beyond the Canadian network. Develop written publications, workshop facilitation and presentations to an international audience	All participants at all levels, generating *holistic* knowledge
Reflecting and evaluating Assessing the degree to which concerns and challenges have been addressed the ways that frames of reference have changed	Questionnaires Interviews Evaluation frameworks Embedding evaluation into project follow-up Reflection through structured workshops	All participants at all levels, generating *holistic* knowledge

[a]Adapted from: Keen et al. (2005), Wildermeersch (2007), Brown (2008), Cundill (2010), Cheng and Sturtevant (2012), and Brown and Lambert (2013)

10.4.2 Problem of Definition

Considering the absence of a networked platform for learning, in 2011, the Canadian Biosphere Reserves Association (CBRA) and Canadian academic researchers formed a research partnership to determine if they could jointly develop a "community of practice" dedicated to collective learning and action through improvements in collective exchange, learning, and networking among Canadian biosphere reserves.

10.4.3 Participating in an Action

Research participants chose participatory action research (Kemmis and McTaggart 2008) because its reflexive nature would ensure that the process could be adapted as it was implemented to meet the changing needs of the research partners. For instance, in the first facilitated workshop, biosphere reserve practitioners, together with the Canadian-MAB committee, Canadian Commission for UNESCO, and academic researchers, undertook a visioning exercise to identify "what best practices do we want to share in the next 3 years?". While practitioners found this exercise very exciting because it acknowledged their hard work and accomplishments, they found it more challenging to identify practices for evaluation because of their limited funding and operational resources. Consequently, biosphere reserve practitioners decided that prior to determining specific project ideas, an inventory of current practices was needed. The project facilitator compiled a database of 430 projects involving Canadian biosphere reserves, using annual reports, strategic plans, websites and direct contact to generate the inventory. The inventory was then used to identify thematic clusters (projects addressing similar issues) to select which projects and practices were most useful for the assessment.

The process of developing the inventory and the inventory itself had two effects: First, it further instilled a sense of pride of accomplishment as biosphere reserve practitioners were able to demonstrate the hard work they did, with data to support them. Second, the inventory helped identify key areas where practitioners could share information about best practices that could be of value for other biosphere reserves. From the inventory, three thematic clusters were identified for further work:

1. Management and governance in sustainable tourism;
2. Land management and ecological goods and services; and
3. Education for sustainable development.

10.4.4 Sharing and Communicating

Each of the three clusters consisted, on average, of five biosphere reserves. Cluster groups focused on their chosen topics from September 2011 to August 2012, investigating practices of their own biosphere reserves. Biosphere reserve managers were given funds to allow them to share their practices in face-to-face meetings within their clusters, meet on SKYPE as necessary, and document their reflections and their practices according to a prescribed template. Although the template was not described as an "evaluation," the questions it posed served this function. Practitioners were then asked to explain the methods of the practice, including identifying partners; mechanisms for coordination and administration; how budgets, communication, and education programs (if relevant) were established; key factors that made it a success; and any evaluation or follow-up following implementation. They were also asked to describe limitations in terms of timing and the number of people involved. Explicit attention was paid to identify lessons learnt from undertaking the practice, how results were documented, and what processes were used to evaluate the outcomes (see Sect. 10.5).

Despite sharing a common vision and similar practices, many biosphere reserves initially found it challenging to communicate and share their practices. For instance, the facilitator observed that some participants were concerned about being perceived as laggards, which made them reluctant to share their views. Others felt they had strong ideas but had been directed by their boards not to invite competition. Careful facilitation and the emergence of leaders from within each group were important factors that helped break the ice, address potential conflicts, and encourage exchange among participants.

10.4.5 Integrating and Co-creating

Each cluster selected a number of cases to present in a written collection of good practices that was distributed prior to the second workshop in September 2012. The collection consisted of summaries of the detailed case studies addressing respective themes and describing issues, project details, challenges and opportunities, benefits, constraints and limitations of the results. The September 2012 workshop was attended by 14 biosphere reserve practitioners, academics, the facilitator, the Canadian-MAB committee, a representative of the Canadian Commission for UNESCO, and a representative from the federal department, Parks Canada Agency. All participants took part in all activities and each cluster presented their good practices to the other participants. Additionally, time was devoted to allow group members within each cluster to reflect on what they learned from participating in the cluster, how they might share the results, and what 'next steps' might be taken to enhance their learning and management effectiveness. The clusters also reflected on the learning experiences within their cluster, on what had been learned from the project as a whole, and examining its strengths and weaknesses, benefits, key elements of success, and recommendations for the next stage. To document additional insights, participants completed a questionnaire that included questions asking them to reflect on what they had learned from participating in the work of the cluster.

10.4.6 Negotiating and Deciding

The second workshop in September 2012 was challenging to host because Federal funding for the Canadian Biosphere Reserves Association and individual biosphere reserves had been cut the previous June. Nevertheless, biosphere reserve practitioners re-committed to the project, stating that they now, more than ever, needed the support of one another to improve their individual practices. Additionally, they re-committed to hosting an international meeting of North American and European Biosphere Reserves (EuroMAB) in Canada in Fall 2013. With this target in mind, biosphere reserve practitioners set to work on how they might be able to translate their results into 'new products' to make them worthy of an international audience. The Canadian Commission for UNESCO offered to convert the good practice collection into a professional report that would be translated into French and English and distributed to international participants (Godmaire et al. 2013).

The 2013 EuroMAB meeting proved pivotal because of its high profile and fixed deadline. It was the first time Canada had ever hosted the bi-annual conference. The theme of the conference was "Engaging Our Communities." One hundred and ninety scientists, policy advisors and biosphere reserve practitioners from 27 European and North American countries attended. It is worth noting that prior to 2013, Canadian practitioners had rarely attended EuroMAB conferences. At this event, however, Canadian biosphere reserve practitioners from 15 biosphere reserves, the partnership facilitator, Dr. Reed, and other partners in the research partnership led a half-day plenary presentation and workshop about what they had learned over the past 2 years. This included information about specific practices within biosphere reserves, how they undertook systematic evaluation, and ideas for transferring and applying lessons learnt. Canadian biosphere reserve practitioners also led many of the subsequent sessions (from 3 h to 1.5 days) to share their proven good practices and recently-adopted networking strategies. With this event, Canadian practitioners went from being passive bystanders to leaders in the broader international MAB network.

10.4.7 Reflecting and Evaluating

Assessment was an on-going function of the partnership. Questionnaires and interviews were conducted at the outset of the project to determine a baseline of practice against which future practice could be compared. The results from the first round were shared in a "plain (non-academic) language" report and then presented verbally at the second workshop. Two subsequent evaluations were undertaken – at the mid-point of the funding and at the end. Academic participants completed two additional written "plain language" reports about the academic findings to all participants to share overall findings and solicit feedback. Furthermore, the principal investigator made a verbal presentation at the EuroMAB meeting in October 2013 and at the annual general meeting of the Canadian Biosphere Reserves Association in 2014. During the partnership, a new priority – working with Indigenous peoples – emerged. This priority came from critical reflection on the role of biosphere reserves in Canadian sustainability practices, both within individual organizations and within the governing bodies. As explained in the next section, this reflection, then led to more explicit inclusion of Indigenous partners who facilitated on-going dialogue, exploration, and action for the inclusion of Indigenous peoples and knowledge in the work of biosphere reserves.

10.5 Learning Outcomes

Through this project, several specific learning outcomes were accomplished; a few of which we highlight in this Section. Most common learning outcomes came from the sharing of practices that were then adopted by other biosphere reserves in the network. These outcomes can be classified as "instrumental" or "single loop" learning (Table 10.2) because they are associated with improving specific knowledge or skills necessary to improve technical competence. For example, the campaign "Amazing Places" was first established in Fundy Biosphere Reserve in New Brunswick (Godmaire et al. 2013). This campaign is both an educational and tourism campaign involving a combined interactive web, cell phone, and brochure application that was designed to allow virtual and in-person visitors to take an interpretive hike in the region. The purpose was not simply to enhance tourism and local economic benefits but it sought to educate local people and visitors alike about the natural and cultural heritage of the area. Its success encouraged four other biosphere reserves to seek funding to take up this initiative, and has since become a national initiative. Other educational initiatives of the project gained also widespread appeal, such as a new secondary school course on "sustainability studies", approved by the School District at Clayoquot Sound and involving Indigenous peoples, scientists, and local citizens in its delivery. The course became a model for other biosphere reserves seeking to promote sustainability in their regions.

Double loop learning, involving changes in negotiated intentions, procedures and governance processes (Table 10.2), also emerged from within the partnership but from a different level. Since 1995, the MAB programme has required that all biosphere reserves be subject to a periodic review of practice once every 10 years. Since the majority of Canadian biosphere reserves were less than 10 years old at the time of the partnership, only a few had actually been reviewed and a clear template to guide management of the review process had not yet been developed. Biosphere reserve practitioners found the review processes unclear and overwhelming. To support both the "oversight bodies" and the "practitioners", in 2011–12, the primary investigator and a graduate student used a participatory approach to undertake a systematic assessment of the periodic review process of biosphere reserves in Canada (Egunyu and Reed 2012; Reed and Egunyu 2013). The Canadian-MAB committee used the findings to restructure the process and adopted an evaluation template to comply with the international requirements, engaging the partnership in the process. The value of the partnership was the collaborative development of a ready platform by which practitioners on the ground could meet and discuss with members of the Canadian-MAB committee and Canadian Commission for UNESCO.

The initial work on governance (that demonstrated double loop learning at multiple levels) also laid the foundation for triple loop learning (Table 10.2). As this type of learning involves deeper reflection to encourage transformation of relationships, it is not surprising that triple loop learning outcomes have taken longer to surface and are part of an on-going set of priorities. Detailed assessment of this outcome is not possible yet, but some glimmers of activity are evident. Engaging Indigenous peoples in biosphere reserve work is an example of such triple loop learning. In Canada, longstanding treaties and contemporary agreements between the Government of Canada and its Indigenous people specify rights and responsibilities to lands and resources between specific Indigenous peoples and provincial, territorial and/or federal governments, which makes the engagement of Indigenous people in Canada a vital part of fair and effective natural resource management efforts. Yet, Indigenous peoples are seldom active partners in Canadian biosphere reserve organizations, despite the international guiding documents for biosphere reserves that have long encouraged biosphere reserves to include traditional, local and Indigenous communities (e.g., UNESCO 2008) and the United Nations Declaration on the Rights of Indigenous Peoples (2007).

Public discussion of past injustices and present rights and responsibilities involving Indigenous peoples is very sensitive in Canada. Engaging with Indigenous peoples requires an acknowledgement of colonial practices that have been (and continue to be) rooted in racist ideologies and a fundamental re-thinking about how to build respectful and enduring governance relationships that bring together settler and Indigenous peoples, knowledge and ways of knowing. As the work of the partnership unfolded, it became clear that the capacity of Canadian biosphere reserves to work directly with Indigenous peoples was limited. While biosphere reserve practitioners in Canada realize that they must work more effectively with Indigenous partners when pursuing a sustainability agenda, few gave this agenda a high priority. For instance, in a survey administered in 2011, biosphere reserve practitioners reported that Indigenous organizations had participated in the events of eight biosphere reserves and had participated in joint projects with seven. But only three of the 15 Canadian biosphere reserves indicated that they maintained communication with Indigenous organizations about their activities and only two reported having Indigenous representatives on their management boards. The one notable exception being Clayoquot Sound Biosphere Reserve which has their governing board co-chaired by an Indigenous leader and a non-Indigenous leader. Furthermore, their board is composed of members from the Indigenous peoples and settler communities in the region. However, this arrangement has deep roots in the historical development in the area and is a result of years of hard work and trust building. Most other biosphere reserves had historically had very little engagement with

Indigenous peoples, despite being located in regions with relatively high Indigenous populations.

The internal trust–building within the partnership allowed participants to bring forward this type of challenge that otherwise might remain ignored. During the partnership, new initiatives began to take root. For instance, in 2012, the Canadian-MAB committee created a seat for an Indigenous representative, signaling that this would be a priority for all biosphere reserves. At the 2013 EuroMAB meeting, a Working Group on Indigenous peoples was established, comprised of biosphere reserves from Canada and Europe. This Working Group seeks to raise awareness and encourage inclusion of Indigenous peoples and Indigenous knowledge in the partnerships and governance of the biosphere reserves. In 2014, members of the Working Group facilitated a short workshop to the Canadian Association. Consequently, the Association chose to use the remaining partnership funds to allow interested biosphere reserve representatives to attend a 2-day workshop at Clayoquot Sound and learn about how Indigenous people work within that biosphere reserve.

An example of the triple-loop learning effect beyond the partnership timeframe could at be the 2016 annual meeting of biosphere reserves. Here, a full meeting was dedicated to a talking circle wherein every biosphere reserve gave a "status report", regardless of whether they worked with Indigenous peoples or not. Three Indigenous representatives, including one Elder, facilitated the circle. The Working Group was renamed a Working Circle and all biosphere reserve organizations were invited to participate in its on-going work. The purpose was not to identify leaders and laggards, but rather, to allow a space where people could begin a dialogue, ask direct questions, brainstorm ideas, and learn from Indigenous partners who sought to support greater inclusion. The partnership laid the foundation for more in-depth learning and helped build trust and momentum to confront the on-going challenges.

Triple-loop learning takes a long time and may not give rise to concrete or easily measured outcomes. However, the following examples suggest that more transformative learning has been taking place across the network. Much of this reflection and action was initiated as practitioners were able to learn from one another through the research partnership. In 2010, one of the older biosphere reserves that had received a long set of recommendations following its periodic review. During the next 4 years, the organization dissolved its governance structure and spent time building relationships with Indigenous partners who then formed part of the new governance system. Similarly, in 2013, one of the newer biosphere reserves provided its own funds to ensure that one of their Indigenous board members participated at the EuroMAB meeting, making visible their commitment to inclusion. In 2014, members of an Indigenous organization came to the annual meeting and the workshop at Clayoquot Sound to declare their interests in becoming a biosphere reserve. They asked a lot of questions as they were trying to determine if the network would welcome their participation. As a result, their region became Canada's first biosphere reserve to be established solely from the impetus of Indigenous people. As these activities were taking place, pre-existing biosphere reserves biosphere reserves without previous experience working with Indigenous people started to learn from others' experience and to reach out to their Indigenous neighbors, identifying common interests and working on joint projects. Today, about nine of the 18 biosphere reserves have on-going relationships with Indigenous peoples. Five have involved them directly in local governance.

These efforts demonstrate a movement towards transformative or triple-loop learning because they require changes in routines, governance processes and ways of knowing, doing and learning across multiple levels. Working with Indigenous partners respectfully involves un-learning previously-held assumptions about one's worldview and re-learning approaches for respectful knowledge-sharing, and working together. In March 2016, Indigenous and settler Canadians literally stood together in opposition to elements of the proposed international Lima Action Plan and consequently, were invited by the international MAB committee to suggest revisions before its final adoption. Many of the recommended revisions were indeed adopted prior to finalization of the new Action Plan that will now guide the international program until 2025. While these actions do not suggest that all biosphere reserves in Canada or the governing bodies have radically changed their practices, they do indicate that a set of triple-loop learning outcomes has infused the network at multiple scales – from individual members to international partners.

10.6 Conclusions

In this chapter, we demonstrated that social learning can take place across a large and diverse multi-level network through a deliberate, facilitated and structured platform. We explained how we formed a platform that allowed learning to take place among diverse individuals and organizations operating at different levels of decision-making. Developing a platform based on a learning and action cycle allowed us to use reflections to deepen learning outcomes – encouraging instrumental, communicative, and transformative outcomes. Specific learning outcomes included the broader adoption of pre-existing practices as well as the generation of new ideas (e.g., “Amazing Places”), products (e.g., curricula, videos), tools (e.g., web applications, charters), and skills (e.g., facilitation, structured evaluation) that are now moving across the national and international networks (often available in both English and French on the Internet). The partnership improved alignment of local activities with international strategic priorities and co-created usable knowledge for policy audiences (e.g., review of processes for periodic review). Since hosting EuroMAB in 2013, Canada strengthened its relationships within the national and international MAB network. From 2014 to the present, based on their contributions to Canadian programs for UNESCO, the Canadian Commission for UNESCO has invited representatives of all Canadian BRs to participate annually in its annual general meetings, strengthen their association with UNESCO, and to showcase their work across broader UNESCO programs.

We found that social learning across a multi-level partnership does not just ‘happen’ smoothly and democratically by simply bringing people together but requires systematic approaches and structured facilitation. The social learning processes within the partnership were facilitated by financial support (e.g. by making funds available for face-to-face meetings and workshops), knowledge support (e.g. by writing lay-language reports and providing oral presentations), and process support (e.g. by explicitly hiring an experienced bilingual facilitator, who spoke both French and English; had higher academic education in natural and social sciences, including a degree in environmental education; and with earlier work experience both as a researcher and as a practitioner). Like all collaborative work, this project was not free from sociocultural, economic, or epistemological differences. By careful facilitation and remaining focused on the three questions: "who is to learn?", "what is to be learned?" and "how is learning to be accomplished?", we created safe platform for social learning that proved to be key to achieving single, double and triple-loop learning outcomes (including change in knowledge, skills, behaviors, structures, beliefs and worldviews) at multiple scales across the partnership (Reed and Abernethy 2016).

Throughout the partnership, attention to who was involved, what was being learned and how learning took place was an on-going requirement, to both deepen learning outcomes and ensure they became embedded in practice. Arguably, the efforts to engage Indigenous peoples and knowledge represent the beginning of transformative or triple-loop learning. This is a process that likely will take a generation or more to realize, but is more likely to transform the knowledge systems and structures by which biosphere reserves are conceived and governed. Experience through the partnership of building trust and realizing more immediate and "shallow" learning outcomes allowed for the introduction of deeper learning about the more contentious issues surrounding Indigenous-settler relations. Although the formal funding for the partnership has ended, the principal investigator continues to work with the network to support on-going learning on key issues, particularly engagement with Indigenous peoples. Hence, we believe the partnership represented the type of community envisioned by Wenger when he suggested:

> As a locus of engagement in action, interpersonal relations, shared knowledge, and negotiation of enterprises, such communities [of practice] hold the key to real transformation – the kind that has real effects on people's lives. (Wenger 1998: 85)

For biosphere reserves, such a community of practice involving peer learning and sharing across a multi-level platform has also supported them to become the models of sustainable development to which they aspire.

References

Argyris C, Schon DA (1978) Organizational learning: a theory of action perspective. Addison-Wesley Publishing Company, Reading

Armitage D, Marschke M, Plummer R (2008) Adaptive co-management and the paradox of learning. Glob Environ Chang 18:86–98

Bacsu J, Smith FM (2011) Innovations in knowledge translation [electronic resource]: the SPHERU KT casebook. Saskatchewan Population Health and Evaluation Research Unit, University of Saskatchewan, Saskatoon

Batisse M (1982) The biosphere reserve: a tool for environmental conservation and management. Environ Conserv 9:101–111

Berkes F (2009) Evolution of co-management: the role of knowledge generation, bridging organizations and social learning. J Environ Manag 90:1692–1702

Berkes F (2010) Devolution of environment and resources governance: trends and future. Environ Conserv 37:489–500

Brown V (2008) Collective decision-making bridging public health, sustainability, governance, and environmental management. In: Soskolne CL (ed) Sustaining life on earth: environmental and human health through global governance. Lexington Books, Latham, pp 139–154

Brown B, Lambert J (2013) Collective learning for transformational change: a guide to collaborative action. Routledge, London/New York

Cheng AS, Sturtevant VE (2012) A framework for assessing collaborative capacity in community-based public forest management. Environ Manag 49:675–689

Crona BI, Parker JN (2012) Learning in support of governance: theories, methods, and a framework to assess how bridging organizations contribute to adaptive resource governance. Ecol Soc 17:32. https://doi.org/10.5751/ES-04534-170132

Cundill G (2010) Monitoring social learning processes in adaptive comanagement: three case studies from South Africa. Ecol Soc 15:28 http://www.ecologyandsociety.org/vol15/iss3/art28/

Diduck AP (2010a) Incorporating participatory approaches and social learning. In: Mitchell B (ed) Resource and environmental management in Canada: addressing conflict and uncertainty, 4th edn. Oxford University Press, Toronto, pp 495–525

Diduck AP (2010b) The learning dimension of adaptive capacity: untangling the multi-level connections. In: Armitage D, Plummer R (eds) Adaptive capacity: building environmental governance in an age of uncertainty. Springer, Heidelberg, pp 199–221

Egunyu F, Reed MG (2012) Learning from the periodic reviews of biosphere reserves in Canada. Report to Canada-MAB, April. University of Saskatchewan, Saskatoon. Available from the authors

Glasser H (2007) Minding the gap: the role of social learning in linking our stated desire for a more sustainable world to our everyday actions and policies. In: Wals AEJ (ed) Social learning: towards a sustainable world. Wageningen Academic Publishers, Wageningen, pp 35–61

Godmaire H, Reed MG, Potvin D, Canadian Biosphere Reserves (2013) Learning from each other: proven good practices in Canadian biosphere reserves. Canadian Commission for UNESCO, Ottawa

Keen M, Brown VA, Dyball R (eds) (2005) Social learning in environmental management: towards a sustainable future. Earthscan, London

Kemmis S, McTaggart R (2008) Participatory action research: communicative action and the public sphere. In: Denzin N, Lincoln Y (eds) Strategies of qualitative inquiry, 3rd edn. Sage, Los Angeles, pp 271–330

Mezirow J (1994) Understanding transformation theory. Adult Educ Q 44:222–232

Pahl-Wostl C (2009) A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. Glob Environ Chang 19:354–365

Plummer R, Armitage D (2010) Integrating perspectives on adaptive capacity and environmental governance. In: Armitage D, Plummer R (eds) Adaptive capacity and environmental governance. Springer, Berlin, pp 1–22

Reed MG, Abernethy P (2016) In review. Knowledge co-production and use in an action research partnership: scaling and extending integrated local environmental knowledge among biosphere reserve practitioners in Canada. Submitted to: Soc Nat Res

Reed MG, Egunyu F (2013) Management effectiveness in UNESCO biosphere reserves: learning from Canadian periodic reviews. Environ Sci Pol 25:107–117

Reed MS, Evely AC, Cundill G, Fazey I, Glass J, Laing A, Newig J, Parrish B, Prell C, Raymond C, Stringer LC (2010) What is social learning? Ecol Soc 15:r1 http://www.ecologyandsociety.org/vol15/iss4/resp1/

Reed MG, Godmaire H, Abernethy P, Guertin MA (2014) Building a community of practice for sustainability: strengthening learning and collective action of Canadian Biosphere Reserves through a national partnership. J Environ Manag 145:230–239

Schultz L, Lundholm C (2010) Learning for resilience? Exploring learning opportunities in BRs. Environ Educ Res 16:645–663

Sinclair AJ, Diduck AP, Fitzpatrick PJ (2008) Conceptualizing learning for sustainability through environmental assessment: critical reflections on 15 years of research. Environ Impact Assess Rev 28:415–522

UNESCO [United Nations Education, Scientific and Cultural Organization] (1996) Biosphere reserves: the Seville strategy and the statutory framework of the world network. UNESCO, Paris. http://unesdoc.unesco.org/images/0010/001038/

UNESCO [United Nations Education, Scientific and Cultural Organization] (2000) Solving the puzzle: the ecosystem approach and biosphere reserves. UNESCO, Paris

UNESCO [United Nations Education, Scientific and Cultural Organization] (2005) Biosphere reserves: benefits and opportunities. UNESCO, Paris

UNESCO [United Nations Education, Scientific and Cultural Organization] (2007) 3rd World Congress of Biosphere Reserves: biosphere futures, UNESCO biosphere reserves for sustainable development. Background paper to the Palacio Municipal de Congresos, Madrid, SC–08/CONF.401/5, Paris, October 25

UNESCO [United Nations Education, Scientific and Cultural Organization] (2008) Madrid action plan for biosphere reserves 2008–2013. UNESCO, Paris

United Nations Declaration on the Rights of Indigenous Peoples (2007) United Nations: Paris. Available at: https://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf

Wenger E (1998) Communities of practice: learning, meaning, and identity. Cambridge University Press, Cambridge

Wenger E (2003) Communities of practice and social learning system. In: Nicolini D, Gheradi S, Yanow DA (eds) Knowing in organizations: a practice-based approach. M.E. Sharpe, New York/London, pp 76–99

Wildemeersch D (2007) Social learning revisited: lessons learned from north and south. In: Wals AEJ (ed) Social learning: towards a sustainable world. Wageningen Academic Publishers, Wageningen, pp 99–116

Chapter 11
Creating Platforms for Capacity Building in Rural Communities: Noto Peninsula, Japan and Ifugao, the Philippines

Koji Nakamura and Kenji Kitamura

Abstract Approximately 40–50% of Japan's total land area is made up of satoyama (areas between mountain foothills and arable flat lands), where people have engaged in agricultural and forestry work since ancient times. Human activities have played a large part in shaping the natural environments of satoyama, giving rise to ecosystem services and enriching the lives of those who live there (Takeuchi, Ecol Res 25:891–897, 2010; Duraiappah et al. Satoyama–Satoumi ecosystems and human Well-being: socio-ecological production landscapes of Japan. United Nations University Press, Tokyo, 2012). However, in recent years, depopulation coupled with an increasingly low birth rate and aging populations in areas with satoyama has led to more and more agricultural land and afforestation areas being left untended. This in turn has led to the degradation of landscapes and ecosystem services such as production, environmental control and inherited traditional cultures, and in some cases rural settlements are collapsing as a result. In order to break this vicious cycle of the deterioration of satoyama environments, securing suitable human resources is vital. This requires a form of revitalized nature, which is sustained through the activities of humans to encourage regional regeneration and sustainable development, despite the atrophy of local communities. However, while nobody would argue against the importance of human resources of this kind, putting in place the frameworks necessary for developing these human resources is no easy matter. This chapter discusses the frameworks that have been put in place for training human resources who are responsible for bringing about regional regeneration and reforms in satoyama environments located on the Noto Peninsula, as well as the processes by which these have been put into practice. In addition, this chapter introduces trials that

K. Nakamura (✉)
Kanazawa University, Kanazawa, Japan

Ishikawa Prefectural Museum of Natural History, Kanazawa, Japan
e-mail: kojink@staff.kanazawa-u.ac.jp

K. Kitamura
Kanazawa University, Suzu, Japan

Research Institute for Humanity and Nature, Kyoto, Japan
e-mail: kenjikm@staff.kanazawa-u.ac.jp

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_11

have been made to utilize the know-how from Noto in developing human resources for rice terraces in Ifugao, the Philippines.

11.1 Background

11.1.1 Issues at Global and National Scales

As part of the fight to tackle global environmental deterioration in recent years, the United Nations has held Earth Summits on three separate occasions since 1992, as well as meetings of the Conference of the Parties to the Convention on Biological Diversity (CBD-COP) in alternate years. During the Tenth Meeting of the Conference of the Parties to the Convention on Biological Diversity (COP10), held in 2010 in Nagoya City, Aichi Prefecture, Japan, the International Partnership for the Satoyama Initiative (IPSI) was launched. This is a network based on the concept of Japan's satoyama, which brings together 'satoyama' from regions throughout the world to oppose large scale development work that is taking place in various areas and to maintain and promote sustainable agriculture. While at the global level large-scale development work and population explosions are serious issues, many counties such as the Republic of Korea and China are also predicted to suffer in the future from depopulation coupled with an increasingly low birth rate and aging populations. No more so is this the case than in Japan, where the effects of population aging and depopulation are already being felt. The aim of IPSI is to put into practice methods for dealing with these issues based on the concepts of satoyama and satoumi, and to contribute to their resolution not only within Japan, but the world as a whole. Satoyama and satoumi are Japanese concepts with long-standing traditions associated with land (satoyama) and more recently coastal (satoumi; Yanagi 2013) management practice.

In addition, the Japan Satoyama Satoumi Assessment (JSSA) was implemented from 2006 to 2010 as a Sub-Global Assessment (SGA) of the Millennium Ecosystem Assessment (MA) run by the United Nations from 2001 to 2005, thus applying the methods of MA to Japan's satoyama and satoumi. The indication of the historical transformations which have taken place to satoyama and satoumi along with current assessments and future scenarios plays an important part in setting guidelines for the necessity and directionality for developing human resources with the goal of achieving the sustainable development of satoyama and satoumi. Over the course of discussions around the JSSA, a new term was coined, namely "socio-ecological production landscapes and seascapes" (SEPLS), which helps to specifically highlight the productive capacity of satoyama and satoumi, as well as the important social and ecological components that contribute to their resilience. This descriptive and inclusive term also helps to communicate satoyama outside of Japan and has been used by the Satoyama Initiative to refer to examples in other parts of the world where landscapes and land uses have been shaped and maintained in a broad variety of different ways by harmonious interactions between people and the nature they

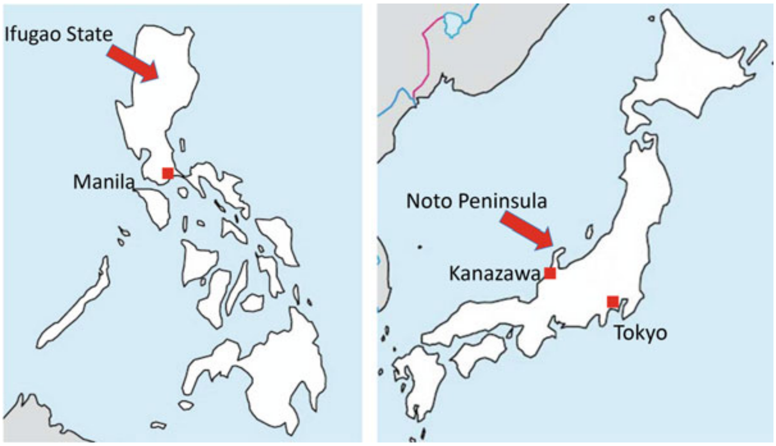


Fig. 11.1 Regions in Japan and the Philippines where human resource training activities have taken place. Left: The Philippines (Ifugao State and 4 municipalities); Right: Japan (Kanazawa, Noto Peninsula)

inhabit (IPSI Secretariat 2013). In the case of JSSA, analysis in Japan was conducted at the National level and in five demarked regions (called clusters), and national reports along with individual reports for the five clusters were published based on the results.

In the Hokushinetsu Cluster, to which Noto belongs, it became apparent that while on the one hand water resource management systems had been systematized through the development of irrigation facilities, on the other hand the small reservoirs that had played an important role in satoyama areas, which includes cultural values, were in a state of increasing deterioration and abandonment (Japan Satoyama Satoumi Assessment (JSSA) – Hokushinetsu Cluster 2010). JSSA succeeded in highlighting problems facing satoyama from a global perspective and indicating steps that could be taken to remedy these problems, thus playing a major role in the foundation of IPSI. In addition, it made it possible to gain an accurate grasp of the problems facing satoyama in Japan and the Philippines, and as will be discussed later in this chapter, enabled the know-how on the development of human resources gained at Noto to be transferred to Ifugao (Fig. 11.1).

The Food and Agriculture Organization (FAO) of the United Nations administers a list of “Globally Important Agricultural Heritage Systems (GIAHS).” This system came about as a result of reflection on how an overemphasis on agricultural productivity that utilizes large quantities of chemical fertilizers, synthetic insecticides and energy has caused numerous environmental problems throughout the world, such as the destruction of forests or water pollution, and that it is leading to the disappearance of local endemic cultures, landscapes and biodiversity. Therefore, GIAHS is highly correlated with satoyama. The aims of GIAHS are to put in place “local systems” consisting of the integrated maintenance and conservation of those things which are disappearing through the course of modernization, such as traditional agricultural methods and practices. These traditional methods and practices utilize the specificities of local environments, land use that serves to protect biodiversity, rural cultures and landscapes, and to hand these down to ensuing generations.

11.1.2 Issues Within Ishikawa Prefecture

Around 70% of Ishikawa Prefecture's total land area is made up of satoyama, and the Noto Peninsula and Kaga Coast are satoumi, meaning that the area is rich in natural surroundings and traditional culture. As part of its policies, Ishikawa Prefecture places great emphasis on regional revitalization through the conservation and utilization of satoyama and satoumi. During COP9 (2008) and COP10 (2010) to the Convention on Biological Diversity, side events were staged centering on Ishikawa Prefecture. Debates were held on the importance of satoyama and satoumi. Following this, an application was made for GIAHS accreditation as "Noto's Satoyama and Satoumi" through the collaboration of such organizations as the Ministry of Agriculture, Forestry and Fisheries (Hokuriku Regional Agricultural Administration Office), the United Nations University and the FAO, which was approved in 2011. Following this approval, the Noto GIAHS Promotion Committee was organized. It is comprised of nine municipalities in the accredited region, along with the Noto Regional GIAHS Executive Committee, a committee that is led by Ishikawa Prefecture and which includes, among others, the nine municipalities. This committee is endeavoring to bring about regional revitalization through this concept of global agricultural heritage by combining a number of initiatives that include symposiums, study tours and life history narratives collected by high school students for members of local communities.

In addition, in 2008 Ishikawa Prefecture invited the United Nations University Institute for the Advanced Study of Sustainability, Operating Unit Ishikawa/Kanazawa (UNU-IAS OUIK) to set up operations in Kanazawa City. This unit, which was set up as a branch of the United Nations University through the development and reorganization of an organization called Ishikawa International Research Cooperation Center (IICRC), plays a major role in facilitating United Nations accreditation, such as GIAHS, as well as all follow-up processes.

However, even with the presence of such measures initiated by administrative and international institutional bodies, it is not the case that the problems experienced by areas which are being buffeted by the effects of population aging and depopulation can be solved so quickly. Human resources play a crucial role when giving consideration to the medium- and long-term sustainability of regions, the key to which are frameworks designed for nurturing human resources from younger generations, who can play a part in regional development into the future.

11.2 Human Resources for Dealing with Satoyama

In Japan, there are two kinds of problems facing satoyama. The first is the destruction of green tracts of land along with agricultural land and areas of forest on the outskirts of cities as a result of development stemming from economic growth. In response to this, from the 1980s onward there has been a flourish of environmental conservation movements led by volunteers from among urban residents seeking to protect their immediate natural environments. The second is increasing depopulation and population aging in provincial areas due to the concentration of populations in major cities, with the resulting shortage in labor leading to the deterioration of satoyama because of the abandonment of agricultural land and areas of forest. Regional depopulation and population aging both started occurring from the 1960s, but in recent years these issues have become particularly severe and regional communities are under threat of disappearing. This is why developing human resources capable of tackling regional regeneration and revitalization is a matter of the utmost urgency. It is against this background that Kanazawa University launched the following initiatives aimed at addressing the problems surrounding satoyama.

11.2.1 Nature School and Volunteer Activities on Kakuma Campus

Kakuma Campus, which was built in the suburbs of Kanazawa City, contains an area known as the Satoyama Zone. This is an area of satoyama forest and site of former cultivated land that had been abandoned, a total of 74 hectares. Kanazawa University does not only use this Satoyama Zone for educational and research purposes; in order to make this area of land accessible to surrounding local communitiies, it opened Kanazawa University Kakuma Satoyama Nature School in 1999. Today, with the participation of university faculty members, this school continues to engage in volunteer training and conservation activities centering on members of local communities.

In 2010, the University established Kakuma Satoyama Headquarters as a means of reinforcing its university-wide framework. In addition, between 2014 and 2015, it used funding from the private sector to run the Kakuma Satoyama Seminar (Nakamura 2013). Activities such as these on Kakuma Campus have been used to help develop human resources for areas of satoyama in Noto as described below.

11.2.2 Developing Human Resources in Noto Peninsula

In Japan today, the aging population in addition to depopulation in regions and secondary problems relating to satoyama stemming from these are challenges

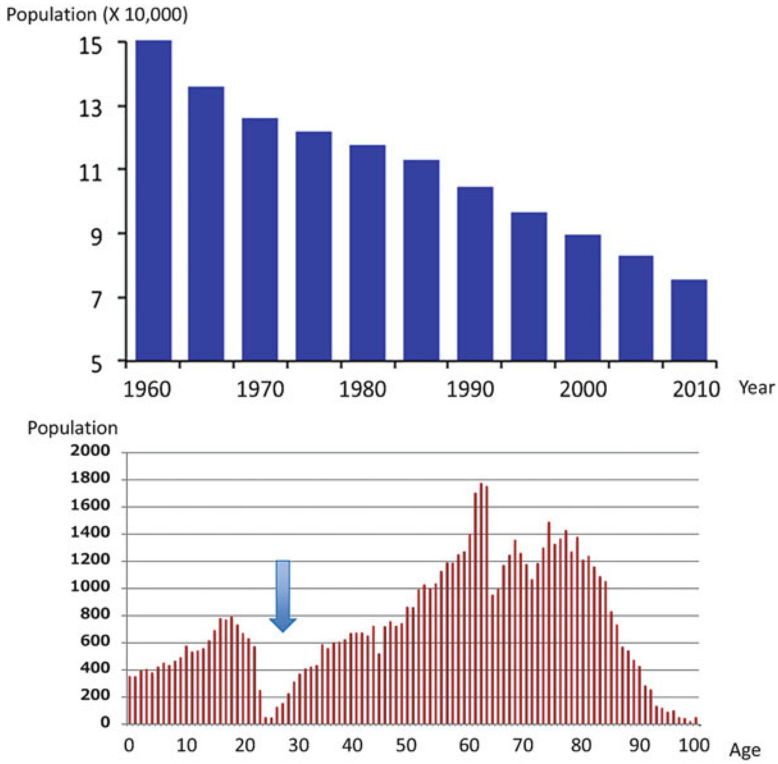


Fig. 11.2 The progression of depopulation and aging in Noto Peninsula (top) and its impacts on population structure (bottom)

warranting immediate attention. As a means of tackling the issues head on, Kanazawa University has continued to engage in its activities through the above-mentioned nature school located on Kakuma Campus, while shifting the focus toward Noto Peninsula, where efforts have begun seeking to develop human resources. Noto Peninsula is blessed with a rich natural environment and cultural traditions, and as mentioned before, received GIAHS accreditation in 2011. However, rapid population aging and depopulation continue unchecked, and there are some areas in which rural settlements are fighting for survival, thus meaning that all concerned are facing a harsh reality (Fig. 11.2).

Activities first commenced in Noto in October 2006 with the opening of the Noto Peninsula Satoyama Satoumi Nature School (Akaishi 2010). In regard to funding for this school's activities, a grant lasting for 3 years was obtained from the private sector. For the base of activities, an old elementary school building from a school that had been closed down was renovated with the assistance of Suzu City, which was established as the Kanazawa University Noto School Building.

Next, Kanazawa University ran what was called the Noto Satoyama Meister Training Program in the Noto School Building. This program, which ran for

5 years starting in fiscal year 2007 with funding from the Strategic Funds for the Promotion of Science and Technology of the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT), sought to develop human resources who could assume responsibility for Noto over the next generation. This program envisaged the following kinds of ideal qualities that human resources from the next generation will need to assume responsibility for Noto in the future: (1) “Exemplary farmer human resources” who engage in forms of agriculture which give consideration to the environment (in actual fact, the scope of this covers not only agriculture but also forestry and fisheries); (2) “Business human resources” with the capacity to bring about added value in secondary industries (processing) and tertiary industries (services) for primary products; and (3) “Leader human resources” with the capability to bring together exemplary farmer human resources and business human resources and create new projects covering the region as a whole (Kanazawa University 2012).

In order to train human resources of this nature, Kanazawa University launched a 2-year course aimed at younger working members of society under the age of 45 years. Because the course targeted working members of society, classes were held on Friday evenings and Saturdays. Over the course of the 5 years of the program’s duration, a total of 62 people successfully completed the course. Among these individuals, 14 people moved from major cities like Tokyo to settle in Noto and continue to play an increasingly diverse range of roles in the area.

Kanazawa University, municipalities from the Noto region, Ishikawa Prefecture and members of local communities succeeded in building strong relationships based on cooperation through the Noto Satoyama Meister Training Program. Once this training program came to an end in March 2012, all involved held a shared awareness that there was a need to continue the achievements made during the 5 years of the program’s existence, and to come up with new projects that further developed these achievements. This is why Ishikawa Prefecture, four municipalities from Okunoto (Wajima City, Suzu City, Anamizu Town and Noto Town, in the northernmost part of Noto) and two universities, including Kanazawa University, established the Promotion Council for the Noto Campus Concept in 2011, and following a year of deliberations launched the Noto Satoyama Satoumi Meister Training Program as the second phase of the program. This was a 1-year course due to constraints with project durations that also took into consideration the convenience of trainees, and included not only satoyama in inland areas, but also satoumi. This demonstrated ties between people and the sea in coastal areas (Yanagi 2013) with the aim of extending the scope of training human resources to include fisheries.

The second phase of the program can be characterized as follows: (1) Each party contributed towards the funding of the project without relying on subsidies from the government; (2) Bases for activities were established not only at Noto School in Suzu City but also in Wajima City, Anamizu Town and Noto Town, and the program was launched in line with local issues; and (3) The program aimed to train human resources who can function not only in Noto but also at the global level. As will be discussed later, this ties in with the training of human resources for rice terraces in Ifugao, the Philippines.

Over the course of 3 years, from 2012 to 2015, the program succeeded in training 66 Meisters while achieving the above three targets. From 2016, the program entered its third phase, and 3 years of projects are now underway. In 2016, 16 people graduated from the program, bringing the total number of people who have successfully completed the course over the first three phases to 144.

Under the Meister Training Program, those graduating from the program become involved in thinking up a range of measures for support. This support is facilitated through a network made up of a diverse range of human resources, such as Satoyama Resident Researchers who are appointed from among those who have been working for many years at the forefront of their respective livelihoods in satoyama and satoumi, such as people working in agricultural, restaurant and farm-based guest house industries, as well as the Noto Satoyama Satoumi Meister Support Network, whose members are made up of progressive farmers. Furthermore, in addition to support through a system of subsidies run by Ishikawa Prefecture, municipalities, local credit associations and others, follow up work was provided by designated members of staff from the Meister Training Program. As part of this follow up process, workshops were held in which graduates gave reports on their current situation and worked to solve problems; in particular, from October 2015 to March 2016, following the end of the second phase of the program, five successive workshops were held relating to ten kinds of fields of activities, during which about 70 program graduates participated. What is more, the graduates themselves have formed their own networks, through which they reach out widely to members of the younger generation outside of the program, staging such things as workshops and events that bring together people from different industries.

Not only this, but several other programs in Noto have been initiated in tandem with the Meister Training Program. In addition to the aforementioned Noto Peninsula Satoyama Satoumi Nature School, a project called the Noto Peninsula Satoyama Satoumi Activity Program, which was also funded through support from the private sector, was held for 3 years from 2009. Under this project, a Collaboration Director was hired to facilitate exchanges between young people from urban areas and Noto, and activities were initiated through the creation of a committee with municipalities from Noto (Mizuguchi 2015). From 2010 to 2013, the Noto Ikimono (Biodiversity) Meister Training Program was implemented using separate funding from private sources. This was a held in the form of a digest version of the regular Noto Satoyama Satoumi Meister Training Program, and focused on the issue of biodiversity.

As a way of providing support for Noto Peninsula Satoyama Satoumi Nature School and Meister Training Program projects, NPO Noto Peninsula Oracha no Satoyama Satoumi (“oracha no” means “our” in the local Suzu area dialect) was set up in 2008. This NPO, which is run by members of the local community including municipality employees, farmers and others, continues to operate to this day. The organization acquires its own funding for activities and is also connected with the activities of Meister Training Program graduates. This series of initiatives is being

Table 11.1 The development of human resource training programs in Japan (Noto) and the Philippines (Ifugao)

Fiscal year	Item
1999	Foundation of Kanazawa University Kakuma no Satoyama Nature School
2006	Foundation of Noto Peninsula Satoyama Satoumi Nature School
2007–11	Noto Satoyama Meister Training Program
2009–11	Noto Peninsula Satoyama Satoumi Activity Program
2010–12	Noto Ikimono (Biodiversity) Meister Training Program
2012–present	Noto Satoyama Satoumi Meister Training Program
2014–16	Ifugao Satoyama Meister Training Program (Phase 1)
2017–19	Ifugao Satoyama Meister Training Program (Phase 2)

run as a single package, and has served to widen the scope of the Meister Training Program and intensify cooperation with the region (Table 11.1).

11.3 Achievements and Ripple Effects

11.3.1 Achievements

During the first phase (2007–2012) of the Meister Training Program in Noto, 62 people successfully completed the course, of which 14 were people who had relocated to Noto from elsewhere. 66 people successfully completed the course during the second phase of the program, of which 16 were people who had relocated to Noto from elsewhere. In addition, around half of those attending the program commuted from Kanazawa or outside the prefecture. These facts highlight one of the key characteristics of the program – i.e., that it attracts new human resources from other regions. The trainees on this program were highly diverse, including members of the agricultural industry, those involved in tourism, administrative employees, members of municipal assemblies, and those working in the processing industry. There was also a high ratio of female participants, with women accounting for one-third to a half of all trainees.

Another defining characteristic is that, as the Meister Training Program progressed, a series of multi-layered networks were formed consisting of a diverse range of actors. For instance, the aforementioned Noto Satoyama Satoumi Meister Support Network is playing a role in supporting those who wish to gain employment in the agricultural sector as Meisters; in addition, the Noto Satoyama Satoumi Meister Network, an organization made up of graduates of the program, serves to promote collaboration between Meisters. Not only this, but program graduates are also holding a range of workshops and events with a other related parties from outside the Meister program. The activities of the Meister staff and graduates are frequently reported in the media, such as in newspapers and on television, as a result of which they are being invited to attend workshops in other regions.

The achievements made through the Meister Training Program have resulted in awards including a Commendation for Regional Development from the Minister of Internal Affairs and Communications in 2013, and the Platinum Vision Award in 2015. Awards such as these have served to further heighten the profile of the program, garnering increased interest as a successful example of human resource training and regional revitalization to which others can refer.

11.3.2 Ripple Effects for Municipalities Within Ishikawa Prefecture

At the time of the completion of the first phase of the Meister Training Program in Noto, momentum was already building to run the program for a second phase in light of the fact that the program had been run using an independent budget without relying on subsidies from the Ministry of Education, Culture, Sports, Science and Technology. This led to the establishment of the Promotion Council for the Noto Campus Concept in 2011 by Kanazawa University, Ishikawa Prefecture and four municipalities from Okunoto. This council formulated a master plan of the program along with proposals for funding, leading to the start in 2012 of the second phase of the Meister Training Program. Since then, with the involvement of three universities within Ishikawa Prefecture, the council has been functioning in numerous other ways as a platform for collaboration between municipalities and universities, in addition to Meister training. For example, it held the Summit for Collaboration between Regions and Universities, an annual event that was staged at each of the four municipalities from Okunoto. For this summit, guests were invited from progressive regions from all over Japan to come and debate the nature of regional regeneration- and human resource training. Therefore, this council has become a model case in Japan for collaboration between regions and universities (Noto Campus Project 2014).

For the duration of the program's second phase, activities were not confined to Noto School Building in Suzu City. On the initiative of Wajima City and Noto Town, satellite schools were opened in both municipalities that further reflected local needs, both of which ran for 3 years. Both municipalities lacked sufficient funding and were unable to allocate designated teaching staff at these schools, meaning that the scope of their achievements was limited; however, despite this, they were able to learn many lessons concerning the administration of human resource training systems. In Tome, Noto Town, the Satoyama Rice Farming and Agricultural Museum was opened in 2016 in a former elementary school building from a school that had been closed down. This museum now functions as a local center for displaying information relating to such areas as the ecosystems and agriculture of satoyama. Many of the people involved in this museum are connected in some way with the Meister Training Program.

The ripple effects of the Meister Training Program are being felt in other areas of Ishikawa Prefecture outside Noto. In Komatsu City, located in the Kaga District, the Komatsu SATOYAMA Council was set up in 2010 as a platform for, among other things, fostering collaboration between local organizations and Komatsu City as a means of encouraging regional revitalization under the keyword of satoyama. This council opened Satoyama Nature School Komatsu Takigahara in a former elementary school building from a school that had been closed down, and is utilizing the knowledge possessed by local leaders to run professional training programs in seven different fields, including agriculture, ecology and tourism. What is more, it also runs a cafeteria incorporating local culinary culture. The council's other diverse activities include the Environmental Kingdom Komatsu Satoyama Conference, which is held on an annual basis in collaboration with Ishikawa Prefectural University as a venue for sharing the insights which trainees have learned together with members of local communities. The above-mentioned activities in Tome, Noto Town and Komatsu City are examples of ripple effects from the activities of Kanazawa University Kakuma Satoyama Nature School and the Meister Training Program in Noto. In the case of the activities in Komatsu City in particular, people connected with the Meister Training Program in Noto are sharing their know-how as chairpersons and advisors.

11.3.3 Ripple Effects to Other Areas Undergoing Regional Regeneration in Japan

As a means of countering the deterioration and collapse of local communities as a result of the concomitant progression of population aging and depopulation, systems have been proposed at universities throughout Japan in recent years for community-based education that emphasizes fieldwork and the participation of local stakeholders (or the incorporation of trainees in local communities), including among others municipalities, local businesses, and those working in the agricultural, forestry and fishery industries, and a series of new departments have been opened and structural reforms made to this end. The Meister Training Program in Noto has garnered attention from universities nationwide, with observers coming to Noto from across Japan to witness the work that has been going on here.

For example, Utsunomiya University designed and implemented a framework for training human resources in reference to the Meister Training Program in Noto. This framework was designed to take into consideration the particular circumstances of Utsunomiya, originating with the local issue of damage to agricultural produce by wildlife such as deer and wild boar. The design and policies behind this framework mirror those utilized in Noto and, as will be discussed later, the rice terraces in Ifugao, the Philippines (Utsunomiya University 2014).

11.3.4 Ripple Effects to International Platforms

The success of the Noto Satoyama Meister Training Program is one of the reasons behind the accreditation of Noto's Satoyama and Satoumi as GIAHS in 2011. The concepts of satoyama and satoumi have been met with international acclaim, and the Noto Satoyama Meister Training Program is making major achievements in training human resources who are aware of the international values of the natural and cultural resources of satoyama and satoumi and who are able to utilize this in regional regeneration and sustainable development.

In Ishikawa Prefecture, in addition to Noto as a GIAHS site, other areas which have received accreditation of some kind include the Ramsar Site Katano Kamoike Wetlands, Mount Hakusan Biosphere Reserve (UNESCO, Man and the Biosphere Programme) and Intangible Cultural Heritage ("Aenokoto," a traditional agricultural ceremony from Okunoto, and the Seihaku Festival of Nanao City). In all of these areas, there is a severe shortage in human resources who can continue and develop these projects. Those who have taken the Meister Training Program are engaging with their own challenges while maintaining an awareness of the importance of international accreditation.

OUIK, a branch of the United Nations University located in Kanazawa, functions as a hub for the creation of platforms seeking to facilitate organic collaboration between these accredited regions and promote them at the global level (Watanabe 2015). In October 2016, the 1st Asian Conference on Biocultural Diversity was held in Nanao City. This event was held on a joint basis by the United Nations University, Ishikawa Prefecture, UNESCO and the Secretariat of the Convention on Biological Diversity. During the working group meetings, a session was held concerning the training of human resources, which featured a presentation of the work that has been done in training human resources in Noto and for rice terraces in Ifugao.

11.3.5 Academic Development

Graduates of the Meister Training Program play a central role in Noto, and the series of activities that Meister mentors have been initiating in collaboration with members of local communities have been producing excellent results in terms of both scientific achievements and the conservation and utilization of satoyama. The following are some examples of the work that has taken place here.

The first example is the activities of an environmental education group called "Maruyama-gumi" (Mii, Wajima City), which have proven extremely fruitful in a broad range of fields, such as the continuation of traditional knowledge and agricultural methods from the satoyama of Noto, including religious ceremonies, the conservation and monitoring of biodiversity, and the processing and sales of agricultural products. In recognition of these achievements, the group won the Biodiversity Action Award Japan in 2014.

The second example is the activities of Ono Charcoal Factory in Suzu City, which is run by a graduate of the Meister Training Program. This factory, a forestry enterprise which is run along the principles of self-employed timber harvesting and afforestation, produces high added value charcoal for use in the tea ceremony in collaboration with Meister mentors specializing in the field of ecological research and volunteers from urban areas. Long term monitoring of this factory's operations has proven that the way in which it manages forests has helped enrich the area's biodiversity.

Changes that have taken place to such things as the material circulation and biodiversity in satoyama and satoumi ecosystems in Noto like those mentioned above along with their current status and predictions for the future have been compiled in a comprehensive report by the Kanazawa University Satoyama Satoumi Project (Nakamura 2015). In parts of this report, members of local communities and researchers collaborate to set challenges and design and implement research which seeks to tackle these challenges. An example is research relating to the impacts on ecosystems of the introduction of new methods of wet rice cultivation, e.g. low labor input direct seeding method, with suggestions for agricultural management (Ito et al. 2015; Koji et al. 2015). The development of research of this nature in Noto has attracted much interest from outside the region, and many researchers and administrative officials visit Noto School Building in Suzu City for hearings, collaborative workshops, stakeholder meetings and other events.

11.4 Training Human Resources in the Philippines

The importance of Japan's satoyama, the fact that regions with satoyama are faced with an aging population and depopulation, and the notion that there is a need to nurture young human resources who can find ways to overcome these issues, revitalize regions and bring about sustainable development became increasingly known at the international level as the Meister Training Program developed. The aforementioned Japan Satoyama Satoumi Assessment (JSSA) comprises of research in which all kinds of agents collaborate concerning satoyama and satoumi from both national and regional levels (Hokuriku cluster etc.). JSSA rated Noto's Meister Training Program highly as a model case for human resource development and it was shared among the participants. In addition, the achievements made through JSSA were publicized both in Japan and overseas, giving rise to new initiatives in human resource training, such as the case of rice terraces in Ifugao that is introduced here.

One institution with which the concept of satoyama resonated strongly was the University of the Philippines Open University (UPOU), which asserted that the training of human resources would be necessary if the Philippines were to tackle similar problems facing rice terraces in Ifugao. In light of this, a collaborative project started between Japan and the Philippines in which the know-how gained through the Noto Meister Training Program was applied to the case of Ifugao.

The rice terraces of Ifugao are located in a mountain range in the northern area of Luzon Island, 450 km (approximately 9 h by automobile) from Manila. The Ifugao rice terraces were inscribed as World Cultural Heritage by UNESCO in 1995, and as GIAHS by the FAO in 2005, meaning that they have two separate accreditations. In 2001, UNESCO added the rice terraces of Ifugao to its List of World Heritage in Danger out of concern for the deterioration of the rice terraces due to a shortage of labor and haphazard touristic development. While the rice terraces were removed from this list in 2012, sufficient steps have yet to be taken to solve the problems. The people of Ifugao are eager to maintain their traditional culture that includes rice cultivation, religious observances and crafts on the terraces, but machinery cannot be used on the rice terraces and they receive little income for the amount of heavy labor that is involved in tending the terraces. This is why many young people from these communities have chosen to move to the city, resulting in a shortage of people to take over agricultural work and difficulties in maintaining these rice terraces that have been handed down by their ancestors over centuries (Fig. 11.3). This is why, in an effort to protect the rice terraces and traditional culture of Ifugao and to nurture young people capable of promoting sustainable development in the region, Ifugao Satoyama Meister Training Program (ISMTP) was implemented for 3 years from February 2014 to Feburuary 2017 by using the the financial support from a Grass-roots Technical Cooperation Project of the Japan International Cooperation Agency (JICA). This represents a trial in transferring the know-how gained through the Noto Meister Training Program to Ifugao as a means of developing a diverse range of human resources who can work in such fields as agriculture, food processing, tourism and administration.

The Ifugao GIAHS Sustainable Development Committee (IGDC) was established as a framework for the implementation of the project through an agreement between the two universities of Ifugao State University (IFSU), the hub for training human resources, and UPOU, located on the outskirts of Manila, Ifugao State Government (Governor is the chairperson of IGDC), four municipalities which have rice terraces within the state that have been inscribed as World Heritage, and Kanazawa University. At the same time, Ifugao GIAHS Support Committee (IGSC) was launched in Noto by nine minucipalities which are members of Noto GIAHS, Ishikawa Prefecture Government, Kanazawa University, Ishikawa Prefectural University and Sado City, where Sado GIAHS. The chairperson of IGSC is the Mayor of Suzu City. In Ifugao, the trainees lived in remote locations and classes could only be held once a month, but over the course of 3 years, a total of 51 individuals graduated from the program. As with the Noto Meister Training Program, ISMTP trainees with a diverse range of goals tackled their own topics for completing the program. The program was taught by faculty staff from IFSU, UPOU and two other universites (Benguet State University and Mountain Province State Polytec College), and trainees were evaluated for graduation on the basis of graduation thesis and a public presentation of their thesis. Trainees dealt with a vast range of issues, including those relating directly to their livelihoods, such as improvements to rice cultivation techniques for rice terraces, the brewing of rice wine using traditional rice from rice terraces, organic pig farming, and eco-tourism. Other trainees chose to focus on

Fig. 11.3 Rice terraces in Ifugao past (top) and present (bottom). Deterioration is ongoing due to a lack of upkeep

issues connected with biodiversity, such as the conservation of endemic forms of life that inhabit rice terraces or the eradication of harmful non-endemic species, while still others examined roles that traditional religious ceremonies or shamans could play. This notion of having local members of the younger generation learn about themes such as these and try to apply them to solving issues in the future is a characteristic of the Meister Training Program. In the same way, Meister Program trainees in Noto took up research topics such as the traditional ceremony

"Aenokoto" or the Kiriko Festival and have been using these to bring about actual regional development.

As part of ISMTP, every year mentors and trainees from the program (a total of around 20 people) were invited to Kanazawa and Noto to inspect production sites at satoyama and satoumi in Noto and to engage in exchanges with those involved with the Noto Meister Training Program. Program graduates went on to set up their own networks and are now involved in a range of activities, continuing to raise the profile of the Satoyama Meister Training Program in the region. Some of the graduates have even been able to secure funding and technical support from the Ifugao State Government, municipalities and regional offices of the Government of the Philippines.

While the experiences gained through the Noto Meister Training Program were utilized for ISMTP, this is not to say that the methods formulated in Noto were incorporated in Ifugao as is; rather, it was more a case of providing support so that those involved on the ground in Ifugao could make adjustments and design and administer a program appropriate to the regional situation (JICA Hokuriku Branch 2016). In this way, the training of human resources in Noto and Ifugao has taken place simultaneously through a process of mutual collaboration.

11.5 Characteristics of Human Resource Training and Future Issues

Human resource training programs such as those introduced above can be characterized in the following three ways. The first is the sheer diversity of the human resources targeted by the programs. The programs contain a variety of individuals, from those who have always lived in the area concerned to those returning to the area after having lived in other areas and those relocating from other areas (particularly urban areas) to start a new life. These individuals also possess diverse career backgrounds, including those working in agriculture, eco-tourism, administrative employees, welfare, manufacturing, traditional culture, and members of municipal assemblies, and it is this diversity which is a defining feature of these programs. Many of the trainees in Noto also possessed experience overseas, including as Japan Overseas Cooperation Volunteers, and have unfurled their activities at the international level, such as cooperation with the Ifugao Satoyama Meister Training Program.

The second is their emphasis on livelihoods and permanent residency within the region concerned. While respect is given to the occupations and career backgrounds of the program trainees, the programs all share a common goal in that they aim to train human resources who can play a part in regional development through livelihoods which position local natural environments and cultures as resources. This is based on the idea that it is important for people to live permanently in the local community while engaging in their livelihoods rather than serving as temporary or transient volunteers.

The third are the roles played by universities. Human resource training programs consist of lectures, practical lessons, field work and seminars relating to a wide variety of themes. In the case of Noto's Meister Training Program, trainees are provided with opportunities to learn from some of the leading experts in their field from universities across Japan, including Kanazawa University, research institutes and NPOs. In addition, they are also provided with opportunities to interact with local innovative farmers, learned people and leaders. Furthermore, there are five members of mentoring staff with doctoral degrees stationed permanently at Noto School Building, who provide trainees with careful individual instruction. Under this kind of learning environment, trainees create a graduation thesis comprising of a plan for activities including the creation and improvement of livelihoods that they aim to undertake in the future. The trainees present their papers at a public presentation session, and those who pass the screening are eligible to graduate from the program. Universities excel at developing human resource programs based on research and education of this kind. Another distinctive feature of this program is how universities also worked to design and implement a program suited to the unique goal of training human resources from among members of society whose lives revolve around satoyama and satoumi.

When viewing frameworks for the development of human resources with characteristics like those outlined above from the perspective of local environmental studies, it becomes apparent that the multilayered translation of knowledge plays a key role in facilitating these. The Meisters who have graduated from the program themselves play a role as bilateral knowledge translators by understanding the ways in which the natural environments and cultures of their own region are connected to broader themes, such as academic research and global environmental problems, and work to convey this knowledge not only to other members of the local community, but also to the wider world. The translation of knowledge gives new significance to regional natural environments and cultures for both the members of local communities and stakeholders at a broader geographical level, providing opportunities to promote cooperation between a diverse range of agents from both inside and outside the region.

In the course of training Meister human resources, a diverse range of individuals from different standpoints also function as translators of knowledge, including university faculty members, administrative employees, members of local communities, employees at international organizations, and NPO staff. Kanazawa University hired specially appointed teaching staff from the outside to administer the Meister Training Program. For instance, a senior individual with managerial experience from the Department of Agriculture at Ishikawa Prefectural Office served as the principal of Noto School Building, and another individual with experience at media organizations acted as a planning coordinator, thus assuming charge over certain important aspects of the program's administration (Kawabata 2010; Uno 2010). Translators with the capacity to bring people and organizations together and get projects off the ground is important. This enables a diversity of agents, who by nature possess differing organizational qualities and goals, to collaborate in implementing activities with the common goal of training human resources who can take charge of regional development in the future,.

The experiences of training human resources in Noto and Ifugao has been hailed at the International Forum on Globally Important Agricultural Heritage Systems as a model case of mutual collaboration (GIAHS Twinning) by two specific regions that transcends national borders. The significance of international cooperation such as this has yet to become fully clear. It is hoped that, in the future, those connected with the Meister Training Program in Noto and Ifugao (staff, trainees and graduates) will actively seek to go to international gatherings and conduct side events there, not only the International Forum on Globally Important Agricultural Heritage Systems, but also meetings of UNESCO's Man and the Biosphere Programme (MAB), the Conference of the Parties to the Convention on Biological Diversity and others. But how exactly should these human resources trained through the Meister Training Program fulfill their roles as translators who bring together regions and the outside world at the global level? This is the next major challenge in need of consideration.

References

Akaishi D (2010) Living in satoyama and satoumi – challenges for resident researchers (里山里海に生きる~常駐研究員の挑戦~). In: Nakamura K, Kada R (eds) Satoyama Renaissance – message from Noto. Soshinsha, Tokyo, pp 178–193 (in Japanese)

Duraiappah AK, Nakamura K, Takeuchi K, Watanabe M, Nishi M (eds) (2012) Satoyama–Satoumi ecosystems and human Well-being: socio-ecological production landscapes of Japan. United Nations University Press, Tokyo

IPSI Secretariat (2013) The International Partnership for the Satoyama Initiative (IPSI) formation and development. United Nations University Institute of Advanced Studies, Tokyo

Ito K, Koji S, Utsunomiya D, Nakamura K (2015) Conservation and utilization of biodiversity on the satoyama of Noto through the collaboration with the community (地域連携による能登の里山での生物多様性保全・活用). In: Nakamura K (ed) Research and practice of "Satoyama Satoumi Reactivation" for Sustainable Development of Rural Communities: global perspectives from Noto Peninsula. Kanazawa University, Ishikawa, pp 33–43 (in Japanese)

Japan Satoyama Satoumi Assessment (JSSA) – Hokushinetsu cluster (2010) Satoyama & satoumi: Japan's socioecological production landscape – experiences and erudition from Hokushinetsu (里山・里海:日本の社会生態学的生産ランドスケープ～北信越の経験と教訓～). United Nations University, Tokyo (in Japanese)

JICA Hokuriku Branch (2016) FY2016 JICA Technical Cooperation for Grassroots Projects, Philippines. Human resources development program for sustainable development of the GIAHS designated site, "Ifugao rice terraces (IRT)" in the Philippines (Final monitoring report) (2016年度 草の根技術協力事業 フィリピン国 世界農業遺産(GIAHS)『イフガオの棚田』の持続的発展のための人材養成プログラムの構築支援事業(地域経済活性化特別枠)終了時評価調査報告書). Japan International Cooperation Agency, Tokyo (in Japanese)

Kanazawa University (2012) Establishment of capacity building for regional reactivation: "Noto Satoyama Meister" Training Program (post-evaluation report) (地域再生人材創出拠点の形成 事後評価「能登里山マイスター」養成プログラム報告書). Kanazawa University, Ishikawa (in Japanese)

Kawabata H (2010) Revitalization of local communities in Okunoto and Satoyama Meister Training Program (奥能登の地域再生と里山マイスター養成プログラム). In: Nakamura K, Kada R (eds) Satoyama Renaissance – message from Noto. Soshinsha, Tokyo, pp 104–123 (in Japanese)

Koji S, Ito K, Hidaka K, Nakamura K (2015) Effects of the low labor input farming, “V-furrow direct seeding method” on arthropod and plant diversity in rice paddy fields (省力型農法としての「不耕起V溝直播農法」が水田の節足動物と植物の多様性に及ぼす影響). Japan J Ecol 65:279–290 (in Japanese)

Mizuguchi A (2015) Youth exchange and education program on Noto satoyama and satoumi (能登の里山里海をテーマとした地域交流と教育プログラム). In: Nakamura K (ed) Research and practice of “Satoyama Satoumi reactivation” for sustainable development of rural communities: global perspectives from Noto peninsula. Kanazawa University, Ishikawa, pp 115–117 (in Japanese)

Nakamura K (2013) Forest conservation and capacity building on university campus – message from “Kakuma Satoyama Head Office, Kanazawa University” (大学キャンパス内の森づくりと人材養成　「金沢大学角間里山本部」からのメッセージ). Green Lett 35:33–35 (in Japanese)

Nakamura K (ed) (2015) Research and practice of “Satoyama Satoumi Reactivation” for sustainable dvelopment of rural communities: global perspectives from Noto Peninsula (持続可能な地域発展をめざす「里山里海再生学」の構築—能登半島から世界への発信—). Kanazawa University, Ishikawa (in Japanese)

Noto Campus Project (ed) (2014) Local community-univeristy summit meeting 2014 in Anamizu – learning from communities, reactivating local communities – aiming for broader exchange of students and researchers with local communities (地域大学連携サミット2014 in 穴水 地域に学び,地域を元気にする~地域再生に向けた学生・研究者との交流拡大を目指して~). Noto Campus Project, Ishikawa (in Japanese)

Takeuchi K (2010) Rebuilding the relationship between people and nature: the Satoyama Initiative. Ecol Res 25:891–897

Uno F (2010) Working as a community liaison coordinator (地域連携コーディネーターという仕事). In: Nakamura K, Kada R (eds) Satoyama Renaissance – message from Noto. Soshinsha, Tokyo, pp 195–208 (in Japanese)

Utsunomiya University (2014) Establishment of capacity building for regional reactivation: “Satoyama wildlife managers” training program (post-evaluation report) (地域再生人材創出拠点の形成　事後評価「里山野生鳥獣管理技術者養成プログラム」(報告書)). Utsunomiya University, Tochigi (in Japanese)

Watanabe T (2015) Creating new culture through the integration of urban cities with Satoyama and Satoumi (都市と里山里海の連関による」新たな文化創造を目指して). In: Operating Unit Ishikawa/Kanazawa, Institute for the Advanced Study of Sustainability, United Nations University (eds) The Ishikawa-Kanazawa biocultural region: a model for linkages between biological diversity and cultural prosperity. United Nations University, Tokyo, pp 54–57 (in Japanese)

Yanagi T (2013) Japanese commons in the coastal seas: how the satoumi concept harmonizes human activity in coastal seas with high productivity and diversity. Springer, Tokyo

Chapter 12
Catalysts to Mobilize Local Communities: Conservation of Coral Reef Cultures in Shiraho, Okinawa

Masahito Kamimura

Abstract In order to conserve biodiversity of coral reefs, it is necessary to enlist the cooperation of local communities. The daily lives of local people residing in coastal areas are inseparable from the threats facing coral reefs. This is why conservation groups involved in coral reef conservation actively seek to involve local communities. However, those living in these areas possess diverse sets of values, and are also experiencing various challenges of their own. Not all residents necessarily take an enthusiastic stance toward coral reef conservation. Consequently, community-based coral reef conservation initiatives cannot be easily achieved. The author was hired as officer of the WWF Coral Reef Conservation and Research Center located in Shiraho village, Okinawa prefecture, Japan, in January 2004, and worked with the local people on various community development activities until March 2016. This chapter focuses on the processes of community development and coral reef conservation in Shiraho village since 2004, and describes the roles, challenges and potentials for individuals to become catalysts for community actions from the perspectives of a residential researcher involved in these activities.

12.1 Coral Reefs and Their Meanings to People Living in the Shiraho Village

12.1.1 Shiraho Village as the Inheritor of "Coral Reef Culture"

Ishigaki Island is the economic, cultural and administrative center of the Yaeyama Islands, located approximately 400 km southwest of the main island of Okinawa. The area is home to one of the world's most outstanding coral reefs, and has been designated as Iriomote-Ishigaki National Park. Situated on the east coast of the

M. Kamimura (✉)
Chikushi Jogakuen University, Dazaifu, Japan
e-mail: m-kamimura@chikushi-u.ac.jp

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_12

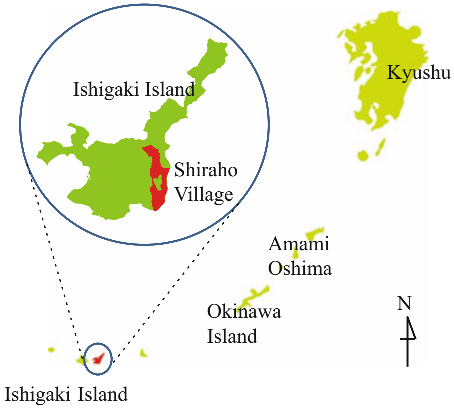


Fig. 12.1 Location of Shiraho village

island, the Shiraho village has a population of approximately 1600 people, and is an agricultural village home to approximately 700 households (Fig. 12.1).

Life in Shiraho is intimately connected with the various benefits of the coral reefs (ecosystem services) (Table 12.1). Osamu Shimamura, who has been involved in Yaeyama's nature conservation movement for many years, calls this lifestyle "coral reef culture" in a collaborative study with his colleagues to visualize the connections between people of Shiraho and nature (Shimamura and Ishigaki 1988). Before the Pacific War, most of the people of Shiraho were engaged in agriculture in addition to subsistence fisheries. At ebb tide, people would take a break from working in the fields and dip into the sea to harvest marine resources. If one walks through Shiraho Village, which still maintains its townscape from that period, it is possible to get a sense of how the village is intimately connected with the coral reefs. Stone walls (called *ishigaki*) are a characteristic of traditional townscapes in this area, taking advantage of its plentiful coral stones. Branching corals have been crushed into coral gravel and spread neatly on the front garden. The cornerstones of posts supporting roofs of houses made use of coral stone of Faviidae and brain corals. Plaster coating for Okinawan red tile roofs was once made by baking table-corals. The relationship between Shiraho residents and the sea is also seen in rituals. Salt for offerings was made from seawater in the village, and coral sands are still used in incense burners.

In the interviews with elderly people conducted to get an understanding of Shiraho, the author learned about many blessings related to the coral reefs. For example, when agriculture was not possible during wartime or when crops could not be harvested because of drought, people could still obtain daily foods from the sea. People expressed their gratitude to the sea with honorary titles such as "treasure sea" and "life-sustaining sea," which have been passed on to the people of today.

Table 12.1 Relationship between daily life and coral reef ecosystems in Shiraho village

Ecosystem component	Form of usage	Ecosystem service categories
Coastal vegetation	Windbreak and tide protection forest, summer evening cool place	Regulating service
	Place for procurement of food such as coconut crabs, pandanus palm shoots, etc.	Provisioning service
	Place for procurement of materials for folk handicrafts for daily life and traditional craftworks	
	Contribution to development of ethnic technologies for folk handicrafts for daily life and traditional craftworks	Cultural service
Soil	Sediment weathered soil derived from coral reefs forms rich farmland	Supporting service
Terrain	Coral reef flats offer a natural breakwater and prevent erosion of the island	Regulating service
Marine products	Going into the sea in between farm works to gather seaweed and catch fish	Provisioning service
	Use of coral stones and coral gravels as construction materials	
	Use of seashells and coral gravel as a material for fishing gear	
	Decoration with seashells and coral gravel; use for religious rituals and protection against evil influence	Cultural service
Seas surrounding the island	Keep away an evil by saying grace to the sea; believe that gods came from the sea	Cultural service
	Use as snorkeling location for tourism	
	Use as a place of environmental education for children	
Seawater	Make salt from seawater	Provisioning service
	Use seawater as bittern to solidify island tofu	
	Use seawater to wash and purify the dead for funerals	Cultural service
Environment, including biological species and water quality	Use by various researchers as a field of research	Cultural service
Environmental deterioration	Activities such as volunteering for coral reef conservation	Cultural service

Note: Compiled from interviews for “Shiraho the Past and Present Exhibition” in Shiraho Village and other participatory observations

12.1.2 New Ishigaki Airport and Coral Reef Conservation

The connections between people’s lives and coral reefs faced a significant crisis in 1979. That year, plans to build the New Ishigaki Airport by filling in land over the

Fig. 12.2 Blue Coral (*Heliopora coerulea*) in Shiraho coral reefs, which forms the largest colony of the species in northern hemisphere. (Photo taken in 2015)

Shiraho coral reefs were announced. The people of Shiraho opposed the plan. An academic study was conducted in 1985 supported by the World Wide Fund for Nature (WWF) and other organizations, which revealed the value of the Shiraho coral reefs including one of the world's largest colonies of Blue Corals (Fig. 12.2). Plans for the construction of the airport, however, were maintained, and the airport became a long-term issue, with the Shiraho community divided into "pro" and "con" camps.

According to the historical records of the village, the Shiraho Self-governance Association, the local self-governance body in Okinawa region, was split by the airport issue for 10 years from 1985 to 1994. "The Primary Shiraho self-Governance Association" was established as the counter-organization by residents who hoped for economic development associated with the airport's construction. During this time, the traditional Year of Good Harvest Ceremony as well as coming-of-age ceremonies and year of birth celebrations were held separately by those pro and con organizations.

The movement against the new airport's construction developed into an international nature conservation movement, influencing the decision to avoid building on top of the coral reef. In 1992, Okinawa Prefecture relocated the candidate site for construction of the airport from the Shiraho coral reefs to another inland location. In 1992, WWF announced that a base for conservation and research of coral reefs would be established in Shiraho. The New Shiraho Self-governance Association was dissolved in 1995, and the two were integrated into a single self-governance association in Shiraho. This provided an opportunity to elect the new deliberative members of the association, which aimed for community development that extended beyond and broached the "pro" and "con" factions.

The new candidate site, the Miyara Makinaka area, was superior agriculture land, which caused the start of a new opposition movement. In 1999, Okinawa Prefecture once again began reconsidering the location for airport construction. A selection board for the location of the New Ishigaki Airport consisting of experts and local officials was established, and began focusing on four possible sites (Shiraho coral reef reclamation, Shiraho Karadake on land, Miyara plan and Fusakino plan). WWF also joined the selection board as a member. An academic expert sub-committee, local stakeholder sub-committee and general committee met and discussed the project 15 times, and in March 2000, the proposed site of Shiraho Karadake on land was selected. The representatives of the Shiraho Self-governance Association declared their agreement. The WWF opposed the plan, as they were concerned over the impacts of soil runoff from such a massive construction on the coral. However, the other members backed the plan and the WWF expressed its consent on the conditions of establishment of an environmental review board and implementations of red soil runoff preventive measures to contribute coral conservation. A special general meeting of the Shiraho Self-governance Association was held, and decided that 16 items of the local development measures would be the conditions of acceptance of the plan (Uechi 2013). Since the announcement of the plan in 1979, after 20 years of turmoil, the construction site was finally decided. In April 2000, the WWF opened Shiraho Coral Reef Conservation and Research Centre (hereinafter referred to as "CRCRC"). Environmental impact assessments for construction started in 2002, actual construction started in 2006, and the airport began operating in 2013.

The contentious issues surrounding coral reef conservation gave the strong impression that supporting coral reef conservation was equated with being against the new airport. This perception had been an obstacle for residents to participate in coral reef conservation.

12.1.3 Threats Facing Shiraho Coral Reefs

Coral reefs are on the decline on a global scale. Human activities including higher seawater temperatures due to global warming, the influx of sedimentation, reclamation, and destruction by tourism and fishing industries are causing coral damages. In a report announced by WWF-Netherlands in 2003, 27% of coral reefs in the world have already been decimated, and 60% may be lost by 2030 (WWF-Netherlands 2003).

Coral bleaching in 1998 also killed off a significant amount of Shiraho coral reefs, and the percentage of the seabed covered with coral was decreasing. When I assumed my post at CRCRC in January 2004, there was concern that airport construction would exacerbate the degradation of the corals.

The airport construction on land avoided destroying coral reefs directly through reclamation. However, the expansion of agriculture through the Agricultural Land Improvement Projects caused the elution of red soil, which is regarded as one of the major factors behind the deterioration of coral reefs. The term “red soil” refers to reddish soil consisting of fine particles characteristic to the Ryukyu Islands. Red soil disperses easily in water and flows out to sea when it rains.

By 2004, coral cover in Shiraho coastal areas had recovered to the level before the coral bleaching of 1998. Bleaching, however, occurred again in the summer of 2007, causing the reduction of coral cover. The 11 years of environmental monitoring since the opening of CRCRC has revealed significant deterioration of coral reef communities in this period (WWF Japan 2016). Coral bleaching has been observed as higher seawater temperatures continued in the summer of 2016.

12.2 Developing a Sustainable Community in Shiraho

12.2.1 Visions of Sustainable Community Development Promoted by Shiraho Residents

When I started my work in 2004, it was a period of uncertainty for the construction of the airport. At that time, there were still many persons who own a small piece of land for opposing the airport at the new construction site. The prevention of red soil runoff accompanying construction works were another problem to be solved. In this situation, I needed to shape various approaches to facilitate coral reef conservation by Shiraho community members themselves. The movement against new airport construction was supported by nature conservation organizations and researchers, and as a result, reclamation was avoided. However, there were more than just a few residents indicating rejection of the influences of such outsiders in the decision-making processes for the community.

Shiraho is a village with a strong awareness of autonomy, with close territorial and familial ties. Therefore, autonomous and spontaneous actions among the residents are assumed to be indispensable for the continued conservation of coral reefs. Instead of collaborating with outside actors with sympathy and understanding of the conservation of the sea of Shiraho, I decided to work together with Shiraho residents to tackle various challenges facing the people in Shiraho to achieve sustainable development of the community, even though it would take time.

Nature is an essential contributing source for the well-being of people in the community. In the interviews we conducted in Shiraho, we heard many people talking about their affections toward and pride related to the sea, and their gratitude for its benefits. If there is a place where people can discuss on an equal footing and research and community development processes are mobilized with the consensus among stakeholders and other relevant parties, it seemed unlikely that the nature would be seriously spoiled because of the decisions made by people.

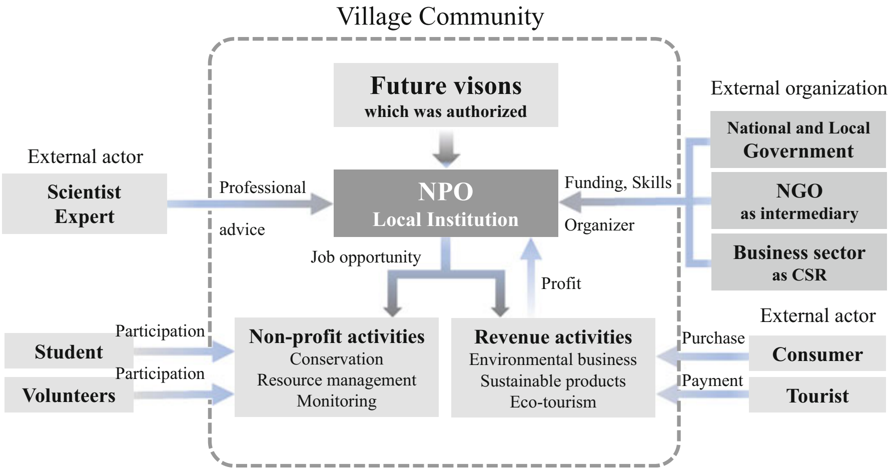


Fig. 12.3 Visions of the sustainable community actions in Shiraho contributing to coral reef conservation

My research experiences on sustainable community development have led to my belief that coral reef conservation can be achieved as a result or a by-product of community development inheriting coral reef cultures. However, it took a long time for these ideas and approaches to be shared by the Shiraho community and WWF.

Figure 12.3 shows sustainable community visions. Coral reef conservation was perceived as voluntary work in this village. However, I aimed to establish a system to manage conservation activities as a part of economic activities in the village without placing too much stress on the participants. As local development activities require creation of various livelihood options, diverse community businesses related to coral conservation are deliberately designed to create employment and revitalize economy of the village.

The government agencies and external organizations such as WWF should assume supporting roles; it is the local community that actually carries out the activities. I myself as a member of WWF also assumed a strategy to provide careful support to the activities in the community during the initial stage, handing the coordinator roles over the community members at the later stages.

12.2.2 Filling in the Missing Pieces of Community Development

Environmental conservation in the community does not proceed smoothly if appropriate organizations, human resources, materials, financial resources and/or time are inadequate. Various conditions should be met to mobilize community action towards effective environmental conservation. Differences in ways of setting up questions

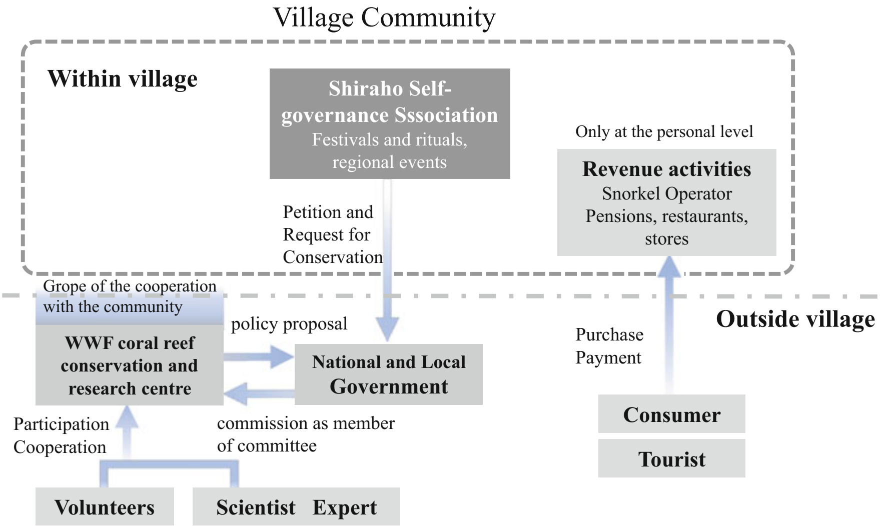


Fig. 12.4 Conditions in Shiraho as of 2004

between researchers from outside and the local community members could be a reason why the environmental conservation activities are not gaining enough ground (Miyauchi 2013). I assumed that another important factor was the lack of conditions in the real community that researchers would consider ideal for environmental conservation. For example, local community may not necessarily have an organization for environmental conservation. Someone should deliberately create a mechanism in the community to push forward environmental conservation. People voluntarily work in cases of crisis in the community where an urgent solution must be found. Such activities cannot be sustained unless they are interesting/enjoyable or residents feel obliged as the community members. Even when clear community visions with the benefits for the people are shared, there are various obstacles in the process of their realization. Community development cannot proceed without core personnel and organizations. Therefore, I designed activities to fill in the gaps between the visions and the real conditions of the Shiraho community in 2004 and attempted to implement them (Fig. 12.4).

Through this process, useful information was collected from outside and the people in the village were linked together. When necessary, the cooperation of external experts was sought and external funds were applied for and secured. Of course, various types of approval procedures needed by the government were handled. I tried to compensate for these parts not available locally. The progress of these activities was shared in the community and participation opportunities were opened to all in order to encourage more people to participate.

I see this role of filling in the missing pieces of local development as catalysts for community actions. The concept of catalyst, a term used in chemistry, is redefined here as a professional who takes the roles of prompting local people to take an action, encouraging practical actions in the community, and producing significant changes in the local community by promoting collaborations among diverse stakeholders, much as a chemical catalyst makes reactions proceed more readily.

Building upon the successful experiences among local people enables them to take a more proactive involvement in community development processes. Many people are empathetic to participatory processes involving more stakeholders, resulting in a chain reaction of participation. As the catalysts are fostered in the area, activities take root in the community and become more stabilized, resulting in step-by step mobilizations and transformations of the community.

12.2.3 "Catalysts" Transforming Their Own Roles in the Processes of Local Actions

Sustainable community development is achieved by the people who live within the community. I was only able to serve as a catalyst by providing support for effective local actions, and the types and approaches of this support dynamically changed in the processes of activities. Three categories of functions of the catalyst in the processes are summarized in Table 12.2: "aims of interventions," "targets of the local community," and "role of catalyst for community actions".

For the first year, I learned the connections between coral reefs and life in Shiraho, and poured most of my energy into understanding expectations and visions among villagers to the development of the community. I produced a documentary film on living together with coral reefs in Shiraho, aiming to foster ownership of the coastal seas by rediscovering local cultures and reevaluating the value of coral reefs. At the same time, we attempted to help create future visions for the community through participation in the processes of establishing the Shiraho Yurateiku Charter promoted by the Shiraho Self-governance Association. Communications with people in the village focusing on local lifestyles and cultures gave me an opportunity to learn well about the village and create a point of contact with many people. Many in Shiraho misunderstood WWF as an organization established to oppose the construction of the airport, and were hesitant to cooperate with its activities. I therefore also tried to eliminate the misunderstanding and develop constructive relationships with the many residents of the village (Table 12.2).

I identified the local challenges related to the perception of villagers (agency), such as "I would like to try but probably can't do anything" or "I would like to help but I do not know what to do", and tried to think together to provide support to find solutions. This includes actions to restore or create a point of contact between people and coral reefs, such as restoring traditional fishing equipment and establishing green belts around agricultural fields to prevent soil runoff. These efforts have stimulated the people's interest in the conservation of coral reefs.

Next, I worked on capacity building to jump-start local organizations in the community and strengthen their capacity. Actions as a catalyst supported the design

Table 12.2 Processes of activities for building sustainable communities and roles of catalysts

Development stage of the local community	Stage where opportunity to participate in community development increases		Stage where activities suitable for the region take root		Stage where local activities are turned over to the local community
Encouragement	Fostering ownership	Capacity building	Local networking	Empowerment	Inter-regional networking and sustainability
Goals of the local community	Reliability	Awareness	Confidence	Responsibility	New tradition (pride)
Role of catalyst for community action	Creation of such awareness (stimulating interest through communication)	Trying together (manner, transmission of structure, build on successes experiences)	Building a system to get the region moving (organization startup, try one cycle, relationship of withdrawal as condition)	Continue to build mechanism (leave up to local community, devotion to logistics support)	Provide stimulus from the outside (wide area networking, transmission of story and details)
Role of catalyst for community action	Secretary general, Shiraho Conservation Council for Bountiful Seas (SCCBS)	Secretary general, Shiraho Conservation Council for Bountiful Seas (SCCBS)	Director, Shiraho Conservation Council for Bountiful Seas (SCCBS)	Director, Shiraho Conservation Council for Bountiful Seas (SCCBS)	Involvement as one of a variety of supporters
	Deliberative member of Shiraho self-government association	Deliberative member of Shiraho self-government association	Deliberative member of Shiraho self-government association	–	
	Secretary general, charter promotion committee	Secretary general, charter promotion committee	Secretary general, charter promotion committee	Member, charter promotion committee	
	Representative of Shiraho Sunday Market	Representative of Shiraho Sunday Market	Advisor, NPO Natsuhana	Director, NPO Natsuhana	
	Shiraho Fishery Association	Shiraho Fishery Association	Shiraho Fishery Association	Shiraho Fishery Association	
Annual activities in Shiraho	2004–2007	2008–2011	2012–2015	2016–2019	2020 and subsequent

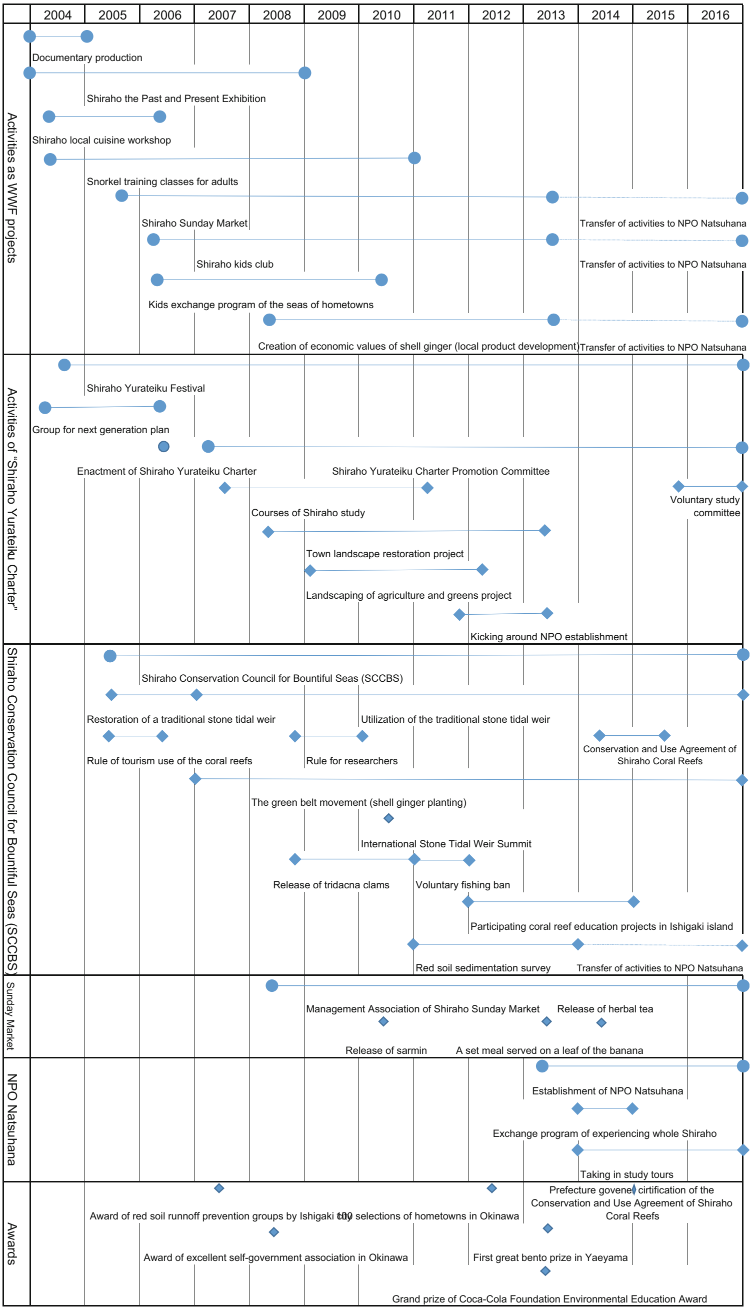
and implementation of various plans to solve the problems in the community, and worked together with local people on projects to accumulate experiences of success. The sense of accomplishment and self-efficacy can improve capabilities of both local organizations and participating individuals. By acting as a catalyst, I promoted local autonomous actions from behind the scenes to enable people to perceive the outcomes of the efforts as their own.

The first year held great significance in paving the way for subsequent activities to proceed smoothly. Many of the people on the island who were interviewed expressed the opinion that they felt coral reefs were an essential part of life on the island. Therefore, it has become clear that achieving more profitable and sustainable lifestyles among Shiraho people is the key to promoting sustainable use of coral reefs. It was this conviction that enabled me to overcome conflicts between my missions as a member of an international conservation organization and the realities of local communities. At the initial stage, the accumulation of local experiences of success is the driving force of establishing mutual trust between the catalyst and the community to propel subsequent activities (Fig. 12.5).

Sharing the practices and processes in ways that are suited to the community – culturally and based on local conditions – is an indispensable step for diverse activities to take root in the community. I tried to make the roles I played as a catalyst clear to the community members, and started to discuss with people about alternate approaches for the functions and roles of catalysts to be played by other human resources and organizations in the village. The local community reached an agreement to establish a non-profit organization (NPO) to use limited local manpower more efficiently to play various functions. Local networking was pursued to integrate and link the activities of existing local organizations in the community. An NPO, Natsupana was finally established to provide bases of actions for sustainable development corresponding to local challenges.

Activities aimed at sustainable community development moved to the next stage of the process of empowerment. The ways of doing things suited to the community arise out of the processes of thinking and acting by local people themselves. By reducing the range and clarifying the time limit of my commitment in stages to those involved, I tried to hand over my roles and functions to the local organization to take more responsibility for various activities. After I was transferred to my new affiliation and was no longer physically present in Shiraho, the local community and the newly established organization became more autonomous. Activities will no longer continue just because I am there; rather, they will continue as they have taken root in the community. The role of catalyst had already been taken on and well performed by the community and its new organization.

The processes are now moving into the future stage. The next step is to prepare a mechanism to turn over the established local ways of doing things to the next generation. Fostering human resources to coordinate activities and handing over implementation to the next generation means returning to the beginning of the processes, repeating the cycle of stimulating interest, accumulating experiences of success, and carrying out activities autonomously. I will continue to provide support from the outside in this stage.



Sources: Records and materials of WWF Coral Reef Conservation and Research Center, Shiraho Yurateiku Charter Promotion Committee, Shiraho Conservation Council for Bountiful Seas (SCCBS)

Fig. 12.5 Initiatives related to building sustainable communities in Shiraho

In order to establish the systems of collaboration among diverse actors of the community to promote local actions, catalysts play a role to identify and activate local human resources, experiences, and expertise to work through all processes in collaboration with local people. Subsequently, this process aids in to crystalizing the visions and hopes emerging from local people in accordance with the specific conditions they face within the local community.

12.3 Three Initiatives to Activate Local Communities

12.3.1 Establishment of "Shiraho Yurateiku Charter"

For coral reef conservation activities to take root in the community, it is necessary to obtain the understanding of the people that play a core role in the autonomy of the community. When I started various activities in Shiraho, I was careful to share the purposes and goals of the activities with local people. Taking actions without first obtaining the understanding of local people often invites retaliation or resistance.

In February 2004, I visited the director of the Shiraho Self-governance Association to ask permission to conduct a residents' opinion survey. To advance conservation of coral reefs together with the community, it was necessary to understand the needs of the community. However, he did not allow WWF, the outsider of the community, to conduct the opinion survey. I visited him repeatedly to explain the purpose of the survey not to oppose but to coexist with the new airport to create sustainable futures of the village.

In May 2004, on the recommendation of the director, I was selected as a member of the "Shiraho Yurateiku Experience 2004 project" as a part of the Remote Islands and Depopulated Areas Support Project of the Okinawa prefecture. As a member of the Next Generation Plan group, I attempted to create the future visions for the village. Based on interviews, surveys and round table discussions, we were able to create visions, which most people of the community would understand and agree about. Through the process of consensus in the self-governance association, the "Shiraho Yurateiku Charter" was enacted in 2006 (Fig. 12.6, Kamimura 2010).

Coral reef conservation was ranked as one of seven articles of community development in the charter. This allowed coral reef conservation to be implemented as part of community development processes rather than as a movement against new airport construction. I was appointed as the secretary general of Shiraho Yurateiku Charter Promotion Committee and as a deliberative member of Shiraho Self-governance Association, because of my contribution to the charter development.

Participatory processes in the enactment of Shiraho Yurateiku Charter contributed to obtaining legitimacy, and most of all, to gaining trust with the local community. The trust relationships established during this time enabled many people to subsequently participate in diverse activities. Through the processes of enacting Shiraho Yurateiku Charter, I understood the mechanisms of the decision making and autonomy of the community and the importance of formal consensus building

Sequence of events leading to the enactment of "Shiraho Yurateiku Charter"

(Enacted by Shiraho Self-gevernance Association)

Charter drafted by: 2004 Remote Islands and Depopulated Areas Support Project
Prepared by "Shiraho Yurateiku experience 2004 project" group for Next Generation Plan
(The author participated in drafting as deputy leader of the group)

Preparation period: Started May 31, 2004. Basic Policy Proposal for Community Development at first Shiraho Yurateiku Festival on December 10 (including 6 community development articles).

Draft writing: Promotion of charter preparation officially handed over to Next Generation Plan group at general meeting of self-governance association in May 2005.
The draft was proposed, discussed and approved by deliberative members of Shiraho Self-governance Association in April 2006.

Enactment of the charter: Draft was proposed, approved and enacted at regular general meeting of Shiraho Self-governance Association in May 2006.

Establishment of charter promotion committee: Commissioned by director of Shiraho Self-governance Association in February 2007 (with the author as general secretary)

<Methods used to understand and share the needs and perception of the residents>

- Visualizing attractive local resources of Shiraho through writing/drawing contest for elementary school and junior high school students
- Records of cultural heritage and historical sites through interviews with elderly people and experts
- Creation of Shiraho local resource map
- All residents survey (for all residents of junior high school age and above)
- Roundtable discussions (9 times)
- Next Generation Plan group meeting (5 times)
- Discussion with deliberative members of Shiraho Self-governance Association
- Deliberations and approval at the general meeting in public hall in Shiraho

Source: Reports of "Shiraho Yurateiku Experience 2004 project" and others

Fig. 12.6 Sequence of events leading to the enactment of Shiraho Yurateiku Charter by Shiraho Self-governance Association

processes to elicit participation of diverse people in quantity (Kamimura and Yamazaki 2015). Shiraho Yurateiku Charter pushed forward a process by making the foundation for conservation of coral reefs and associated coral reef culture by the community themselves.

12.3.2 Shiraho Conservation Council for Bountiful Seas (SCCBS)

The people of Shiraho village recognized the shallow coastal seas of coral reefs in front of the village known as "Ino (coral reef lagoon)" as the sea of shared ownership (commons). The residents of villages along the coast of Okinawa islands have historically had priority in the use of the lagoon over professional fishers. The ino was therefore traditionally the property of the people who lived along the coast (Ueda 1996). In 2004, however, I strongly felt that there was a strong sense of entitlement among a limited number of people involved in the movement to oppose the airport. To advance coral reef conservation, it was necessary to obtain the cooperation of larger set of people living in the village. It was especially necessary to revitalize the connection between farmers and the sea and to take back a sense of ownership of the sea as belonging to the local community.

In addition to fishers and snorkel tour operators using the coral lagoon for their livelihood, the lagoon should be managed and taken care of by diverse people and groups including the self-governance association, elderly citizens' group, women's association, stockbreeders' association and farmers. The Shiraho Conservation Council for Bountiful Seas (SCCBS) was established in July 2005 to invite all these stakeholders to provide such an arena. In its prospectus, the intention behind its establishment was clearly mentioned to show respect for the daily life culture of those who have lived together with the sea, to maintain and develop traditional ways of using coral reef resources, to devise collaborative ways to conserve and restore natural and living environments, and to contribute to the sustainable development of the community through appropriate resource management (Shiraho Conservation Council for Bountiful Seas 2016).

SCCBS created rules for use of the sea. With this rule, snorkel tour operators (mostly as a side business of fishers at that time) were expected to play major roles to lead conservation activities and safety measures on the sea, thereby facilitating other community members to become more involved. "Voluntary Rules for Snorkel Tour Operators" were established in June 2006, and voluntarily fishing ban areas were established at the sites of release of tridacna clams (sedentary bivalves) aimed to improve stock status of the clam (Kamimura 2011a, b). In December 2015, twelve snorkel tour operators signed the "Conservation and Use Agreement of Shiraho Coral Reefs" with the certification by the governor of Okinawa. Various voluntary rules on the sea usage were established corresponding to emerging local issues.

To promote participation by farmers, a traditional fish trap made by stones (stone tidal weir: Inkachi)" was restored (Kakuma and Kamimura 2010). Stone tidal weirs are semicircular stone walls that trap fish by taking advantage of the tides. In the past, the traps were built and used by farmers who had farmland nearby. The elderly people who once used the stone tidal weir, members of SCCBS, students of Shiraho elementary and junior high schools and PTA members participated in the restoration activities. Some participants expressed the opinion that, "Fishermen and snorkel operators have been the main voice for the issue of the sea. But now we feel we are entitled to voice our opinions about the seas," thereby reclaiming their sense of ownership (Kamimura 2007). People began to recognize deteriorations of the coastal environment through their experience using the stone tidal weirs, leading to the initiation of the shell ginger greenbelt project to prevent soil runoff from agricultural fields. And, SCCBS held international Stone Tidal Weir Summit in Shirho for creating SATOUMI in 2010 (Kamimura 2011a).

These series of actions opened a window for the coral reef conservation activities on farmlands that were once impossible, another step forward in the entire process.

12.3.3 Shiraho Sunday Market and Coral Reef Conservation Products

Food culture and handicrafts that take full advantage of the blessings of nature is an important component of coral reef culture. Shedding light on the wisdom and skills required to make use of local natural resources to develop local signature products is needed for sustainable local development in coral reef cultures.

With the cooperation of the people of Shiraho, I first launched a local cuisine study group in May 2004. In order for Shiraho people to participate easily, I designed an activity focusing the topic not directly related to coral reef conservation. We invited members of the older generation in their seventies and eighties to teach us how to make local dishes inherited from tradition in Shiraho. Young mothers who wanted to learn about traditional food culture also participated in the study group. We learned how to harvest natural food ingredients and cook them in the traditional way for 2 years. Taking advantage of the experience and human relations developed in this group, we started the “Shiraho Sunday Market” as a place for direct sales of natural products in September 2005. The Shiraho Sunday Market also invited people selling their products at Shiraho Yurateiku Festival held at the same time as the charter was enacted in December 2004. The market began operating once a month on the corridor of CRCRC with major success, developing into operating weekly since August 2012, and becoming a popular tourist spot in Ishigaki Island when the new airport was opened in 2013. The Shiraho Sunday Market is also working on developing products using shell ginger grown in the green belt. Purchasing shell ginger leaves provides an economic incentive for farmers collaborating with green belt planting. While planting for green belts works to prevent soil runoff, it also reduces the amount of arable land and obstructs the movement of farming machineries, thus making it hard to get more farmers to participate (Kamimura 2012a, b).

Currently, products such as floral water extracted from the leaves and shell ginger teas are developed and sold. Shell ginger from the green belt is used as a raw material for these products, and a part of the sales of these products is used for financing maintenance of the green belts.

In 2014, subsidies from the ministry of internal affairs and communications were obtained and used for equipment, such as large dryers and grinding machines, for production of these commodities. In 2015, we requested Ishigaki City to apply to the Local-community Vitalization Program of the ministry to employ a young development specialist in Ishigaki City to work full time at Shiraho on expanding the shell ginger industry. A development specialist was assigned to NPO Natuspana in September 2016 to develop products and pioneer new markets to support management of the Sunday market. I have also begun to support sales and marketing of shell ginger products together with students at Chikushi Jyogakuen University in Dazaifu City, Fukuoka Prefecture, where I have been newly assigned (Fig. 12.7). If these activities take root to provide incentives, the network of green belt farmers is expected to expand.

Fig. 12.7 Shell ginger tea packages designed by students

When economic activities closely tied to coral reef conservation are well established, sustainable community development will proceed to the next stages.

12.4 Ensuring Activities to Be Rooted and Mobilized in Local Communities

An effective way of activating efforts connected with coral reef conservation in Shiraho is to create mechanisms linking conservation to economic activities.

CRCRC have received many inquiries from outside the island regarding opportunities to participate in environmental education and environmental conservation activities. Shiraho community can provide people from outside the island with opportunities to experience coral reef cultures and conservation activities that are deeply rooted to the community. As a part of the activities of Shiraho Yurateiku Charter Promotion Committee, the Course of Shiraho Studies was convened for local people to learn local history and cultural resources together with case studies of community development activities addressing local challenges to rekindle active commitment of local people. School excursion trips from outside the island began to be taken in by Shiraho community from 2011 with farming experiences provided by local farmers, greatly stimulating the self-confidence of those involved. As a result, the establishment of an NPO was approved at the general meeting of the Shiraho Self-governance Association in 2012, giving birth to NPO Natsupana licensed by the prefectural governor in May 2013 (NPO Natsupana 2016).

Natsupana is an incorporated non-profit organization dedicated to community development consisting of voluntary residents in Shiraho. Its initial goal was to maintain and expand community development activities in which I had been involved in, creating full-time employment opportunities for young people in organization management and coordinating activities. Natsupana employs study tours utilizing local resources as a mainstay for income. In order to balance community development and coral reef conservation, the tour program includes snorkeling in the coral reefs and participating green belt planning for preventing red soil runoff together with homestays to experience the lifestyles of local people inheriting coral reef cultures. Activities in Shiraho to which I have been committed since 2004 cover a wide range of community challenges. The intention behind this strategy was to build relationships with many local residents to mobilize a wide range of activities to make a few of them continue well into the future (Table 12.3).

Many activities in Shiraho would have been impossible to start if it had not been the period around the year 2004. In order to promote sustainable community development based on coral reef culture, existence of elders who had inherited the culture and lifestyle deeply connected with coral reefs was indispensable. By directly listening to stories about the blessings of coral reefs from elderly people in their seventies and eighties, we could deepen our sympathy and understandings of coral reef cultures.

The future of the community is in the hands of the people who live there. The people who live in the area have diverse sets of values, and each person is faced with his or her own challenges. In order to build a sustainable local community, it is necessary to patiently discuss future directions of the community while respecting all sorts of viewpoints and opinions. It is therefore necessary to have both the strong attachments among people to their own community and the mechanisms to bring such perceptions and visions to take a concrete form, the latter being a function of catalyst.

Those who assume the role of catalysts face many difficulties. One is to manage distances between catalysts and the communities. The catalyst can work with local people based on trust. It is therefore vital to fill in all missing pieces to avoid deadlocks of the activities. However, if the catalyst make a commitment to all community challenges by filling in essential pieces, people may become too dependent on the catalyst, thereby hampering independent efforts. Therefore, keeping balanced positions and distance with the community is important. The second is to maintain motivations of the catalyst working from behind the scenes, because it is sometimes hard to recognize their contributions in the community or from the outside. Human societies do not usually have mechanisms to evaluate and appreciate functions and contributions of actors working behind the scenes, such as catalysts, making it difficult for the catalysts maintain their motivations. Strong will and determination of the catalysts are required to keep them well motivated in current social systems.

In summary, there are three factors that I found to be invaluable as catalysts for community actions.

Table 12.3 Diversity of local community actions and development of community businesses

Types of actions	2004–2007	2008–2011	2012–2015	Development stages of community businesses
Create organizations to lead community actions (Develope organizations)	Shiraho Conservation Council for Bountiful Seas (SCCBS)	Shiraho Sunday Market Management Association	NPO Natsuhana	Diverse community businesses liaised through NPO Natsuhana
	Charter Promotion Committee			
	Shiraho Sunday Market			
Visualizing and utilizing local daily life culture linked to coral reefs (Communication)	Documentary production	Registration of cultural property by Shiraho Self-governance Association	Setting signs of registered cultural heritages	Setting model walking trails of the village
	Local cuisine workshop	Publication of “Shiraho Village in paleography”	Guidebook of cultural heritages	
	Yurateiku map			
	List of cultural heritage			
Promoting collaboration among diverse stakeholders to agree upon community visions and targets (Establish rules)	Yurateliku Charter	Autonomous rules for use of the sea (Rules for researchers)	Rule of tourism use of the sea (Conservation and Use Agreement of Shiraho Coral Reefs)	Operation of snorkel tours
	Autonomous rules for use of the sea (Snorkel tour operators, manner of visitors)	Autonomous no-take zones for tridacna clams		
Creating diverse opportunities of participation to empower human resources to take responsible roles in the community (Develop human resources)	Shiraho Kids Club	Yamanguu Camp		Nature Experience Programs
	Snorkel training classes for adults	Courses of Shiraho study		Coral Reef Culture Experience Programs
	Yurateiku Festival	Environmental education for Shiraho Junior Highschool		
	Environmental education for Shiraho elementary school	Town landscape restoration project		
		International Stone Tidal Weir Summit		

(continued)

Table 12.3 (continued)

Types of actions	2004〜2007	2008〜2011	2012〜2015	Development stages of community businesses
Establishing mechanisms to secure continuity of diverse actions (Create local industries)	Shirano Sunday Market (once in a month)	Shirano Sunday Market (twice in a month)	Shirano Sunday Market (every week)	Shirano Sunday Market (every week)
	Kids exchange meeting between Kashima city and Shiraho village	Shell ginger products (Sarmin)	Shell ginger products (herb tea)	Production and marketing of Shell ginger products
			Set menu served on a leave	Study tours
			Study tour	University training courses
			Experience of Shiraho life	Homestay businesses
			Development of shell ginger processing facilities	
Developing methods for coral reef conservation, resource management and sustainable utilization (Conservation)	Restoration and use of stone tidal weir	Landscaping of agriculture and greens	Development of shell ginger fields	Use of stone tidal weir (Fishing experience tours)
	Green belt project	Tridacna clam release	Red soil monitoring	Experience tours of coral reef conservations (Planting green belts)
			National trust management	Environmental monitoring tours

The periods of launch of each action are noted before 2015. Continued actions are noted after 2016

The first is learning attitudes of catalysts from the community. By actively learning and utilizing local natural and cultural resources passed down through generations, the catalyst can share and enhance their affection and pride in the local community.

The second is sharing a sense of accomplishment and self-efficacy with people to perceive the impacts of their own activities. Visualizing outcomes of their activities with the participants creates greater satisfactions to promote a virtuous chain reaction of activities.

The third is preparing diverse modes of commitments to the community to achieve its goals. It takes time for the activities to take root in the community.

Therefore, it is important to steadfastly work towards goals while altering modes of commitment matching to circumstances in the community.

I began working in bottom-up sustainable community development in hopes that the potential uses of catalysts would be widely recognized and that their positions in local communities would be established. The time would come for the professionals with ample experiences and expertise as catalysts tackling with difficult challenges of local communities to create actions toward sustainable development of local communities. Through creation of integrated local knowledge systems related to the environment and sustainability of local communities promoted by professional catalysts with appropriate social valuations, we are looking forward to local autonomous activities to create sustainable communities spreading throughout the world, contributing to sustainable futures of human society.

References

Kakuma S, Kamimura M (2010) Okinawa: effective conservation practices from Satoumi in a coral reef ecosystem, CBD Technical Series No. 61. Secretariat of the Convention on Biodiversity, Montreal, pp 85–93

Kamimura M (2007) Restoration of Kachi, traditional fishing installation of Shiraho coral lagoon: community-based coral reef conservation and resource management. (石垣島白保「垣」再生–住民主体のサンゴ礁保全に向けて). Reg Stud (Okinawa University) 3:175–188 (in Japanese)

Kamimura M (2010) Biodiversity conservation begins at community development: through the activity of Shiraho sango-mura. (生物多様性の保全は地域づくりから-しらほサンゴ村の取り組みを通して–). In: Regional biodiversity strategy forum. The Institute of Regional Studies, Okinawa university, Naha, pp 47–53 (in Japanese)

Kamimura M (2011a) Possibility of biodiversity conservation using “SATOUMI” as a keyword – report of Shiraho’s international stone tidal weir summit (「里海」をキーワードとした生物多様性保全の可能性–世界海垣サミットin白保を通して–). Reg Stud (Okinawa University) 8:17–28 (in Japanese)

Kamimura M (2011b) Marine biodiversity conservation by the community of Shiraho on Ishigaki island, Okinawa (沖縄県・石垣島白保集落でのコミュニティによる海洋生物多様性の保全). Fish Promotion 517:24–41 (in Japanese)

Kamimura M (2012a) Coral reef conservation and sustainable community development in Shiraho, Ishigaki island: investigating traditional relationships between farmers and coral reefs for conservation. (石垣島白保集落におけるサンゴ礁保全と持続可能な地域づくり –農村集落のサンゴ礁とのつながりを掘り起こしながら–). J Rural Plan 31(1):96–98 (in Japanese)

Kamimura M (2012b) Ishigaki island: did the agricultural land improvement project provide well-being of local community?: influence on coral reef by the economic development after Okinawa reversion to Japan (石垣島:土地改良事業は豊かな暮らしを生み出したか –復帰以降の経済開発によるサンゴ礁への影響–). In: Sakurai K, Sunagawa K, Nakanishi M, Matsushima Y, Miwa D (eds) Environmental problems of Ryukyu islands. Koubunken, Tokyo, pp 127–135 (in Japanese)

Kamimura M, Yamazaki J (2015) The system of nature conservation and community design in Shiraho, Ishigaki, Okinawa – focusing on the origin and dwelling history of local residents. In: Architectural Institute of Japan, Proceedings of the housing Studies Symposium, 2015, pp 43–52 (in Japanese)

Local science network for environment and sustainability (2016) What's LSNES? http://lsnes.org. Accessed 23 May 2016

Miyauchi T (2013) Why doesn't environmental conservation go well?: possibility of adaptive governance (なぜ環境保全はうまくいかないのか –順応的ガバナンスの可能性–). In: Miyauchi T (ed) Why doesn't environmental conservation go well? Shinsensha, Tokyo, pp 14–18 (in Japanese)

NPO Natsupana (2016) What's Natsupana? (夏花とは?). http://natsupana.com/aboutus/. Accesses 21 May 2016 (in Japanese)

Shimamura O, Ishigaki S (1988) Pilot study report "natural lifestyle journal on coral reef cultural sphere: relation with the living and the barrier lagoon of coral reef in Shiraho village, Yaeyama" (サンゴ礁文化圏の自然生活誌 –八重山白保部落のイノーと暮らし–). Uogaki-no-kai (in Japanese)

Shiraho Conservation Council for Bountiful Seas (2016) Agreement of Shiraho Conservation Council for Bountiful Seas revised edition 2010.5.18 (白保魚湧く海保全協議会規約 改訂版 2010.5.18). http://sa-bu.natsupana.com/aboutus/. Accessed 21 May 2016 (in Japanese)

Uechi Y (2013) Tale of new Ishigaki airport: traces of the 30-year suffering and conflict in Yaeyama county (新石垣空港物語 –八重山郡民30年余の苦悩と闘いの軌跡–). The Yaeyama Mainichi Newspapers Co., Ltd. (in Japanese)

Ueda F (1996) Fishery rights on coral reefs and marine use (サンゴ礁の漁業権と海の利用). In: Hamamoto Y (ed) Theory of the Gardian of the sea. Mana Book, Tokyo, pp 181–192 (in Japanese)

WWF Japan (2016) About activities in Shiraho, Ishigaki island (石垣島・白保(しらほ)での活動について). https://www.wwf.or.jp/activities/nature/cat1153/cat1187/index.html. Accessed 21 May 2016 (in Japanese)

WWF-Netherlands (2003) The economics of worldwide coral reef degradation. Cesar Environmental Economics Consulting, Arnhem

Part IV
Creating Linkages

Local communities are open complex systems that interact with internal and external institutions and actors. Multiple, varied linkages with institutions and actors both inside and outside the communities emerged from transdisciplinary processes in the local social-ecological systems and have led to transformation of local communities. Part IV analyzes transformative mechanisms in the emergence of new linkages among internal and external institutions and actors of local communities in TD processes, including the functions of bilateral knowledge translators in these processes.

Chapter 13
Certification Schemes Wielded by Producers and Communities

Reiko Omoto

Abstract There are two types of certification schemes wielded by local communities to deal with socio-ecological sustainability issues. One type utilizes international frameworks for solutions to issues faced by communities. While with the other type, communities create their own specific local schemes on a custom-made basis. The former type is denoted as “International Third-Party Certifications,” which are specifically designed for sustainable resource management purposes and play a role in communicating universal values of sustainability. On the other hand, “place-specific certifications” are only applied to defined regions and possess detailed standards that are suited to each region’s specific forms of agriculture, forestry and fisheries, taking into consideration such factors as the region’s society, environment, culture and local resources. Both are tools in the search for solutions to local issues through institutional approaches. They both also share common ground in the sense that they play a role in linking the producers and their communities with the outside world. In other words, certification schemes fulfill the role of embodying values of regions in products that transcend material values – for example, sustainability through environmentally sound production practices. Consumers and distribution channels then can respond to these embodied values by choosing to buy the products.

13.1 What Do International Third-Party Certifications Do for Resource Management?

13.1.1 The Risk of “Let Issues Be”

Natural resources can be categorized into those which are renewable and those which are not. For example, reserves of oil and coal are being depleted and will be completely gone once used up. Meanwhile, forestry and fishery resources are

R. Omoto (✉)
Research Institute for Humanity and Nature, Kyoto, Japan

Tottori University, Tottori, Japan
e-mail: reiko.omoto@tottori-u.ac.jp

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_13

precious resources that, if they continue to be used at appropriate levels, will keep regenerating and increasing. This is the case with forests, but even more so with fishery resources, where even without human intervention, fish stocks will replenish themselves simply by having sufficient numbers of parent fish in the sea.

The main aim of International Third-Party Certification for resource management (hereafter: International certifications) is to take advantage of the renewable characteristics of specific resources of this kind to promote their sustainable use within markets – i.e. utilizing the mechanism of demand and supply, they seek to generate a demand for environmentally sound products and promote the supply of sustainable products among producers. This concept is known as "market-based solutions" (Dietsch and Philpott 2008, p. 248). These schemes which play a role in informing consumers about the intangible values of the "sustainability" of products through ecolabels.

International Certifications, which include such schemes as the Forest Stewardship Council (FSC) and Marine Stewardship Council (MSC), have become extremely well known in recent years, but they are a relatively recent phenomenon. Agenda 21, which was adopted at the 1992 United Nations Conference on Environment and Development (the Rio de Janeiro Earth Summit), contains clauses like the following relating to International Certifications.

> 4.21. Governments, in cooperation with industry and other relevant groups, should encourage expansion of environmental labelling and other environmentally related product information programmes designed to assist consumers to make informed choices. (4.21)

FSC, which was founded in 1993, the year after the Earth Summit, is an International Certification scheme which aims to ensure the sustainable management of forestry resources (Table 13.1). Prior to this, the conservation of forests generally took the form of environmental conservation groups conducting lobbying activities against companies involved in the felling of forests (during the 1980s in particular, protest movements against the destruction of the Amazon Rainforest were prevalent, mainly in the Western countries). In addition, there were also movements calling for boycotts of tropical timber, in response to which the countries producing tropical timber protested that the movements were unfair trade barriers. However, the establishment of FSC was realized through the cooperation of the World Wide Fund for Nature (WWF), an international conservation organization, along with corporations. In other words, those involved in forest conservation movements felt frustrated by the style of working in which they protested and waited for governments to enact related legislation (Auld 2014), and companies, fearing that this criticism would have a negative impact on their corporate activities, searched for ways to prove to the wider public that they were not accomplices to irresponsible deforestation. It was FSC certification that brought both sides together under the common goal of "the sustainable use of forests," for which the FSC has drawn much attention as an alternative solution. Today, Business-NGO partnerships (Murphy and Bendell 1999) are far from rare, but at the time the fact that the perpetrators and protestors were beginning to work together was met with much criticism as "greenwashing" – using the meaning of environmental conservation as a pretense.

Table 13.1 The history of international certification schemes and their revolutions

1928	The first global environmental logo mark (Demeter for organic farming)
1972	The first global certification scheme (Demeter for organic farming)
1977	The first Governmental eco-label (Blue Angel by the federal government of Germany)
1980	The establishment of IFOAM (International Federation of Organic Agriculture) offers
	The common definition of organic farming
	The mutual recognition of national and regional certification schemes
1982	The establishment of Naturland
1992	The Rio de Janeiro Earth Summit (The United Nations Conference on Environment and Development)
	Agenda 21 (4–4.2) encouraged the global collaborative resource management through the use of eco-labels as alternative to national regulations
1993	The establishment of FSC (Forest Stewardship Council)
	The partnership between NGO and commercial corporations
1995	Naturland introduced organic seafood certification standards
	Salmon, 1996
	Mussels, 1999
	Trout, 2000
	Shrimp, 2001
1997	The establishment of MSC (Marine Stewardship Council)
	Established by WWF (World Wide Fund for Nature) and Unilever
	Modeled on FSC applied to wild-caught seafood
1999	The establishment of PEFC (The Programme for the Endorsement of Forest Certification)
	Established by certification schemes of 8 countries
	Mutual recognition of national and regional forest certification schemes
2002	ISEAL (International Social and Environmental Accreditation and Labelling Alliance)
	The global membership association for sustainability standards
	"ISEAL Code of Good Practice for Setting Social and Environmental Standards"
2004	The establishment of RSPO (Roundtable on Sustainable Palm Oil)
	Established by 7 organizations including WWF
	Operated by 7 sectors (oil palm producers, processors or traders, consumer goods manufacturers, retailers, banks/investors, and environmental and social NGOs)
2009	FAO (Food and Agriculture Organization of the United Nations) published the Guidelines for the Ecolabelling of Fish and Fishery Products from Marine Capture Fisheries
2010	The establishment of ASC (Aquaculture Stewardship Council)
	Established by WWF and IDH (Dutch Sustainable Trade Initiative)
	Standards setting for each species through stakeholder participation called "aquaculture dialogue"

Modified from Omoto (2016a)

When resources move beyond national borders, international management systems are needed in addition to regulations at the domestic level. However, it is an extremely lengthy process to draw up international treaties and international management systems. One of the factors behind the success of International

Certifications is that, to a certain extent, they have made it possible to put in place rapid resource management; in other words, they can act to help avoid the risk of "let issues be". Until now, resource management relied on the laws and regulations of countries. However, drawing up and implementing inter-country agreements that are agreeable to all associated parties takes an inordinate amount of time. International Certifications are based on voluntary participation, rather than compulsory obligations. However, the resource users who consent to these schemes have their performance assessed over a comparatively short period of time and are then able to prove their sustainability credentials. Furthermore, while those on the consumer side do not have any direct involvement with laws and regulations, the fact that certified producers can sell products containing an ecolabel enables the general consumer to become indirectly involved in the resource management process.

The FSC was established in 1993; once it was apparent that its certification system functioned, the MSC (covering wild-caught marine products) followed on and commenced its operations in 1999. These International Certifications, which in principle consist of assessments according to set criteria and ecolabels, differ in many ways depending on the characteristics of the resources and the structure of industries that they target. The resources covered by the MSC are mainly marine resources for human consumption, such as food (although the FSC also has some certified products that are for food purposes, such as mushrooms and honey (forest products)). In addition, the resources covered by MSC are migratable; for example, in the case of highly migratory species (tuna, salmon etc.), there is a degree of ambiguity as to whom really owns these resources. To further compound this complexity, their populations cannot be counted or confirmed visually, meaning that estimates of resource stocks for certification assessment require more scientific data. What is more, the Aquaculture Stewardship Council (ASC), founded in 2010, aims to manage aquaculture that uses ecosystem services to efficiently produce seafood instead of the direct use of natural resources. ASC is a certification scheme for the sustainability of aquaculture, a form of activity which uses resources that are in a relationship with tradeoffs with other ecosystem services (e.g., aquaculture, palm oil production). This system of certification, therefore, needs to incorporate things such as the international standardization of chemical agents required for aquaculture (e.g., some chemical agents may be legal in some countries and illegal in others) along with the sustainability of wild fish used as feed within its evaluations of sustainability. In addition, certification schemes for products cultivated in plantations, such as palm oil and coffee beans, have their own characteristics according to the particularities of the resources concerned along with differences in the agents involved. For a more detailed account of the commonalities and differences between these International Certifications, please see Table 13.1.

13.1.2 Fundamental Requirements for International Third-Party Certifications

There are several elements, which could be classified as fundamental requirements, which the International Certifications currently in wide-use throughout the world have in common. As shown in Table 13.1, they represent a series of requirements that credible International Certifications should have in place based on, for example, the guidelines published by ISEAL or FAO. These requirements can be summarized as follows: (1) Voluntary program (based on voluntary participation); (2) Consistent with international frameworks; (3) Third-party assessment; (4) CoC and ecolabel programs; and (5) Systems which guarantee credibility (Omoto 2014).

International Certifications are based on voluntary participation and in principle do not possess enforceability by a legally-binding force. This is because while laws and regulations serve to penalize activities which place a burden on the environment, International Certifications are schemes which reward those who give consideration to the environment and makes the fact in public with ecolabels. Therefore, as mentioned above, they have come to be used widely for resources which are traded at the international level and/or for which ownership is ambiguous (especially forestry and marine products). In these cases, solutions would be difficult through regulations at the domestic level alone. In other words, despite being voluntary, they could also be considered as tools for realizing resource management over broader geographical scales. This is why they have been referred to as “non-state market-driven governance” (Cashore et al. 2004, p. 12) – rather than laws and regulations, companies select certified raw materials and consumers choose certified products – i.e. management through transactions which take place in the market.

When looking at the list of members on the International Social and Environmental Accreditation and Labelling (ISEAL) website, it is apparent that many (if not all) of internationally widely-used sustainability certification and fair trade certification schemes have joined this organization. ISEAL is an organization which monitors improvements to the quality and standards of certification schemes aiming to ensure sustainability. In its “ISEAL Code of Good Practice for Setting Social and Environmental Standards” (ver6.0, revised in December 2014), it sets out the principles of certification schemes which aim to achieve social and environmental sustainability. They are codes behind trustworthy certification schemes, procedures and consistency for setting certification standards, participation by stakeholders in assessments, revisions and amendments to certification standards, and the setting of variations of standards that can be applied to each region. Organizations that acquire a full membership of ISEAL appeal to the public by declaring on their website that their certification systems is in conformity with the items set out in this documents. In addition, in the world of fisheries, the FAO has published the “Guidelines for the ecolabelling of fish and fishery products from marine capture fisheries” (FAO 2009). These guidelines set out the minimum necessary requirements and standards for fishery operations to be deemed sustainable, and for elements including “management systems,” “stocks under consideration” and “ecosystem consideration” that are required to qualify for displaying an ecolabel. In regards to aquaculture, the FAO issued the "Technical Guidelines on Aquaculture Certification" in 2011 (FAO 2011). These FAO guidelines are only meant to serve as guidelines, and they differ from ISEAL in that there is no audit or membership system, with compliance being made on the basis of self-declaration.

Another fundamental requirement for International Certification is a third-party assessment system. Certification systems can be classified according to the agents who assess conformity to certain standards and the associated processes. First-party certification refers to assessment against standards that companies and producers have set themselves regarding items which fall in line with their own goals, the adherence which they self-assess – in other words, internal audits and self-declaration. Next is second-party certification, in which industry organizations such as unions and associations assess the products of their members, or retailers assess the products of their suppliers based on their own standards. This is a system of certification between two parties engaged in a commercial relationship. Finally, in the case of third-party certification, the standards for assessment are set by a standard setting organization (Fig. 13.1). Assessment of producers who wish to acquire certification is conducted by third-party organizations that are independent from the standards setter (called conformity assessment bodies: CABs, many of these organizations are commercial companies that also conduct assessments of certifications for such things as safety and quality management). Third-party organizations (CABs) are organizations which are completely independent from commercial relations, and it is these CABs which award certifications rather than the FSC or MSC, the organizations which set the standards (the certificates are issued under the CABs' name). Of further note, ASI, one of the full members of ISEAL, is an organization which is consigned accreditation (screening of qualifications) of each CABs to ensure certifications and assessment services of a consistent quality.

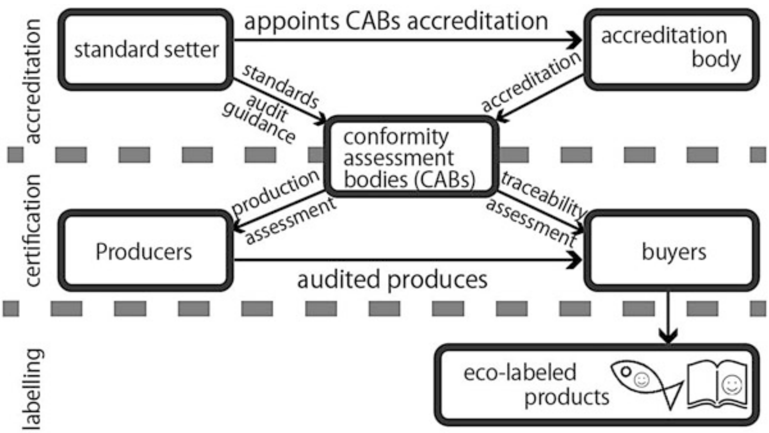


Fig. 13.1 Structure of third-party certification

Certification systems and ecolabels are paired programs, but in order to put this pair into practice, separate CoC certification (Chain of Custody, applied to FSC, MSC and ASC) or SCCS (Supply Chain Certification System for RSPO) are required. These are so-called certificates of traceability for guaranteeing that ecolabels are only displayed on products for which certification has been received. In other words, ecolabels guarantee that these products were produced using the raw materials for which certification has been received, thus playing a role in reassuring the end consumers through the supply chain that consideration has been given to the environment during the production process.

Finally, concerning systems which guarantee credibility, assessments are carried out based on scientific evidence and the standards for assessment which form the grounds for certification are published openly. In addition, the transparency of standards and assessments is ensured through the participation of those involved in setting/amending the standards, the publication of the progress of assessments, and the publication of such data as the names and fields of expertise of auditors, the input of information and opinions into the assessment process by interested stakeholders, disclosures of the results of assessments, and the grounds and scores behind the items included in each evaluation.

13.1.3 The Focus of International Certifications; Consumers or Producers?

International Certifications have become widely used throughout the world as tools for the construction of sustainable business models and the implementation of CSR (Corporate Social Responsibility) among companies that rely on natural resources. Accordingly, a range of research has been carried out from the perspective of having consumers participate in resource management through such cooperates' integration of certifications on their products. For example, with certification the conservation activities that companies engage in can be a part of their work or their work itself serving to conserve biodiversity through economic mechanisms rather than being additional costs. While with the mechanisms such as offset in biodiversity and biodiversity banking forming new lines of business, International Certifications make it possible to conserve the environment through the procurement of sustainable raw materials as continuation of conventional corporate activities (Adachi 2010). In addition, a vast body of surveys and research has been conducted on the degree of recognition of International Certifications among consumers. These show that current views on certification focuses on ensuring the sustainability of resources that have many benefits for companies and consumers.

Meanwhile, it is the producers who turn resources into forms which we can use, and unless the framework of International Certifications is such that they can be used by producers, they will not become an option for producers' long term operations and will be essentially useless. Furthermore, the prospect for a ripple effect not only for producers but also for the surrounding communities where production activities are carried out helps support industry and translates more easily into long term operations. With this perspective in mind, the author wishes to introduce three case studies in which International Certifications are actively being utilized by producers.

Case 1: From Traditional Aquaculture to the Latest Eco-Aquaculture (Organic Certification for Extensive Shrimp Aquaculture in Vietnam) In the Mekong Delta region of Vietnam, there is a thriving shrimp aquaculture industry, with the cluster of shrimp processing companies forming what is a major export industry. The shrimp aquaculture industry in Vietnam was slower to introduce intensive farming techniques than other countries in Southeast Asia, and aquaculture through a transition from rice paddies has served to increase production volumes. However, while the rate of intensive or semi-intensive shrimp aquaculture stood at 3% in 2002 (Thi 2007), literature dating to 2011 suggests that it has increased to between 10% and 15%. Even so, most shrimp aquaculture is carried out by around 250,000 small scale family-run farming operators (Nhuong et al. 2011). One of the methods employed by small-scale family-run farm operators of this kind is traditional extensive non-fed aquaculture. In conventional shrimp farming cases, shoreline mangroves are cut down to create aquaculture ponds. Shrimp larvae are then added to these ponds and fed, which enables high densities of shrimp to be cultivated within a short period of time. Under this method of aquaculture, a small water wheel is turned to prevent the shrimp from becoming deficient in oxygen, which is why they can be recognized from a distance. The density of shrimp is around 15–30 individuals per square meter; given this high density, it is often the case that chemical agents or antibiotics are used as a measure to prevent sickness among the stock.

Meanwhile, in the case of traditional extensive aquaculture, mangroves within aquaculture ponds are allowed to grow; and therefore, it is sometimes not possible to tell that these areas contain aquaculture ponds (Fig. 13.2). Furthermore, other than introducing shrimp larvae into the aquaculture ponds, no feed or chemical agents are used, meaning that shrimp are cultivated using methods that are extremely close to nature. Not only the commercially-targeted species, but other shrimp, crabs and fish that enter the ponds because of natural tidal fluctuations form a source of extra income or subsistent food consumption for farmers. Since 2001, shrimp that have been raised using this method of aquaculture have received certification as “organic shrimp” using the standards of Naturland which is based in Germany, and are exported to Europe. While in some cases there is a need to plant mangroves in order to meet the standards for mangrove surface coverage according to the size of the pond, the original method of aquaculture itself is in almost complete accordance with organic standards, which is why most farmers receive certification despite being small scale family-run farm operators.

A demand has been generated for these organic shrimp among consumers in Europe due to an increased awareness of the decline of mangroves as a result of conventional shrimp aquaculture. Meanwhile, in Vietnam, which is moving in the direction of intensive aquaculture, this traditional method of aquaculture was a “out of date” method. However, with the receipt of certification, it became repositioned as

Fig. 13.2 A traditional extensive non-fed aquaculture pond of shrimps

the latest "eco aquaculture." With the flow of information which has resulted from globalization, people in consumer countries have learned about the impacts that intensive aquaculture is having on the environment in this producer country. It is in response to situations such as this that International Certifications serve to reevaluate the sustainable methods of production remain in producing countries and deliver information to consumers who are looking to purchase environmentally ethical products. However, the introduction of International Certifications necessitates that producing countries ensure traceability; this serves to limit the options available to producers as to where they sell their products. It has become apparent in Vietnam that, in some cases, farmers are not necessarily able to sell their shrimp at a higher price (Omoto and Scott 2016).

Case 2: ASC Certification as a Means of Avoiding the Dilemma of Intensive Aquaculture (the Revival of Oyster Aquaculture in Minamisanriku) In March 2016, oyster aquaculture in Minamisanriku Town, Miyagi Prefecture, Japan (specifically, the "Oyster Subcommittee," which belongs to the Togura Office of the Shizugawa Branch of Miyagi Prefecture Fisheries Cooperative), became the first organization in Japan to acquire ASC certification, an International Certification scheme for sustainable aquaculture. This event occurred exactly 5 years after the 2011 earthquake and tsunami off the Pacific coast of Tohoku.

Prior to the earthquake and tsunami, oyster aquaculture here did not produce oysters of such a high quality as one would think due to the over-crowded oyster culture rafts; what is more, a period of 3 years was required for oysters to grow before they are harvested. Ironically, just as people here were thinking that something had to be done to change this situation, the tsunami struck and washed away all the aquaculture facilities. In the wake of the tsunami, heated discussions continued among producers concerning appropriate aquaculture densities. Thus, they decided to reduce the number of rafts by a third, a decision which, following implementation, led to their acquisition of ASC certification. Needless to say, one of the aims behind this decision was to gain added value through certification. However, more than that, the acquisition of International Certification was a means to support the establishment of a resilient form of aquaculture against future disasters (a reduction in the number of rafts would reduce the extent of the damage in a future disaster) and to make the transition to private enterprises from collaborative operations through subsidies for earthquake disaster reconstruction (a return to the system which was in place prior to the disaster) (Maekawa 2016). While perhaps not an entirely effect of the certification itself, the reduction in the number of rafts resulted in the period needed for aquaculture, which used to be 3 years, being shortened to 1 year, and the oysters also improved in quality, given that they were now being raised with sufficient plankton intake volumes. The acquisition of this certification was supported by WWF Japan, a nature conservation organization. By acquiring a form of International Certification which possesses clearly defined standards as a policy for appropriate aquaculture densities, Minamisanriku's acquisition of ASC certification has enabled it to share set rules among all producers, distribute the use of resources equally and realize long term sustainability for its regional industry (Omoto 2016b).

In addition to the above two case studies, I would like to introduce a fishery which is currently working toward acquisition of MSC certification. Kesennuma City in Miyagi Prefecture, Japan is famous for its shark industry. This is because it catches the most sharks in Japan and has a longstanding tradition of using various parts of the shark for numerous purposes. Shark meat is used as an ingredient for fish cakes, the sharks' fins are dried to be use in Chinese dishes, and the skin and other parts are used for such things as material for leather and ingredients for pharmaceuticals and cosmetics.

Throughout the world, countries and states are putting in place laws and self-regulations banning shark fishing and suspending the provision of dried shark fins (Animal Welfare Institute and Human society International). This is due to attention being drawn to the practice of so-called finning, a method in which only the fins of sharks are removed and the rest of the carcass thrown back into the sea. Finning is practiced since shark fins have much higher economic value than shark meat and when vessels have limited storage capacity fins are prioritized. Shark fins account 7% of all volume of sharks traded but by economic value, they account for 40% (Lack and Sant 2008). Publicity has been given to this issue through various campaigns initiated by animal welfare organizations and environmental conservation groups. What is more, the protests made by comparatively extreme environmental NGOs and media bodies to directly reach the producers, which have given rise to conflict of a kind resembling whaling and dolphin hunting. The impact of protests over finning and shrinking markets has also extended to Kesennuma's longline fishing, a fishery that does not involve the practice of finning. This in turn has been a factor which has served to delay the fishery's and the city's reconstruction efforts from the 2011 earthquake and tsunami.

Kesennuma's shark fishing industry has been striving to acquire MSC certification following the aftermath of the disaster. The fishery opted to pursue MSC certification to carve out a global market for sustainable shark fins, and as a tool to draw a clear distinction between those shark fins that have been produced through finning and their own shark fins. The strategy here is to counter the criticisms of animal welfare lobbyists by providing guarantees based on scientific sustainability evidence.

From the above case studies, we get a sense of how International Certifications are being actively utilized not only by companies and consumers, but also by producers. Moreover, this utilization is noteworthy in that it aims not only to improve prices and differentiate one set of products over others, but also to pave the way for solutions to a broad range of issues spanning from a local to global scale. Furthermore, in addition to the cases presented here, there are other cases in which the introduction of International Certifications (or even just the consideration of introducing such certifications) has led to the expansion of networks of people into different businesses and has forged ties to specific locations. In other words, International Certifications provide a "platform" which brings together a diverse range of stakeholders (Omoto et al. 2016). International Resource Management Certification systems have been widely accepted by both companies and consumers as tools that enable the verification of a product's ecological credentials without having to visit production sites in person. And one important point worthy of note is that they have also served to generate direct relationships between people.

13.1.4 International Designation Programs

In addition to International Certification, in recent years attention has been drawn to the utilization by regions of international designation programs for sustainable land use and production activities. International designation programs refer to including UNESCO's World Natural and Cultural Heritage and Biosphere Reserves, as well as the FAO's Globally Important Agricultural Heritage Systems. These programs differ in comparison to International Certifications in that while International Certifications award certification to all the applicants which meet certain standards or scores, international designation programs give value to regions by designating regions for their "outstanding universal significance" valuableness, or recognizing regions which serve as model areas in other ways. World Natural Heritage status has the potential to bring major economic benefits to regions on the one hand and to create inconvenient circumstances on the other. While World Natural and Cultural Heritage aims to protect and conserve natural areas that possess outstanding universal value – that is to say, to preserve these areas as they are – Biosphere Reserves aim to promote harmony between the conservation of ecosystems and their sustainable use. In other words, in addition to the protection and conservation of natural areas, emphasis is placed on cohabitation between these areas of nature and human society. For more detailed information on biosphere reserves, please refer to Chaps. 10 and 14 of this book. In addition, as of 2017, nine areas in Japan have been registered as Globally Important Agricultural Heritage Systems, with aspects of Japan's characteristic agriculture and land use such as rice paddies, grasslands, tea farming, and slash-and-burn farming having been appraised as outstanding examples of active landscapes.

13.2 Place-Specific Certifications

As stated at the beginning of this chapter, an important aspect of certification schemes which aim to put in place resource management is that they can be wielded by the regions adopting them. Two specific types of programs exist: International Certifications that regions utilize, and place-specific certifications that regions create by themselves. While International Certifications serve to communicate "universal values" at the international level (Omoto 2017a), this section examines "place-specific certifications" as schemes of certification originating from certain regions. Place-specific certifications are "local" in contrast to "international" certifications, and are certification systems which apply to a specific region. Place-specific certifications are defined as schemes of which contain standards established in accordance with regional conditions utilizing characteristics such as the local climate, ecosystems and soil environment, aiming not only to conserve specific ecosystems but to also ensure the sustainability of the region as a whole. In addition, their core aim is to work towards solving regional issues, rather than solely pursuing economic benefits; they place emphasis on regional development in terms of society, culture and environment, and improving the diversity of economic and agricultural environments along with the processing and sales of local produces (Omoto 2017a).

The setting of regions/area for place-specific certifications to be applied is diverse, but they consist of regions with a certain degree of common ground in terms of geography or environment, and to an extent, they possess overlapping social, cultural and industrial stories. In addition, concerning the agents that administer these place-specific certifications, many of schemes in Japan have been overseen by administrative bodies, but in other cases, they are run by independent organizations like NGOs and NPOs. Furthermore, place-specific certifications differ from local branding, something which is realized through the creation of a specific image, in that "certification systems" can provide justifiable grounds for their claims. One way in which these grounds are presented in place-specific certifications is to deftly incorporate the certifications within existing frameworks (e.g., mutual certification with other forms of certification which are already in use, or administrative and regional frameworks). By doing this, place-specific certifications can be designed in a way that reduces costs and facilitates the participation of a wide range of local producers.

13.2.1 Marketing of Places

Kotler published the book "Marketing places" in 1993 which notes that "Strategic marketing calls for designing a community to satisfy the needs of its key constituencies" (Kotler 1993, p. 18). In general, the word "marketing" is used to refer to "Marketing is the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large" (American Marketing Association 2013). With more community-minded perspectives, marketing of places refers to "the application of principles and methods of marketing that aim to promote community development and solve regional problems" (Miyazoe 2014, p. 17), or "activities which aim to encourage people or organizations who are looking to select an area for some particular purpose to choose their area over other areas, or activities seeking to create and communicate the kinds of local values that are desired by the target people or organizations" (Sasaki et al. 2014, p. 18).

With the marketing of places in mind, place-specific certifications are "(frameworks) through which the development of products and services in forms which maintain the characteristics of regional resources, such as local agriculture and marine products, achieves at the same time solutions to regional social and environmental issues" (Omoto 2017a). What makes place-specific certifications unique is that while they are based on grounds which possess a certain degree of reliability and have in place systems which provide guarantees, they are by no means a watered-down version of International Certifications. In other words, they have been designed in detail in order to fit perfectly with specific regions.

13.2.2 Place-Specific Certifications Which Transform Regional Issues into Values

"Kounotori no mai" (i.e., Circling-Stork Certification) is a perfect example of place-specific certification as this scheme support creation of feeding grounds for Oriental white storks while promoting rice and rice products from the feeding grounds with its ecolabels.

Toyooka City in Hyogo Prefecture, Japan was the final breeding ground of the Oriental white stork (*Ciconia boyciana*), which once became extinct in the wild in Japan in 1971. This bird often feeds in rice paddies and factors that led to its extinction in the wild are said to include changes to agricultural practices (i.e., drain water from the paddies at earlier stage) and a decrease in the numbers of creatures which Oriental white storks feed on due to the spraying of large volumes of agricultural chemicals (Onuma and Yamamoto 2009). Currently not only this area but whole country is experiencing an aging farming population and therefore a conspicuous number of fields are left fallow. Re-vitalization of rice farming was a key for the city for both social and ecological point of views.

Oriental white stork disappeared from Japan’s skies for more than 30 years, but following a series of trials with artificial breeding, in 2005 five Oriental white storks were reintroduced into the wild. Since then, the number of birds in the wild has increased steadily, and at the time of writing, there are 90 Oriental white storks living in the wild, including ones naturally hatched under wild conditions (for additional details, see Toyooka City’s website). A range of work was carried out in anticipation of releasing Oriental white storks into the wild, including turning fallow fields into biotopes. And as part of this series of activities, Toyooka City initiated its own form of place-specific certification in 2003, called “Kounotori no mai (Circling-Stork Certification).” This has made it possible to certify and label things including rice, vegetables, buckwheat, soy beans, tree fruits and processed food. The essential prerequisites for this certification are:

1. Agricultural products or processed agricultural products produced within Toyooka City and
2. Products which have received “Hyogo Safe Brand Products” certification, a form of certification issued by Hyogo Prefecture

In addition to above two prerequisites, for the case of rice, the use of applicable agricultural pesticide and chemical fertilizers must be half or below the common standard for this region (can be no pesticide for the highest certification rank), and farmers must cultivate rice using cultivation techniques which encourage creatures to thrive, with traceable records. In regard to tests for agricultural chemical residues that form the basis of scientific evidence, the burdens and costs incurred by producers have been reduced by incorporating this place-specific certification within existing certification run by Hyogo Prefecture (Omoto 2017a). This system of certification has been designed and initiated by the “Department of Oriental White Stork Coexistence” within Toyooka City Hall, a municipal department unlike any others in Japan. This situation is unique in that it was a governmental department charged with promoting coexistence with Oriental white storks that established this certification system rather than a department specializing in agriculture, like the Department of Agricultural Policy.

Another example of place-specific certifications named after an iconic animal species is Salmon-Safe, which appears in Chap. 16. This system of certification has a unique watershed perspective in the form of managing land use from the viewpoint of salmon.

While the Oriental white stork is a local cultural and ecological resource, it also possesses strong elements of a public goods. In other words, the stork population can serve as a tourism resource, but is a Special Natural Monument in Japan and therefore cannot be a tradable goods or resources just as it is (local resources include tangible and intangible resources, as those which can be directly processed and sold and those which cannot). One of the merits of systematizing solutions to regional issues in the form of place-specific certifications is that, Kounotori no mai is serving to link the Oriental white stork with primary industry through certification and is playing a useful role in promoting the sustainable development of the region (Omoto 2017a).

Place-specific certifications are much more than just certifications as systems, as the essence of it can stretch out to those activities in which food manufacturers with close ties to the local community produce products which maintain the identity of local resources; serving as a hub for the exchange of information between consumers and producers. Examples include a company playing a central role in the restoration of coral reefs in Okinawa through the production and sale of vinegarate Mozuku seaweed products (Mozuku Fund, IGETA TAKEUCHI Co., Ltd. in Tottori Prefecture and Onna Village Fisheries Cooperative Association in Okinawa Prefecture) (Omoto 2017a, also see Chap. 3), as well as a company helping to increase the diversity of local agriculture through the development of cider using heritage varieties of Japanese apples (Omoto 2017b).

13.3 Visualizing Values in Regional Practices and Creating Ties

13.3.1 The Utilization of Certification Schemes: Moving Toward the Local Production for Informed Consumption

At present, movements are springing up around the world aimed at localization of food supply systems in an attempt to provide an alternative to the mainstream mass production and consumption of food. The contemporary localization of food systems is significant in two senses. In a narrow sense, there is the kind of localization which emphasizes geographical proximity to food sources and aims to complete the processes of supply and consumption within the region, thus realizing improvements to self-sufficiency within the region. Typical examples of localization of this kind include the concepts of "local production for local consumption" and "face-to-face relations." In a broader sense, though, there is the kind of localization that, irrespective of geographical distance, aims to improve the transparency of production and distribution channels, connect the identities of the production region and producers to products, and communicate the region's characteristic values to the wider world. In this case, trust born through proximity and face-to-face relations are supplemented and substituted by the functioning of forms of "authentication," such as certifications and labels (Guthman 2004; Omoto 2017a). In other words, this constitutes a transition from local production for local consumption to the local production for informed consumption (Kubota 2009 p. 12).

13.3.2 Certification Schemes Which Connect Producers with the Wider World Through Values

As stated at the beginning of this chapter, certification schemes turn chain-like distribution into networks made up not only of those involved in the transaction of things but also an extremely diverse range of stakeholders.

Schemes in which products containing an ecolabel are seen as having value over other products in the sense that they are more environmentally friendly. The relevant appeal to consumers to choose to purchase these are commonplace these days, but at the time of the FSC's inception in 1992, they represented a completely new kind of socio-economic intangible values and were met with both acclaim and criticism (this continues to be the case today with International Certifications). Today, most people take the existence of these systems as a given; however, for example, as with a completely new genre of music which becomes recognized as culture over time, or a new technology that gradually permeates into our daily lives, there can be no objection to the notion that International Certifications have steadily moved on from being "socio-economic innovations" to regular systems that are a familiar existence in today's world.

Westley et al. (2007) recommend we view the world not as complicated, but as a complex system. "Relationships" are an important aspect of a complex system, and how a complex system functions in turn depends on these relationships. This is a description relating to transformations which take place as a result of social innovation, but could the same not be said of certification systems that make it possible to bring a diverse range of stakeholders together to engage in dialog? In addition, while in many cases local issues consist of a complex simultaneous intertwinement of environmental and social issues, clues as to their solution that until then had not been apparent come into view through the construction of relationships concerning these. International Certifications that aim to put in place resource management and place-specific certifications whose goal is to achieve regional sustainability are systems that enable producers who produce food and utilize resources to communicate a range of values and connect with those who share the same broader values, even if the issues for which a solution is being sought or the level of governance are different.

References

Adachi N (2010) Thoughts from 11 leading Japanese companies together with NPO, local authority and university: practical approach to biodiversity by business (国内先進企業11社とNPO、自治体、大学が語る 企業が取り組む「生物多様性」入門). JMA Management Center, Tokyo (in Japanese)

American Marketing Association (2013) https://www.ama.org/AboutAMA/Pages/Definition-of-Marketing.aspx. Accessed 29 Mar 2018

Animal Welfare Institute. International shark finning bans and policies. https://awionline.org/content/international-shark-finning-bans-and-policies. Accessed 29 Mar 2018

Auld G (2014) Constructing private governance: the rise and evolution of forest, coffee, and fisheries certification. Yale University Press, New Heaven/London

Cashore B, Auld G, Newsom D (2004) Governing through markets: forest certification and the emergence of non-state authority. Yale University Press, New Haven

Dietsch TV, Philpott SM (2008) Linking consumers to sustainability: incorporating science into eco-friendly certification. Globalizations 5(2):247–258

FAO (2009) Guidelines for the ecolabelling of fish and fishery products from marine capture fisheries. Food and Agriculture Organization of the United Nations, Rome

FAO (2011) Technical guidelines on aquaculture certification. Food and Agriculture Organization of the United Nations, Rome

Guthman J (2004) The 'organic commodity' and other anomalies in the politics of consumption. In: Hughes A, Reimer S (eds) Geographies of commodity chains. Routledge, London/New York, pp 233–249

Kotler P (1993) Marketing of places. Free Press, New York

Kubota J (2009) Region and the earth linked by a thing (モノがつなぐ地域と地球). In: Kubota J (ed) The border transgression of commodities and global environmental problems- localized consumption in globalized era. Showado, Kyoto (in Japanese)

Lack M, Sant G (2008) Illegal, unreported and unregulated shark catch: a review of current knowledge and action. TRAFFIC, Canberra

Maekawa S (2016) Sea revitalization and aquaculture certification – earthquake disaster and fisheries industry in Minamisanriku (海の再生と水産養殖認証—震災と南三陸町の水産業). In: Omoto R, Sato T, Naito D (eds) International Resource-Management Certifications: ecolabels linking the global and the local. University of Tokyo Press, Tokyo, pp 66–83 (in Japanese)

Miyazoe K (2014) Community revitalization marketing (地域活性化マーケティング). Doyukan, Tokyo (in Japanese)

Murphy DF, Bendell J (1999) Partners in time? Business, NGOs and sustainable development. UNRISD Discussion Paper No. 109. Geneva: United Nations Research Institute for Social Development

Nhuong TV, Bailey C, Wilson N (2011) Governance of global value chains impacts shrimp producers in Vietnam. Global Aquaculture Advocate, Portsmouth, pp 44–46

Omoto R (2014) Prerequisite for sustainable fishing – FAO's guidelines for the ecolabelling of fish and fishery products (持続可能な漁業の要件:FAO「海洋漁業からの漁獲物と水産物のエコラベルのためのガイドライン」). Gyogyokonwa Reports of Japanese Society of Fisheries Science, No. 63. The Japanese Society of Fisheries Science (in Japanese)

Omoto R (2016a) Functions and the history of International Resource-Management Certifications (国際資源管理認証の機能と歴史). In: Omoto R, Sato T, Naito D (eds) International Resource-Management Certifications: ecolabels linking the global and the local. University of Tokyo Press, Tokyo, pp 16–29 (in Japanese)

Omoto R (2016b) Seafood eco-labeling – sustainable prawns and oysters (シーフードのエコラベル—持続可能なエビとカキ). UP 527: 30–35 (in Japanese)

Omoto R (2017a) Local certifications schemes – initiating supply chains from the sites of production (ローカル認証—地域が創る流通の仕組み). Shimizu Kobundo, Tokyo (in Japanese)

Omoto R (2017b) The role of region-based enterprises in place-specific marketing using regionally embedded resources: the case of heritage variety apple in Iizuna Town, Nagano (町おこし資源を活用した地域マーケティングに果たす地域企業の役割-長野県飯綱町の「高坂リンゴ」を事例に). Jpn J Reg Policy Stud 18:82–88 (in Japanese)
Omoto R, Scott S (2016) Multifunctionality and agrarian transition in alternative agro-food production in the global south: the case of organic shrimp certification in the Mekong Delta, Vietnam. Asia Pac Viewpoint 57(1):121–137
Omoto R, Sato T, Naito D (2016) Resource-Management Certifications as considered from the perspective of the production sites – a platform for community-building (生産現場から考える資源管理認証—地域づくりのプラットフォーム). In: Omoto R, Sato T, Naito D (eds) International Resource-Management Certifications: ecolabels linking the global and the local. University of Tokyo Press, Tokyo, pp 221–232
Onuma A, Yamamoto M (2009) Economic analysis of returning the white storks to the wild in Toyooka City, Hyogo Prefecture: economic rationale for adopting white stork friendly farming method and the effect of returning the white storks to the wild on the local economy (兵庫県豊岡市におけるコウノトリ野生復帰をめぐる経済分析-コウノトリ育む農法の経済的背景とコウノトリ野生復帰がもたらす地域経済への効果). Mita J Econ 102(2):191–211 (in Japanese)
Sasaki S, Ishikawa K, Ishihara S (2014) The core of local marketing – constructing local brands and the supported community building (地域マーケティングの核心-地域ブランドの構築と支持される地域づくり). Doyukan, Tokyo (in Japanse)
Thi NDA (2007) Shrimp farming in Vietnam: current situation, environmental-economic–social impact and the need for sustainable shrimp aquaculture. In: 7th Asia Pacific roundtable for sustainable consumption and production, Hanoi, pp 1–13
Westley F, Zimmerman B, Patton M (2007) Getting to maybe: how the world is changed. Vintage Canada, Toronto

Chapter 14
International Systems Deployed at the Local Level: UNESCO's Man and the Biosphere Programme in Japan

Akiko Sakai and Hiroyuki Matsuda

Abstract This paper examines the history of and reasons behind the acceptance by local communities in Japan of Biosphere Reserves, a global initiative established through UNESCO's Man and the Biosphere (MAB) Programme, as well as their challenges and future directions. The effective utilization of international systems necessitates processes which give rise to a range of collective actions through the knowledge translation of the systems concerned. Here "knowledge translation" means translation of knowledge, rules and concepts between global and local actors based on the principle and original criteria established in a general and comprehensive context. In the case of Biosphere Reserves, the translated systems emphasize municipalities as a particularly important actor at the national level, while at the local level, the work of residential researchers, who live for an extended time in the area of research, has been equally important. Adding to the processes, this paper draws on specific case studies to examine the types of areas that should be registered and the kinds of management that they require to develop as platforms for social learning that seek to realize the global principles of the MAB.

14.1 Overview of the System and Aims of This Chapter

Under UNESCO's Man and the Biosphere (MAB) Programme, an intergovernmental scientific programme, Biosphere Reserves are nominated by countries to the MAB International Coordinating Council, which then examines each nomination and decides whether to grant approval. Biosphere Reserves serve as model areas around the world for realizing sustainable societies that are in harmony with nature (Sakai and Matsuda 2016). Registrations under this program commenced in 1976; as of March 2016, 120 countries and 630 areas have been registered. In the case of Japan, 7 sites have been registered as Biosphere Reserves, and preparations are underway for further applications in several other areas. Biosphere Reserves

A. Sakai (✉) · H. Matsuda
Yokohama National University, Yokohama, Japan
e-mail: sakai-akiko-xw@ynu.ac.jp

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_14

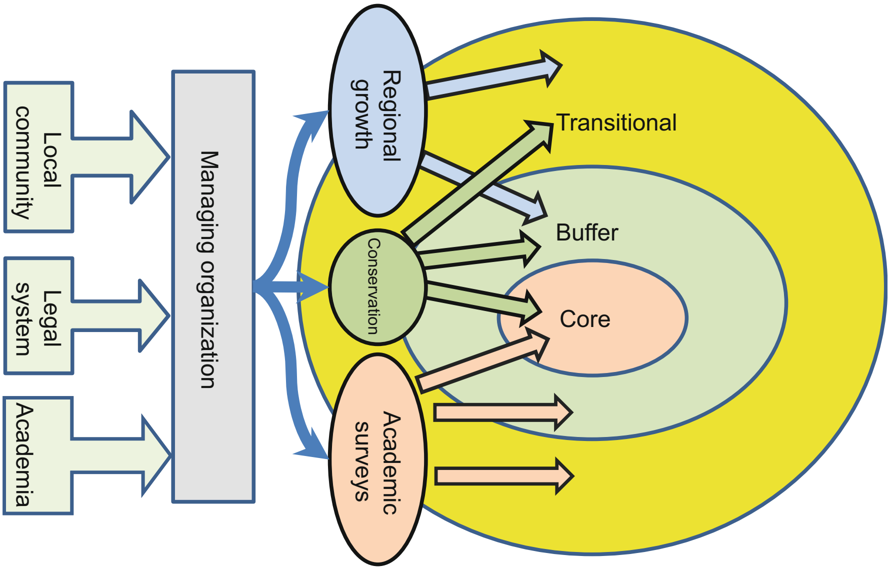


Fig. 14.1 Conceptual diagram showing the management structure of Biosphere Reserves, the various activities and area divisions. (Modified from a diagram by Choi Chung-Il)

comprise of the following separate areas: “core area”, which refers to a natural environment with important ecological value that is being properly conserved legally; “buffer zone”, the immediate area surrounding the core area; and “transition area”, where people conduct their daily lives (Fig. 14.1). In Japan, the general pattern for Biosphere Reserves has been that (1) official nature reserves such as special protection areas of nature parks (Ministry of the Environment) and protection areas of Forest Ecosystem Protection Areas (Forestry Agency) to serve as core areas, (2) with other public land prioritized for conservation serving as buffer zones, and (3) areas with much private land, such as agricultural land and urban areas, serving as transition areas. Concerning their spatial extent, some Biosphere Reserves comprise of single municipality, while in other cases they extend over 10 or more municipalities, spanning prefectural boarders. The Japanese National Commission for UNESCO, which has an office in the Ministry of Education, Culture, Sports, Science and Technology, along with the National MAB Committee assume overall control over domestic activities and dealing with external affairs. Biosphere Reserves are not only expected to function as nature conservation areas but also to serve other purposes that include fostering growth among local communities through such things as promotion of industries oriented toward nature conservation and environmental education, leading to an awareness among residents of the importance of protecting their local natural environment as their own social and cultural resources, as well as sites that will contribute to academic research that aims to resolve primary ecological and socio-ecological issues of regional and global significance.

This paper examines the processes and reasons behind the acceptance of this international system by local communities in Japan, as well as challenges and future directions. The main actors involved are as follows:

1. The National MAB Committee, the organization responsible for making decisions concerning the Man and the Biosphere Programme, and the Ministry of Education, Culture, Sports, Science and Technology, which holds jurisdiction in substance over the committee;
2. The Ministry of the Environment and Forestry Agency, which hold jurisdiction over Japan's nature reserves;
3. Relevant departments in local municipal bodies that are rapidly establishing a more extensive presence as managing and administrating organizations for Biosphere Reserves;
4. The Japanese Coordinating Committee for MAB, an organization comprising of researchers in which scientists – especially ecologists– along with scholars from other fields, such as sociologists, have been since the very start in recognition of the fact that MAB is by nature an academic program;
5. The Japanese Biosphere Reserves Network, a place where Biosphere Reserve offices exchange ideas;
6. Residential researchers who have contributed to the introduction of Biosphere Reserves in the course of their work dealing with local issues;
7. Citizens as the true stakeholders in Biosphere Reserves.

14.2 Adaptive Transformations of the International System and the History of MAB in Japan

Four Biosphere Reserves were registered in Japan in 1980 (Table 14.1), but over the following three decades or so, Biosphere Reserves remained largely forgotten by members of staff in local municipal bodies and members of local communities. In the 1970s, when the program was still in its early days, Biosphere Reserves functioned as a system of environmental conservation as a means of countering environmentally damaging development work, and a large body of basic research relating to the values of the natural environment in registered locations was required. At that time, the area classifications consisted solely of core areas and buffer zones, and transition areas did not exist back then. Therefore, even in Japan, the then Environment Agency was the main body for selecting candidate areas, and local municipal bodies were told that they did not have to do anything, as they were under no obligation to do so (Okano 2012). The point of contact for matters relating to Biosphere Reserves was the National Park Office of the Environment Agency. Meanwhile, scientists involved with MAB did pay little attention to Japanese Biosphere Reserves, and the majority of their research focusing on coastal areas in Southeast Asia (c.f., Takai 1988), where pressures from development was more serious than in Japan. Biosphere Reserve activities in Japan never went beyond biological surveys and

Table 14.1 Main internal and external events surrounding UNESCO's Man and the Biosphere Programme

Year	Event
1971	UNESCO's Man and the Biosphere Programme launched, Japan becomes a member country of the MAB International Coordinating Council (ICC) (until 1999)
1976	Biosphere Reserve registrations begin
1980	Japan registers the following 4 new areas: Shiga Highlands Biosphere Reserve, Mt. Hakusan Biosphere Reserve, Odaigahara/Mt. Omine Biosphere Reserve and Yakushima Biosphere Reserve
1985	2nd World Congress of Biosphere Reserves (Seville). "The Seville Strategy and The Statutory Framework of the World Network"
1987	First issue of Japan InfoMABwas published, activities of the Japanese Coordinating Committee for MAB commence from the previous year
1996	East Asian Biosphere Reserve Network (EABRN) meeting held in Kagoshima City and at Yakushima Biosphere Reserve
1999	The National MAB Committee publishes its "Japan UNESCO/MAB Catalog of Biosphere Reserves" (2nd edition published in 2007)
2008	3rd World Congress of Biosphere Reserves (Madrid). Madrid Action Plan for Biosphere Reserves (2008–13)
2010	Sub-event relating to sustainable development and MAB held at the 10th Conference of the Parties to the Convention on Biological Diversity (Nagoya)
2011	Japan resumes membership of MAB-ICC at the UNESCO General Conference
2012	The Minister of the Environment declares that Japan will increase cooperation between Biosphere Reserves, global geoparks and national parks
2012	Aya registers as a new Biosphere Reserve (5th in Japan, the 1st in 32 years)
2013	1st Japanese Biosphere Reserves Network (JBRN) meeting held in Tadami
2014	Tadami Biosphere Reserve and Minami-Alps Biosphere Reserve register as new Biosphere Reserves, Shiga Highlands Biosphere Reserve makes an expanded registration
2015	14th EABRN meeting and 3rd JBRN meeting held at Shiga Highlands Biosphere Reserve. Revision and reorganization of JBRN's statutes
2016	13 Japanese participate in the 4th World Congress of Biosphere Reserves (Lima). Lima Action Plan
2016	Mt. Hakusan Biosphere Reserve makes an expanded registration, Odaigahara/Mt. Omine/ Osugidani Biosphere Reserve and Yakushimaand Kuchinoerabujima Biosphere Reserve makes an expanded registration with a change of name

international training for environmental surveys to be carried out at the Shiga Highlands Biosphere Reserve in which activities on Education for Sustainable Development for young people are promoted nowadays, as well as university researches (Mizutani and Ida 2015).

There are extensive issues surrounding the MAB Programme. However, in the1995 Seville Strategy (UNESCO 1996), a policy was set out which sought to focus on issues centering on Biosphere Reserves by taking highly original initiatives. At the same time, in respect also to the roles of Biosphere Reserves, the fact that there was now an added obligation to set up transition areas and draw up management plans utilizing these transition areas lead to an emphasis being placed on becoming a model area for the realization of sustainable societies while striking harmony with the goals of nature conservation. The Convention on Biological Diversity seeks to ensure the following three principles: (1) Conservation of biodiversity; (2) Sustainable use of biological resources; and (3) Fair and equitable distribution of the benefits generated from the use of genetic resources (UNESCO 1996).

Japan sensed this major turning point at an early stage, and in 1987, there were some individuals who were already working to provide insights into the functions that Biosphere Reserves should take through tours of inspection of Biosphere Reserves in Europe, which already included areas corresponding to transition areas, where people were engaged in livelihoods such as agriculture (Okada 1988). However, it proved somewhat difficult to steer Biosphere Reserves in the desired direction. Then, the series of Madrid Action Plans set out from 2008 (UNESCO 2008) and the 2013 MAB International Coordinating Committee stated that existing Biosphere Reserves lacking a transition area may be issued with a recommendation of withdrawal unless an expanded application containing a new transition area was made by 2015 (UNESCO 2014).

Around early 2010, a movement began in the Aya Town of Miyazaki Prefecture aiming at Biosphere Reserve status (Shumiya et al. 2013), marking a turning point in Japan's MAB activities (Sakai 2016). In a move to follow-up on this movement, the Japanese National Commission for UNESCO adopted "UNESCO Eco-park" as the nickname for Biosphere Reserves in Japan that basically used only with Japanese language on January 2010, a name to which local citizens could relate on an informal level. By 2011, the criteria had been put in place for a domestic screening of the area's suitability, and it became necessary to create an organizational framework centering on local municipalities. The procedures leading to a domestic recommendation were also put in place through adaptive changes. In Japan, local municipal bodies function as the managers of local communities. In other words, it would prove difficult for Biosphere Reserves to function without the active involvement of municipalities. The municipal authorities needed to explain to residents the reasons behind the application, and those aspects concerning regional development were given particular emphasis. In this way, Japan's MAB activities experienced something of a revival through the reconstruction of Biosphere Reserve frameworks, functions and procedures. Aya Town, the catalyst for this change, has now become a subject of research and point of reference for drawing up policies as a successful example of an area that has managed to unite nature conservation and regional development over the course of many years (Shumiya et al. 2016).

In 2012, the Aya Biosphere Reserve became the first registered Biosphere Reserve in Japan in 32 years, followed by new registrations in 2014 of the Tadami Biosphere Reserve and Minami-Alps Biosphere Reserve. All of the expanded applications for transition areas in the existing 4 areas were approved in 2014 and 2016 (Table 14.1). There are many old registered areas around the world that have yet to put in place a transition area, so Japan's sudden change of stance came as something of a surprise.

The form for registrations and expanded applications is in the form of a questionnaire (UNESCO 2013). In addition to providing explanations on the academic values of areas as reserves for protecting natural environments and area division plans, applications are required to contain descriptions of the purposes of the registrations, the area's culture and history, initiatives by residents and administrative bodies that agree with the principles of UNESCO's MAB Programme, organizational frameworks, management plans, and other relevant matters, along with the signatures of those involved. Before creating an application form, municipalities are required to establish a committee that brings together a diverse set of stakeholders, and to use this as a platform to hold discussions and build consensus. Municipal employees are core members who gather information, create concepts and texts, provide explanations to residents, and coordinate between the various actors (Nakamura et al. 2016). It could be said that these processes themselves already constitute Biosphere Reserve activities of a kind.

In the case of MAB, the importance of network activities is something that has been reiterated for many years, and each Biosphere Reserve is registered in the World Network of Biosphere Reserves (WNBR) at the time of approval. Networks also exist at the regional level, such as the East Asian Biosphere Reserve Network (EABRN), but this is an alliance at the national delegates. Japan's domestic network was launched as a mailing list provided by the Japanese Coordinating Committee for MAB and included a wide range of parties concerned with Biosphere Reserves. In 2013, Tadami, which at the time was still applying for registration, proposed to hold a conference at the same time that it offered to provide a venue and support for participation costs. The first of Japanese Biosphere Reserves Network meetings was held as a result. In addition to those in charge of the Biosphere Reserves around Japan, it was the first time that the major players in Japan's MAB activities were brought together under one roof, including members of the office of the Japanese National Commission for UNESCO, the Japanese Coordinating Committee for MAB, and related ministries and agencies.

In 2015, Japan's Biosphere Reserves network meeting was held in parallel with the EABRN Meeting at the Shiga Highlands Biosphere Reserve, during which the Japanese Biosphere Reserves Network (JBRN) was officially launched, with the qualification for membership at the individual Biosphere Reserve level. Hakusan City also runs a regional office of the Japanese Geoparks Network, and this wealth of experience is now being put to use in JBRN. For instance, while JBRN is being administered under a membership system in the fashion of JGN, when it comes to MAB, this in itself is unconventional from an international perspective. By eliciting a membership fee, it becomes regarded as a municipal activity and helps generate momentum to get things done. Mount Hakusan Biosphere Reserve has collaborated with the United Nations University's Institute for the Advanced Study of Sustainability Operating Unit Ishikawa/Kanazawa (UNU/IAS/OUIK) to introduce the world to Japan's initiatives, enthusiastically engaging in international exchanges through, among other things, lectures at international conferences (Iida and Nakamura 2016).

14.3 Knowledge Translation as the Key to Systems

One of the purposes behind setting-up transition areas is no doubt to help those living in such areas to generate an awareness of their place in a sustainable society. However, a practical problem with this is that, when it comes to the organizations for their management and administration, MAB only stipulates the following in its registration criteria: "Organizational arrangements should be provided for the involvement and participation of a suitable range of *inter alia* public authorities, local communities and private interests in the design and the carrying out of the functions of a biosphere reserve" (Article 4 section 6) (UNESCO 1996). Therefore, it remains unclear as to who exactly is responsible for organizing activities, as well as who should become the external point of contact. While the country's views are uncertain, in Aya, at the application stage Aya Town Hall presided over administration of the transition area, in contrast with other Biosphere Reserves in Japan. The managing bodies are liable to change according to shifts in the conditions of each country. Aya therefore created a precedent during the application process for Aya Biosphere Reserve that was not the decision of the Japanese National Commission for UNESCO.

As stated above, the Aya area had in place platforms facilitating dialog between a diverse range of actors of a kind envisaged by MAB, and it was through these that the town took the initiative in making decisions, putting in place systems to ratify these. Bottom-up processes of this kind are extremely meaningful.

Methods for maintaining natural environments effectively can be sorted into top-down and bottom-up methods. Top-down methods can facilitate unified action and are powerful if they function well. A typical example of this is World Natural Heritage. Countries that have ratified the Convention concerning the Protection of the World Cultural and Natural Heritage select candidate sites according to the international criteria and decide on which of those sites to nominate. In Japan, the Ministry of the Environment decides on which sites to nominate based on scientific evidence, which are then inscribed after having passed an international review.

However, this method makes it difficult for local communities to exert autonomy. Meanwhile, many examples of successful bottom-up nature conservation activities can also be seen in Japan in the form of grassroots civilian movements.

MAB in its present form itself constitutes one of UNESCO's top-down activities; at the same time, however, it states bottom-up methods in the form of participation by local actors. The values for local communities of the 4 areas registered in Japan in 1980 were recognized through the establishment at the domestic level of rules set down autonomously by the municipal authorities themselves, and this was a reason that the decision was made to lodge an expanded application. Next, the domestic network, JBRN, was arranged to conform to municipal systems through independent discussions between Biosphere Reserves. Japan did not have a single participant in the 2008 World Congress of Biosphere Reserves, but in the 2013 World Congress of Biosphere Reserves, held in Lima, there were 13 Japanese nationals present, including those connected with JICA and the United Nations University. The fact that

Japan, which until then had been in a state of "hibernation," suddenly woke up and became active again caught the attention of the world, and today it continues to maintain a strong presence and voice within the global network, such that representatives from some Japanese Biosphere Reserve offices are provided with expenses-paid visits to other countries. On the other hand, a system is in place in which the Japanese National Commission for UNESCO supervises and conducts reviews based on decisions made at the MAB International Coordinating Committee, and in which the intentions of the various related ministries and agencies have a strong influence. In other words, both in the past and present, there has been a mixture of currents flowing from both the top and bottom. Of further importance are exchanges of opinions in horizontal and diagonal directions, such as between ministries and agencies, between ministries and agencies and Biosphere Reserves, and between sectors including the Japanese National Commission for UNESCO, Biosphere Reserves, and the Japanese Coordinating Committee for MAB. The various related ministries and agencies have a strong influence; while initially adopting a passive stance, they are now actively considering ways to liaise with Biosphere Reserves. In Japan, this kind of multilayered knowledge translation has arisen swiftly over the past 5 years (see Table 14.1); as a result, it has seemingly made an instant comeback on the global frontline in this field.

Local municipal bodies occupy a relatively suitable spatial scale for seeking to build consensus between a range of parties through direct dialog with people, an important aspect when it comes to putting the Biosphere Reserve principles into practice, and for working to conserve the environment and resources, and promote local economic growth based on these. For instance, municipalities are the ones who oversee the management and administration of geoparks and wetland sites registered under the Ramsar Convention (Tanaka 2016). This tendency for local municipal bodies to take charge of the conservation of natural environments manifested from the 2000s onward against a backdrop of governmental policy and awareness among people (Shirai 2015). This is also related to Japan's moves toward decentralization. Municipalities analyze the local situation and the needs of residents, clarify their vision for the future, formulate policies to turn these into reality, and explain these to residents and the central government.

Many members of the Japanese public have expressed a desire for more opportunities to enjoy nature (Cabinet Office 2006). This would bring practical gains to areas that possess outstanding natural environments, not only in terms of nature conservation but also tourism, people moving into the area and tax revenue. For Japan's municipalities, many of which have villages in rural and mountainous areas, accounting for 80% of Japan's national land, the remaining rich natural environments are viewed as a potential resource in an era of low economic growth in which there is little desire for large-scale land development as in the past. The introduction of international systems will be able to increase the value of these assets. In the process of increasing the motivation to apply as a candidate for a Biosphere Reserve, Tadami Biosphere Reserve is a typical example of this (Tadami Town Hall 2014; Suzuki et al. 2016).

As seen above, local municipal bodies are expected to or are actually increasing functioning as: (1) agents for the conservation of natural environments; and (2) frameworks for the administration of cooperative societies. These facts are probably the key social background by which local municipal bodies have become the managers and administrators of Biosphere Reserves. In other words, the fact that Japan's Biosphere Reserve review criteria require municipal initiative is in accord with Japan's moves toward decentralization.

14.4 Toward Further Advancement of the System

Japan's MAB initiatives have come to global attention, because Japan has established a system in which local municipal bodies take the initiative, has successfully made a series of expanded registrations that include transition areas for all its old registered areas, has created a domestic network linking all its registered areas, and, as will be mentioned in more detail later, has registered areas that serve as excellent models for constructing sustainable development society. We can thus say that, so far, its MAB initiatives have by and large been a success. However, it is also a fact that Japan is experiencing some major problems, including those detailed below.

In Japan, municipalities have put in place an environment and processes that make it easy to apply for Biosphere Reserve status. They have access to a large pool of researchers and comparatively good academic descriptions of Japan's natural environment and are blessed with a wealth of materials describing the unique qualities of the country's history and culture, along with efforts to hand these down to future generations. As such, any area in Japan that has legally guaranteed nature reserves like national parks could, in theory, register as a Biosphere Reserve. However, even if they meet the review criteria on paper, it is possible that this will not be accompanied by actual activities. We also already see cases in which municipalities have held next to no committees or meetings, a key component in the decision-making process for Biosphere Reserves. The existence of unsubstantial registered areas lowers the value of the system as a whole and has a negative impact on other registered areas. Therefore, new Biosphere Reserve recommendations require more stringent and strategic investigations than just the domestic review criteria in their current form.

Biosphere Reserves are a practical field of the MAB Programme and not a system in which UNESCO or governments provide financial assistance to registered areas. Ultimately, they are model areas for increasing sustainability globally and considering policies through which to achieve this goal.

In the global context, Aya Biosphere Reserve serves as an excellent example of what a Biosphere Reserve should be. The core area of this Biosphere Reserve is a laurel forest, a climax forest extending from western Japan to China, of which only 3% of the original forest remains in Japan as a result of development (Osawa 2008). Aya possesses academic value in the sense that it is a largest surviving forest of its kind in Japan (Shumiya et al. 2013). However, the town's basic industry used to be forestry, and much of the primeval forest was felled. Around half a century ago, the then mayor of the town felt a sense of crisis at having an economy in place that relies on non-renewable resources, one involving the destruction of the natural environment. He discovered a sense of meaning for conserving the area's forests in the notion that there exists a distinctive "East Asian evergreen forest culture" (Nakao 1966) and resolved to cease felling of the primeval forest (Goda 1998). Instead, he endeavored to introduce organic agriculture and turn the area's primeval forest into a tourist resource, and achieved a major structural transformation of the region's industries. What made this possible was the leadership of the town's mayor, the dedicated efforts of local civil servants, a system of direct democratic social participation among the town's residents through independent community center activities, and support in numerous forms from outside the region (Shumiya et al. 2013, 2016).

Aya Town is one of very few municipalities in Japan today that are able to sustain populations in such rural mesomountainous and mountainous regions. Aya is having an impact on policy nationwide. For example, the town receives around a hundred tours of inspection a year from other municipalities throughout Japan and interested parties from overseas, and its own system of certifying organic agriculture has formed a point of reference for Japanese Industrial Standards (JIS). In other words, Aya's case represents much more than just the values of the natural environment; rather, the town has utilized its natural resources for a range of initiatives which support the local economy, both directly and indirectly, and has become a model area for sustainable growth to which others can look to. This is the ideal image for Biosphere Reserves as indicated in the "Lima Action Plan for UNESCO's Man and the Biosphere (MAB) Programme and its World Network of Biosphere Reserves (2016–2026) (UNESCO 2016)." This is not something that Aya achieved after having become a Biosphere Reserve; in fact, it had already achieved this when it registered as a global model Biosphere Reserve. Aya applied for Biosphere Reserve status at the suggestion of the Japanese Coordinating Committee for MAB (Shumiya et al. 2013). In the future, too, finding these kinds of model areas and advising them to apply will be an important challenge.

MAB is an academic program. In order to increase global sustainability, Biosphere Reserves need to be founded on more than just practical activities relating to environmental conservation and regional growth. They also need to function as centers for research by conducting their own academic research and providing locations and opportunities for research to take place. Explanations on the academic importance of the area's natural environments, especially the core area, and ongoing monitoring are requirements for registration and maintenance of Biosphere Reserve status. The notion of simply commissioning experts from consultancy firms to deal with specialist areas that are beyond experience of town officers is too straightforward. Ideally, municipalities should hire researchers, recruit human resources from outside the area and organize scientific committees, form academic hubs by setting up museums and research centers, establish funding programs to support research activities within the area, and form collaborative agreements with local universities and invite laboratories to create satellite offices. In fact, there are already actual examples of such things happening.

While Aya Biosphere Reserve fulfills these requirements, Tadami Biosphere Reserve has also been working hard to put a number of initiatives in place (Suzuki et al. 2016). As with Aya, the turning point for Tadami Biosphere Reserve's regional regeneration came through a protest movement against the felling of primeval forests (beech forests). In contrast to Aya, however, the development of new forms of industry has yet to be established and depopulation is still an ongoing issue. Nonetheless, the town has declared its resolve to engage in regional development that is founded on its rich ecosystems, especially its beech forests. Aya Town has hosted the International TERUHA Forest Conference, and Tadami Town the International Beech Forest Conference, during which a symposium was held featuring researchers from Japan and overseas. Tadami Town later set up the Tadami Beech Center, which brings together environmental policies from among the town's administrative organs and has also established a museum with educational and research functions as an annex. The purpose behind this is to turn the area into a center for inviting researchers to come and conduct academic research and surveys, as well as to promote education and training in this field. It also publishes the Bulletin of the Tadami Beech Center on an annual basis, which contains the results of its research endeavors. In 2016, the "Ordinance for the Protection of Wild Fauna and Flora in Tadami Town," originally drawn up by the Tadami Beech Center, was promulgated. This ordinance, which provides comprehensive coverage of the area's wildlife as a whole, not only specific flora and fauna, is extremely rare at the basic municipal level. Recently, it has scrapped developing new pathways in wetlands that are home to rare forms of life; instead, it is planning comprehensive academic surveys considering incorporating them into neighboring forest ecosystem conservation areas and future forms of conservation and use of these areas. Registration as a Biosphere Reserve reinforced such directions that the town had already been moving in for many years.

As long as they make use of municipal resources, research and conservation activities of this kind are expected to contribute to local communities. Some of the town's highest-ranking administrative managers belong to Tadami Beech Center, and the mayor himself also keeps a close eye on its progress. Researchers are therefore in a position to influence the town's overall administration and make contributions to the local community. The town council also welcomed the aforementioned ordinance as a measure for combating business operators coming into the area to catch large quantities of insects for commercial purposes. Meanwhile, those in receipt of research grants from the town report the results of their research to residents through public briefing sessions. Residents of this town are greatly interested in their local natural environment and culture. Also, as the core organization for promoting the activities of Tadami Biosphere Reserve, Tadami Beech Center is not only involved in research and conservation activities for the natural environment, but also a whole range of other initiatives seeking to raise the area's profile as a Biosphere Reserve. From the planning stage to implementation, the center's remit includes raising public awareness, educational activities, gathering information and supporting activities for safeguarding the area's culture and traditional technologies, and commercializing local products. And its efforts cover a diverse range of academic disciplines, from the natural sciences to folklore. Currently, it is making efforts to put in place frameworks for accommodating a projected increase in visitors to the town coming for specific purposes, such as university research and field trips, as well as company training programs. There are high hopes in Tadami that these efforts will have a knock-on effect in raising the area's brand value, creating employment, increasing the town's population by enticing people back into the area, as well as others wishing to move to the countryside, and increasing the number of visitors.

When municipal offices act as offices for administrating Biosphere Reserves like this, there is a greater potential to make MAB even more effective. Once governmental organizations have a project, budget, staff and administering department in place, if the budget goes through they are at the very least obliged to continue the project for a certain duration of time. Biosphere Reserves differ to World Heritage in that registration itself has very little effect, and that it is necessary to increase the value of the reserves through concrete efforts. Furthermore, in Japan's case, the national government does not provide direct financial support to its Biosphere Reserves. And even the indirect benefits of Biosphere Reserve registration are by no means guaranteed.

Biosphere Reserves require the cooperation of local communities and all kinds of related organizations, who together must face a whole host of local issues through mutual dialog and learning. In Japan, switching the point of contact for Biosphere Reserves from national park offices to municipalities has accelerated this process. It could be said that this transformation has served to verify the importance of the bottom-up approach. Specifically, municipalities take on the functions of an office and organize and run conferences. Municipal offices are well placed to consider the composition of conferences run through collaboration between industry, government, members of the public and academia, and work toward gaining consensus among the participants. This is one of the factors that have helped Japan garner praise from the international community.

However, civil servants working for municipalities are administrators in a position of authority in the eyes of the local residents. The initiatives of government offices are not always the initiatives of the people. In order for members of local communities to engage in their own initiatives in an independent manner through the practice of the MAB principles, municipalities are better placed than central government to provide extensive support from close quarters. And yet, this in itself constitutes a policy as an administrative organization and is naturally different in nature to independent resident-led activities in the true sense. This system would become a mere dead shell without the ingenuity and inventiveness of local communities coupled with cooperation with administrative bodies.

The existence of "residential researchers" (see Chaps. 1 and 5), who, feeling a sense of responsibility toward a specific area, live in this area in an effort to provide comprehensive solutions to a number of different issues, is extremely important.

Residential researchers are one of the biggest factors behind the success of the aforementioned Aya and Tadami. Aya and Tadami have been able to make major progress by adeptly using visiting researchers from outside the area through the intermediation of residential researchers. They are the ones who organize supporting committees comprising of researchers from various fields along with thematic working groups, liaise with universities, and create opportunities for applying knowledge, ideas and labor for the benefit of the area. Visiting researchers sometimes do not understand the local situation and consequently make misinterpretations and misdirected remarks. Residential researchers, who are knowledgeable about the local area, can bring out realistic ideas and remarks from the visiting researchers. It is also preferable for the local coordinator of visiting researchers to be a researcher her- or himself. When it comes to learning about local issues, it is also a valuable experience for visiting researchers to be able to meet researchers from a range of fields and discuss things, while also listening to the opinions of members of the local administration. It is vital for Biosphere Reserves to secure outstanding residential researchers if they are to effectively make use of external researchers.

For residential researchers, there are a limited number of settings in which their own specific specialist knowledge itself can be of use, which is why they also need to move beyond their own fields and organize and bring together groups of researchers from the outside. In other words, they are required to be well versed in knowledge beyond their own areas of expertise, and to have the ability to engage in dialog as translators. They cannot get away with just hiring postdoctoral researchers unfamiliar with the local issues. Equally problematic are the kinds of researchers who use scientific jargons that are not understandable by non-researchers or who do not have the trust of their fellow researchers. It may be the case that the successful expansion of the Biosphere Reserves system itself resides in whether or not other areas can enlist the services of gifted researchers as did Aya and Tadami.

Biosphere Reserves could be called a system for local areas in the sense that the local areas themselves are placed in the driving seat. However, the MAB Programme is not a system for registering areas. In order to build sustainable societies throughout the world, MAB aims to be a platform for "sustainable sciences." Biosphere Reserve registration is a practical field of endeavor for making this a reality. Each registered area should choose the most appropriate course of action for its own development. However, in order for them to function as global models, they need to adopt perspectives encompassing the system as a whole.

Another characteristic specific to Japan's case is that, in addition to the National MAB Committee, there also exists the Japanese Coordinating Committee for MAB, which was formed and has been administered by scientists on an independent basis. While the National MAB Committee also contains many scientists, it is an organization responsible for making decisions. Therefore, in order to sustain academic activities, the Japanese Coordinating Committee for MAB was set up in 1986 by the then chairperson of the National MAB Committee as an advisory body. At the time, its purpose was to implement related overseas research projects and to create regular reports (catalogs; see Table 14.1) for registered Biosphere Reserves. Later on, from the time when the authors were participating in the committee in the positions of chairperson and vice-chairperson, the main content of its activities came to consist of making proposals to the National MAB Committee to stimulate a revival of MAB activities in Japan, as well as holding symposiums and providing regional support. While its membership used to consist mainly of scientists in the field of natural sciences, a conscious decision was made to include individuals who are at the center of local activities along with experts in the system's policies.

Today, after much progress has been made in redesigning the system, it is the hope of the authors that more work will be done to reevaluate this system in respect to the principles that provide support from an academic perspective, and to strengthen the organization as a whole. It would seem that in many countries around the world, the National MAB Committee also provides regional support. And we also see patterns corresponding to this in other similar systems. However, it is important to separate organizations that make decisions, including reviews, and organizations that provide regional support and state academic opinions. The advantage of Japan's MAB is that it has academic support organizations in place in addition to the National MAB Committee.

References

Cabinet Office, Government of Japan (2006) Public-opinion poll on protection and use of nature (自然の保護と利用に関する世論調査). Poll in June 2006 (in Japanese)

Goda M (1998) Kind heart – why did town planning in Aya succeed? (結いの心 —綾の町づくりはなぜ成功したか—). Business-sha, Tokyo, 241pp (in Japanese)

Iida Y, Nakamura S (eds) (2016) Mount Hakusan Biosphere Reserve: creating a new path for communities and nature. UNU-IAS OUIK, Kanazawa, 116pp

Mizutani M, Ida H (2015) Introduction to Shiga-highland Biosphere Reserve: field visit guide for the 14th Meeting of UNESCO-MAB East Asian Biosphere Reserve Network (EABRN-14). Shiga-highland UNESCO Biosphere Reserve Council, Nagano Prefecture Yamanouchi Town Office, Nagano, 30pp

Nakamura S, Nakada S, Yamaguchi T (2016) The management of Mount Hakusan Biosphere Reserve. In: Iida H, Nakamura S (eds) Mount Hakusan Biosphere Reserve: creating a new path way for communities and nature. UNU-IAS OUIK, Kanazawa, pp 24–29

Nakao S (1966) The origins of cultivated plants and farming (栽培植物と農耕の起源). Iwanami Shoten, Tokyo, 192pp (in Japanese)

Okada M (1988) Manmade biosphere and its conservation – European MAB and biosphere conservation area (人間によって作られた生物圏とその保存 —ヨーロッパのMABと生物圏保存地域—). Jpn InfoMAB 2:5–6 (in Japanese)

Okano T (2012) Japanese activities in biodiversity conservation and biosphere reserves in Japan (我が国の生物多様性保全の取組と生物圏保存地域). Jpn J Ecol 62:375–385 (in Japanese with English abstract)

Osawa M (2008) The global position of Japan's protected areas and future issues (日本の保護地域のグローバルな位置づけと今後の課題). In: The Nature Conservation Society of Japan (ed) Nature preserves and their conservation of diversity as seen from ecology perspective. Kodansha, Tokyo, pp 236–242 (in Japanese)

Sakai A (2016) UNESCO's Man and the Biosphere (MAB) Programme and biosphere reserves in Japan. In: Iida H, Nakamura S (eds) Mount Hakusan Biosphere Reserve: creating a new path way for communities and nature. UNU-IAS OUIK, Kanazawa, pp 20–23

Sakai A, Matsuda H (2016) Biosphere Reserve as an effective institution for realizing sustainable society (特集「持続可能社会を実現するための実効性のある制度としてのユネスコエコパークの可能性」趣旨説明). Jpn J Ecol 66:119–120 (in Japanese)
Shirai N (2015) Local authority environmental policy (地方自治体の環境政策). In: Washida T, Aoyanagi M (eds) Environment actors and organizations. Iwanami Shoten, Tokyo, pp 137–158 (in Japanese)
Shumiya T, Okonogi H, Kawano K, Ishida T, Soma M (2013) Conservation of endangered ecosystem of warm-temperate evergreen broad-leaved forest (lucidophyllus forest) with local community: implementation of collaborative management in Aya Town, southern Kyushu, Japan (照葉樹林生態系を地域とともに守る—宮崎県綾町での取り組みから—). Jpn J Conserv Ecol 18:225–238 (in Japanese with English abstract)
Shumiya T, Kawano N, Kawano K, Ishida T, Shimomura Y, Soma M, Okonogi H, Doke T (2016) Initial responses for three years after registration of Aya Biosphere Reserve, Miyazaki, southern Japan (ユネスコエコパーク登録後の宮崎県綾町の動向 —世界が注目するモデル地域—). Jpn J Ecol 66:121–134 (in Japanese with English abstract)
Suzuki W, Nakano Y, Sakai A (2016) Tadami Biosphere Reserve: initiative of a mountainous town for sustainable development to overcome depopulation and aging society, using nature resources (只見ユネスコエコパークが目指すもの -過疎・高齢化に直面する山間地域における自然環境と資源を活用した地域振興—). Jpn J Ecol 66:135–146 (in Japanese)
Tadami Town Hall (2014) Protecting & harnessing the lifestyles, culture and nature of snow country: Tadami Biosphere Reserve– philosophy & overview. Fukushima, Japan, Tadami
Takai Y (1988) Structure and major activities of the MAB Programme in Japan. Jpn InfoMAB 3:1–4
Tanaka T (2016) A comparative analysis of national networks of international conservation institutions: World Heritage Convention, Ramsar Convention, UNESCO MAB Programme, and Global Geopark Network (国際的な自然保護制度を対象とした国内ネットワークの比較研究 —世界遺産条約,ラムサール条約,ユネスコMAB 計画,世界ジオパークネットワーク—). Jpn J Ecol 66:155–164 (in Japanese)
UNESCO (1996) Biosphere reserves: the Seville strategy and the statutory framework of the world network. UNESCO, Paris, p 18
UNESCO (2008) Madrid action plan for biosphere reserves (2008–2013). http://unesdoc.unesco.org/images/0016/001633/163301e.pdf. Accessed 31 Mar 2018
UNESCO (2013) Man and the Biosphere (MAB) Programme, biosphere reserve nomination form, January 2013. http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/designation-process. Accessed 31 Mar 2018
UNESCO (2014) International Coordinating Council of the Man and the Biosphere (MAB) Programme, twenty-sixth session, item 11 of the provisional agenda: update on the exit strategy. http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/SC-14-CONF-226-9_exit_strategy_en_01.pdf. Accessed 31 Mar 2018
UNESCO (2016) Lima Action Plan for UNESCO's Man and the Biosphere (MAB) Programme and its World Network of Biosphere Reserves (2016–2025). http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/Lima_Action_Plan_en_final.pdf. Accessed 31 Mar 2018

Chapter 15
Coastal Resource Management Connected by Marine Protected Area Networks

Shinichiro Kakuma and Jokim Kitolelei

Abstract In tropical and subtropical zones, the majority of people live along the coastline, relying on coastal fishery resources to make their livings. Yet, over fishing is deteriorating these resources, and coral and mangrove ecosystems that underpin the resources are threatened. Recently, though, attention is turning to marine protected areas (MPAs) as a method to effectively preserve ecosystems and manage fishery resources. In this chapter, we introduce two cases concerning Okinawa and Fiji, to show how community-based MPA approaches were activated by bilateral knowledge translators, as well as how specific processes were used to develop a broader framework. In the five types of Okinawan MPAs established with fishery cooperative associations (FCAs) at their core, prefectural fisheries extension officers and researchers are proving helpful as bilateral translators in effective management of resources. In Fiji, activities are incorporated into an international framework, with an MPA network system spreading rapidly. And, in Fiji as well, various bilateral translators are active in managing coastal resources.

15.1 MPA Network

At the 10th meeting of the Conference of the Parties (COP10) to the Convention of Biological Diversity held in Aichi in 2010, the idea to set aside at least 10% of marine areas administered by all countries as MPAs was put forward as the "Aichi Target 11." Other international targets, such as targets at the World Summit on Sustainable Development (WSSD) in 2002, had been put forward to increase the area of MPAs and build up their networks.

There are two meanings to MPA networks that appear in the international targets. The first is an ecological network meaning physical and ecological connection. The

S. Kakuma (✉)
Okinawa Prefectural Deep Sea Water Research Center, Kumejimacho, Okinawa, Japan
e-mail: kakumsh@pref.okinawa.lg.jp

J. Kitolelei
Research Institute for Humanity and Nature, Kyoto, Japan

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_15

second is a societal network meaning people, organization and information connections. And, while large-scale MPA ecological networks are rare, there are moves to associate these international ecological networks with societal networks. The MPA networks introduced in this chapter are societal networks.

15.2 Fisheries Extension Officer as a Bilateral Knowledge Translator

In this chapter, we turn our attention to the role of fisheries extension and advising officers (noted as fisheries extension officers *from here on*) as bilateral knowledge translators (see Introduction of this book). Fisheries extension officers are staff members holding national qualifications who are employed in each prefecture to work with the fishers in fishing villages. Their role is to pass on information and to advise about technology, such as fishing, stock enhancement and aquaculture, resource management and fish distribution. And, in recent years, the role of passing on information and knowledge, rather than technology alone has taken on greater importance.

One form of translation the fisheries extension officers provide is to take the information available from research bodies/institutes and government, organize it into a format that is readily understandable and then pass that on to fishers. Another form is a reverse direction translation, in which they translate the knowledge and experiences of fishers into terminology suitable for science and government, so that the information can be introduced to scientific and administrative realms.

In the latter form of translation conducted by fisheries extension officers, it is clear that other concepts and ideas may be translated as well; one example is the translation of the self-described needs of fishers to be passed on to scientists. Fishers expect new technology that may not be achieved easily and studies that do not produce answers quickly. The scientists do not have time to engage in the studies. One specific example of this phenomenon is the release technology used for sea cucumbers, a resource that is rapidly in decline in the Asia-Pacific, including Okinawa. What is required of translation is to not just to pass on verbatim all of the fishers' expectations to scientists, but instead to translate and pass on content that – even if it differs slightly from the expectations – will stand a far better chance of ultimately producing results that will fulfill the expectations. Hence, in an example like that of the sea cucumber, where the survival rate to adulthood is extremely low for juvenile sea cucumbers that have been produced and released, an alternative approach to releasing would be resource management, such as MPAs, size limits or catch quotas. To achieve this change, the fisheries extension officer must be able to comprehend the contents of present studies, as well as knowing the currently proposed plan for the future studies.

Furthermore, fisheries scientists at times may set-up research issues that are covered by their own scientific interest and will not directly help to resolve the problems faced by fishing communities. In such cases, before scientists finalize the research content details, the fisheries extension officer concerned must pass on to the scientists some element of the fishers' expectations that falls within the framework of the research. Subsequently that element can be selectively prioritized by the scientists from the view point of problem solving.

15.3 Community-Based MPAs in Okinawa

15.3.1 Okinawa's Diverse MPAs

Okinawa has diverse MPAs. The ones legislatively representing the region are marine parks (natural parks law) and protected waters (law of conservation of aquatic resources). In marine parks, aquatic animals and plants that represent the fishing resource are often not regulated, so protecting fisheries resources is difficult. In protected waters it is hard to implement effective surveillance, which is an important requirement for the success of MPAs. As the government and prefecture both have a history of spearheading initiatives, surveillance and policing protected waters are their responsibilities, which means that most local fishers do not get seriously involved in surveillance. Indeed, a real weakness in this approach is that adaptable management is difficult because the rules that govern marine parks and protected waters are totally inflexible. Conversely, the MPA (fishing-ban areas) decided upon by fishers themselves are surveyed autonomously by the fishers and have flexible rules. However, being self-imposed rules, they have little standing in laws, so the fishers require the cooperation of people like recreational fishers and divers to uphold the rules (Kakuma 2011).

15.3.2 Sedentary Resources MPAs in Onna Village

In 1988, the Onna FCA in the northern part of the main island of Okinawa formed the Onna village fisheries promotion plan, which includes MPA plans for sedentary resources (i.e., marine life that maintains a permanent residency on the seabed without moving greatly as fish do) like giant clams and Trochus shellfish. As a fisheries extension officer at that time, the first author helped create the plan. The author restructured the proposed plan put together by the FCA's counselor with the addition of scientific information, such as study reports, from the fisheries experimental station, and explained the content at meetings held for fishers (Kakuma 2007).

Resource management undertaken in the Onna FCA was introduced as a splendid example to many areas in Okinawa – however, very few FCAs actually set up similar MPAs. One reason for this was that they were in a different situation to the fishers of Onna, whose livelihoods mostly came from Mozuku (edible seaweed) aquaculture and thus they were not deeply dependent on wild sedentary resources. So, having measures to provide an alternative income source is vital to resource management. The reason for this is that in the early stage of resource management there often needs to be a degree of self-control exercised in resource harvesting in order for the resource to increase – thus, resource management is unsustainable unless an alternative income source can be provided to support daily living.

15.3.3 Zamamison Diving MPA

Situated in the west of the main island of Okinawa, the village of Zamami uses its rich coral ecosystem as a cornerstone for tourism, which is the main industry of the village. However, in the second half of the 1990s, overuse of the resource by swelling numbers of divers became a problem. In popular diving spots, several hundred divers per day were making dives; their fin kicks resulted in swirling sand that severely damaged coral. Because of this, diving operators in Zamami closed and put several prime diving spots into a temporary rest period. At that point in the past, a diving association had yet to be formed in Zamami, so the FCA, which was providing diving as a business and, therefore, had many members involved in diving, played the key role in this resting initiative. And, the FCA established a community-based MPA in which fishing and diving would be refrained from in three areas for 3 years (Kakuma 2007). In one of these areas, the live coral coverage (the proportion of live coral on the seabed surface) after establishment of the MPA showed an average recovery from 30% to close to 50% between 1999 and 2001, which can be judged to be the efficacy of the MPA (Taniguchi 2003).

The 10th International Coral Reef Symposium was held in Okinawa in 2004. In the 3rd segment of an open symposium titled “Okinawans and Coral Reef” (chaired by the first author), an elderly fisher and the president of FCA were invited from Zamami and they spoke to the symposium about knowledge related to the sea, fish and fishing as well; they additionally explained the timeline for establishing their MPA (Kakuma 2006b). This talk provided useful information for coral reef researchers from around the world who are working on the problem of overuse by divers.

The East Asia Regional Strategy on MPA Networks 2010 was proposed to COP10 by the Ministry of the Environment (Japan) and the International Coral Reef Initiative (ICRI) (Ministry of the Environment/ICRI 2010). To form and follow up on the strategy, international conferences were held in Japan, Vietnam, Thailand, Cambodia, Korea and Singapore, to bring all the relevant stakeholders of East Asia together. These meetings of relevant East Asia stakeholders resulted in the East Asia MPA Network being configured. The first author was involved in all of these international conferences, introducing the community-based MPAs in Okinawa in several of the conferences. As a result, in 2013, a Vietnamese MPA study group visited Zamami, undertook an underwater study of the MPA, and exchanged opinions with local fishers.

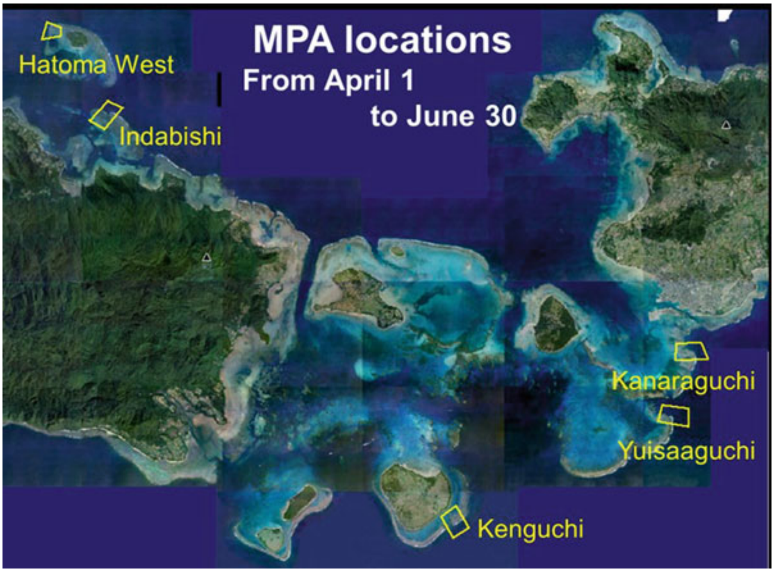


Fig. 15.1 Spawning protection MPA location map (2008–12). (© The Ministry of Environment Japan)

15.3.4 Spawning Protection MPAs in Yaeyama

In the most southern part of the Okinawa prefecture, Yaeyama FCA established MPAs between 1998 and 2002 with the objective of providing spawning protection for the Kuchinagi (which is the name used in Yaeyama for an emperor fish: *Lethrinus atkinsoni*). Based on long-term research over many years by the Okinawa prefecture Fisheries Experimental Station (OFES) and the results of eight fisher's meetings held to discuss management methods, four main spawning areas were established as MPAs, with all fishing banned during the main spawning season from April to May. The reason for having a total fishing ban was that a way had not been found to tell whether Kuchinagi were being caught or whether some other fish was being caught inside the MPAs. Although the stock level did not rise due to the establishment of the MPA, the MPA can be attributed to raising awareness about resource management among fishers. Nevertheless, after the planned period for these MPAs came to an end, they were discontinued.

After resource management was discontinued, catches for all coral reef fish (not just Kuchinagi) plummeted, so a new resource management effort commenced via MPAs from 2008. Management targets were broadly increased to include not only Kuchinagi, but also many species like groupers. The fish-ban period was the main spawning season between April and June, and MPA covered the five main spawning areas (Fig. 15.1), approximately a fivefold increase in the MPA area size, which came about because the area size of the previous MPAs was possibly too small to offer sufficient recovery to the Kuchinagi resource.

The first author, acting as the fisheries extension officer for the Yaeyama region, put this FCA approach forward as good practice to the National Meeting for the Healthy Ocean held in Niigata in 2008. As a result, this approach was awarded the Minister of Agriculture, Forestry and Fisheries Award for fisheries co-management. The award was given a lot of coverage by local newspapers, which galvanized the will of fishers to continue with the activity as well as paved the way for measures for recreational fishers (Kakuma 2009).

15.3.5 A Grouper MPA at Yaeyama

The grouper *Epinephelus ongus* gathers en masse at a particular spawning area during the spawning season. At that time, catches increase and the market prices for the grouper drop. So, because of this, Yaeyama FCA commenced an MPA from 2010. For 5 days (4th–8th) in May, some 325 hectares of the Yonara Channel underwent a fishing ban on all species. There are other spawning areas, but the Yonara Channel is the biggest. Apart from the spawning season, the area hardly sees any *Epinephelus ongus*, but the density increases more than a hundredfold during the spawning season (Ohta and Nanami 2009).

Mass spawning of the grouper *Epinephelus ongus* occurs on the fourth 23rd day of lunar calendar counting from New Year’s Day. Depending on water temperature of the year concerned, mass spawning may also take place third or fifth 23rd day of lunar calendar, but this can be approximated from accumulated water temperatures from 1 month prior to spawning. The lunar calendar is used by Yaeyama fishers in their fishing plans because it is in sync with the tides, which need to be well-known in order to fish successfully in coral reef areas. Historically fishers have known that mass spawning takes place on spring’s 23rd day of the lunar calendar, and that knowledge has been passed down from generation to generation.

The Yaeyama FCA experienced failure in implementing an *Epinephelus ongus* MPA over 25 years ago. There were many methods employed to catch *Epinephelus ongus*, such as hook and line, bottom longline, basket trap and dive fishing, but a group using bottom longline broke the rules, leading the entire resource management effort to unravel. In 2010, the MPA was established mainly by the subcommittee of dive fishing, the main fishing method employed by the Yaeyama FCA. The MPA was realized and continues mainly due to the strong leadership of the then subcommittee president along with national and prefectural researchers who functioned as translators at the time. Fishers understood the behavior of the grouper in terms of traditional knowledge, but the national and prefectural researchers added scientific knowledge to that traditional knowledge, giving gravitas to the decision to establish an MPA and acting as a link to action that followed. Through a trusting relationship, the dive fishing subcommittee president was able to use the translators to persuade fellow fishers to agree to the MPA (Kakuma 2014).

With a mere 5 days, the 2010 MPA approach can be judged a success. The grouper gathered in spawning aggregation to do mass spawning on the 23rd day of

Fig. 15.2 Grouper *Epinephelus ongus* gathered on 23rd day of lunar calendar, with females bloated with eggs. (© Shinichiro Kakuma)

Fig. 15.3 Emperor fish *Lethrinus nebulosus*

lunar calendar (Fig. 15.2). Furthermore, there was no massive price drop due to oversupply in the market. From 2011 onward also, with a flexible approach to changing the period and area, the *Epinephelus ongus* MPA in the Yonara Channel is continuing on.

15.3.6 Emperor Fish MPAs at Haneji and Nakijin

From 2000, MPAs for an emperor fish *Lethrinus nebulosus* have been in place at Haneji and Nakijin in the northern part of the main island of Okinawa (Fig. 15.3). The fishing-ban is not year-round, but rather from August to November when young fish are most prevalent. Thanks to study results from OFES together with a series of five fisher's meetings, MPAs were established in two marine areas in the vicinity of algal areas where many young fish gather. In this case, the OFES researcher was

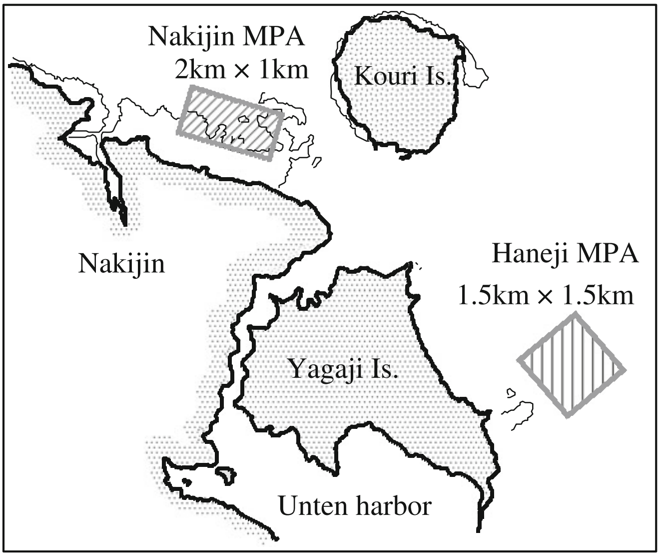


Fig. 15.4 Emperor fish MPAs at Haneji and Nakijin (Kakuma 2006a)

fulfilling the role of translator. In fisher's meetings, the researcher provided scientific information and put forward choices to the fishers in two stages regarding resource management. As study results show that protection of young fish is an effective way to manage the resource, he provided alternative choices for the type of management tools to be used; these include limiting size of gill net mesh, limiting fish size in hook and line, setting a young-fish protection MPA and enlightenment of the fishers and recreational fishers (Ebisawa 2000). As a result, the fishers chose the MPA. Next, the candidates of the MPA locations were put forward based on the results from hearings about fishing grounds with fishers, as well as minimum MPA sizes based on scientific knowledge. Then, at a fisher's meeting for the management of the emperor fish, the fishers decided the locations and sizes of the MPAs (Fig. 15.4).

The Yaeyama Kuchinagi MPA was halted after the five-year plan came to an end. This was most likely influenced by insufficient dialogue and provision of scientific information in the final year. The Haneji and Nakijin MPA was initially a three-year plan from 2000 to 2002 – but, as of 2015, it has been continuing on for 16 years. One reason for this continuation is that there was plenty of time allotted to discussions in the final year of the original plan, with scientific information displaying the results offered at that time, from there on also, and study results showing the efficacy have been made available every year.

The MPA case at Haneji and Nakijin is one of the few examples where the effects have been stringently validated scientifically. OFES has continued its study work, with results showing that since the MPA was implemented, catches of one-year-old fish have decreased while catches have increased substantially for two-to-three-year-old fish. And, fishing mortality of one-year-old fish has decreased appreciably, too. All of these show that the protection of young fish is a success.

From the outside this MPA case looks as if it is moving along smoothly; however, the first author has heard that many people within the two stakeholder FCAs are opposed to the MPAs. A leader of the fishers has noted that: “in truth many people want to quit (the MPA) because they do not really perceive any real increase in the number of fish; so, they only continue it because every year prefecture researchers provide scientific data to show the efficacy.” The author told the fisher how the case of the Haneji and Nakijin MPAs is being introduced at meetings held by the East Asia MPA network, to which the fisher requested, “Please keep telling the world.” A thought occurred to the author that if the fishers get to know that the world is paying attention to their activities, those of them pushing ahead with the MPA within the FCAs will probably take greater pride in their efforts. Additionally, such attention might act as a stimulus to change the minds of the fishers opposing the MPA. After that, in 2013, when the Vietnamese study group visited Haneji and Nakijin, local TV and newspaper substantially spotlighted the exchange of opinions between the study group and local fishers.

The Okinawa community-based MPAs are beginning to show benefits thanks to fisheries extension officers and researchers acting as translators. Yet, inter-area liaising is insufficient, which means that issues remain in the societal network for the MPAs.

15.4 Coastal Resource Management Via Fiji MPA Network

15.4.1 Overview of Fiji

The authors have been studying coastal resource management in Fiji since 2003. Fiji is located in the South Pacific (Fig. 15.5), and, with a population of 880,000, it is the most populated Pacific island nation after Papua New Guinea. Fiji’s main industries are tourism, sugar cane, mining, and forestry. The majority of people live along the coast, making their livings from agriculture and fishing. More than 800 communities rely on coastal resources, with generation after generation having used the resources (Kitolelei et al. 2011).

Fiji comprises 332 islands (Kitolelei and Sato 2016), with most people living on the two main islands, Viti Levu and Vanua Levu. Pacific islands can be broadly divided into two types: high island and atoll. Compared to atolls, high islands are resource-rich, such as fresh water and agricultural produce. Both Viti Levu and Vanua Levu are big high islands. And, Fiji receives more assistance in terms of scientific resource management from institutions like the University of the South Pacific and environmental NGOs such as WWF than other island nations. Also, there are more than 70 government fishery extension officers working in Fiji.

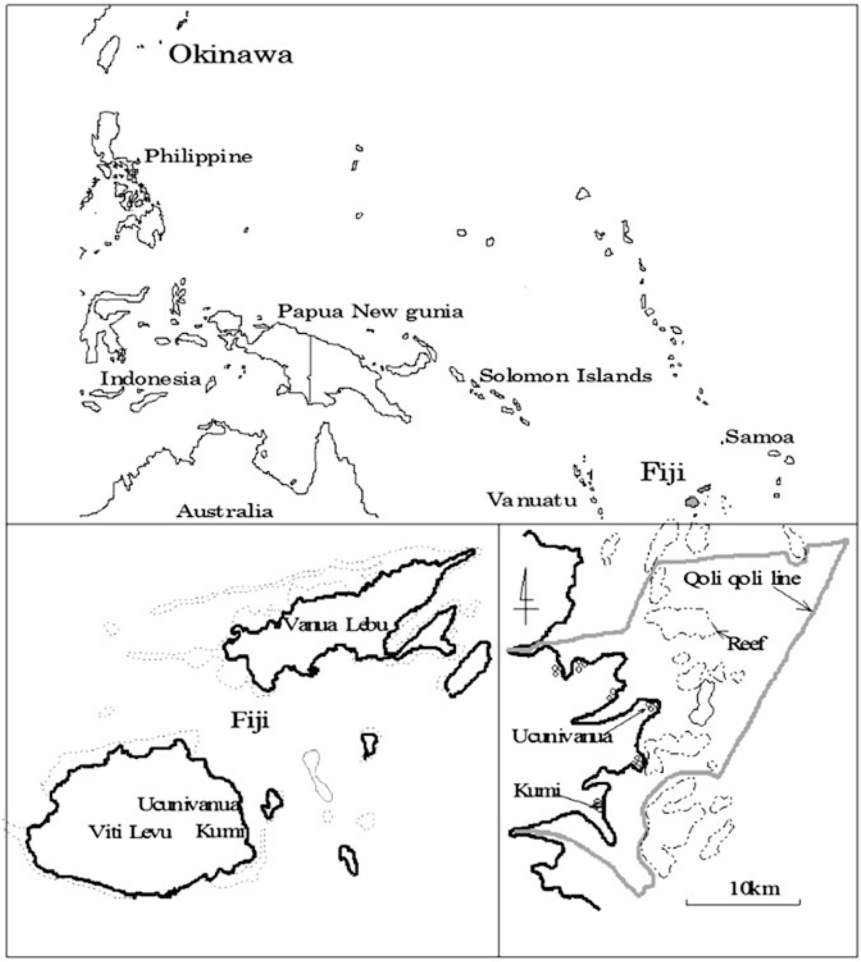


Fig. 15.5 Positions of Ucunivanua and Kumi in Fiji

According to 2001 fisheries statistics for Fiji, tuna catches by foreign ships amounted to 14,000 tons, tuna catches by Fiji ships were 6000 tons, coastal fish catches were 4000 tons and coastal catches other than fish were 3000 tons. However, it should be noted that the coastal fishing figures are for commercial fisheries, but it is conceivable that coastal catches could be at the same order of magnitude in the form of subsistence fisheries (fishing to provide food for one's family). In coastal regions, rather like the common fishing right fishing grounds in Japan, there are 410 management areas called "qoliqoli", with the chiefs of coastal villages overseeing community-based management of resources (Kakuma 2005).

15.4.2 Development of FLMMA

In the Asia-Pacific region, the resource management activities of Locally Managed Marine Areas (LMMA) networks are increasing. It started in 1997 in the village of Ucunivanua on the east coast of Viti Levu. At the time, LMMA had not yet formally begun, but the community-based activities in Ucunivanua were incorporated into a new international framework called LMMA, which then spread across all of Fiji, as well as to other island countries in the Asia-Pacific region, such as Solomon Islands, Papua New Guinea and Indonesia. Also, there are Indigenous and Community Conserved Areas (ICCAs), which provide examples of how community-based initiatives are incorporated from bottom up into international frameworks. There are many diverse initiatives that have been implemented around the world to independently preserve land and sea areas that have in turn been arranged by International Union for Conservation of Nature and Natural Resources (IUCN) to fit into the framework of ICCAs. And, the value of that has been recognized internationally, and is being carried forward to reach even higher levels of value (ICCAs website).

The Fiji government formally adopted a coastal resource management policy using Fiji LMMA (FLMMA) in 2004. As of 2003, there were 27 FLMMA sites, but, as of 2015, this number had grown to more than 400 communities involved in FLMMA, and 466 MPA had been established (FLMMA Network n.d.).

With FLMMA, community-based adaptive management is obligatory. And, while the MPA system is not obligatory as a management tool, it is used by nearly all the areas. Among MPA, there are some that are “no-take” ones that totally ban fishing in a continual manner and then there are others that allow temporary open and some areas where locations are rotated. Traditionally, in Fiji, after a village chief died, there was a system that rendered certain marine areas as taboo, with a 100-day fishing ban. The main reason was to assure seafood to be used in ceremonies 100 days after the death – so, there is knowledge that was being passed down to say fishing bans increase marine product resources. FLMMA is introducing a new concept with the MPA; because the local people already understand the concept of fishing-ban areas and the efficacy derived, the new MPA idea is readily accepted.

With FLMMA, bodies exist to scientifically support communities that are implementing resource management. The University of the South Pacific, the Department of Fisheries and NGOs shoulder the responsibility for this role. As of 2003, the University of the South Pacific was the body involved most with support to areas, but, as the FLMMA expanded and with more than 70 Department of Fisheries’ fisheries extension officers, it was predictable that those officers would start to take on an important role (Kakuma 2005). Along with further FLMMA expansion, the number of supporting bodies has increased in tandem to 23 by 2013. This has led to problems in consistency of activities as a network. Indeed, with the number of related communities involved exceeding 400, the support bodies lack manpower to cope, so a provincially-run natural resource management support team has been

Fig. 15.6 Kava ceremony. (© Shinichiro Kakuma)

established, with local manpower converting over to a system that can help communities in their activities (FLMMA Network n.d.).

15.4.3 Resource Management in Ucunivanua

The first author studied Ucunivanua in 2003. It is not possible to just enter a village in Fiji to conduct a study, a request must be made to the village head, or known as Turaga ni koro, and a ceremony undertaken. The ceremony involves drinking kava that is dissolved ginger tree root powder in water (Fig. 15.6). And, when visiting a village, it is considered polite to carry some yagona (kava) root. Normally, visitors make greetings in Fijian, but in the author's case, the accompanying fisheries extension officer provided that courtesy.

As of 1999, the village population was 338, comprising 68 households. Of this, 20 people were professional fishers. Most of these fishers used spear fishing, while females also were involved in hand fishing. Of the village's ten fishing boats, five or six were made of fiber reinforced plastic (FRP) and the others of wood. On the broad tideland (Fig. 15.7) that stretches out in front of the village, an MPA had been set up to protect the bivalve Kaikoso (Anadara spp., Fig. 15.8) (Kakuma 2005).

Fig. 15.7 Beach in front of Ucunivanua. (© Shinichiro Kakuma)

At the time of this study (in 2003), there was a young researcher taking the lead in FLMMA for the University of the South Pacific. He was a residential researcher who also acted as bilateral knowledge translator. He regularly visited FLMMA fishing villages to impart necessary scientific information as well as writing papers to pass on community activities to the world. The following are extracts from his papers. "The collecting of kaikoso clams is a vital industry in Ucunivanua. Catches are consumed by families as well as sold, the proportion of kaikoso clams that sold is very high at 76–85%, making it the number one catch to be sold. Estimates show that kaikoso sales occupy some 37% of a household's total income. Collecting kaikoso is a year-round task for women and children, because access to collecting grounds is easy and the work non-technical. The clams consumed by families also are important as a source of good protein for the community" (Tawake 2003).

Furthermore, the researcher validated the effectiveness of monitoring by communities and the MPA spillover effect, which means target species in the MPA move out of the MPA to become part of catches elsewhere. In this village, spawned eggs flow off on the current to places outside the MPA, grow in those places, and can be caught by fishers. In the cases of total ban and year-round MPAs, such spillover effect is indispensable. This is because fishers have no other benefit than making catches outside the MPA that have increased thanks to MPA.

Fig. 15.8 Kaikoso being sold at market. (© Shinichiro Kakuma)

"A benefit of establishing a 24-hectare MPA on tideland is that kaikoso clam density has quadrupled while outside the MPA it has doubled, which confirms spillover effect. MPA efficacy is monitored once a year by the local community, employing a method where population counting and size measuring are conducted in one-meter square quadrats at ten-meter intervals along a 500-meter line. The results from this method were compared with a different method used to study density by the University of the South Pacific, and showed no statistical difference" (Tawake et al. 2001).

In Ucunivanua, a fisher leader, Pio Radikedike, spearheaded this activity. He too is a bilateral knowledge translator. He was awarded the Equator Prize for 2002 at the WSSD held in Johannesburg. And, he was later employed by the University of the South Pacific as a fisheries extension officer, and expanded FLMMA activities across Fiji (Kakuma 2005). Doubtless, rather than university professors or NGO specialists giving the advice, a fisher from the same kind of background telling people about FLMMA via his own experiences was going to be easier to understand for the various communities. When the author was conducting a study on Ucunivanua, this fisher leader provided accommodation at his mother's home, where discussions with him showed his persuasive powers. He is one of the people who contributed to the swift expansion of FLMMA.

Fig. 15.9 Tideland in front of Kumi. (© Shinichiro Kakuma)

15.4.4 Resource Management at Kumi

During 2013–14, the authors carried out studies at Kumi, a village in the Verata district, about ten kilometers south of Ucunivanua. In 2014, the population of Kumi was 273, with 84 households, and livelihoods were centered around agriculture and fishing. Agriculture is not just about producing a single crop, but rather seasonally orientated cultivation of various produce, which is helped by traditional knowledge about the land's ecosystem.

Tideland and mangrove forest spreads out in front of the village (Fig. 15.9), with coral reef found offshore. Villagers harvest a wide variety of seafood from these ecosystems. In the village there are six motorized boats, two boats without motors and seven or eight rafts made of bamboo. The fishing method employed by nearly all households is hand lines and gill nets up to 300 m long and with a mesh size of 8.5 cm. Also, there is some harvesting using spear fishing (without diving) and gathering of shellfish and sea cucumbers from the tideland. Joeli Veitayaki of University of the South Pacific compiled the local names for the Fijian fishing methods and species names both in English and in local language (Veitayaki 1995). The qoliqoli marine area used by the community is shared by all six villages in the Verata district, including Ucunivanua. Nearly all the fish caught are consumed by families, but some are sold at a far-off market.

Fig. 15.10 Eucheuma cultivation and harvesting. (© Jokim Kitolelei)

Like Ucunivanua, harvesting of bivalve kaikoso clams is important to Kumi, and mostly female members of the village do the harvesting. Half of the households that harvest also sell the clams, which also makes them an important source of income. Consistent with FLMMA practices, the MPA that mostly target kaikoso and sea cucumbers at Kumi is set in tideland. A rotation system is employed for this MPA, with it being moved from north to center to south of the village in three periods (2007–2009, 2009–2011 and 2011 onward). Four people are selected from among the villagers to serve as unpaid fish wardens. And, with the efficacy of spillover, the kaikoso resource is increasing; the community is aware of this status.

With government support, the projects to cultivate the sea cucumbers and the seaweed, Eucheuma, were implemented (Fig. 15.10). In the first fiscal year of the projects, the government provided materials, etc., with the system developing into one where the community independently operated the initiative from there on. Moreover, the government dispatched fisheries extension officers to the village in order to conduct workshops offering advice to the community about aquaculture techniques. The fisheries extension officers provided scientific knowledge, but the community made use of their own traditional knowledge in choosing tree material for building enclosures and the optimum locations for aquaculture. Only two aquaculture sites still provide a small amount of cash income, but thanks to the joint work and income to be used on community activities, the projects have enhanced social capital and contributed to strengthening community bonds.

The fishers of Kumi make the most of their abundant knowledge about ocean ecology to catch and harvest seafood. They understand the behavior of some 122 species, selecting the optimum harvesting season and grounds for each of the species and employing multiple fishing techniques to use the resources. The pieces of knowledge and the techniques that make up the traditions are orally handed down from generation to generation. And, like the fishers of Yaeyama, they understand the tides and how the behavior of the species responds to those tides. And, the fishers hand down knowledge about mass spawning that conforms to the lunar cycle in the same way the lunar calendar is used to predict grouper *Epinephelus ongus* spawning (Novaczek et al. 2005). Also, as described in a book “Words of the Lagoon” by Robert Johannes, in Palau, another Pacific island nation, traditional coral reef fishing that makes use of unbelievably diverse and abundant knowledge about ocean ecology is implemented (Johannes 1981).

In Kumi, there are several systems for producing, blending, and distributing traditional knowledge and scientific knowledge. The bottom-tier system is a family one, with school, clan, religion and committee systems underpinning production, blending and distribution of knowledge. Yet, social gatherings to drink kava also enable the sharing of knowledge. And, there are nine committees for advancing various community activities: development, youth, female, water management, education, cooperative store, seaweed aquaculture, sea cucumber aquaculture and ginger cultivation committees. The members of these committees, who are volunteers, are selected at general meetings for the entire community that are held at least once a month. The chair of all of these committees is the Turaga ni koro. These committees and general meetings are the settings for decision making related to community activities and the passing on of knowledge. The decision making for issues of vital importance is finally entrusted to the village chief.

The chief is a hereditary post but the Turaga ni koro is elected. Final decision making is clearly divided by roles between the chief and the Turaga ni koro. Apart from decision making, the Turaga ni koro also has the important role of bilateral knowledge translator. Likewise, other Turaga ni koro roles include attending a variety of meetings outside of the village, acquiring information and translating it to pass on to the community; inviting outside scientists to come and pass on scientific information to the village, and, as reverse translation, compiling the various traditional knowledge that exists in the community to pass it onto outside scientists.

15.5 Towards Multi-Layered MPA Networks Linked by Bilateral Knowledge Translators

In Okinawa, centered around FCAs, community-based MPAs are beginning to function. Here, fisheries extension officers and researchers are acting as bilateral knowledge translators who link local communities to the world outside. Whereas, in Fiji, in addition to that link, MPA networking also is moving forward, and being used to expand into global activities. Compared to Fiji, the Okinawa MPA network is weak − why is that?

The role of the University of the South Pacific is immense in terms of expanding FLMMA. The university has taken a single village’s initiative and incorporated it into an international framework to be expanded. Obviously, the efforts of the two bilateral translators affiliated to the university are paying off. Amidst such moves, another important factor is that the Fiji government, which has many fisheries extension officers, recognized the value of FLMMA, and formally used FLMMA in its own policy in order to participate as yet another actor in initiatives. Moreover, attention is being given on a global level to the functions and values of MPA – in particular, the effectiveness of community-based MPAs where the MPAs are not top-down ones. This attention is doubtless another factor behind global expansion. Likewise, the expansion of ICCAs provides benefits in the same way.

What are the merits of turning MPAs into networks? Probably the greatest merit is how networks enhance the function of MPAs through mutual learning between areas. And, comparisons of many MPAs in the networks may contribute to MPA sustainability.

In Okinawa, MPA network weakness is also influenced by the lack of community-based MPAs. At Onna, currently there is no no-take areas, but instead a method of zoning the entire marine area into areas such as aquaculture ones by way of sedentary resources management (Onnason FCA 2008). At Zamami, the diving-ban areas were opened in 2001, but anchoring buoys were installed to strictly limit the number of diving boats that can enter a given area at one time. And in these areas there is no fishing. However, most likely, neither village recognizes that they have MPAs in their marine areas. A community-based MPA has been newly established in Okinawashi on the east coast of the main island of Okinawa, but the number of MPA is really not enough yet to form a network.

What about Japan as a whole? It is not well known, but there are at least 387 autonomous MPAs in Japan (Yagi et al. 2010). Yet, these have not been formed into a network. The fishers in areas also have said that they fear poaching from outside would increase if positions of the autonomous MPAs were made public. Surely, for such areas, positive efforts to link up with the outside world to build a network that can be used for mutual learning is of far greater merit than guarding resources in an insular manner?

To make Japanese community-based MPA more efficient, the Japanese government needs to recognize their value, and provide a system that builds them into a network. And, to do that, surely the 433 fisheries extension officers at present in Japan should logically function as bilateral knowledge translators. The Japanese FCA system of effectively managing resources as commons is receiving attention internationally (Makino 2011). So, if a system can be created where bilateral translators link the FCA-orientated MPAs together, surely it would have more than enough potential to broadcast the initiatives to the world.

References

Ebisawa A (2000) Fisheries co-management promotion study (spangled emperor *Lethrinus nebulosus* resource management (資源管理型漁業推進調査(ハマフエフキの資源管理)). Annual report of Okinawa Prefectural Fisheries Experiment Station in Fiscal Year 1999. Okinawa prefectural fisheries Experiment Station, Okinawa, pp 81–86 (in Japanese)

FLMMA Network (n.d.) FLMMA strategic plan 2014–2018

ICCA s Website. http://www.iccaconsortium.org/. Accessed 19 May 2016

Johannes RE (1981) Words of the lagoon. University of California Press, London

Kakuma S (2005) Co-management of coastal resources in Fiji (part 1): FLMMA and coastal fisheries management (フィジーにおける沿岸資源共同管理の課題と対策(その1)-FLMMAと沿岸水産資源管理の状況-). J Reg Fish 46(1):261–282. (in Japanese)

Kakuma S (2006a) Study on coastal fisheries resources and ecosystem management in Asia-Pacific island regions – Toward co-management and adaptive management with problem-solving approach (アジア太平洋島嶼域における沿岸水産資源・生態系管理に関する研究-問題解決型アプローチによる共同管理・順応的管理にむけて-). PhD thesis, Tokyo Institute of Technology, Tokyo (in Japanese)

Kakuma S (2006b) Issues and measures for MPA, coral reef conservation and ecotourism in tropical and subtropical regions – cases studies of Zamamison in Okinawa and Asia-Pacific island regions (熱帯亜熱帯におけるMPA・サンゴ礁保全・エコツーリズムの課題と対策-沖縄県座間味村とアジア太平洋島嶼国を事例として-). In: Aragaki M (ed) Building a sustainable development model in depopulating and aging Okinawa inshore islands. Okinawa University, Okinawa, pp 101–119. (in Japanese)

Kakuma S (2007) Diversity and multi-functions of marine protected areas (MPAs) in coral reefs (サンゴ礁海域における海洋保護区(MPA)の多様性と多面的機能). Galaxea JCRS 8:91–108. (in Japanese)

Kakuma S (2009) Eco-system conservation and fisheries management in the coastal areas: a case study of coral reef areas in Yaeyama, Okinawa (沿岸域における生態系保全と水産資源管理-沖縄県八重山のサンゴ礁海域を事例として-). J Reg Fish 49(3):67–89. (in Japanese)

Kakuma S (2011) Conservation of coral reefs (サンゴ礁を守る取り組み). In: Suzuki Y, Oba H, Tsuchiya M (eds) Coral reef studies. Tokai University Press, Kanagawa, pp 314–337. (in Japanese)

Kakuma S (2014) Co-working flexibly with tough fishermen (したたかな漁業者としなやかに協働する). Local science network for environment and sustainability website http://lsnes.org/relayessay/00002/. Accessed 7 July 2016 (in Japanese)

Kitolelei J, Sato T (2016) Analysis of perceptions and knowledge in managing coastal resources: a case study in Fiji. Front Mar Sci 3:189. https://doi.org/10.3389/fmars.2016.00189

Kitolelei J, Torii T, Bideshi V (2011) An overview of Fiji fisheries. Discussion Paper Series. J Reg Fish 5:1–7

Makino M (2011) Fisheries management in Japan, its institutional features and case studies. Springer, Berlin

Ministry of the Environment/ICRI (2010) ICRI East Asia regional strategy on MPA networks 2010. Ministry of the Environment, Tokyo

Novaczek I, Mitchell J, Veitayaki J (eds) (2005) Womens pacific voices. In: Pacific voices: equity and sustainability in Pacific Island fisheries.Oceania Printers Limited, Suva, pp 90–94

Ohta I, Nanimi A (2009) Distribution of white-streaked grouper (*Epinephelus ongus*) spawning grounds (ナミハタの産卵場での分布状況). In: Okinawa Prefectural Fisheries and Ocean Research Center (ed) Annual report of Okinawa Prefectural Fisheries and Ocean Research Center in fiscal year 2009. Okinawa Prefectural Fisheries and Ocean Research Center, Okinawa, pp 36–39. (in Japanese)

Onnason fishery cooperative Association (2008) Chura-Umi (beautiful sea) PART 3 (美ら海PART3). Onnason fishery cooperative Association, Okinawa. (in Japanese)

Taniguchi H (2003) Effects and regret points on diving points closure in Zamamison (座間味村におけるダイビングポイント閉鎖の効果と反省点). Midoriishi (Acropora) 14:16–19. (in Japanese)
Tawake A (2003) Human impacts on coastal fisheries in rural communities and their conservation approach. The Master thesis, University of South Pacific, Suva
Tawake A, Parks J, Radikedike P, Aalbersberg B, Vuki V, Salafsky N (2001) Harvesting clams and data. Conserv Biol Pract 2(4):32–35
Veitayaki J (1995) Fisheries development in Fiji: the quest for sustainability. University of the South Pacific, Suva
Yagi N, Takagi A, Takada Y, Kurokura H (2010) Marine protected areas in Japan: institutional background and management framework. Mar Policy 34(6):1300–1306

Chapter 16
Salmon-Safe Certification in the Pacific Northwest of the United States

Kevin Scribner and Reiko Omoto

Abstract Salmon-Safe is the place-specific sustainability certification and eco-label program in the Pacific Northwest region of the United Sates. Salmon-Safe's mission is to transform land management practices so salmon can thrive in West Coast watersheds. Its core strategy is to use an eco-label certification program to inspire and incentivize water quality protection and habitat conservation on working landscapes. What makes Salmon-Safe innovative and different from other eco-label schemes is that Salmon-Safe's coverage is defined by the watershed of Columbia River basin (state of Oregon, Washington and a part of California and British Columbia in Canada). There have been over 800 agricultural and urban landowners across the Pacific Northwest Region working to eliminate runoff from fields, reduce and alternate harmful pesticide and chemical use, and restore streamside habitat; certified entries include vineyards, hop fields, Nike's headquarter in Portland and City of Portland's entire services. Salmon-Safe values the collaboration with other certification and conservation programs and this makes the organization able to reach throughout the Columbia River basin, which is equivalent in size as France, with just one staff member, its Executive Director, from 1996 to 2014.

16.1 Salmon-Safe Certification: History and Current Status

> The salmon are among the oldest natives of the Pacific Northwest, and over millions of years they learned to inhabit and use nearly off the region's freshwater, estuarine, and marine habitats. . .the salmon have penetrated the Northwest to an extent unmatched by any other animal. They are like silver threads woven deep into the fabric of the Northwest ecosystem. . . . (Lichatowich 2001, p. 6)

K. Scribner
Salmon-Safe, Portland, OR, USA

R. Omoto (✉)
Research Institute for Humanity and Nature, Kyoto, Japan

Tottori University, Tottori, Japan
e-mail: reiko.omoto@tottori-u.ac.jp

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_16

After millennia of sustainable interaction with Pacific Northwest indigenous cultures, wild Pacific salmon have endured two centuries of Euro-American natural resource cultural patterns. Introduced the early 1800's, these new patterns became dominant across the landscape and dramatically decreased the populations of salmon and some salmon runs have gone extinct. Beginning in the early 1970's, this loss was increasingly recognized as unacceptable, prompting application of numerous US Federal and State Laws, joined by a long overdue recognition of Native American Tribal Treaty obligations. These have provided the legal foundation for regulatory efforts to restore and sustain the still existing populations.

In the United States, Federal laws and regulations are most effective when applied to actions managed or overseen by other forms of government, at Regional, State or Local levels. They are less effective when applied to the private sector, where land ownership and management is very diffuse and decentralized. Federally mandated salmon recovery efforts have been most effective in the mountainous headwaters of salmon-bearing watersheds, for much of this landscape is under Federal and State ownership. But the salmon's anadromous life-cycle has them migrate in many streams and rivers that flow through private land that is managed by a diverse array of individuals and businesses. To apply one set of regulations to many different landowners and economic pursuits is difficult, especially when administered by understaffed Federal agencies. This difficulty is frequently exacerbated by resistance by some landowners to comply with management dictates to which they feel they have been subjected to without their consent, by "heavy-fisted regulators" that demonstrate a "command and control" approach. In the mid-1990's, environmental leaders recognized that other methods than regulation are necessary to ensure private sector waterways are safe for salmon. Consequently, Salmon-Safe was launched in 1996.

Salmon-Safe was founded by the Pacific Rivers Council, a river conservation organization based in the Pacific Northwest, transitioning into an independent nonprofit in 2002. Salmon-Safe's mission is to transform land management practices so salmon can thrive in West Coast watersheds. Its core strategy is to use an eco-label certification program to inspire and incentivize water quality protection and habitat conservation on working landscapes. What makes Salmon-Safe innovative and different from other eco-label schemes is that Salmon-Safe's coverage is defined as the watershed of Columbia River basin (encompassing to Oregon, Washington and a part of California and British Columbia in Canada).

As of 2016, Salmon-Safe has worked with nearly 800 agricultural and urban landowners across the Pacific Northwest Region to eliminate runoff from fields, reduce and provide alternative options to harmful pesticide and chemical use, and restore streamside habitat. More than a decade after first certifying farms in Oregon's Willamette Valley, Salmon-Safe has become one of most established regional eco-labels with more than 95,000 acres of farm and urban lands certified in Oregon, Washington, California, and British Columbia. Salmon-Safe certification requires

Fig. 16.1 Salmon-Safe's mountain to ocean concept. (Provided by Salmon-Safe)

rigorous third-party certification of water quality protection and habitat restoration actions based on peer-reviewed, science-based standards. Salmon-Safe operates through a Partner Network of collaborating watershed councils and conservation organizations.

High profile Salmon-Safe urban projects in Portland, Oregon, have included the City of Portland's (Oregon)10,000-acre system of parks and natural areas, The Oregon Museum of Science and Industry, Lewis and Clark College, and Portland State University, and many of the Willamette Valley's leading farms, orchards, and vineyards. And in October, 2016, the City of Portland completed a 3-year effort to have all of its City services become Salmon-Safe.

As of 2016, Salmon-Safe has encapsulated its watershed-wide approach in a comprehensive Mountains-to-Ocean vision. This vision matches the freshwater and near-shore marine life-cycle needs of the salmon (Fig. 16.1).

Although the application is limited to the basin level, it should be noted that in this chapter we are talking about one very large river basin: the Columbia River Basin in the Pacific Northwest of the United States. This Basin drains an area about the size of France, encompassing 1200 river miles, has the fourth largest annual river flow in North America, and is comprised of many smaller watersheds. The Columbia River produced more salmon and steelhead than any other river in the world, with 10–16 million adult salmon of all species returning to the Basin each year.

16.2 Salmon as Flagship Species and More in the West Coast US

Before describing the rationale for a land-water management and salmon-supportive strategy as Salmon-Safe, a historical and legal perspective is important also in regard to Native American and Canadian First Nations.

The *Salmonidae* Family is thought to have been in existence for 100 million years (Behnke 2002). Salmon are anadromous, spawned and born in fresh water, reared in salt water and if these Pacific Coast watersheds could speak, they would likely use the "language of salmon." The indigenous cultures that relied upon salmon as a primary food source integrated the salmon ways—their life-cycle patterns—into their cultures, enabling them to "communicate" with the fish. In the rituals and fishing practices, these cultures may have a vernacular as close to a salmon language as is humanly possible.

> The First Salmon Ceremony renewed and reinforced the belief that the salmon would remain abundant if they were treated with the respect due a gift. . .But the ceremony was more than just a ritual. The exchange of gifts between salmon and man—the giving of food in exchange for respectful treatment—actually assured a continuous supply of food for Native Americans. By causing men and women to treat the salmon with respect, the ceremony reinforced behaviors that minimized waste and reduced the chance of overharvest. (Lichatowich 2001, p. 36)

As well there is an array of non-human species that have co-evolved with salmon, and thus have an understanding of how salmon express themselves:

> The salmon's gift . . .benefits the whole ecosystem, including at least twenty-two species of mammals and birds that feed on salmon flesh, such as bears, eagles, and even little winter wrens. The decaying carcasses release nutrients back into the river and the surrounding forest. (Lichatowich 2001, p. 37)

The arrival of the Euro-Americans, beginning in the early 1800's, introduced to the Columbia River Basin a new culture, based on a radically different world-view and set of values, and unfortunately, the associated lack of respect also extended to the Native American cultures who used to follow salmon's calendar.

From 1804, when the Lewis and Clark Corps of Discovery reached the Pacific mouth of the Columbia River, having crossed overland from the middle of what is now the United States, to 1991—roughly 10 human generations—scientists discovered that 214 wild runs of *Salmonidae* in the States of Oregon, Washington, Idaho, and California were at risk of surviving, with 101 of these at a high risk of extinction, 58 with moderate risk, and 54 were of special concern. In addition, at least 106 major stocks were already extinct (Nehlsen et al. 1991).

Many components of the contemporary industrial economy had significant negative impacts on the Columbia River salmon runs. Timber harvests in forested headwaters, plus the necessary road construction to extract logs, would clog spawning beds with sediment, increase water temperatures from diminishing riparian shading—a potential death knell for cold water fish like salmon—and cause wash-outs of stream beds from decreasing the water retention capacity of previously forested lands. Mining would dredge up stream beds, rendering them unusable by salmon and interrupting the natural trophic systems that begin with aquatic invertebrates. Irrigated agriculture, with an attitude that food comes best when applying water to land, would withdraw river water, decreasing flows to levels that barred salmon from their freshwater spawning and rearing areas, as well as increasing temperatures.

In addition to these impacts, the Columbia River was envisioned, by the engineers from the industrial economy, as a source of hydro-electric power. By the 1970's, 19 major dams were built on the US portion of the River—there are five more on the Canadian side. Each dam presented significant, if not fatal, obstacles for both adult and smolt salmon: adult upriver passage required construction of "fish ladders," with some dams lacking ladders and thereby barring salmon from extensive historical habitat; slowing and warming of river water impounded in reservoirs which disrupts salmon passage timing and the trophic system with which they co-evolved; fatal supersaturated gases generated by the spillways; disorientation and death from traveling through turbines (Collins 1976; Ruggles and Murray 1983). Adding to this, Euro-American commercial fishermen paid insufficient attention to salmon ecology and fisheries management to sustain the runs. In 1980, the last Columbia River salmon cannery closed, from a peak production in 1920's of 550,000 cases (48 lbs. of salmon per case).

The call to restore some semblance of the Columbia River salmon runs began to emerge in the 1970's, with Federal laws and Tribal Treaty obligations providing the impetus to dedicate resources for salmon and river restoration. In 1980, the US Congress passed into law the Northwest Power Act that created the Northwest Power and Conservation Council (called the Northwest Power Planning Council until 2003). This Act also forced the Bonneville Power Administration (originally established in 1937 to manage the hydroelectric system) to add fish and wildlife programs to its management portfolio.

16.2.1 Northwest Electric Power Planning and Conservation Act, and Treaty of 1855

In 1980, Congress authorized formation of the Northwest Power and Conservation Council (Council)...The Northwest Power Act directs the Council to prepare a plan to protect, mitigate and enhance fish and wildlife of the Columbia River Basin that have been affected by the construction and operation of hydroelectric dams while also assuring the Pacific Northwest an adequate, efficient, economical and reliable electric power supply (Harrison 2008).

Two years prior, in 1978, Federal officials began to consider using the powers of the Endangered Species Act (ESA) to list some of Columbia River's salmon stocks as *threatened* or *endangered* but this process was suspended in anticipation of the Northwest Power Act's passage and its capacity to protect and restore salmon.

The ESA was designed to protect critically imperiled species from extinction as a "consequence of economic growth and development untempered by adequate concern and conservation." The U.S. Supreme Court found that "the plain intent of Congress in enacting" the ESA "was to halt and reverse the trend toward species extinction, whatever the cost."(National Oceanic and Atmospheric Administration).

A decade later, beginning in 1991, the ESA (ESA) was invoked to list twelve Columbia River salmon and steelhead stocks as *threatened* or *endangered*.

In addition to the Northwest Power Act and the Endangered Species Act, the Treaty of 1855 with Columbia River Tribes established legal obligation for the US Federal Government to protect tribal "rights to fish, hunt, and gather traditional foods and medicines throughout the lands ceded" to the United States, as described by the Confederated Tribes of the Umatilla Indian Reservation:

16.2.2 Treaty of 1855

In 1855 the U.S. Government and the Cayuse, Umatilla, and Walla Walla Tribes signed a treaty. In the Treaty, the tribes gave up, or ceded, to the United States more than 6.4 million acres. In exchange, a parcel of land was designated as the Umatilla Indian Reservation which the tribes would retain as a permanent homeland. Also in the Treaty of 1855, the tribes **reserved** rights to fish, hunt, and gather traditional foods and medicines throughout the 6.4 million acres of ceded lands (Confederated Tribes of the Umatilla Indian Reservation).

In additional to Native American Tribal Treaties, there is an international agreement between Canada and the United States that provides a management framework for the Columbia River Basin: the Columbia River Treaty. The River's headwaters originate in British Columbia, Canada, but only about 15 percent of the 259,500 square miles of the total Basin is located in Canada. Even so, Canadian waters supply about 38 percent of the average annual volume. This Treaty was signed in 1964, facilitating shared water resource management to maximize benefits to both the United States and Canada, and is scheduled for re-authorization in 2024. Canada and the US have indicated intention to renew the Treaty, and both have declared interest in adding "ecosystem considerations" to the original Treaty's focus on power generation and flood control. Salmon restoration is a key aspect of these ecosystem considerations. These numerous and complex legal, regulatory, science-rich and science–dependent, high-level policy frameworks can be challenging for full-time government and agency staff to understand, integrate and with which to comply. For many of those private businesses and landowners whose primary focus is on the demands of their own operations, the processes, underlying concepts and values, the goals and objectives, schedules, their families and even the language of these frameworks can seem to be "from another planet." Whereas, Salmon-Safe, with its focus on the marketplace, can be an attractive, if not familiar, entry point for private landowners into the complex system of salmon management and recovery.

16.3 Salmon-Safe Approach to Certification

When conducting outreach for prospective clients, Salmon-Safe Certification begins with the goal to add value to land management and the business case for sustaining ecological functions in working landscapes. This is a different approach from those that strive to transition working lands into production-exempt refuges. Carving out and maintaining refuges from working lands can benefit salmon but it is costly and unlikely to have widespread application at the watershed-scale. Salmon-Safe's approach of sustaining ecological function on working landscapes can be applied widely and at a fraction of the cost of refugia strategies.

Salmon-Safe's Farm Certification process operates on a 3-year cycle. The first year involves an on-site audit by a qualified independent third-party assessor. For farms, Salmon-Safe requires the prevention of runoff from fields, the use of alternatives to harmful chemical pesticides that impact downstream wildlife, restoration of streamside buffers and wetlands, and conservation of water to ensure that rivers are not negatively impacted by irrigation. If the Program Standards are sufficiently met, certification will be awarded. In the second and third years, annual progress reports are submitted. In some cases, certification may be awarded contingent upon certain specific actions implemented according to agreed-upon schedule. In Year Four, the 3-year cycle re-starts, with the on-site audit. The Urban Certifications operate on a 5-year cycle.

Salmon-Safe has identified four areas where its certification can add value to private land management: (a) the marketplace; (b) land management efficiencies; (c) resource restoration project funding; (d) regulatory assurance. With its eco-label (Fig. 16.2), Salmon-Safe provides production systems a means of product differentiation in the marketplace. In the language of the marketplace, a consumer "speaks with their money" and if the Salmon-Safe eco-label is persuasive, it's eco-label can generate a range of added-value expressed by market access, share, certainty and premium price.

Salmon-Safe's Certification Standards can also stimulate a thorough evaluation of an operation's current land management practices that may then translate into management efficiencies and increased cost-effectiveness. These management

Fig. 16.2 The Salmon-Safe ecolabel. (Provided by Salmon-Safe)

values may be realized even if certification is not the ultimate outcome. In some cases, on-site restoration projects may be required to attain or sustain Salmon-Safe Certification. To assist landowners with associated project cost, Salmon-Safe works to persuade restoration programs to rate project proposals on certified lands as a priority. There is an example where a Land Trust made a Conservation Easement contract contingent upon Salmon-Safe Certification.

Compliance with the profusion of salmon management laws, policies and regulations described above could interrupt a landowner's operation, either with lengthy and possibly confusing processes and paperwork, or from the perceived threat of an enforcement action that could include a fine or an order to cease to operate. In the face of these potentially disruptive regulatory enforcement actions, landowners desire to have certainty that they can conduct their operation and maintain their business. To help establish and sustain certainty, Salmon-Safe works with Federal and State regulatory agencies to have them equate certification with some level of assurance that certified operations are pro-actively committed to regulatory compliance.

The basis of peer-reviewed Salmon-Safe Certification Standards gives its Program the credibility to provide the value-propositions listed above. And when coupled with an independent, third-party audit process—the most rigorous of the certification audit types—Salmon-Safe keeps its integrity.

These Standards, developed substantially by fish and aquatic toxicology scientists, pay considerable attention to water quality. Run-off from the land, into salmon-bearing water bodies, is how the land, and its management practices, greatly affects the health of salmon. In the *language of salmon*, erosion and run-off is how the land *speaks* to salmon. The Salmon-Safe Standards are comprised of the following area management; riparian area management, water use management, erosion and sediment control, integrated pest management and water quality protection, animal management, and biodiversity conservation.

16.3.1 The Extension of Certification Spheres

Salmon-Safe began with a focus on farm certification, but has developed additional land management sector programs in order to achieve the mandate of its mission to work at the watershed scale. Following are the Salmon-Safe's current coverage (certification and accreditation) based on the aggregated watershed impact.

Urban Development Building on our work with innovative developers of large-scale commercial projects in Seattle, Salmon-Safe's development standards apply to any large-scale urban project with the goal of elevating environmental performance through design and construction to ongoing operation. The standards can be applied at any of these stages.

Vineyards Salmon-Safe has become a leading U.S. certifier of ecologically sustainable viticulture with more than 350 Oregon, Washington, and British Columbia vineyards achieving certification, including nearly half of the wine grape acreage in Oregon's Willamette Valley and a growing number of Washington's most acclaimed producers. Certification for winegrowers focuses on reducing runoff from hillside vineyards and enhancement of native biodiversity on vineyard sites.

Farms Since 1997, Salmon-Safe and its place-based implementation partners have worked with more than 500 West Coast farms to provide incentives for the adoption of practices that protect water quality and fish habitat. Salmon-Safe certified farms include both organic operations and growers using biologically-based integrated pest management. Salmon-Safe and its farm partners have promoted their certified products in more than 300 natural food and mainstream grocery stores.

Corporate and University Campuses Nike led the way as the first corporate adopter of Salmon-Safe practices at their 180-acre World Headquarters campus. Salmon-Safe provides important benefits to landowners including validation of environmental performance, innovation credit under U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) program, public credibility, and enhanced operational efficiency and cost savings.

Large-Scale Infrastructure Salmon-Safe has rolled out a green street design and development standard for mass transit, large-scale stormwater, and other infrastructure projects that integrate the principles of low impact development (LID) site design while focusing on habitat vulnerability most critical to reduction of nonpoint source pollution and survival of imperiled fish.

Parks Systems and Natural Areas Developed in partnership with the city of Portland with the collaboration of many other Northwest municipalities, Salmon-Safe park and natural area certification is a system-wide approach that relies on a comprehensive evaluation of overall management policies and planning related to habitat and water quality protection.

Golf Courses Salmon-Safe Golf seeks to inspire a new level of environmental innovation in golf course design and management with respect to the protection of urban water quality and the preservation of imperiled West Coast salmon. The project is a collaboration between Salmon-Safe and our Seattle-based implementation partner Stewardship Partners.

16.3.2 Accreditation Programs

Contractor Accreditation As Salmon-Safe's first practice-based accreditation program, Salmon-Safe's program for construction companies engages contractors in consistently applying best construction site management practices with the goal of achieving zero sediment runoff across their entire operation.

Fig. 16.3 Salmon-Safe's regional partnership areas. (Salmon-Safe website)

Developer Accreditation Now in pilot phase, Salmon-Safe's newest initiative is accreditation for large-scale developers that commit to implementing Salmon-Safe principles across all of their development projects.

16.4 Working Through Partnerships

These sector programs have increased the demand for Salmon-Safe Certification throughout its mission area, but most emphatically in the Pacific Northwest. To serve this growing interest while remaining a staff-light organization (Salmon-Safe relied upon one staff member, its Executive Director, from 1996 to 2014), Salmon-Safe developed a regional Partner Network (Fig. 16.3). Some of these Partners have their own certification programs with which Salmon-Safe has combined services. Partnership with well established programs such as Oregon Tilth's Organic Certification, LIVE's Vineyard Certification, and Demeter's Biodynamic Certification, has enabled Salmon-Safe to spread more quickly throughout Pacific Northwest watersheds and agriculture crop sectors than working in isolation. And as Salmon-Safe has an ecological function focus and is designed to be applicable to all land management, it has easily meshed with these other programs. Combining certification programs has helped Salmon-Safe serve its clients by requiring one inspection process for two certificates, decreasing net cost and time, and lessening the chance for "audit fatigue."

Salmon-Safe also relies upon outside help for technical assistance. Reflecting its mission and core strategy, Salmon-Safe's expertise is maintaining a credible certification program based upon standards whose applicability and integrity is constantly stewarded. This stewardship requires periodic re-evaluation and potential updating of the Salmon-Safe Standards, which is always subjected to peer-review. And since Salmon-Safe is not comprised of scientists, applied researchers or land managers, it looks to unbiased sources for advice and recommendations. These include technical experts from the University Extension Service, United States Department of Agriculture researchers, and private sector consultants. In addition to these formal Partners and frequent technical advisors, Salmon-Safe collaborates with initiatives that relate to its mission and provide the opportunity for Salmon-Safe Certification to complement the methods of these initiatives to enhance the recovery and viability of salmon runs.

Salmon-Safe has interacted with NOAA's lead planning entities in two sub-regions: the Yakima Basin Fish and Wildlife Recovery Board and the Snake River Salmon Recovery Board. Salmon-Safe Certification is positioned to provide the added-values of certification to the restoration activities hosted by these two Recovery Boards, and is exploring with NOAA Fisheries the capacity for Salmon-Safe Certification to be a positive contribution to ESA compliance.

United States Environmental Protection Agency (EPA) is responsible for administering the Federal Clean Water Act, which "establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters" (EPA website) and hosts the Columbia River Basin Toxics Reduction Working Group Salmon-Safe is a general member of this Working Group, and serves on both its Steering and Executive Committees and collaborates with EPA enables Salmon-Safe to promote certification as a measurable contribution to compliance with the Clean Water Act. This increases the confidence of farmers that certification will persuade EPA to support the voluntary approach of Salmon-Safe, instead of requiring costly regulatory actions. EPA's confidence in the voluntary approach is strengthened by the success of Oregon State Department of Environmental Quality's (ODEQ) Pesticide Stewardship Partnership Program (PSP). Salmon-Safe has been an active partner with the PSP in the Walla Walla River Basin, providing management Standards that have been embraced by vineyards and tree fruit managers. The Walla Walla PSP has verified a definitive correlation between best management practices and improved water quality, verified by ODEQ's testing of water samples. This success has further strengthened the confidence in both EPA and farmers that the voluntary approach does work. Also, Salmon-Safe is collaborating with the Greater Yamhill Watershed Council, in the lower Willamette River Basin (a major tributary of the lower Columbia River), in using the PSP approach in an urban setting. This collaboration demonstrates the suitability of the voluntary approach for a variety of situations involving potential sources of toxic pollution.

Another example of collaboration is the Columbia Basin Water Transaction Program (CBWTP) funded by Bonneville Power Administration. This program has the mission of "Replenishing freshwater stream flows vital for fish and people in the communities of the Columbia Basin." (National Fish and Wildlife Foundation). The CBWTP uses market-based tools such as acquiring or leasing water, or investing in water efficiencies that translate to increased stream flow. Salmon-Safe is positioned to complement the CBWTP's voluntary, market-based methods.

Willamette Partnership (WP), an NGO that is a leader in developing frameworks to measure and promote the value of ecosystem services is also a collaborative partner. Salmon-Safe collaborated with WP on an innovative project entitled "Incentives Trifecta" that explored the capacity to bundle the values from an eco-label (Salmon-Safe responsible), ecosystem services credits (for which WP is responsible), and some form of environmental law regulatory assurance into a package that would be attractive to landowners and thus drive voluntary participation. The results were promising, with additional research and refinement required before a formal program could be activated.

Most recently, Salmon-Safe successfully collaborated with GlobalG.A.P. an NGO that sets voluntary standards for the certification of agricultural products around the globe. In the past 3 years, Salmon-Safe has heard from its certified tree-fruit growers of their desire to have Global G.A.P. and Salmon-Safe integrated into one program for time and cost efficiencies. GlobalG.A.P. expressed the interest in partnering with a regional environmental certification program that would enable it to combine global standards with the finer resolution of regional resource use standards. Beginning in 2017, growers will be able to obtain joint certification of Global G.A.P. and Salmon-Safe.

These examples of collaboration are evidence of Salmon-Safe's interest in and ability to partnering with organizations or initiatives that complement its mission and certification strategy. This preference for partnerships enables Salmon-Safe to extend its strategic reach far beyond that from a stand-alone approach.

16.5 Bundle Values, Proactive Intention for Regulators

16.5.1 Case Study: Hops, Yakima Watershed, Washington: A Story of Sustainability

In 2010, Salmon-Safe was invited by Ann George, Executive Director of the USA and Washington State Hop Commissions, to inform the Commission of its mission and approach. Salmon-Safe representative Kevin Scribner (the lead author of this chapter) made this presentation and has continued to work with Executive Director

George and the Yakima Watershed (Yakima River Basin) hop growers. The presentation focused on the added-value of the marketplace, having discerned this approach to be the most attractive aspect of Salmon-Salmon Certification to this audience.

Salmon-Safe's engagement in the Yakima River Basin was funded substantially by a Sustainable Agriculture Grant from the United States Environmental Protection Agency (EPA). This grant award indicated EPA's recognition of Salmon-Safe's ability to work with the agricultural community and that Salmon-Safe Certification was effective at improving water quality, using marketplace incentives to have growers comply with the Federal Clean Water Act. Though funded by a Federal Regulatory Agency, Salmon-Safe constantly assured the private sector growers that it was not acting as an extension of EPA, and that all information exchanged during the certification process would remain confidential. In private sector agriculture, this is the *language of trust*.

When working at the watershed-level, Salmon-Safe frequently attempts to collaborate with local organizations. This is an extension of its Partner Network strategy, and recognizes the value of aligning with those who live in the local area, are familiar to and have credibility with the prospective certification clients—those who can *talk the talk* and *walk the talk* in a community. In the Yakima River Basin, Salmon-Safe partnered with the Washington Resource Conservation and Development Council (WRCD). This partnership was prompted by a recommendation from the Executive Director of the Yakima Basin Fish and Wildlife Recovery Board. This partnership with the WRCD enabled Salmon-Safe to maintain a trusted, consistent local point-of-contact, as Salmon-Safe outreach Kevin Scribner was responsible for actions throughout the much larger Columbia River Basin. The WRCD partnership was further funded by a small grant from the Yakima Community Foundation.

In 2010, the US hops industry was experiencing widespread disruption, with a dampening effect on the Yakima hop farms. These farms generate seventy percent of the total US hop production; therefore significant market disruption is likely to have an effect on their operations. In 2010, roughly 70% of the Yakima hop production was of the *alpha* or commodity variety, prized solely for its bitter flavor and favored by large international brewers. The remaining thirty percent were *aromas*, hops grown for an array of flavored oils and scents. Aromas are much preferred by the emerging craft brewing sector. Several years prior to 2010, Salmon-Safe had certified hop growers in the Willamette River Valley, in Oregon, Their aroma hops were being purchased and promoted by popular Oregon craft brewers. One of the Oregon growers also had an operation in the Yakima area. In addition, many Willamette Valley growers knew and communicated with Yakima growers, and the Oregon certification success story was heard in Washington.

Following the introductory presentation to the Washington Hop Commission, Executive Director George and Salmon-Safe developed a 2 year outreach and education plan that culminated in a presentation at the 2012 USA Hops Convention. At this Convention, Kevin Scribner facilitated a panel presentation by four certified hop growers. This appearance was followed at the 2014 USA Hops Convention by a panel presentation with representatives from breweries that were purchasing Salmon-Safe hops. This outreach plan also included collaboration with Washington State University Extension, involving a number of applied science researchers. This engagement brought additional credibility to the Salmon-Safe effort, as these researchers have worked with the hop growers for many seasons, earning their trust. And these scientists help Salmon-Safe learn the *vernacular of crop science* by which these researchers communicate with the growers. In turn, Extension scientists have the capacity to help Salmon-Safe correlate crop science with salmon science through a common focus on water quality.

By 2015, four farms had become Salmon-Safe Certified: Roy Farms, Green Acre Farms, Loftus Ranches, and Perrault Farms. Roy and Green Acre Farms are both larger than five thousand acres, and grow multiple crops in addition to hops. These two Farms have proceeded to have their entire operations Salmon-Safe Certified. These early adopters anticipated another disruption in the marketplace, that of increased market share for the craft brewery sector. This sector has experienced dramatic growth since 2010 with a direct effect on Yakima Basin hop production. As the craft brewers prefer aroma hops, their sector growth has reversed the ratio of alpha-to-aroma grown. Now 70% of the hops grown are aromas. This reversal and recent dominance by the craft brewers has been a positive influence for Salmon-Safe Certification. Craft brewers pay close attention to their recipes and the sourcing of their ingredients. This frequently becomes a key marketing component, as their customers respond favorably to this information, and then begin to require it. In addition, sustainability often plays a role in the marketing story for these beers, as this is integral to an emerging ethos in the craft beer customer demographic, especially in the Pacific Northwest, Interior West, and California. As well, this ethos runs deep in the world view of the brewers themselves.

With Salmon-Safe's strategic reliance on the marketplace to provide the incentive for a grower to become certified, it is very encouraging to see the commitment from prominent craft breweries. The third largest US Craft Brewer, Sierra Nevada, has certified their home brewery and its surrounding hops demonstration farm. The fourth largest New Belgium Brewing has publically stated its preference to have all of its hops be Salmon-Safe, a clear demonstration of two Salmon-Safe's added-values: market access and increased market share. The eighth largest Deschutes Brewery has long been a supporter of Salmon-Safe, highlighted by its "Drink Like a Fish" promotion (Fig. 16.4).

This heightened interest by the craft brewers in both the quality and sustainability story of hops has led to increased annual visits by brewers to the Yakima River Basin, to see operations and test for quality themselves. This interest and these repeat visits have established working relationships between the growers and brewers that could develop into long-term, loyal commitments, which is another Salmon-Safe added-value: market certainty over time. These relationships between hop grower and brewer are reminiscent of that between vineyard grower and winemaker,

Fig. 16.4 The "Drink Like a Fish" promotion. (Provided by Salmon-Safe)

including carrying the story of the hops (e.g., the what, how and where of the beer's story). For this story to flow elegantly, the hop grower and brewer must "be on the same page," i.e., have a common language.

Among the four Salmon-Safe hop operations, this vertically-integrated communication can occur directly between grower and brewer, or be facilitated by the grower-owned hop supplier named Yakima Chief-Hopunion (YCH HOPS). YCH HOPS conducts an annual Hop and Brew School, and hosts numerous tours and forums for growers and brewers. One grower, Loftus Ranches, has vertically integrated in another fashion by building a brewery on their property, an "estate brewery"—to borrow language from the wine industry.

> We believe that the true meaning of sustainability is to meet the needs of the present without compromising the ability of future generations to meet their own needs. After all, so many of our growers have been farming the same lands for generations with the hopes of passing on those same opportunities to their children and grandchildren
>
> In order to realize this long-term sustainability and growth for both the hop and beer industries, we support collaboration between hop growers and breweries. . .Each harvest brings to the Pacific Northwest not only a bounty of hops, but brewers and beer enthusiasts from all over the world. These visitors come to learn about the farms and facilities, select lots from the new crop year, and share their beers with the growers that developed and supply their favorite hops. (Yakima Chief-Hopunion 2016)

	16 Major Standards	GlobalGAP	Life Cycle Assessments	Salmon Safe	Rainforest A	SCS-001	Ethical Trading Initiative	Common Code for the Coffee Community	Marine stewardship Council	Basel Criteria	Roundtable on Sust. Palm Oil	SA8000	Fair Trade Standards	IDF	SAI	EISA	Utz Certified
Environment	Ecosystems & Biodiversity	√	√	√	√	√		√	√	√	√		√		√	√	√
	Natural Resource Inputs	√	√	√	√	√		√		√	√		√		√		√
	Manmade Inputs	√	√	√	√	√		√		√			√		√		√
	Energy Use & GHG Emissions	√	√					√		√			√		√		√
	Waste Management	√	√	√	√	√			√	√	√		√	√	√	√	√
	Production Practices	√	√	√	√	√			√	√	√		√	√	√	√	√
Labor	Occupational Health & Safety	√			√	√	√	√		√	√	√	√		√	√	√
	Terms of Employment				√	√	√	√		√	√	√	√		√	√	√
	Human Right in the Workplace				√	√	√	√		√	√	√	√		√		√
	General Employee/Family Welfare				√	√	√	√				√	√		√	√	√
Economy & Community	Producers' Economic Viability					√				√	√				√		
	Flow of Economic Benefits				√	√				√			√		√	√	
	Social/Economic Rights of others				√	√		√	√	√	√						
	Business Ethics							√		√	√						
	Education & Role-Modeling				√						√					√	
Safety & Quality	Traceability	√	√		√	√		√		√					√		√
	Hygienic Production & Handling	√				√				√				√	√	√	√
	Quality of Inputs	√								√				√	√		√
	Quality Management Systems	√				√		√					√				√

Fig. 16.5 Hops best practices and related standards. (Courtesy of Roy Farms)

There are a variety of ways these farms connect with their local community—to achieve "horizontal-integration"—including Roy Farms helping with salmon education in the public school system, with Green Acre Farms seeing Salmon-Safe Certification as a way to demonstrate their commitment to being a good neighbor to the nearby Yakama Indian Nation. And Perrault Farms conducts ongoing hop breeding experiments, to help the industry anticipate hop varietal needs and desires, as well as develop pest-resistant strains of existing varieties.

In 2015, the Washington Hop Commission recognized that its grower members faced an increasing number of sustainability and best management practice requirements from the brewing industry including: Good Agricultural Practices (GAP), sustainability, food safety, and quality control/quality assurance programs. To better serve these needs the Commission submitted a successful proposal to the Washington State Specialty Crop Grant Program, entitled *Sustainability/Best Practices Program Development for Hops*. In this program, existing sustainability/quality control/GAP programs are evaluated to determine common elements, and develop a baseline "Best Practices" program for hop producers (Fig. 16.5). Salmon-Safe's inclusion as the most important, commonly accepted practices along with Global GAP, USDA GAP and several merchant programs in this Program demonstrates how it has become embedded in the hop culture of the Yakima Basin Below is the summary of the proposal.

16.6 Wearing Multiple Hats: The Role of Translator

16.6.1 A Tapestry of Nations *and* Languages

> Each drop of rain is a starting point for seeing the shape of our region in a new light. Raindrops build streams, and streams are nudged this way and that by the contours of the land. Tracing ridgelines across the landscape, our maps reveal a jigsaw pattern of drainage areas: watersheds. If we piece those watersheds together, we arrive at a larger geography defined by the life and culture it supports: our bioregion, Salmon Nation. (Salmon-Nation website)

When Salmon-Safe enters a watershed (or river basin), it is with a working knowledge of the legal, policy and scientific frameworks described above. Salmon-Safe representatives can understand, if not also speak, the many languages of these frameworks. In addition, these representatives strive also to understand the language and associated perspectives of prospective certification clients. This requires awareness of the vernaculars associated with particular landscapes, those within various land management operations, and in the case of agriculture, vocabularies associated with a variety of crop sectors.

Viable salmon runs extended from as far south as the current Los Angeles River watershed in Southern California, up the Pacific coast into Alaska, as well as in the Western Pacific rivers along the coasts of Russia and Japan. This vast geographical area has recently been identified as Salmon Nation, with salmon the common animal to these lands that had rivers connected to the ocean. There are many “nations”; Salmon Nation, Hop Nation, Apple Nation and Grape Nation. Urban Nation; interwoven into the cultural tapestry that overlays the Pacific Northwest. Each cultural thread has a vocabulary, if not a vernacular or even a distinct language. Each nation has an entry point, with distinct “passwords.” Each of these nations contributes to the identity of the Pacific Northwest, to a resilient fabric that strengthens with inter-communication.

When politicians and policy-makers are able to communicate with hop producers, and vice-versa, when Native American tribes share the sacredness of their First Foods and hop growers speak of a generational past and aspirations for generations into the future, when science does research guided by growers and, in turn, helps growers understand the connection between their land and the adjoining waterways, when brewers and their patrons call out with pride that they know and treasure the source of their beers’ ingredients, when this multi-lingual understanding happens, then we are on our way to authentic sustainability. And these are the fields within which Salmon-Safe has the honor of playing a contributing role.

This journey of sustainability requires passion and commitment, and a dash of courage to challenge one’s own world view, to face-then-embrace change, and, at times, to peer into the unknown. What may also connect all the nations in the Pacific Northwest is a sense of mystery.

The significance of Salmon Safe certification is discussed in relation to its geographical application of certification that is “watershed”. This view gives a way for various actors including farmers, city residents and companies to visualize the connection along the water way and the journey of water represented by the species "salmon".

The first author of this chapter, Kevin Scribner comprehends that the "translator" as identified by Integrated Local Environmental Knowledge project researchers (see Introduction of this book) has a unique blend of characteristics. The *translator* must be conversant with a variety of professional and community vernaculars, including a familiarity with acronyms: colloquialisms, and vocabulary that may carry under- and overtones as "code" for an exclusive meaning. Our *translator* has to be observant, similar to a cultural anthropologist, but must also be willing to become engaged, to cross the boundary of ethnographic observation from distance. This engagement speaks to authenticity, an upfront honest portrayal of purpose. Effective listening is a critical capacity, both for the information gleaned and for the dignity instilled by acknowledging the value of what is said, thereby conveying honor to the speaker. Often this is more easily actualized in less formal social settings. As well, effective listening is often a natural expression of an innate curiosity, the desire to learn, and being entertained by the ensuing stories. It is also important for our *translator* to have the confidence and boldness to initiate contact with strangers and then enjoin in the passive (listening)/active (speaking) interaction of dialogue.

The Salmon-Safe *translator* Kevin Scribner brings additional helpful characteristics. As a former commercial fishermen, Kevin knows the challenges and joys from making a living from natural resources which, when communicated to growers, conveys a commonness of experience. With the background of college educated skilled in the arena of policy, science and critical thinking, Kevin is able to dialogue with policy-makers and scientists at the same time. And 20 years of commercial fishing has given Kevin a familiarity and respect for the positives that can be generated in the marketplace. In addition to the skills described above, Kevin Scribner brings a deep passion to his work on behalf of Salmon-Salmon. This passion is the fuel of persistence, and likely is a pre-requisite for sustaining effort across the vast landscape of Salmon Nation, with journeys seeming to match the length, breadth and time of the salmon's life.

References

Behnke R (2002) Trout and salmon of North America. Free Press, New York

Collins GB (1976) Effects of dams on pacific salmon and steelhead trout. Mar Fish Rev 38:39–46

Confederated Tribes of the Umatilla Indian Reservation. http://ctuir.org/treaty-1855. Accessed 28 Mar 2017

Environment Protection Agency. Summary of the Clean Water Act. https://www.epa.gov/laws-regulations/summary-clean-water-act. Accessed 28 Mar 2017

Harrison J (2008) Northwest power act. https://www.nwcouncil.org/history/NorthwestPowerAct. Accessed 28 Mar 2017

Lichatowich J (2001) Salmon without rivers: A history of the pacific salmon crisis. Island Press, Washington, DC

National Fish and Wildlife Foundation. The Columbia basin water transactions program. http://wws.cbwtp.org/jsp/cbwtp/program.jsp. Accessed 28 Mar 2017
National Oceanic and Atomospheric Administration. Endangered Species Act (ESA). http://www.nmfs.noaa.gov/pr/laws/esa/. Accessed 28 Mar 2017
Nehlsen W, Williams JE, Lichatowich JA (1991) Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16(2):4–21
Ruggles CP, Murray DG (1983) A review of fish response to spillways. Government of Canada: Canadian Technical Report of Fisheries and Aquatic Sciences No 1172
Salmon Nation. http://salmonnation.com/. Accessed 28 Mar 2017
Yakima Chief-Hopunion (2016) Great beer grows here (Sustainability Report 2016). https://d3b8rq9ztst8vv.cloudfront.net/docs/GRI-FINAL-Small.pdf?mtime=20161026163059. Accessed 28 Mar 2017

Part V
Supporting Decisions and Actions

In the previous chapters, we have examined important factors and enablers mobilizing collaborative decision making and actions among diverse stakeholders through transdisciplinary approaches and co-creation of integrated knowledge. However, we also recognize various obstacles and limitations of collaborations among stakeholders in attempting to mobilize societal transformation toward sustainability, even in the cases where these factors and enablers are in place. Part V summarizes viable approaches and social technologies that effectively support decision making and actions with production and utilization of an integrated knowledge base for informed transitions toward more sustainable communities.

Chapter 17
Co-creation, Co-evolution and Co-management of Japanese Coastal Fisheries: A Tool-box Approach

Mitsutaku Makino and Hidetomo Tajima

Abstract Taking changes, uncertainty and diversification of ecosystems and societies as prerequisites, the effective way to implement stable fisheries management involves engaging the stakeholders (e.g., fishers, authorities and researchers) in discussions of issues. Such dialogues allow the participants to select and implement initiatives for measures that suit the location in question. This process also can accommodate revisions to compensate for changes in nature and society as the results and significance of the initiatives are continually appraised via the varied knowledge possessed by the stakeholders. And, to support this kind of deliberation and decision-making, in cooperation with fishers, we have developed and are sharing a fisheries management tool-box. As a result, we are now able to compare various sites using a common framework, which enables us to search out general theories for fisheries management in the future. Moreover, by using the tool-box in recurring discussions among the diverse range of knowledge holders at the site in question, the diverse perspectives of stakeholders (including researchers) change. In turn, that change can be fed back to the tool-box, with the hope that it will contribute to "co-evolution" of knowledge related to fisheries management.

17.1 Japanese Fishing and Its Co-management

Mankind thrives on various ecosystem services of the sea from diverse species and ecosystems of the oceans. In particular, the marine areas around Japan consist of complicated topographies varying wildly in depth, while also having ocean currents, e.g., the warm Kuroshio and cold Oyashio currents, which are all comprised in an elongated archipelago stretching north and south, covering a vast area (Ministry of the Environment 2011).

M. Makino (✉)
Japan Fisheries Research and Education Agency, Yokohama, Japan
e-mail: mmakino@affrc.go.jp

H. Tajima
Tajima Labo Co., Ltd, Kawasaki, Japan

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_17

The Japanese fishing industry harvests seafood using various gears and techniques. Comparing the diversity of Japanese catches with those of other countries, 17 fish types that make up 80 percent of total catches in Japan. But, for instance, the number is only five in Iceland and seven in Norway, both in a coldwater region where species diversity is low (Japanese Fisheries Agency 2014). In Japan, the diverse ocean bounty available is respected and the nation has developed a food culture that utilizes diversity in ocean food that involves varied style of preparation and cooking. (Uejo 1992; Ochi et al. 2009; Hirakawa 2011). And, in 2013, the traditional Japanese food culture, which uses protein-rich seafood as ingredients, was inscribed as an Intangible Cultural Heritage by UNESCO – thus, showing the high esteem given internationally to Japanese cuisine.

Taking a closer look at the content of fishing in Japan, we see that of the 4.8 million tons of fish caught by Japan in 2014 more than half the catches were from offshore or deep-sea fishing. Most of the caught fish are good-catch ones (from relatively abundant fish stock resources), such as chub mackerel, sardines, Pacific saury, horse mackerel, and Alaska (walleye) pollock (Japanese Fisheries Agency 2016). These species are the main players that underpin the seafood supply and food self-sufficiency in Japan. In contrast, the majority of fresh local fish that underpin the diversity of regional food culture have been caught up to now by small-scale coastal fisheries aiming to catch multiple fish types along the coast of Japan using various fishing equipment (Yamaguchi 2007). And, even today, in Japanese fishing, there are still many coastal small-scale fisheries operating along the coasts of Japan; this is a feature that is more in common with the Asia Pacific nations than with the advanced nations of, for example, Europe or North America (Makino and Matsuda 2011).

Fisheries' resources constantly change in relationship to various factors, such as migration and/or prey changes, accompanying changes in ocean environments, as well as prey-predator pressure via the food chain. As seen in the Asia Pacific countries, including Japan, in cases where various fishing gears are used to catch a variety of fish species that are changing, the costs of top-down management executed by governments are relatively high and inefficient. Consequently, the bodies making use of local resources (e.g., in Japan's case, fishers bodies such as fisheries cooperative associations (FCA)) have come to the fore in co-management, which has developed between them and official governmental management (Lim et al. 1995; Jentoft et al. 1998; Makino and Matsuda 2005; Uchida and Makino 2008; Makino 2011).

A view of catch volumes and numbers employed in fishing industries show the core fishing industry locales globally to be moving from advanced nations to the Asia Pacific countries as well as to coastal nations of Africa (FAO 2015, 2016). For such regions, co-management of the fisheries industries is the realistic choice for avoiding the tragedy of commons (Gutierrez et al. 2011). Therefore, Japan, through support for the development of co-management in these regions together with simultaneous support of sustainability in Japan's fishing industries, doubtless feels that it is important to contribute to the achievement of a sustainable development goal as an international objective, specifically UN Sustainable Development Goal

14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development).

In the traditional fisheries management theory (until the 1990s), the mainstream of international debate deemed the solution for realizing an optimum society was setting well-defined property rights for fisheries resources and then leaving the rest to free competition, allowing market mechanisms to work (Neher et al. 1989; Grafton et al. 2010). In such a case, government need only oversee three tasks: setting of rights in accordance with production capacities, organizing those trading markets, and cracking down on offenses, with the point of the argument being that small government can achieve these with economy. In the 1990s, this argument was in line with trends at the time in general political economics. However, in the international debate from 2000 onward, with changes, uncertainties and diversification of ecosystems and societies as the premise – based on the suitability and effective range/limitations of various management policies – the importance of realizing stable management through a combination of management measures is being pointed out (Charles 2001; Garcia et al. 2014). This can be understood as giving importance to establishing a stable management system for the long-term, even if local, short-term efficiency is sacrificed to some extent.

As one specific policy based on the above viewpoint, the authors believe that the development of a “fisheries management tool-box” would be effective if compiled with comprehensive relevant knowledge to inform measures for local on-site application. With such a tool-box, local stakeholders (e.g., fishers, scientists, authorities, environment NGO and the general public) would be able to choose measures to suit their local site based on cooperative discussions. And, as the stakeholders use their various knowledge sets to continually appraise the efficacy and significance of those implemented measures, they will be able to add accommodative revisions to cope with changes in the status of nature and society. The objective of developing the tool-box is to provide support to cooperative discussion and decision making taking place in the manner described above.

17.2 Development of Theoretical Tool-Box (FY2009 to 2012)

17.2.1 Structure of Theoretical Tool-Box

In 2009, the Fisheries Research Agency (currently the Japan Fisheries Research and Education Agency) developed and announced a “Fisheries Management Tool-box” as “a way for overall management of fisheries resources and fishing in Japan” (Fisheries Research Agency 2009). The objective being to support stakeholders (e.g., fishers, fishers’ bodies, government workers and fisheries researchers) of all regions in their cooperative discussions and decision making in order to enhance the level of co-management. In reality, the assumption is that the tool-box will be used at

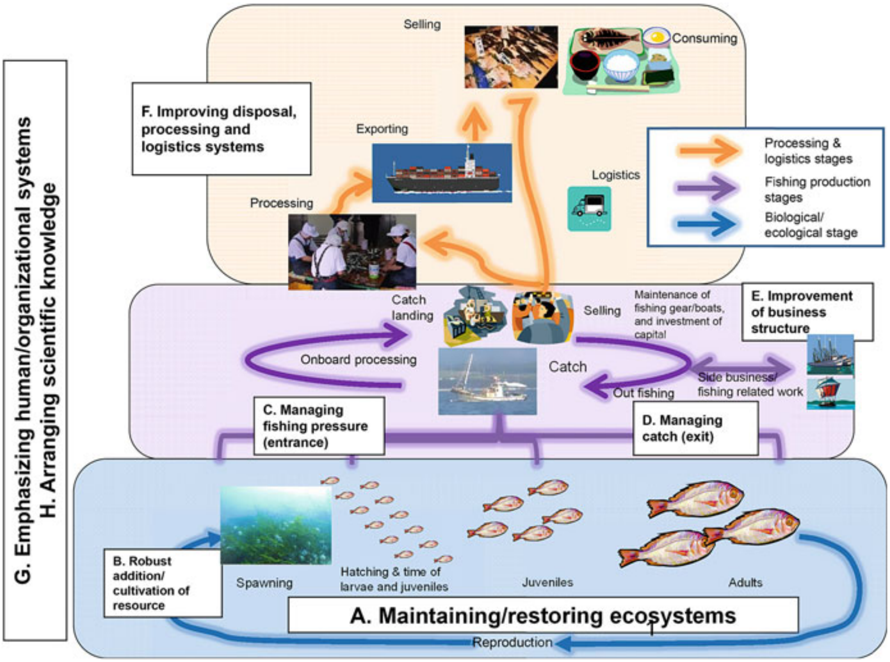


Fig. 17.1 Eight groups (A-H) for fishing management measures

sites such as fishery cooperatives and subcommittees (defined by fishing gear/ technique/species) by fishing stakeholders to self-appraise the current status of management and the problems within it, share the awareness of problems and then debate the specific revision measures.

The various measures related to fisheries management were organized into eight categories from A to H (see Fig. 17.1 above) to show which measures can be expected to be effective in which parts among the overall flow of seafood from reproduction of species in the sea to serving seafood on the dining table. Furthermore, even a single measure can be introduced to sites in various ways – for example, the administrative method of introducing it from the top down, a method that uses the market mechanism, and the self-introduction method. Consequently, in accordance with the method (management approach) for introducing the measure, we have classified measures into five methodological categories: (1) Administrative, (2) Economic, (3) Informational, (4) Legislative, and (5) Self-management. And, as shown in Fig. 17.2 and Tables 17.1 and 17.2, we have compiled a list of information for various fishery sites across Japan and in other countries around the world providing points, such as which measure and which introduction method will hopefully be beneficial for a certain problem as well as indication of where specific case studies on the measure/problem in question can be found. In this chapter, we call this a theoretical tool-box. Readers interested in this tool-box should refer to the

Five Introducing Methods (Categories)

Eight Categories by Subject

	1. Administrative Methods			2. Economic Methods			3. Informational Methods			4. Judicial Methods		5. Self-Implemented Methods	
	Legal Protection	Regulations/ Restrictions	Guidance/ Orders	Promotion	Control	Mediation	Promotion	Control	Mediation	Private Law	Public Law	Public Self-Regulation	Unilateral Oath
A. Maintaining/ Recovering Ecological Functions – Land		2,3,4	1,3,4,63,60	64,67	65		68,69,71		72	73	74	1,2,75,77	1,2,78
A. Maintaining/ Recovering Ecological Functions – Sea		5	5,6, 60,63	7,8, 64,67	65		68,69,71		72	73	74	5,6,7,8,75,77	5,6,7,8,78
B. Robust Adding to Resources			60	9,64,67			68,69		72	73	74	75,77	9,78
Resource Preservation – C. Entrance – Quantitative – Fixed Facilities		10,11,12,13,14 ,58	59,63,60,62	64	65		71	70	72	73	74	10,11,12,13,14, 58,59,75,77	10,11,12,13,14 ,58,59,78
Resource Preservation – C. Entrance – Quantitative – Operation – Transfer Not Possible	56	57	59,60,62	64	65	15,16,17,18	69,71	70	72	73	74	15,16,17,18,59, 75,76,77	15,16,17,18,59 ,75,78
Resource Preservation – C. Entrance – Quantitative – Operation – Transfer Possible	56				65	19,20,21	69,71	70	72	73	74		
Resource Preservation – C. Entrance – Qualitative – Fixed Facilities		58,59	63,60,62	64	65		68,69,71	70	72	73	74	22,58,59,75,77	22,58,59,78
Resource Preservation – C. Entrance – Qualitative – Operation	56	23,57,59	60,61,62	64	65		68,69,71	70	72	73	74	23,24,59,75, 76,77	23,24,59,78
Resource Preservation – D. Exit – Quantitative – Overall		25,26,27	60,62	64	65	66	68,69,71	70	72	73	74	75,76,77	78
Resource Preservation – D. Exit – Quantitative – Per separate item – Transfer Not Possible	56		60,62	64	65	28,29,30	68,69,71	70	72	73	74	28,29,30,75,77	28,29,30,78
Resource Preservation – D. Exit – Quantitative – Per separate item – Transfer Possible	56				65	31,32,33	68,69,71	70	72	73	74		
Resource Preservation – D. Exit – Quantitative		34,35,36	60,62	64	65		68,69,71	70	72	73	74	34,35,36,75,77	34,35,36,78
E. Improvement of Business Structure			37,38,39,60, 62,63	37,38,39,64,67					72	73	74	37,38,39,77	37,38,39,78
F. Improvement of Disposal/ Processing/ Logistics – Onboard			40,60,63	40,64,67			40,68,69,71		72	73	74	40,77	40,78
F. Improvement of Disposal/ Processing/ Logistics – After landing of catch			43,44,45,46, 48,60,63	41,42,43,44,45 46,47,48,64,67			46,48,68,69,71		72	73	74	41,42,45,46,48, 77	41,42,43,44, 45,47,48,78
G. Emphasizing Human/ Organizational Systems	49,50	49,50	49,50,60,62,63	49,50,64,67	49,50				72			49,50,75,77	49,50,78

Fig. 17.2 Theoretical tool-box (FRA 2009)

research applied to comparative analysis of sea cucumber harvest management in various location around Japan (Makino 2011).

17.2.2 Limitations of and On-site Opinions About Theoretical Tool-box

From FY2009 to FY2012 (April 2009–March 2013), to explain the theoretical tool-box and to encourage the popularization of the tool-box among prefectural workers, FCA members and fishers across the entire country, the authors held training events, workshops and lectures sponsored by the Fisheries Agency (for disseminating information and methods for fisheries management across Japan and for training of fisheries extension officers) and the National Federation of Fisheries Cooperative Associations (JF Zengyoren: a nationwide organization for FCA that are groups of local coastal fishers). Several sites started debating the use of this theoretical tool-box, but it has not become as popular as the authors had initially hoped.

Generally speaking, in Japanese coastal fisheries, prefectural Fisheries Extension Officers are the people who are well versed in the status of on-site management as well as passing on new policies and research trends. In other words, they fulfill the role of bilateral translator between on-site fishers and administrations/researchers. Accordingly, we asked Fisheries Extension Officers why they thought the theoretical tool-box was not becoming widely popular, and they gave answers like, “Well, I actually tried it out, but fishers found it difficult to understand.”, “There are too many

Table 17.1 Categories

A. Maintaining/restoring ecosystems		On land		1: Fish-breeding forests, 2: Water quality management, 3: Dam improvements, 4: Silt/sediment management
		At sea		5: Protection/Restoration of seaweed beds/tidelands, 6: Sea-bottom cultivation (tilling), 7: Installing fish reefs, 8: Pest control/culling
B. Robust addition/cultivation of resource				9: Releasing fry
C. Managing fishing pressure (entrance)	Quantitatively	Fixed facilities		10: Restrictions on fishing boat tonnage, 11: Restrictions on fishing boat engine horsepower, 12: Restrictions on size of fishing gear, 13: Restrictions on fish tank capacities, 14: Restrictions on light intensity
		Operation	Non-transferable	15: Fishing effort regulations (number of fishing days, operating frequency, number of nets, etc.), 16: IEQ (individual effort quota), 17: GEQ (group effort quota), 18: IOQ (individual oil quota)
			Transferable	19: ITEQ (individual transferable effort quota) (Catch restrictions: yes/no, Time limit: yes/no), 20: GTEQ (group-specific transferrable effort quota) (Catch restrictions: yes/no, Time limit: yes/no), 21: ITOQ (individual transferable oil quota) (Catch restrictions: yes/no, Time limit: yes/no)
	Qualitatively	Fixed facilities		22: Fishing gear/method restrictions (restrictions on types of fishing gear and methods, mesh-size restrictions, obligations on choices of fishing gear, etc.)
		Operation		23: Restrictions on operated sea areas and periods (fish-ban areas, fish-ban periods, ocean protection areas), 24: Fishing ground rotation, switchover system

(continued)

Table 17.1 (continued)

D. Managing catch (exit)	Quantitatively	Overall		25: TAC (total allowable catch), 26: TAC by sea area/period, 27: TAC by fishing type/method
		Individually allocated	Non-transferable	28: IQ (Individual [catch] quota), 29: IVQ (individual vessel [catch] quota), 30: GQ (group [catch] quota)
			Transferable	31: ITQ (individual transferable quota) (Catch restrictions: yes/no, Time limit: yes/no), 32: ITVQ (individual transferable vessel quota) (Catch restrictions: yes/no, Time limit: yes/no), 33: GTQ (group transferable quota) (Catch restrictions: yes/no, Time limit: yes/no)
	Qualitatively			34: Restrictions on size of fish in catch (body length, etc.), 35: Restrictions on sex of fish in catch, 36: Restrictions on catches of matured individuals
E. Improvement of business structure				37: Promote reduction of vessels, 38: Changeover of fish type/promotion of side business, 39: Reduce costs of capital by downsizing fleet
F. Improving disposal, processing and logistics systems		Onboard		40: Improve onboard processing
		After fishing		41: Support price/Storing for market adjustment, 42: Preparing fishing port/market, 43: Promoting exports, 44: Bringing efficiency to logistics, 45: Developing new products to enhance added value, 46: Standardization of quality via hygiene practice (brand value improvement), 47: Reduction of logistics costs, 48: Accumulating/improving processing and logistics technologies
G. Emphasizing human/organizational systems				49: Founding/modifying management organizations, 50: Selecting, recruiting and training manpower
H. Promotion of science/technology				51: Developing fishing gear, 52: Developing fishing methods, 53: Developing fishing grounds/resources, 54: Developing usage/processing methods, 55: Understanding/evaluating/estimating mechanisms of natural ecology

Table 17.2 Introduced methods by category

1. Administration methods	Legal protection	56: Granting of fishing rights
	Regulations/ restrictions	57: Issuing permit, 58: Setting of all types of restrictions/ regulations/formalities
	Advice/ commands	59: Coordinating between types of fishing, 60: Administrative guidance/popularizing, 61: Orders to stop, 62: Committee instructions/supporting orders, 63: Introduction of components and facilities that help reduce environmental load
2. Economic methods	Promotion	64: Distribution from subsidies/grants/membership fees
	Control	65: Collection of taxes/surcharges/membership fees
	Neutrality	66: Pool system, 67: Use of outside private capital, etc.
3. Informational methods	Promotion	68: Branding, 69: Eco-labeling
	Control	70: Blacklisting, 71: Positive-listing
	Neutrality	72: Business reports/press releases
4. Judicial methods	Private law	73: Injunctions/damage claims
	Public law	74: Criminal penalty/administrative penalty
5. Self-implemented methods	Public self-regulation	75: Agreements on resource management, 76: Agreements on fishing ground usage, 77: Regulations based on FCA rules and subcommittee decisions
	One-sided commitment	78: Any other self-regulation exceeding legal basis

kanji characters in the text and the terms are difficult." and "It cannot be readily understood, so it could not be communicated to the people on-site." The theoretical tool-box definitely uses many technical and scientific terms. Also, from Koji Murakami the then president of the National Extension Officer Council we received the opinion in which he said, "If you show all the various management policies at once (as seen in Fig. 17.2) to fishers, they will be confused, so you should use language that appeals to fishers and introduce them to the measures in a hierarchal structure." So, acknowledging the above comments, we came to the conclusion that the theoretical tool-box still carried a theoretical disposition geared to researchers, and was no more than a prototype, which needed to be further revised in order for it to be accessible and readily usable on site.

17.3 Co-creation of a User-Friendly Version (FY2013 to 2015)

17.3.1 Holding Workshops for Fishers

From FY2013, as part of the "Creation and Sustainable Governance of New Commons through Formation of Integrated Local Environmental Knowledge (ILEK

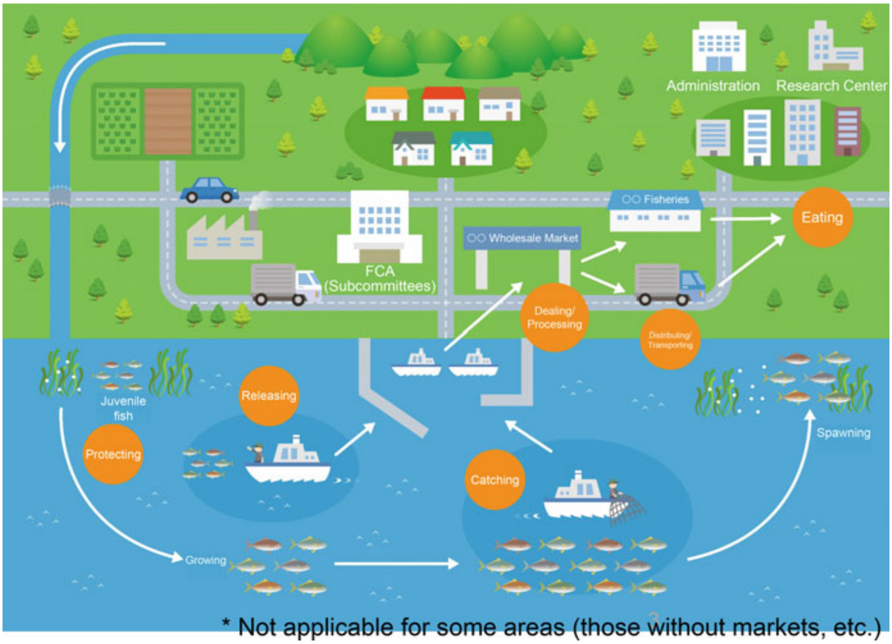


Fig. 17.3 Panoramic view from user-friendly tool-box

project)" within the Research Institute for Humanity and Nature (RIHN), we started development of a user-friendly tool-box that would be far easier to use and understand on site (user-friendly tool-box from here on in this chapter). For development of this user-friendly version, we employed cognitive psychology techniques with the aim of creating a tool-box adapted to the information processing capacity and processes of local coastal fishers.

In November 2013, we held a fishers' workshop in Yokohama. At the workshop, we started by creating "schematic views" to give fishers overall images of fisheries management. The aim being to provide information in the form of a pictures and keywords that reflect images of the fishers' own workplace in order to encourage more effective memory reconstruction and recognition. At the workshop, first we used an analytic hierarchy process (AHP) to quantitatively analyze the fishers' subjective judgments via paired comparison of various schematic views created by the authors (Satty 2008). In conjunction with the fishers, we jointly considered which schematic view was "appealing and stimulated the image of fisheries management". As a result, the mostly highly praised diagram (schematic view, Fig. 17.3) was the one that had the sea in the foreground, the port in the center and land in the background with seafood circulation formatted to flow to the right. Furthermore, the fishers selected a schematic view where official facilities (administration, and research institutes) were diminutively depicted in the top right corner with the general public, consumers and residential area set in the foreground of those facilities. Following on, we undertook the tasks to translate and unify the expressions and terminology used in each of the measures in the theoretical tool-box to provide familiar and easy-to-understand language for the fishers. Also, working in small groups and using the KJ method (Kawakita 1967; Hanington and Martin 2012), we grouped and re-categorized each of those measures, to compile them into a three-tiered hierarchal structure, comprising three locations (fishing ground, port and land), nine groups and 45 ingenuities (measures). Based on this structure, we used photos from successful cases in various areas to create a slideshow to help explain in detail the 45 ingenuities (measures).

Following on from there, in the period June 2014–September 2015, we conducted workshops at various fishing sites in four locations around Japan, trialing out the user-friendly tool-box as well as adding revisions to it based on the opinions of the fishers we met with in each region. The workshops took place in the following regions and involved the following types of fishing industries: (1). cage fishery in the eastern area of Hokkaido, (2). small-scale bottom trawling fishery in the Kanto area, (3). gillnet fishery in the Inland Sea area and (4). diving dart fishery in Kyushu and Okinawa area. In order to cover as much of the variety of Japan as possible, we selected these four regions because of their ecological diversity (subarctic through tropical), biological characteristics of fish types (migration, habitat, longevity, etc.), market characteristics of resources (price, price elasticity, seasonality), fishing operation characteristics (economic dependency level, competitive level, capital scale) and the context of past management (history of usage, overfishing experiences).

With the above and our work on the theoretical tool-box, we worked with fishers in each region to co-create a user-friendly tool-box (Fig. 17.3 and Table 17.3). Adhering to the schematic view and hierarchal structure (three locations, nine groups and 45 measures), fishers discussed and exchanged opinions as they looked through photos of specific cases, and then filled out the sheet shown in Table 17.3. The required time to do this was about one to one-and-half hours.

17.3.2 Trialing the User-Friendly Tool-box

We trialed the user-friendly tool-box together with fishers in the above four areas (Fig. 17.4). The fishers self-appraised (five steps) and discussed their thoughts for future initiatives based on the information and photos of good case examples and the content of Table 17.3 provided and grounded in the tool-box structure. We filmed and sound recorded the discussions, taking full care to capture all the opinions and comments of the fishers. And then facilitators compiled and recorded all the appraisals and opinions made in discussions. Note that the assumption is that facilitation will be fulfilled by prefectural fisheries' extension officers, FCA workers, and/or leaders from among the fishers. From the fishers who participated in the trials we received opinions such as: "We were able to organize ideas for the future by using the tool-box.", "We found out what other areas are doing, which has motivated us," "For the first time I got to find out what each of us is thinking about − and, for

Table 17.3 User-friendly tool-box structure and entry sheet

			Already implemented? Yes (O), Partially (-), No (x)	Self evaluation score (1–5)	Strengths and threads
1. Fishing Ground	(1) Rules for fishing operations	1. regulation of the fishing gear	Self assessment (1 - 5)	Strength /weakness	Ideas for improvements
		2. regulation of the vessel and engine			
		3. regulation on the number of people			
		4. regulations on the fishing season			
		5. regulation of the operation days, times, etc.			
		6. regulation on the catch size, species, sex, etc.			
		7. Zonings such as no-take zones, rotation of fishing grounds, etc.			
		8. Safety (life jacket, etc.)			
	(2) Cares for fishing ground	1. Protection of nursary grounds or spawning grounds			
		2. seabottom tillage for conservation			
		3. fish reef installment			
		4. fish seeds release			
		5. removal of wastes or harmful species			
	(3) Efforts to deliver good quality fish	1. Cares on vessel (airation, icing, etc.)			
		2. Primary treatment on boad (fresh-killing, nerve removal, etc.)			
		3. Prevention of scratch (using plastic films, sorting, use of sherbet ice, individual packing, etc.)			
		4. Sorting for better price (size, sex, species, quality, etc.)			
	(4) Efforts to save costs	1. Group operation			
		2. Capital sharing (co-ownership of vessel, nets, facilities, etc.)			
		3. Regulation on the engine power and cruising speed			
		4. Regulation on the fuel consumption			
		5. Introduction of more enegy-efficient gears or vessels			
2. Port	(1) Efforts to deliver good quality fish	1. Prevention of scratch (using plastic films, species sorting, use of sherbet ice, individual packing, etc.)			
		2. Primary treatment at the port			
		3. Hygienic controls			
	(2) Efforts for higher prices and cost saving	1. Sorting for better price (size, sex, species, quality, etc.)			
		2. coordination of transport timing for better price and cost saving			
		3. Development of new buyers ore retailers			
		4. Saving costs (Co-ownership of the port facilities, saving the consumable goods, etc.)			
3. Land	(1) Efforts for higher prices and cost saving	1. Primary processing			
		2. Direct retailing/promotion to the consumers (not through the middlemen)			
		3. Running restaulants			
		4. Blanding and eco-labeling			
		5. Saving costs (co-ownership of facilities, collective transport, etc.)			
	(2) Ecosystem conservation	1. Coastal restoration for more productive fishing ground (tidal area, sea grass, coral reefs, etc.)			
		2. Forestation and waste water management (forestation activities in the mountain, water discharge control, etc.)			
		3. Beach cleaning activity			
		4. Education and experience activities for local children/tourists			
	(3) Capacity building	1. Holding seminars, lectures, trainings, study groups for fisheries management			
		2. Monitoring the poachers			
		3. environmental monitoring (temperature, salinity, etc.) and stock monitoring activities			
		4. Development of new fishing gears or new processing techniques, etc.			
		5. Development of new target species or new fishing ground			
		6. Re-arrangement of the operational schedule (to find extra time to side-business or training)			
		7. Recruitment of new fishers or new staff for FCAs			

Fig. 17.4 Scene from fishers' workshop in Kyushu/Okinawa area

the most part, we are thinking about the same things," and "I did not realize that other fishers had such thoughts."

After that, we showed the compiled results to the Fisheries Extension Officers who oversee the four areas concerned, receiving their comments and identifying the contents of initiatives that should be prioritized in the future. Figures 17.5, 17.6, 17.7 and 17.8 give outlines of those results. Blue-colored sections in the figures denote high scores (3.5 or above) and orange-colored sections denote low scores (under 3.0).

The following are the summaries of the results per area for user-friendly tool-box trials. First, the trial results for the eastern area of Hokkaido showed greater ratings for all items compared to other areas – in particular, the young class rated items highly in "2. Port" and "3. Land". The overseeing Fisheries Extension Officer basically agreed with their ratings, but commented that the youngsters' rating could be somewhat too high, suggesting that perhaps the appraisal (i.e., rating) of the trustee class (i.e., senior class) might be appropriate. In any case, the conclusion was that the initiatives in "1. Fishing ground" are sufficient but that "2. Port" and "3. Land" initiatives should be strengthened.

Conversely, the trial results for the Kanto area showed the young class rating as low and the trustee class rating as high. The overseeing Fisheries Extension Officer commented that there is a generation gap in awareness, with the elderly trustee class rating the efforts that have been made up to now while the young class fear for the future. Taking all of this into account, the conclusion drawn was that "(4) Ingenuities for reducing waste" for "1. Fishing ground" and "(3) Strengthening of organization and knowledge" for "3. Land" should be prioritized going forward.

With the trial results for the Inland Sea area, regardless of age group, self-evaluation (rating) was low (2–3 points), and scores were low overall compared to

		Fishers' Self-Evaluation		Fisheries Extension Officer's Evaluation/Comment		Approach from Here On
Location	Category	Trustee Class	Young Class	Rating (Evaluation)	Comment	Objective
1. Fishing ground	(1) Matters to be determined when catching fish	5.0	5.0	5.0	Appropriate. Management is sufficient.	Maintaining
	(2) Upkeep of fishing grounds (fishing ground management)	4.0	4.0	4.0		
	(3) Ingenuity in delivering tasty fish to consumers	5.0	4.0	5.0		
	(4) Ingenuity in reducing waste	3.0	4.0	3.0	Future consideration required.	Future
2. Port	(1) Ingenuity in delivering tasty fish to consumers	4.0	5.0	4.0	Appropriate	Maintaining
	(2) Ingenuity in selling at high price/reducing waste	3.0	4.0	3.0	**Good**	**(1) Prioritize**
3. Land	(1) Ingenuity in selling at high price/reducing waste	3.0	4.0	3.0	**Good**	**(1) Prioritize**
	(2) Initiatives for protecting fishing grounds	3.0	4.0	4.5	Poor. Would like to see action maintained.	Maintaining
	(3) Strengthening of organization and knowledge	4.0	4.0	3.0	**Good**	**(1) Prioritize**

Fig. 17.5 Trial results for user-friendly tool-box used in east area of Hokkaido

		Fishers' Self-Evaluation		Fisheries Extension Officer's Evaluation/Comment		Approach from Here On
Major Items	Medium Items	Trustee Class	Young Class	Rating (Evaluation)	Comment	Objective
1. Fishing ground	(1) Matters to be determined when catching fish	3.7	3.5	4.0	Poor. Management is insufficient.	Maintaining
	(2) Upkeep of fishing grounds (fishing ground management)	3.5	2.2	3.5	Appropriate. Would like to see action maintained.	
	(3) Ingenuity in delivering tasty fish to consumers	4.0	2.3	3.0		
	(4) Ingenuity in reducing waste	2.7	1.0	1.0	**Appropriate. Action from here on is extremely important.**	**(1) Prioritize**
2. Port	(1) Ingenuity in delivering tasty fish to consumers	3.3	1.3	3.0	Appropriate	Maintaining
	(2) Ingenuity in selling at high price/reducing waste	4.0	2.2	3.0		
3. Land	(1) Ingenuity in selling at high price/reducing waste	4.0	1.0	3.0	There is a generation gap in awareness.	
	(2) Initiatives for protecting fishing grounds	4.0	1.0	Difficulty in evaluating	Collaboration with parties other than fishers is required.	Collaboration with parties other than fishers
	(3) Strengthening of organization and knowledge	4.0	1.7	2.4	**Good**	**(2) Prioritize**

Fig. 17.6 Trial results for user-friendly tool-box used in Kanto area

		Fishers' Self-Evaluation		Fisheries Extension Officer's Evaluation/Comment		Approach from Here On
Location	Category	Trustee Class	Young Class	Rating (Evaluation)	Comment	Objective
1. Fishing ground	(1) Matters to be determined when catching fish	3.0	3.0	4.0	Poor. Management is insufficient.	Maintaining
	(2) Upkeep of fishing grounds (fishing ground management)	2.0	2.0	3.5		
	(3) Ingenuity in delivering tasty fish to consumers	3.0	2.0	3.0		
	(4) Ingenuity in reducing waste	3.0	3.0	3.0	Appropriate	
2. Port	(1) Ingenuity in delivering tasty fish to consumers	3.0	3.0	3.0		
	(2) Ingenuity in selling at high price/reducing waste	3.0	3.0	2.5	**Good. Shared awareness from here on will be important.**	**(3) Prioritize**
3. Land	(1) Ingenuity in selling at high price/reducing waste	2.0	2.0	2.0	**Appropriate**	**(1) Prioritize**
	(2) Initiatives for protecting fishing grounds	3.0	3.0	3.0	Appropriate	Maintaining
	(3) Strengthening of organization and knowledge	2.0	2.0	2.0	**Appropriate. Shared awareness from here on will be important.**	**(1) Prioritize**

Fig. 17.7 Trial results for user-friendly tool-box used in Inland Sea area

Major Items	Medium Items	Fishers' Self-Evaluation: Trustee Class	Fishers' Self-Evaluation: Young Class	Fisheries Extension Officer's Evaluation/Comment: Rating (Evaluation)	Fisheries Extension Officer's Evaluation/Comment: Comment	Approach from Here On: Objective
1. Fishing ground	(1) Matters to be determined when catching fish	3.0	3.0	4.0	Poor. But fish-ban area approach is praiseworthy.	Maintaining
	(2) Upkeep of fishing grounds (fishing ground management)	3.0	2.3	Difficulty in evaluating		
	(3) Ingenuity in delivering tasty fish to consumers	3.0	3.5	2.5	**Good. But there are still ingenuities that can be introduced.**	**(2) Prioritize**
	(4) Ingenuity in reducing waste	3.3	3.3	3.3	Appropriate	Maintaining
2. Port	(1) Ingenuity in delivering tasty fish to consumers	3.8	3.3	2.5	**Good. Freshness management initiatives are important.**	**(2) Prioritize**
	(2) Ingenuity in selling at high price/reducing waste	2.9	3.3	3.1	Dissatisfaction is understandable. Care should be taken in maintaining freshness.	Maintaining, improving
3. Land	(1) Ingenuity in selling at high price/reducing waste	2.5	2.8	2.7		
	(2) Initiatives for protecting fishing grounds	2.5	3.0	2.8	Protection of coral reef is important.	
	(3) Strengthening of organization and knowledge	2.8	2.5	2.0	**Good. But new initiatives required.**	**(1) Prioritize**

Fig. 17.8 Trial results for user-friendly tool-box used in Kyushu/Okinawa area

the other areas. However, the Fisheries Extension Officer rated highly item "1. Fishing ground" and also commented that "important issues involved joint work to come up with some ingenuity in providing added value for sales and ingenuity in reducing waste" for both items "2. Port" and "3. Land". So these were extracted as items to be prioritized from here on.

Finally, the trial results for Kyushu/Okinawa area showed scores of 2–4 regardless of age group, with notably high scores over 3 coming from the young class for four items in "1. Fishing ground" and "2. Port". In reaction to these results, the Fisheries Extension Officer highly rated "(1) Matters to be determined when catching fish" for "1. Fishing ground" but gave a low rating to "Ingenuity in delivering tasty fish to consumers" in "1. Fishing ground" and "2. Port" that are got a high rating by fishers. The fisheries extension officer commented that, "in particular, initiatives for upkeep and management of freshness were important from now on" and gave these as the items that should be prioritized going forward.

17.3.3 Discussions Based on Results of Trials

In the cases of east Hokkaido and Kanto, catches already have brand values, so giving them extra added value would be difficult, so the policy shown involves reducing costs as much as possible for work and facilities, thus raising efficiency. Meanwhile, the issues of resource reduction and unearthing new market outlets have to be resolved simultaneously, so the policy shown involves joint undertaking of fishing tasks and marketing activities as much as possible. Conversely, in the case of spear fishing in Kyushu and Okinawa, the item chosen to move forward as an initiative was "Ingenuity in delivering tasty fish to consumers", but the fisheries extension officer notably pointed out that "initiatives for upkeep and management of freshness were important". Conceivably, the selection of this item is possibly influenced by ecological and social conditions, such as that in spear fishing areas the average annual temperature is high and the distance to the out-of-the-way market of big cities is far (transport costs are expensive). Now, what is required of the authorities and researchers concerned with each area from here on is to adhere to the extracted policies, give scientific credence to the on-site needs, and use that credence to research issues and develop technologies that will support their areas.

With the east area of Hokkaido, the fishers' self-evaluation was high among the young class and average-to-high among the trustee class. Whereas, in the Kanto area case, the overall rating from the trustee class was high, but was low among the subset of the young class. In both areas, the comment from fisheries extension officers was: "Past dramatic drops in resources paved the way for robust management of resources." According to the fisheries extension officer for Hokkaido, at present, scallop exports from the east marine area of Hokkaido are producing good profits. That is why the young class in that area is satisfied – yet, the highly experienced trustee class in that area are perhaps wary of the dangers of being over dependent on one specific resource. In this way, on the one hand, in areas where two stances exist: good results at present (money is being made) and good results in the past (tending toward a reduction in resource at present), either the young class or the trustee class show satisfaction. On the hand, this also infers that dissatisfaction (concern) for the future is manifesting itself.

Arranging the features common to all the areas, we see that first, in the item "(1) Matters to be determined when catching fish" among those for "1. Fishing ground" the fisheries extension officers for all areas rated this item highly with scores between 4 and 5. And, this item in all areas was rated as being sufficient in the initiatives taken up to now. From here on, the initiatives need to be carried on and there needs to be scientific validation of the efficacies. Whereas, "2. Port" and "3. Land" were rated lowly in all areas and items were raised as policies that should be tackled from here on. Of these, "(3) Strengthening of organization and knowledge" was an item that was rated lowly by all. Thus, from now on, authorities and researchers across the country must take the lead in providing assistance to hold hearings that find out the needs, opinions, and possible solutions for this item.

17.4 Sharing with Sites

17.4.1 Hoped-for Results

The hoped-for results by sharing the tool-box with actual sites can be summarized as follows: first, for the fishing production sites (the subcommittees grouped by fish type and fishing method, as well as research committees found within FCA), the tool-box can be used to promote discussions that lead to the forming of management awareness, comprehension of current management status, information sharing and recognition sharing. The sharing of such keystone information is the first step toward solving problems. Then, after that, in the process of considering and recognizing what specific measures need to be taken next at your own site, emergence of benefits can be expected by referring to good case examples from other areas as a list of options. Indeed, by sharing information and considering conformity of management content with fishers using other gear and/or methods for the same resource in the same area or in adjacent areas, there will probably be an opportunity to use those good case examples to apply to an even wider area of management.

The fisheries management tool-box is useful for the work of the prefectural fisheries extensions officers. First, the overseeing officer thinks over issues with the site's stakeholders. The tool-box can be used as a cue or starting point to commence discussions. In general, for example in an area where awareness about management is not high, there will be interest about fishing gear and methods, with fishers always wanting new information. Therefore, by concentrating on sharing information about fishing gear and methods that the on-site fishers are likely interested in, it is possible to arouse their interest enough for the fisheries extension officer to switch to unearthing the current management status and working on problem identification. In this way, if the fisheries extension officer prepares the tool-box to conform to the circumstances of the site in question, it will allow the officer to take the role of facilitating in discussions with fishers and the ensuing decision-making. Indeed, at the same time, the new wisdom, measures and ideas obtained from on-site discussion can be provided to authorities and researchers by the officer as feedback, prompting coevolution (described later) of knowledge, which will offer the prospect of fulfilling the role of bilateral knowledge translators (see Introduction of this book).

Furthermore, with the multitude of ports and bays in Japan, depending on the place and circumstances, there will often be many problems at those numerous coastal fisheries sites around the country. As the opening of this chapter describes, doubtless a major reason for this is that Japan and Asia Pacific countries do not take easily to top-down management in coastal fisheries. Beyond that, as a general rule, fisheries extension officers have to simultaneously oversee multiple sites. Accordingly, by organizing the circumstances and work content of each fishing site, hopefully this tool-box can be used as the format for sharing information and recognitions with other fisheries extension officers as well as being the mode to smooth the way for incoming replacements or for new people wishing to study the site in question.

17.4.2 Initiatives for Societal Implementation

During resource management planning and extending workshop held by JF Zengyoren between February and March 2016, we conducted a workshop using the user-friendly tool-box, which was the first step in popularizing the tool-box among prefectural officers and FCA members across Japan. As part of the popularization effort, we created and distributed a user manual for the tool-box. Also, based on the reports from the prizewinning initiative reports from the nationwide youth and female fishers' convention held by JF Zengyoren, we created a database of good case examples from around the country, as well as compiling slides used in actual discussions with fishers and the photos of specific cases, to share with the training participants (Figs. 17.9 and 17.10). And, in a survey of training participants, 33 of the 39 respondents gave us encouraging feedback like: "I would like to try it out.", "I am interested.", "It would be helpful reference." and "I would like to do a workshop with it."

As described in the first paragraph of this chapter, support of co-management of fishing in The Asia Pacific countries with similar setups to Japan and the fulfilling of the sustainable development goal (an international target) are effective forms of international cooperation that Japan is capable of. Therefore, we translated the user-friendly tool-box into English, and held a seminar for fisheries' administrators from ASEAN countries at the training headquarters of the Southeast Asian Fisheries Development Center (SEAFDEC) in Thailand in February 2016. The seminar participants rated highly the tool-box's features that allow users to facilitate/accelerate discussions with on-site fishers. Nevertheless, the diversity of fishing sites throughout Asia Pacific countries is greater than that of Japan, while the selection of introducible measures in developing countries varies greatly from those that can be introduced in Japan, which proved to us the need to make many additions, including

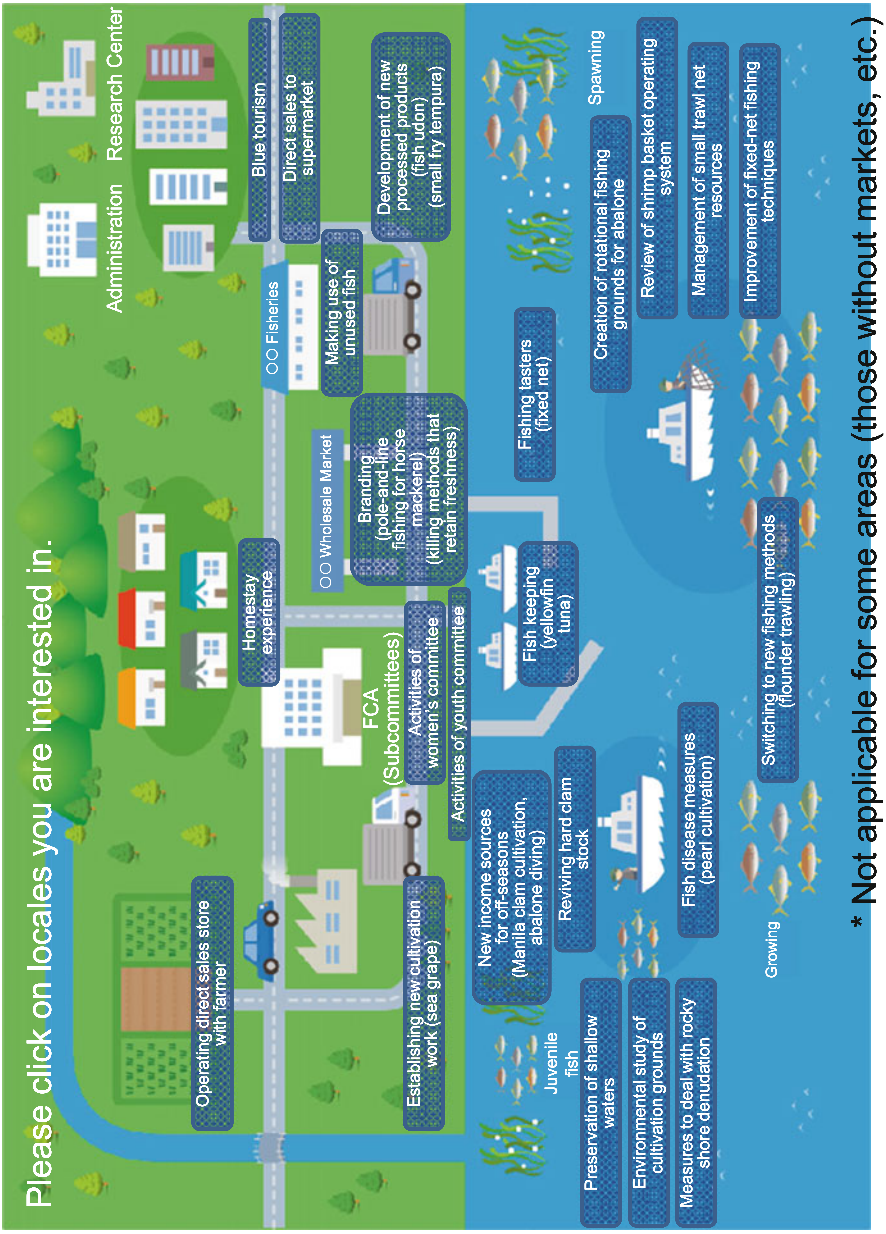
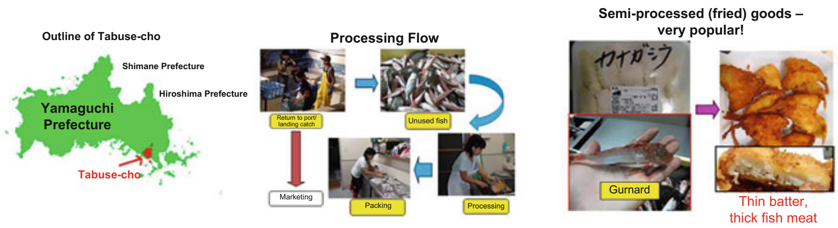


Fig. 17.9 Top screen of database



Title: Pushing back against stagnant fish prices in unused fish processing!!

Initiatives and Ingenuities: (3) Land (1)-1, (1)-2, (1)-4, (3)-1, etc.

Outline: From 2002, based on four policies ((1) Self-reliance, (2) Freshness, (3) Low-pricing and (4) Merit system), direct selling has been undertaken at local venues, like community halls, for items processed at one's own facilities. Care has been taken to respond to local consumer needs –for example, by providing detailed processing of fish into sashimi, etc. Notably, semi-processed goods (fried ones) that can be kept in freezers have proven to be popular.

Efficacy: Unit price of out-of-season fish (conger eel, gurnard) and nonstandard ones (beltfish, sole) increased tenfold (\1,000/kg). Goods processed from unused fish (spotted shark, crescent sweetlips) became popular.

Fig. 17.10 Example of database content

the reworking of the schematic view, in order to make the tool-box a user-friendly one for those countries.

17.5 Future Research Issues in the Push for Coevolution

Using the framework, we call the "Fisheries Management Tool-box," it becomes possible to compare diverse fishing sites via a common theoretical framework. From here on too, we will continue to extend the use of this tool-box both in and outside of Japan, and, by increasing the number of applicable case examples, we hope to be able to discover general theories to explain issues such as how management in each area is regulated by on-site ecological conditions (ecosystem types, biological characteristics of target catches, etc.) and social conditions (prices of catches and method used, types of fishing gear and methods and operating characteristics, level of reliance in business terms, history and context of management), as well as explain how management content under those conditions grows and evolves. As researchers, this is the segment of greatest interest for the authors. For instance, comparing the four areas in Figs. 17.5, 17.6, 17.7, and 17.8, we can see that the further south an area is located the greater the tendency for it to turn from blue (i.e., high score) to orange (i.e., low score). This trend possibly conforms to the tendency of southern lying areas to have greater species diversity. Accordingly, the method of putting together the management measures as well as the content for research and technical development required for that to happen needs to be accommodated by tuning up or down. Moreover, on the back of climate changes that are coming, we will probably see a trend where the features of southern area management approaches gradually become transferred north. Likewise, as economies globalize and remote areas and others with unfavorable conditions become more depopulated, we hope to be able to theoretically predict and evaluate the changes that appear in the content of management.

From here on, relying on the support of the Japan Fisheries Agency and prefectures, we will endeavor to establish a system where the user-friendly tool-box can be utilized at sites across Japan, thus enabling an automatic increase in case examples to follow, which, in turn, we hope, will make it possible to expand the validation and revision of the above general theories as well as lead to a greater selection of measures. For example, in the workshop with fishers held in Yokohama, in the list of ingenuities (measures) prepared by the authors there were no items related to “operating safety” and “prevention of accidents”. When this was pointed out by the fishers, we researchers realized that we had been so obsessed with assuring sustainable resources and environmental preservation that we had disregarded the safety of the people who actually work at sites. In this way, by using the tool-box in discussions with stakeholders at sites, the vantage points and viewpoints change. And, once again, such changes can be fed back to the tool-box, with the hope that it will link to “co-evolution” of knowledge related to fisheries management. That is, mutual accommodative changes in thinking will take place through the use of the tool-box by both fishers and researchers − and, that again links to changes in the dynamic of the material comprised in the tool-box, which is an opportunity for interaction. Furthermore, doubtless there is value in observing how fisheries management systems change at sites where the tool-box is used.

Note that the good-case database is still under development and going forward; we intend to increase the data as well as build in a function to enable searches of cases that meet the ecological and social conditions of the management in question. In the future, it will almost certainly be a good idea to develop integrated software that combines various mathematical models, such as a resource dynamic model based on fish population, age composition and reproduction of target resource, a market model related to price formation and a model related to economic behavior and consensus building of fishers. Moreover, doubtless the approach taken with this tool-box merits theoretical consideration concerning the possibility of expanding it toward to applications other than fisheries resources, such as natural resources and ecosystem services.

References

Charles A (2001) Sustainable fishery systems. Blackwell Science, Oxford
Fisheries Agency (2014) White paper on fisheries in fiscal year 2013 (平成25年度水産白書) (in Japanese)
Fisheries Agency (2016) White paper on fisheries in fiscal year 2015 (平成27年度水産白書) (in Japanese)

Fisheries Research Agency (2009) The grand design of fisheries and resources management in Japan (Final Report). https://www.fra.affrc.go.jp/kseika/GDesign_FRM/FinalReport_eng.pdf. Accessed 26 Jan 2018
Food and Agriculture Organization of the United Nations (2015) Voluntary guidelines for securing sustainable small-scale fisheries: in the context of food security and poverty eradication. FAO, Rome
Food and Agriculture Organization of the United Nations (2016) The state of world fisheries and aquaculture: contributing to food security and nutrition for all. FAO, Rome
Garcia SM, Rice J, Charles A (eds) (2014) Governance of marine fisheries and biodiversity conservation: interaction and coevolution. Wiley Blackwell, West Sussex
Grafton RQ, Hilborn R, Squires D, Tait M, Williams MJ (eds) (2010) Handbook of marine fisheries conservation and management. Oxford University Press, Oxford
Gutiérrez NL, Hilborn R, Defeo O (2011) Leadership, social capital and incentives promote successful fisheries. Nature 470(7334):386–389
Hanington B, Martin B (2012) Universal methods of design: 100 ways to research complex problems, develop innovative ideas, and design effective solutions. Rockport Publishers, Beverly
Hirakawa K (2011) Cultural history concerning fish and humans (魚と人をめぐる文化史). Genshobo, Fukuoka (in Japanese)
Jentoft S, McCay BJ, Wilson DC (1998) Social theory and fisheries co-management. Mar Policy 22 (4):423–436
Kawakita J (1967) Conception – for creativity development (発想法-創造性開発のために). Chuko Shinsho, Tokyo (in Japanese)
Lim CP, Matsuda Y, Shigemi Y (1995) Co-management in marine fisheries: the Japanese experience. Coast Manag 23(3):195–221
Makino M (2011) Fisheries Management in Japan: its institutional features and case studies, Fish and Fisheries Series, vol 34. Springer, Dordrecht, p 200
Makino M (2013) A institutional analysis on the Japanese fisheries– fisheries management and ecosystem conservation (日本漁業の制度分析-漁業管理と生態系保全). Kouseisha Kouseikaku, Tokyo (in Japanese)
Makino M, Matsuda H (2005) Co-management in Japanese coastal fisheries: institutional features and transaction costs. Mar Policy 29(5):441–450
Makino M, Matsuda H (2011) Ecosystem-based management in the Asia-Pacific region. In: Ommar RE, Perry RI, Cochrane K, Cury P (eds) World fisheries: a social-ecological analysis. Wiley-Blackwells, Ames, pp 322–333
Ministry of the Environment (2011) Marine biodiversity conservation strategy (海洋生物多様性保全戦略) (in Japanese)
Neher PA, Arnason R, Mollett N (eds) (1989) Right based fishing. Springer, New York
Ochi S, Nishioka F, Matsuura T, Murata Y (2009) Tracing seafood culture (魚食文化の系譜). Yuzankaku, Tokyo (in Japanese)
Satty TL (2008) Relative measurement and its generalization in decision making: why pairwise comparisons are central in mathematics for the measurement of intangible factors, the analytic Hierachy/Netwaork process. Rev Royal Spanish Acad Sci Series A Math 102(2):251–318
Uchida H, Makino M (2008) Japanese coastal fishery co-management: an overview. In: Townsend R, Shotton R, Uchida H (eds) Case studies in fisheries self-governance. FAO, Rome, pp 221–230
Uejo N (1992) Record of regional climate for fish – How have humans been involved with fish? (魚たちの風土記-人は魚とどうかかわってきたか). The Mainichi Newspapers, Tokyo (in Japanese)
Yamaguchi T (2007) History of coastal fishing (沿岸漁業の歴史). Seizando-shoten Publishing, Tokyo (in Japanese)

Chapter 18
Boundary Organizations and Objects Supporting Stakeholders for Decision Making on Sustainable Water Management in Phoenix, Arizona USA

Dave D. White, Kelli L. Larson, and Amber Wutich

Abstract Integrating divergent knowledge systems among scientists and other stakeholders with diverse values and interests presents a major obstacle for collaboration to inform sustainability in social-ecological systems. This integration has been hampered by, among other issues, unrealistic expectations about the ability of science to inform policy decisions, differences in scientific and political understandings of uncertainty, difficulty achieving scientific consensus on complex topics, different time scales for scientific and political processes, and social and cultural differences between scientists and policy makers. Boundary organizations theory presents one promising approach for overcoming these barriers and enhancing the linkages between science and decision making. Boundary organizations provide institutional structure, space, bilateral knowledge translators, and incentives for the creation of boundary objects such as maps, models, and decision support systems. Boundary organizations and objects can help to structure the relationships between multiple stakeholders. This chapter examines the design and functions of the Decision Center for a Desert City (DCDC) at Arizona State University and the use of the WaterSim and the Decision Theater as examples of effective use of boundary organization principles. We discuss these concepts in the context of water resources management in the Phoenix metropolitan area in arid southwestern United States.

18.1 Introduction

Water resource management, like most sustainability issues, requires integration of multiple forms of knowledge and coordination among diverse stakeholders. Scholars increasingly recognize the need for innovative methods and tools to link multiple knowledge systems with policy and action for sustainability (Clark et al. 2011).

D. D. White (✉) · K. L. Larson · A. Wutich
Arizona State University, Tempe, AZ, USA
e-mail: Dave.White@asu.edu

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_18

Scholars from a variety of perspectives have examined linkages and disconnects between diverse communities in sustainability. This work has conceptualized scientists, policy makers, and stakeholders as distinct, but interrelated communities interacting across an "interface" (Jones et al. 1999), "nexus" (Hoppe 2005), or "boundary" (Guston 2001). A consistent recommendation among these scholars is the need to actively manage stakeholder interactions to improve societal outcomes and achieve sustainability goals (Cash et al. 2003).

In this chapter, we examine efforts to develop shared knowledge to inform water sustainability in Phoenix, Arizona USA. Our goal is to illustrate how scientists are collaborating with a range of other stakeholders to improve the sustainability of the regional water system. Here, we focus on the cooperative production of knowledge and products such as models, simulations, scenarios, and decision support systems that facilitate this knowledge production and enable a productive dialogue. We also discuss how stakeholders and scientists build social networks to enhance knowledge use and exchange and foster social learning in support of sustainable water management. We evaluate interactions between scientists and stakeholders using social science concepts of boundary organizations and boundary objects.

First, we review social science literature on boundary organizations and boundary objects to provide the reader with a conceptual foundation. Next, we provide a brief overview of the water resources management system in Phoenix, Arizona. This summary outlines the major institutions and activities of the water system including governance, supplies, demands, deliveries, and outflows (Wiek and Larson 2012). Then, we apply these notions to illustrate the process of co-creating integrated knowledge for sustainable futures. Finally, we conclude with a discussion of the implications of this specific case for larger questions of sustainability.

18.2 Boundary Organizations Theory

Boundary organizations theory is one approach to understanding and enhancing science–policy interactions. Guston (2001) introduced the concepts, drawing from principal agent theory, boundary work (Gieryn 1983), sociology of science (Jasanoff 1990), and public understanding of science (Shackley and Wynne 1996). Boundary organization theory has been extended in a variety of environmental science and policy contexts including climate change (Pielke 1995), agriculture (Cash 2001), and water resources (White et al. 2008). Guston's initial work highlighted the organizational structure of boundary organizations, with dual accountability to science and policy communities, the participation of actors from multiple communities as well as professional mediators, and the durable products of these interactions (i.e., "boundary objects"). The practical value of such organizations is the active construction and negotiation of boundaries between knowledge production and decision making and the creation of mutually beneficial outcomes.

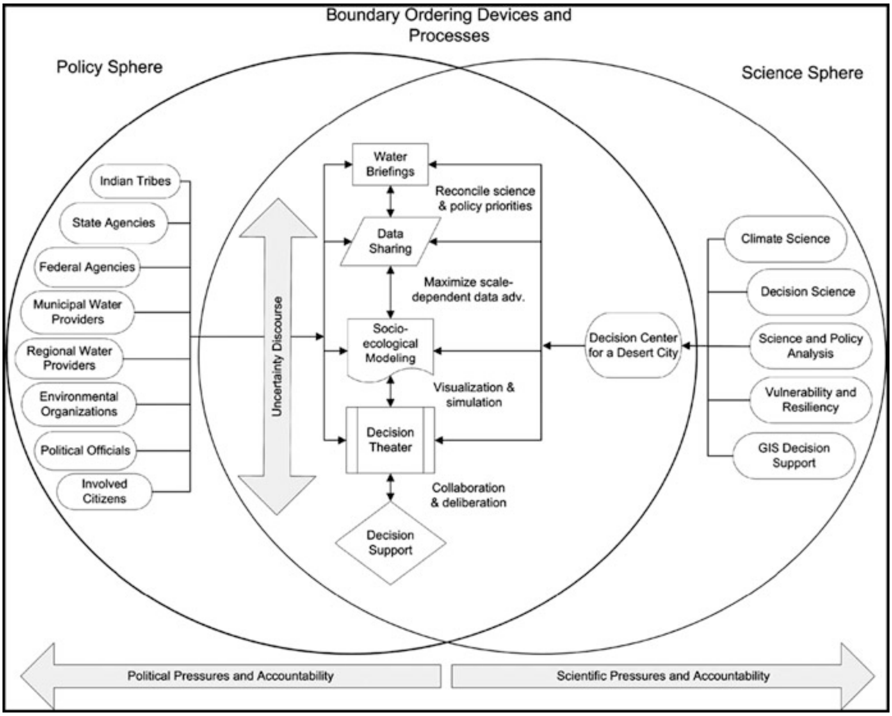


Fig. 18.1 Conceptual model of science–policy interface for water management in Phoenix where the ASU Decision Center for a Desert City operates as a boundary organization to link science and policy communities

An essential function of boundary organizations is to facilitate the creation of boundary objects. The sociology of science literature first described boundary objects as hybrid, portable, and material representations of science–policy interactions (Star and Griesemer 1989). Boundary objects may be adopted and independently interpreted by multiple actors and institutions. Examples of boundary objects from the literature include model-based decision support systems (White et al. 2010), scenarios (Girod et al. 2009), and maps (Cutts et al. 2011). Boundary organizations engage in a variety of processes to construct, deconstruct, and reconstitute scientific and political components of boundary objects. Examples of these processes include multi-stakeholder engagement workshops, participatory model development, data integration and visualization, and decision support. Figure 18.1 provides a visual schematic of one boundary organization, the Decision Center for a Desert City, which described in detail later in this chapter, and highlights the organizational structure, participating stakeholders, and processes used to co-create boundary objects.

According to Cash et al. (2003), successful boundary organizations and boundary objects depend in part upon their credibility, legitimacy, and saliency to multiple audiences. Here, credibility is defined as the trustworthiness and validity of knowledge; legitimacy is the perception that knowledge is fair, unbiased, and integrative of stakeholder values; and saliency as the perceived relevance of information to users. Others have argued that successful science–policy interactions require similar characteristics, such as the relevance of research to decisions, compatibility of research with policy processes, accessibility of research to policymakers, receptivity of policymakers to research (Jones et al. 1999); "interdisciplinarity," interactions with stakeholders, and production of usable science (Lemos and Morehouse 2005). The credibility, legitimacy, and saliency of boundary objects can benefit from a mature boundary organization, or the degree to which an organization has a reputation as an effective facilitator. Surpassing thresholds in each domain depends in part on the degree to which they are complementary to one another both within and across science and policy communities.

18.2.1 Environmental Science and Policy Context: Water Resources Management in Phoenix

The Phoenix Metropolitan Area (PMA) is located in the Sonoran desert in central Arizona, within a hot, arid, subtropical desert climate regime. Average total annual precipitation is 204 mm (8.03 in). Summer daytime temperatures in Phoenix regularly exceed 43C. With a current population of about 4.5 million, the area has been one of the fastest growing urban regions in the U.S. over the past several decades. Despite the arid climate and low annual rainfall, the area was developed due to relatively abundant water supplies, resulting from large scale reclamation and water infrastructure projects and federal government subsidies (Gober and Trapido-Lurie 2006). An extensively engineered water system with a large hydrologic reach enabled secure water supplies to support population growth and economic development (see Fig. 18.2).

The PMA has over 50 regulated water utility systems that together represent a loosely coupled regional water governance system. Water management goals in this urban desert metropolis are ambitious. For example, the City of Phoenix's goal is to ensure the "availability of safe, sustainable, reliable, and affordable water supplies in sufficient quantity to meet the needs of city customers during all foreseeable conditions" (City of Phoenix 2011, p. 1). Water managers have to cope with a series of interrelated challenges, including inherent variability of supplies, population growth and increasing urban demand, periodic drought, and the regional impacts of global climate change. To face these challenges, water managers have historically relied on physical infrastructure, engineering, public policy, and conservation programs.

Fig. 18.2 Map of the Colorado River basin showing the Colorado River watershed, Salt-Verde river watershed, and the Phoenix region

18.2.2 Water Supplies and Demands

The PMA has access to four primary water sources[1]: (a) local surface water from the Salt-Tonto and Verde River systems, (b) surface water from the Colorado River,

[1]Water volumes in the United States are often described in terms of "acre feet" in water resource management. An acre foot (af) is the amount of water necessary to submerge one acre (0.405

(c) groundwater, (d) and reclaimed water. In general, rights to surface water in the western United States, including the PMA, are granted based on the doctrine of prior appropriation, or the principle of "first in time, first in right." Essentially, this means that first users to put water to beneficial uses (e.g., agricultural, industrial, municipal) establish more secure (i.e., senior) legal rights and have priority over less secure (i.e., junior) water rights holders during times of shortage. The centerpiece of the groundwater policy framework for Arizona and the PMA is the 1980 Groundwater Management Act (GMA), which established the goal to balance supply and demand with minimal use of groundwater in active management areas, which include the metropolitan areas of the state.

The Salt-Tonto and Verde River watersheds drain an area of about 33,800 km^2 of forests and highlands in central and northern Arizona. Roughly 1.11–1.23 billion m^3 (1 maf) of water is supplied to the PMA annually from these sources. This local surface water supply is managed in accordance with the doctrine of prior appropriation by the Salt River Project, which delivers water to its customers across a service area of approximately 970 km^2 including residential, commercial and industrial, and agricultural water users.

The Colorado River drains an expansive arid watershed of 640,000 km^2. The Colorado River is managed in accordance with the doctrine of prior appropriation through a patchwork of laws, court decisions, and regulations that are collectively known as "The Law of the River." These agreements guide the allocation of water between seven U.S. states and Mexico. Arizona transports about 1.85 billion m^3 (1.5 maf) of Colorado River water into Arizona annually, 41% of which stays in the Phoenix region. Arizona's allocation of Colorado River water is managed by the Central Arizona Water Conservation District (CAWCD) and that water is delivered to municipal and industrial and agricultural users as well as Native American tribal communities. In response to persistent drought and concerns for the long-term sustainability of the Colorado River system, the U.S. Department of the Interior and the seven states that share in allocation adopted a shortage sharing agreement that specifies the conditions that would trigger cutbacks in deliveries of Colorado River water to states including Arizona under conditions of extreme droughts.

The PMA is characterized by relatively deep groundwater aquifers with significant volumes of water in storage. The groundwater supplies in the PMA have been estimated by the Arizona Department of Water Resources to be approximately 98 million m^3 (80 maf) down to a depth of approximately 305 meters (1000 feet). One of the most important policies affecting water resources management in the PMA is a State of Arizona law called 1980 Groundwater Management Act (GMA). The GMA aimed to extend the agricultural economy for as long as possible while retaining water supplies for future urbanization. The essence of the GMA was to retire farmlands and shift water use to urban areas, gradually impose higher levels of

hectare) of area to a depth of one foot (30.48 cm). An acre foot equals 1233 cubic meters or 43,560 cubic feet.

urban water conservation, guarantee a 100-year assured supply of water for new development to occur, and mandate "safe yield," defined as a balance between the amount of groundwater pumped from the aquifer and the amount naturally or artificially recharged (Jacobs and Holway 2004). This groundwater code established a program of groundwater rights and permits and required users to measure and report water withdrawals. While enforcement of the GMA has been uneven and controversial (Hirt et al. 2008), groundwater overdraft has steadily declined since 2000 due to increased use of Colorado River water and urban conservation.

Today, treated wastewater – or effluent – is being used in the PMA for a variety of beneficial purposes, including agricultural and landscape irrigation, industrial cooling, and groundwater recharge. Based on 2010 estimates, the Phoenix region produces approximately 456 million m^3 (370,000 acre-feet) of municipal effluent and reuse in the Phoenix region is estimated to be as high as 82% (Middel et al. 2013).

Water supplies are delivered to municipal, industrial, and agricultural users in the PMA through an infrastructure network of dams, reservoirs, canals, and pipes. The Salt River Project manages seven dams and reservoirs with total water storage capacity of 2.9 billion m^3 (2.3 maf). SRP relies on gravity to deliver water through a network of 211 km (131 miles) of canals, which connect to municipal water treatment plants as well as laterals and aboveground ditches that carry water to irrigation users. Colorado River water is delivered to the PMA via the Central Arizona Project (CAP) Canal. Construction of the CAP canal started in 1973 and took 20 years to complete at a cost of approximately $4 billion USD. A system of 14 pumping stations pump Colorado River water up 2900 feet of elevation through the 541 km (336 mile) main aqueduct from the California–Arizona border to the PMA and then to Tucson in southeastern Arizona.

The primary water demand sectors in the PMA are municipal, agricultural, industrial, and Native American. Historically, irrigated agriculture was the primary water use in the region, but agricultural use has declined in recent decades. Today, municipal demand represents about 50% of the total, agricultural demand comprises 33%, Native American demand accounts for 11%, and industrial demand accounts for the remaining 7% (ADWR 2010).

Water flows back into the hydrologic system after use via evaporation, runoff, and infiltration into soils and aquifers. Some water is also carried through physical infrastructure to one of 92 wastewater treatment plants in the PMA. For example, in the City of Phoenix, about 30–40% of all water deliveries flow through the wastewater system after usage. At wastewater plants, water is treated through physical, chemical, and biological processes before being discharged. In general, treated wastewater is then discharge into surface water channels, recharged into groundwater basins, or directly used for non-potable purposes.

18.2.3 Climate Trends and Future Challenges

One main concern for the future of water management in the PMA is the anticipated impact of climate change on water resources. The Intergovernmental Panel on Climate Change has reported, with high confidence, that the adverse effects of climate change on freshwater systems will be significant and will aggravate the effects of other stressors, including population growth, economic development, and land-use changes (Bates et al. 2008). As with other semiarid regions, the Western US is projected to suffer a decrease in renewable freshwater supplies and a potential increase in reliance on groundwater mining. There is evidence that this transition is underway and that the warming, droughts, reduced snowpack, and decreased river flows are consistent with anthropogenic climate change and may be occurring faster than predicted (Overpeck and Udall 2010). The present drought in the West is the most extreme in over a century (Cayan et al. 2010), affecting not only surface water storage but also groundwater reserves (Castle et al. 2014). According to the *2014 U. S. National Climate Assessment* (Melillo et al. 2014), snowpack and surface water runoff are projected to decline, decreasing water supply for cities, agriculture, and ecosystems as well as increasing temperatures.

While the PMA has built a remarkably robust and resilient water system engineered to manage uncertainty and vulnerability, there are challenges and tough choices ahead. The existing water governance system must adapt to these new challenges. Conventional water management is often expert-driven, overly bureaucratic, and reliant on technocratic and hard-path engineering solutions. Traditional regimes can suffer from path dependence and lack institutional incentives to consider not only incremental improvements but also *transformational changes* for sustainability. Many are calling for a transition away from centralized, regulatory, predict-and-plan, and engineering-dominated water management models. Proposed alternatives are distributed and participatory water governance regimes that seek to manage multiple uncertainties, incorporate stakeholders' values and preferences, use exploratory scientific modeling, anticipate multiple plausible futures (scenario planning), implement evidence-supported policies, adapt to changing conditions, and foster social learning. In the next section, we discuss boundary organizations theory as one conceptual approach that can inform the creation of networks of scientists and stakeholders cooperative producing credible and useful knowledge, tools, and learning for adaptive water resources management.

18.3 The Boundary Organization: The Decision Center for a Desert City

The Decision Center for a Desert City (DCDC) at Arizona State University (ASU) was established in 2004 with an investment from the U.S. National Science Foundation (NSF) through the Decision Making under Uncertainty (DMUU) program.

The research of this collaborative group has advanced fundamental knowledge about decision making under uncertainty in the context of water sustainability and urban climate-change adaptation. From the outset, DCDC was designed to implement the concepts of boundary organization theory and researchers conducted studies to understand and improve how this particular boundary organization functions as well as to develop lessons useful for similar efforts.

18.3.1 Organizational Design

As noted earlier, key aspects of a boundary organization include dual accountability to science and policy communities and the participation of actors from multiple communities, as well as professional mediators (Guston 2001). To evaluate the success of DCDC in implementing these principles and inform adaptive management, researchers have conducted a number of studies. In one study, water managers participating in the boundary organization expressed two divergent views about the science-policy interface (White et al. 2008). These views were consistent with the "engineering model" and "socio-organizational" models of knowledge transfer. First, some managers – especially those trained in traditional scientific or engineering fields – viewed science and policymaking as distinctive spheres, wherein decisions are made rationally and information flows in a linear chain from researchers to policymakers. The second, post-normal view – held by water managers with decision-making authority – perceived science and policy as more fluid and recursive processes of interaction. The researchers concluded policymakers who hold the latter viewpoint may be more adept at collaborating with researchers to develop relevant knowledge, share data, create scenarios, and communicate findings to diverse stakeholders. From these interviews with water managers, a prescriptive model of the boundary organization was developed in which a variety of policy actors interface with the research community in a way that respects each other's spheres and highlights various types of uncertainty (Fig. 18.1). From this and other studies, major considerations emerged for DCDC to serve as an effective boundary organization, including the need to reconcile scientific versus political pressures, different lines of accountability across sectors, the slow speed of research compared to short-term decision needs, and differing interests in basic sciences versus applied research (Crona and Parker 2008).

To create space for participation by multiple stakeholders within the boundary organization and to facilitate the creation of boundary objects, DCDC developed specific processes including: (a) monthly Water/Climate Briefings that include panel discussions, and promote networking among scientists, students, stakeholders, and community members; (b) the Internship for Science Policy Integration (ISPI), which brings students, faculty, and community partners together as full collaborators in research and training; (c) data and model sharing among scientists and stakeholders to support collaborative research projects and trust-building for collective interests and concerns; and, (d) joint modeling, visualizations and related decision studies to develop a shared understanding of problems and improve the credibility, salience, and legitimacy of research (Quay et al. 2013). According to both researchers and practitioners, the ongoing strengths of the network include: (a) networking through Water/Climate Briefings and science-policy workshops; (b) research outputs relevant to decision makers; (c) modeling results and visualizations for communicating research; and (d) educational and public outreach efforts (Crona and Parker 2008).

18.3.2 Social Networks

To understand how the boundary organization could enhance social learning and knowledge exchange during the initial phases of the project, researchers conducted a social network analysis (Crona and Parker 2011). Results revealed a communication network of one relatively small group of main actors (e.g., the leaders of the boundary organization and their counterparts in the stakeholder community) and nine smaller group (e.g., multiple small groups of faculty and students working on research projects with less stakeholder engagement). This study found that DCDC's early research initiatives were only moderately interdisciplinary, lacking full integration across the social and biophysical sciences and lacking broad stakeholder participation. These findings were used by the boundary organization to adapt the organizational design to improve interdisciplinary research and stakeholder engagement by, for instance, providing incentives to faculty from different disciplines to co-author journal publications, favoring interdisciplinary research in internal funding decisions, and increasing the number of external grant proposals submitted with stakeholders as co-investigators. Results from the same study also showed how the dynamics of social networks influenced knowledge utilization by stakeholders. Specifically, direct social interactions between policymakers and researchers (e.g., through regular meetings) enhanced the use of science for decision making. Discussions among policymakers themselves about the boundary organization also increased their use of the co-created knowledge.

As note earlier, one of the key functions of boundary organizations, like DCDC, is to foster the creation of boundary objects such as maps, models, simulations, and scenarios. These boundary objects give scientists and stakeholders an avenue to cooperate in the design and construction of tools that incorporate multiple perspectives. In the case of DCDC, the primary boundary object was a water balance model called WaterSim.

18.4 The Boundary Object: WaterSim

The Decision Center for a Desert City created the WaterSim model to estimate water supply and demand for the Phoenix Metropolitan Area. The model was developed to fulfill a specific gap in science and policy; namely, the need for knowledge to inform regional water sustainability planning, incorporating the plausible impacts of climate change at multiple temporal and spatial scales. This need was not sufficiently addressed by the many individual water management agencies, each of which was understandably focused on their own service territory and customer base. Nor was this need filled by the state or federal agencies, which tended to focus on larger spatial scales and broader policy issues. With WaterSim, users can explore how water sustainability is influenced by different future scenarios of regional growth, drought, climate change impacts and water management policies. WaterSim is a systems dynamics model. It is a systems model because it integrates data that is usually collected separately – including water supply, water demand, climate, population and policy data – and links it together to give the user a system-level view of how these variables interact. It is dynamic because users can change one variable and see how that change affects the other variables. WaterSim is a visualization tool. Rather than poring over pages upon pages of charts and tables, users can view the data in graphic form. They can make side-by-side comparisons to understand how one variable relates to another.

WaterSim was developed using a participatory modeling approach (White et al. 2010). Scientists from the boundary organization worked with stakeholders from the water management community to design the model, cooperatively selecting and negotiating the data sources, model calculations, spatial extent, time scale, outcome metrics, and visualizations. Through an iterative process, the model was refined and redesigned based on stakeholder feedback to enhance the scientific credibility, improve its relevance to decision making, and to increase the models legitimacy to multiple stakeholder groups. By opening the “black box” of modelling for critique and improve, the boundary organization and stakeholders co-developed the boundary object.

WaterSim was designed to explore future uncertainty using an anticipatory modeling approach. For example, one aspect of uncertainty is the inter-annual variability in river flows for the Colorado, Salt-Tonto, and Verde River systems; the model addresses this uncertainty by classifying the patterns of historic and paleoclimate flows as base scenario inputs. Since we recognize that there are differences of opinion among stakeholders about what constitutes a sustainable water future, WaterSim outputs provide metrics for different perspectives so that scenarios that emphasize different viewpoints of sustainability can be explored. There is also a wide range of opinions about what water management options are appropriate at different spatial scales. WaterSim was designed to include the management options that reflected a wide range of values. The model is utilized through: (a) a web based interface (See Fig. 18.3), which allows users to create a single scenario using visual controls to immediately assess scenarios using urban water sustainability indicators and graphics of various water system performance factors; or (b) applications that automate the process of creating large ensembles of scenarios based on varying exogenous factors that affect water supply and water demand and/or policy levers that reflect varying water management policies.

Fig. 18.3 Screenshot of the WaterSim Phoenix web interface. Users can explore how water sustainability is influenced by various scenarios of regional growth, drought, climate change impacts and water management policies

18.4.1 *Framing Sustainability and Uncertainty in WaterSim*

Since boundary objects such as WaterSim are co-created by scientists and stakeholders, it is important to understand the perspectives of these different social groups. This is important because the assumptions, choices, and decisions they make ultimately affect the knowledge and tools that are produced. The way they understand key issues constructs boundaries for environmental problems and solutions and can narrow or widen the discourse and impact the questions asked, knowledge produced, actors empowered, and ultimately the political opportunities and decisions made. To address these aspects of boundary object design, researchers examined how modelers framed the underlying concept of water sustainability in WaterSim (White 2013). The study found that the modelers defined sustainability in terms of uncertain and long-term water supply shortage caused by prolonged drought, climate change impacts, and population growth. The designers framed the solutions to include demand management and retirement of agricultural lands and conversion of agricultural water to municipal uses to achieve sustainable groundwater management to support population growth and economic development. While such framing is intuitive and reflects a relevant policy framework (i.e., the Arizona Groundwater Management Act), this view does not necessarily open up the discourse to transformative solutions or other dimensions of sustainability such as, social equity. That is, the modelers assumptions and choices reinforced the existing system and policies rather than allowing for new, innovative or transformative solutions. Thus, one implication of this research was that this faming did not define sustainability comprehensively.

Another major challenge for linking knowledge to action for water sustainability stems from differences in how scientists and stakeholders understand, communicate and visualize uncertainty. Such divergent perspectives between social groups make communication and coordination more difficult. Our research shows that decision makers' understandings of uncertainty in their evaluations of decision support systems reflect both political and scientific discourse (White et al. 2015). That is, decision-makers framed the uncertainty of knowledge and model results primarily in political terms, focused on specific social, economic, and policy making context and the perceived political costs of being wrong. However, decision makers also utilized a scientific approach to uncertainty and risk analysis in their evaluation of the WaterSim model. For example, water decision makers not only evaluated the certainty of knowledge in the model in statistical probabilistic terms, a traditional scientific interpretation, but they also used the typical scientific standard of 95% confidence for certainty. Thus, the water decision makers viewed the model as an opportunity to integrate scientific and political uncertainty in their deliberations. For example, respondents noted the potential utility of the model and visualization for educating policy makers, from city council members to state legislators and the Governor, about the water system.

18.4.2 WaterSim in the Decision Theater

WaterSim in the Decision Theater takes advantage of the simulation modeling and visualization research capabilities of the ASU Decision Theater (Fig. 18.4). The DT provides the latest expertise in collaborative, computing, and display technologies for data visualization, modeling, and simulation. In addition to the Decision Theater at the ASU campus in Tempe, Arizona, the ASU McCain Institute for International Leadership built a DT environment in Washington, D.C.

Researchers have examined how stakeholders perceive and respond to boundary objects such as the WaterSim. Studies of WaterSim in the Decision Theater showed how diverse decision-makers (policymakers, data analysts, and consultants) were initially skeptical about the model's credibility, salience, and legitimacy (White et al. 2010). In particular, policymakers viewed the model as more credible and legitimate than the other two groups, perhaps because WaterSim includes policy "levers" (e.g., drought and growth) that are frequently considered in resource management, or because they are accustomed to dealing with uncertainties. More recent activities have addressed these deficiencies by downscaling the model to local provider territories and adding demand side considerations, among other activities.

The process of designing WaterSim in the Decision Theater with stakeholders offered a unique opportunity to study how stakeholders discuss politically sensitive topics in different contexts. Our research (Wutich et al. 2010) demonstrated that

Fig. 18.4 DCDC Director Dave White demonstrates WaterSim Phoenix simulation model in the ASU Decision Theater

decision-makers volunteered more opinions on self-administered questionnaires than in focus groups for highly sensitive topics (i.e., scientific validity of the WaterSim model and vulnerable communities), but not for more benign topics. The exception was if decision-makers saw "gatekeeping" opportunities to share critical information or resolve pressing problems through dialogue, specifically regarding agenda setting and political uncertainty.

18.4.3 WaterSim for Public Education and Engagement

While the boundary object was cooperatively developed primarily by scientists and modelers working with water resource professionals (e.g., policy makers, managers), DCDC has also presented "mobile Decision Theater" version of WaterSim for informal education and engagement for a variety of public venues including schools, conferences, and festivals. For example WaterSim was a featured exhibit in the National Science Foundation's section at the USA Science & Engineering Festival, the largest STEM education event in the U.S. The festival, which draws around 350,000 visitors, was held in Washington, D.C. in 2016 (Fig. 18.5). Building upon the WaterSim model developed for Phoenix, Arizona USA, DCDC recently developed WaterSim America, which is featured in the "Water/Ways" exhibition from the Smithsonian Institution's Museum on Main Street program, which seeks to directly

Fig. 18.5 Community and education outreach coordinator demonstrates WaterSim Phoenix during the USA Science & Engineering Festival, the largest STEM education event in the U.S.

engage small town audiences and bring new attention to underserved rural communities. In other examples, WaterSim has been featured in a science expo for the United States Congress and as part of the NSF "Change the World: Science and Engineering Careers Fair" to promote student engagement in science, technology, engineering, and math careers and the mobile Decision Theater of the model has been utilized for training local K-12 teachers to develop systems thinking and modeling curriculum. These presentations highlight for the public audiences the complexity of managing water resources in an arid environment during times of drought and climate change and facilitate public dialogue about the tradeoffs necessary to maintain a sustainable water system.

18.4.4 Anticipatory Modeling Using WaterSim

In addition to using WaterSim in the Decision Theater, or using a personal computer through the online interface, the model can be used to create ensembles of model runs for advanced scenario analysis. Advanced scenario analysis is an anticipatory approach used to explore uncertainty within natural and social systems by analyzing a large ensemble of possible futures to find patterns that define a small set of strategic concepts to guide short-term tactical decisions and long-term strategic planning. This model creates ensembles of future system states by varying the factors that affect supply and demand across an anticipated range of possible future values and implementing policy levers at various levels and combinations. The performance of the system for each possible future can be evaluated using metrics that characterize water flux through these complex urban systems. Together, these metrics provide very large datasets, which can be analyzed for patterns that yield insights relevant to local and regional decisions about various water management policies under conditions of uncertainty.

Anticipatory modeling using WaterSim has revealed several insights that can inform water resources management in the PMA. For example, under current climate and water resource management policies, the current regional water system would continue to deplete groundwater resources, perhaps as little as 30% but potentially much more over the next 65 years. Our regional analysis of the potential change in the aquifer groundwater credits suggests that, even at historical flows, the region will not achieve "safe-yield" by 2025 (Sampson et al. 2016). Recall that the 1980 Arizona Groundwater Management Act identifies safe-yield – defined as a balance between groundwater withdrawals and recharge – as a major policy goal for the PMA. More, severe climate impacts would require the region to deploy new, more rigorous water management strategies such as water banking; acquisition of new, senior surface water rights; even more aggressive reductions in per capita water use; or growth management strategies. In another study using WaterSim for anticipatory modeling, simulations suggest that it is possible for the urban region to continue to grow and withstand extreme drought, but some combination of modest growth management, new expanded conservation efforts, and expensive infrastructure will likely be required to carry this off Fig. 18.6, from Gober et al. (2016), shows the sensitivity of years of available groundwater to drought-mitigation policies under mega-drought conditions including (a) population growth management, (b) municipal and industrial conservation, (c) water banking, (d), Reverse Osmosis (RO) reclaimed, and (e) water augmentation. Considering the cumulative impact of the policies this modeling shows that modest reductions in growth, coupled with continued conservation and reuse would maintain years of available supply at sustainable levels, and banking and augmentation would reduce the negative impacts of high inter-annual variability.

18.5 Conclusions

In this chapter, we have discussed how engagement between scientists and stakeholders co-produced integrated environmental knowledge and decisions about urban water resources management in the Phoenix metropolitan area. Our goal is to demonstrate the impacts of science–policy interactions on decision-making and knowledge utilization. In a review and synthesis of more than a decade of sustained science-policy engagement, Larson et al. (2015) identified several specific impacts of this boundary work as reported by policy makers. A senior water policy professional concluded, "For me personally (our relationship with DCDC) has given me a

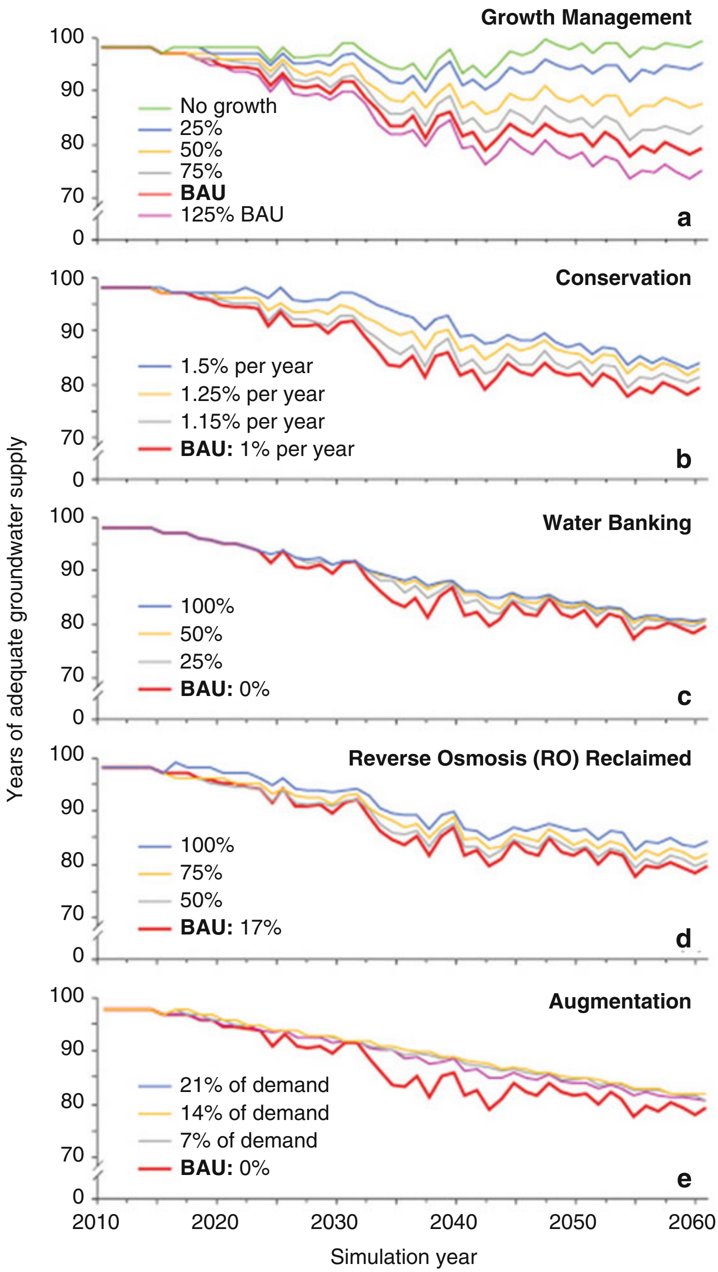


Fig. 18.6 WaterSim analysis of sensitivity of years of available water to drought-mitigation policies under mega-drought conditions; (**a**) population growth management, (**b**) municipal and industrial conservation, (**c**) water banking, (**d**) Reverse Osmosis (RO) reclaimed, (**e**) augmentation

better context for decisions in uncertainty and forced me to think about climate risks more critically." An urban water utility manager said, "Another role is to make people understand through scenario analysis that although predicting the future with great precision is difficult, organizations can benefit greatly by preparing for a variety of likely outcomes – especially when something as important as water is involved." These activities have influenced how we prepare water resource and water/wastewater infrastructure plans" In Phoenix, Arizona, knowledge-action networks have been organized in ways that enhance the efficacy of boundary organizations that bridge scientists and policymakers. Although challenges stem from different professional needs, goals, and pressures, communications within and across scientist and policymaker groups have been essential for ensuring that knowledge produced through DCDC has been considered in decision-making. Boundary studies have also increased the saliency, credibility, and legitimacy of boundary objects such as WaterSim to decision makers, for example, through: increasing the relevance of the model by downscaling from the regional (metro-area) level to the local (municipal) level at which water utilities tend to operate; helping to establish trust in the model by incorporating the best available data and a wide range of plausible scenarios; and expanding the policy levers embodied in the model to include both supply-side and demand-side alternatives. Our experiences highlight the need for iterative interactions between boundary activities, research studies, and decision-making processes that enable the boundary organizations and the scientists and policymakers that support such organizations to learn, grow, and evolve.

References

Arizona Department of Water Resources (2010) Arizona Water Atlas, Active Management Area Planning Area, vol 8. http://www.azwater.gov/azdwr/StatewidePlanning/WaterAtlas/ActiveManagementAreas/documents/Volume_8_final.pdf

Bates BC, Kundzewicz ZW, Wu S, & Palutikof JP (2008) Climate change and water. Technical paper of the Intergovernmental Panel on Climate Change, IPCC secretariat, Geneva. Climate change policy with a renewed environmental ethic, 21, 85–101

Cash DW (2001) "In order to aid in diffusing useful and practical information": agricultural extension and boundary organizations. Sci Technol Hum Values 26(4):431–453

Cash DW, Clark WC, Alcock F, Dickson NM, Eckley N, Guston DH et al (2003) Knowledge systems for sustainable development. Proc Natl Acad Sci 100(14):8086–8091

Castle SL, Thomas BF, Reager JT, Rodell M, Swenson SC, Famiglietti JS (2014) Groundwater depletion during drought threatens future water security of the Colorado River basin. Geophys Res Lett. https://doi.org/10.1002/2014GL061055

Cayan DR, Das T, Pierce DW, Barnett TP, Tyree M, Gershunov A (2010) Future dryness in the southwest US and the hydrology of the early 21st century drought. Proc Natl Acad Sci 107 (50):21271–21276. https://doi.org/10.1073/pnas.0912391107

City of Phoenix (2011) Water resource plan. City of Phoenix Water Services Dept, Phoenix, 89pp

Clark WC, Tomich TP, van Noordwijk M, Guston D, Catacutan D, Dickson NM, McNie E (2011) Boundary work for sustainable development: Natural resource management at the Consultative Group on International Agricultural Research (CGIAR). Proceedings of the National Academy of Sciences, p 200900231

Crona B, Parker J (2008) All things to all people: an assessment of DCDC as a boundary organization. Arizona State University, Tempe

Crona BI, Parker JN (2011) Network determinants of knowledge utilization preliminary lessons from a boundary organization. Sci Commun 33(4):448–471

Cutts BB, White DD, Kinzig AP (2011) Participatory geographic information systems for the co-production of science and policy in an emerging boundary organization. Environ Sci Pol 14 (8):977–985

Gieryn TF (1983) Boundary-work and the demarcation of science from non-science: strains and interests in professional ideologies of scientists. Am Sociol Rev 48:781–795

Girod B, Wiek A, Mieg H, Hulme M (2009) The evolution of the IPCC's emissions scenarios. Environ Sci Pol 12(2):103–118

Gober P, Trapido-Lurie B (2006) Metropolitan Phoenix: place making and community building in the desert. University of Pennsylvania Press, Philadelphia

Gober P, Sampson DA, Quay R, White DD, Chow WT (2016) Urban adaptation to mega-drought: anticipatory water modeling, policy, and planning for the urban southwest. Sustain Cities Soc 27:497–504

Guston DH (2001) Boundary organizations in environmental policy and science: an introduction. Sci Technol Hum Values 26(4):399–408

Hirt P, Gustafson A, Larson K (2008) The mirage in the valley of the sun. Environ Hist 13 (3):482–514

Hoppe R (2005) Rethinking the science-policy nexus: from knowledge utilization and science technology studies to types of boundary arrangements. Poiesis Prax 3(3):199–215

Jacobs KL, Holway JM (2004) Managing for sustainability in an arid climate: lessons learned from 20 years of groundwater management in Arizona, USA. Hydrogeol J 12(1):52–65

Jasanoff S (1990) The fifth branch: scientific advisors as policymakers. Harvard University Press, Cambridge

Jones SA, Fischhoff B, Lach D (1999) Evaluating the science-policy interface for climate change research. Clim Chang 43(3):581–599

Larson KL, White DD, Gober P, Wutich A (2015) Decision-making under uncertainty for water sustainability and urban climate change adaptation. Sustainability 7(11):14761–14784

Lemos MC, Morehouse BJ (2005) The co-production of science and policy in integrated climate assessments. Glob Environ Chang 15(1):57–68

Melillo JM, Richmond TC, Yohe GW (2014) Highlights of climate change impacts in the United States: the third national climate assessment. U.S. Global Change Research Program, Washington, DC

Middel A, Quay R, White DD (2013) Water reuse in central Arizona. Decision Center for a Desert City, Arizona State University. Technical Report 13–01

Overpeck J, Udall B (2010) Dry times ahead. Science 328(5986):1642–1643

Pielke RA (1995) Usable information for policy – an appraisal of the U.S. global change research program. Policy Sci 28(1):39–77

Quay R, Larson KL, White DD (2013) Enhancing water sustainability through university–policy collaborations: experiences and lessons from researchers and decision-makers. Water Resour IMPACT 15(2):17–19

Sampson DA, Quay R, White DD (2016) Anticipatory modeling for water supply sustainability in Phoenix, Arizona. Environ Sci Pol 55:36–46

Shackley S, Wynne B (1996) Representing uncertainty in global climate change science and policy: boundary-ordering devices and authority. Sci Technol Hum Values 21(3):275–302

Star SL, Griesemer JR (1989) Institutional ecology, translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39. Soc Stud Sci 19 (3):387–420

White DD (2013) Framing water sustainability in an environmental decision support system. Soc Nat Resour 26(11):1365–1373

White DD, Corley EA, White MS (2008) Water managers' perceptions of the science–policy interface in Phoenix, Arizona: implications for an emerging boundary organization. Soc Nat Resour 21(3):230–243

White DD, Wutich A, Larson KL, Gober P, Lant T, Senneville C (2010) Credibility, salience, and legitimacy of boundary objects: water managers' assessment of a simulation model in an immersive decision theater. Sci Public Policy 37(3):219–232

White DD, Wutich AY, Larson KL, Lant T (2015) Water management decision makers' evaluations of uncertainty in a decision support system: the case of WaterSim in the decision theater. J Environ Plan Manag 58(4):616–630

Wiek A, Larson KL (2012) Water, people, and sustainability – a systems framework for analyzing and assessing water governance regimes. Water Resour Manag 26(11):3153–3171

Wutich A, Lant T, White DD, Larson KL, Gartin M (2010) Comparing focus group and individual responses on sensitive topics: a study of water decision makers in a desert city. Field Methods 22 (1):88–110

Chapter 19
Semantic Network Modelling and the Integrated Local Environmental Knowledge Simulator

Shion Takemura, Hiroshi Miki, and Kei Tokita

Abstract In this chapter we describe construction of our boundary object, called the Integrated Local Environmental Knowledge Simulator ("ILEK-SIM"), to promote dialog and collective thinking between people to solve their local environmental problems using information obtained from various case studies which we have collected throughout the world. In the ILEK-SIM automatic processing techniques are introduced to evaluate the similarity between case studies and reconstruct information by analyzing the GIS data concerning environmental and social conditions and text data obtained in the case studies. The users of the ILEK-SIM can obtain information about various cases similar to those in their local communities from the case studies accumulated in the ILEK-SIM, and make well-balanced decisions and take actions through communication with the members of their community. The concept of the ILEK-SIM and the relevant case studies have been generated and refined through the collaborative knowledge production with ILEK project members who have functioned as bilateral knowledge translators throughout the world.

S. Takemura (✉)
Research Institute for Humanity and Nature, Kyoto, Japan

Japan Fisheries Research and Education Agency, Yokohama, Japan
e-mail: shiontakemura@affrc.go.jp

H. Miki
Research Institute for Humanity and Nature, Kyoto, Japan

Kyushu Techno College, Kitakyushu, Japan

K. Tokita
Nagoya University, Nagoya, Japan

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_19

19.1 Boundary Objects Promoting Dialog and Collective Thinking

19.1.1 Boundary Objects

In order for diverse people to collaborate in managing local natural resources, a process is needed to recognize differences among people and to help them make decisions which respect the various standpoints of the various stakeholders. Previous chapters in this book have examined the roles played by bilateral knowledge translators in facilitating and achieving these processes. Tools to promote dialog and collective thinking between people with different standpoints to support decision-making processes in the same way as bilateral knowledge translators is known generally as boundary objects (Guston 2001; Cash et al. 2003; White et al. 2010). Boundary objects play a role in supporting knowledge production by providing information and promoting dialog as well as collective thinking. Knowledge produced through collaborative processes between diverse people provides options for the sustainable development of local communities based on the management of natural resources (see the Introduction). The properties that a boundary object should have are defined as saliency, legitimacy, and credibility. Saliency means that people can recognize the options to be acceptable and viable in specific circumstances of their community. Credibility means that the options are reliable and effective from a scientific standpoint. Legitimacy means that the options are not biased in favor of a particular group of people (White et al. 2010; this book, Chap. 18). These properties are not mutually isolated, but are correlated as shown in Fig. 19.1, and are often

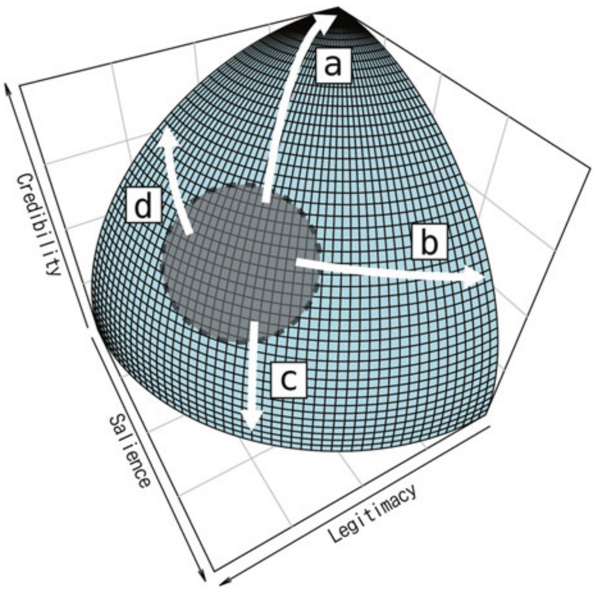


Fig. 19.1 Examples of tradeoffs between saliency, credibility and legitimacy. The gray highlights show balanced areas

accompanied by tradeoffs between them (Cash et al. 2002). For example: (1) scientifically valid options do not reflect the reality of local communities (decrease legitimacy or saliency as a result of improving credibility: marked with “a” on Fig. 19.1); (2) only a part of people obtain benefits or suffer from disadvantages as a result of the options (decrease legitimacy through improving credibility or saliency: marked with “b” on Fig. 19.1); (3) options lose their effectiveness as a result of trying to align themselves with the specific conditions of local communities (decrease credibility as a result of improving legitimacy or saliency: marked with “c” on Fig. 19.1); (4) scientifically valid and fair options are not feasible in communities and remains at the levels of abstract theories (decrease saliency as a result of improving credibility or legitimacy: marked with “d” on Fig. 19.1). Therefore, well-balanced options placed in the gray areas of Fig. 19.1 are required to be implemented in the communities.

In the case of WaterSim, as introduced in Chap. 17 of this book (also see White et al. 2010), a model for water balance has been constructed based on existing knowledge related to water use (securing credibility). This has enabled decision makers concerning water resource management in the city of Phoenix, Arizona to freely set relevant parameters in simulations based on the model to obtain plausible scenarios of water use (securing saliency). And the decision makers can compare each scenario and evaluate them not biased to particular decision makers (securing legitimacy). Through the dialogue and collective thinking using this boundary object, decision makers can determine policies for water resource management that strike a balance between the principles of saliency, credibility and legitimacy.

As in another example of the ILEK Fishery Toolbox (Makino et al. 2011; see Chap. 16), diverse approaches for fisheries resource management (tools) has been collected from throughout Japan with demonstrated positive effects on resources in each case (securing credibility). Fishers can find options for feasible management approaches for their own challenges related to resource management from various cases of other communities in the toolbox (securing saliency). And by comparing different options, they can evaluate the options not biased to particular groups (securing legitimacy). Through the dialogue and collective thinking using this boundary object, fishers can find appropriate approaches of fisheries resource management for their own practices that strike a balance between the principles of saliency, credibility and legitimacy.

In this way, WaterSim is trying to support decision making through promoting interaction between science and policy based on scientific knowledge produced by the simulation model. ILEK Fisheries Toolbox is a new attempt to support decision making through promoting mutual learning and collective thinking among fishermen based on solid knowledge and experience of cases that are categorized by a theoretical framework of fisheries management.

ILEK projects have collected case studies that address environmental problems in various communities around the world and have been analyzing them regarding the process of collaborative production of knowledge with various stakeholders to solve environmental problems. Based on these robust case studies, it is possible to construct boundary objects that support decision making through promoting collaborative production processes of knowledge, targeting a broader resource with more abstract perspectives.

19.1.2 Commonalities Emerging from the Case Studies and Meta-analysis

In the previous chapters of this book, a series of case studies were introduced to address various approaches to local environmental problems and solutions. Reviewing these case studies, we can find that while each activity is quite unique and specific depending on particular situations in each area, there are a number of commonalities between some of these activities. For instance, we see common ground in terms of natural conditions, such as coast or forest, or climate and ecosystems. Also, there is common ground in terms of social conditions including demography or political systems, as well as the issues and objectives of activities, such as the conservation of ecosystems or support for the promotion of sustainable industries. Furthermore, various case studies obtained in the Integrated Local Environmental Knowledge (ILEK) project can be arranged based on the commonality of elements of the ILEK triangle conceptual model and enablers according to the framework of ILEK (see the Introduction). For the people in local communities who are engaged in local sustainable development or who strive to achieve this in the future based on natural resource management, these commonalities serve as a gateway for accessing information in the case studies. They may come to know about activities in communities outside their own community of involvement and, learning from these case studies, utilize them to promote their own effective activities. If we can evaluate the commonalities between case studies, it will become possible to provide information that promotes dialog and collective thinking among diverse actors in various local communities.

How should we extract commonalities to provide information to promote dialog and collective thinking among people? There are two possible approaches to extract commonalities. The first is to provide definitions by human hand to classify activities in communities from across the world and sort them into categories. In the case of the ILEK Project, knowledge sources (documents, video footage, audio recordings, written scripts of spoken remarks, slides from lectures, etc.) related to case studies have been collected and cataloged as the Integrated Local Environmental Knowledge Database (ILEK Project 2013) (Fig. 19.2). However, one of the challenges with this method is that there are many categories for classification; thus, searching the database is quite complicated for anyone who is not a researcher or an expert in the fields concerned. The second is the method by which commonalities are extracted automatically. Under this method, large volumes of data are analyzed using quantitative methods, and commonalities are evaluated according to their degree of similarity. Search and shopping systems on the web showing remarkable

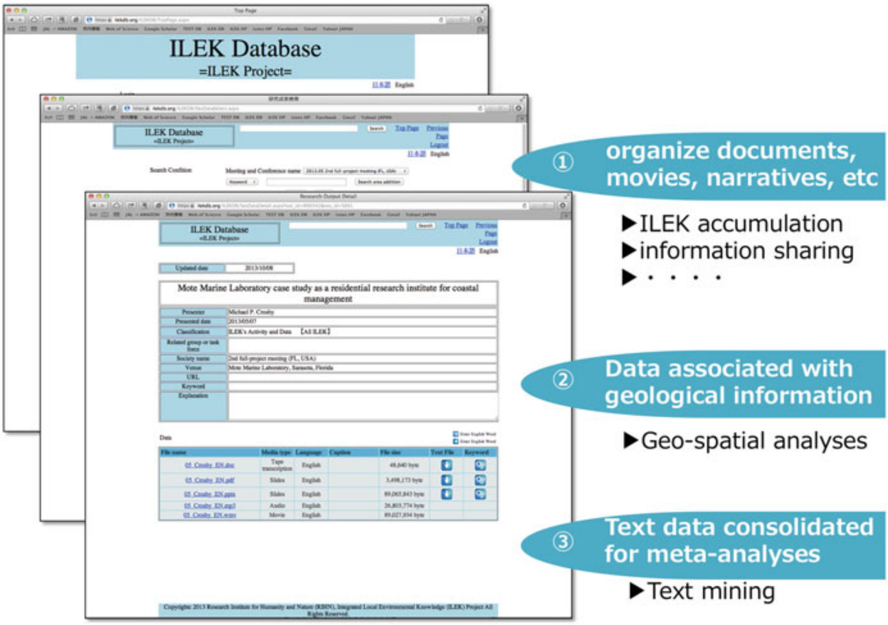


Fig. 19.2 Accumulations of information on case studies using the Integrated Local Environmental Knowledge Database

development in recent years use this method to provide various services. In other words, if automatic processing can be used to evaluate commonalities between case studies on a quantitative basis, users should be able to access information of case studies which may provide useful information to their own community by inputting simple search conditions.

19.1.3 The Boundary Object in the ILEK Project

In recent years, innovations in information and communication technology (ICT) have made it possible to analyze numerous kinds of statistical data and spatial information using Geographic Information Systems (GIS), and to analyze large volumes of text data using natural language processing. We came up with the idea of constructing a system, by utilizing these technologies, that (i) uses automatic processing methods to evaluate the commonalities between case studies that have been collected to date, and (ii) provides specific information on similar case studies. We aimed to develop a system which provides information to promote dialog and collective thinking between diverse actors and users who play roles as bilateral knowledge translators in communities endeavoring to achieve local sustainable development based on natural resource management. In addition, we envisage to provide information which can be used to train the next generation of people as potential bilateral knowledge translators, as well as to those organizations that are seeking to train bilateral knowledge translators. In this chapter, we describe our trial to construct our own boundary object, called the Integrated Local Environmental Knowledge Simulator (ILEK-SIM), as a product of the ILEK Project.

19.2 Concept of ILEK-SIM

We assumed the users of the ILEK-SIM to be: (1) those who are already playing a role as bilateral knowledge translators in their communities, and (2) those who are potentially capable of fulfilling the function of bilateral knowledge translators, as well as to those organizations that are seeking to train bilateral knowledge translators to achieve local sustainable development centering on natural resource management. The manners in which we assumed the users of the ILEK-SIM interact with it is discussed in Sect. 19.2.1, below.

19.2.1 ILEK-SIM Users and Information Utilized

Bilateral Knowledge Translators The ILEK-SIM provides those who are already playing a role of bilateral knowledge translators in the collaborative production process of knowledge with various stakeholders in the communities with information relating to “case studies with the information which users want to know about,” and “case studies which resemble the communities with which users are involved.” The ILEK-SIM provides information based on commonalities from different perspectives (for assurance of credibility). These users can utilize the ILEK-SIM in the different ways. First, they may use it as a tool to acquire human resources to collaborate with natural resource management and to discuss potential concrete ways forward, in reference to information on similar activities that have taken place in case studies to extract, for example, “what kinds of organizations and people they are working with?”, or “how are they dealing with the issues?” In this manner, they can find people with the potential to become involved in activities in their own communities.

Second, it is used as a tool to promote dialog and collective thinking between diverse actors in their community. By comparing their own situation to similar case studies, they can know similarities and differences between the activities of the community they are involved in and those in other communities. For example, this may include the kinds of natural resources being used, issues being experienced in the local areas, steps taken to deal with these issues, etc.. Additionally, they can explore references and data relating to similar case studies based on such similarities and differences. In this way, they can collaboratively discuss the applicable options for their own communities with local community members (for assurance of saliency and legitimacy).

Potential Bilateral Knowledge Translators, and Organizations Seeking to Train Bilateral Knowledge Translators The ILEK-SIM provides information about case studies with useful information to those individuals who are potential bilateral knowledge translators, as well as to those organizations that are seeking to train bilateral knowledge translators in communities. Then the users can utilize the ILEK-SIM as a tool for mutual learning and collective thinking. For instance, they can obtain specific information about case studies that they want (e.g., lists of publications and other materials, and the names and details of the organizations involved in these publications and activities, etc.). Using these basic information sources, they can explore further information by themselves and utilize the information to promote mutual learning and collective thinking. Moreover, they may use systems of internships and training to visit the case study sites to promote mutual learning.

19.2.2 Information Provided by ILEK-SIM

With the ILEK-SIM, the users first input the nature of their own activities, or information on the natural resources and local challenges of the activities that they are attempting to carry out in the future, as well as any other keywords (for instance, the name of the country, locality, or the name of the people concerned). Then, case studies with similar environmental and social conditions, natural resources and challenges are selected from the database using automatic processing methods and are displayed.

For example, if the user selects “fishery resources” as the natural resource and “adaptation to climatic change” as the local issue, and inputs “coral” as the keyword, the applicable case studies are extracted from the database including Sarasota, Florida in the United States (see Chap. 4), and Shiraho Village, Okinawa Prefecture in Japan (see Chap. 11) (Fig. 19.3). In addition, the following information about the case study sites is provided:

1. Publications and other materials

   ...Where can the user obtain reference materials on the community?

2. Natural resources in the region

   ...What kinds of natural resources are being used in the community?

3. Local challenges

   ...What kinds of issues is the community facing?

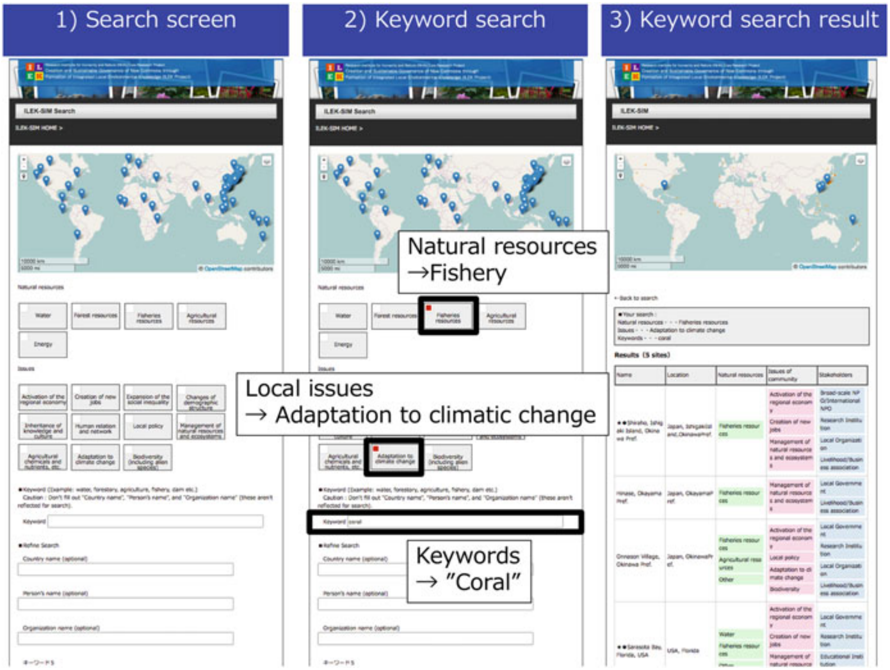


Fig. 19.3 Example of a search of case studies using the ILEK-SIM

4. Initiatives

   . . .How is the community dealing with the issues?

5. Organizations that are heavily involved in the initiatives

   . . .Who are collaborating in the activities?

Figure 19.4 shows an example of a case study from the Nishibetsu River basin (see Chap. 6). In this way, the users can obtain specific information on other areas that have been initiating similar activities to their own.

19.2.3 Search Algorithm for Extracting Similar Case Studies

Here, we present basic concepts of the search algorithm which forms the core of the ILEK-SIM. An overview of the algorithm are as follows:

1. Information related to case study sites in the ILEK Project is stored in a database on a cloud server together with their positional coordinates.
2. The search algorithm calculates the degree of similarity between case studies based on the information stored in the database.

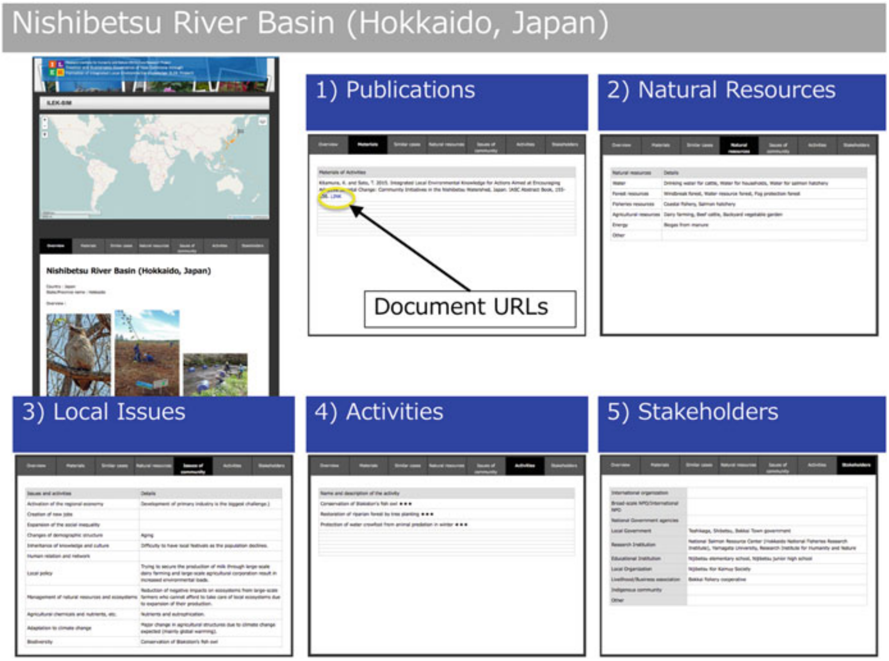


Fig. 19.4 Information on case studies delivered by the ILEK-SIM

3. The user inputs basic information on initiatives in the user's target community from the website on the cloud server.
4. Case studies matching to the information which the user has inputted are then extracted.

In order to extract similar case studies mechanically, we developed a method for evaluating the degree of similarity from GIS data of environmental conditions and social conditions, and from text data related to the case studies. In Box 19.1, we provide a detailed explanation of the technical methodologies and theory that form the core of the implementation of the ILEK-SIM. It would be great if a reader aiming to build boundary objects similar to the ILEK-SIM would benefit from the actual development and implementation of the system with their own hands. In addition to this chapter, we plan to publish the script used in the development of the ILEK-SIM as open source.

19.2.4 Extraction of Similar Case Studies

As an example, let us choose the case of Florida in the United States from the search results displayed in Fig. 19.3. As shown in Fig. 19.5, similar case studies are

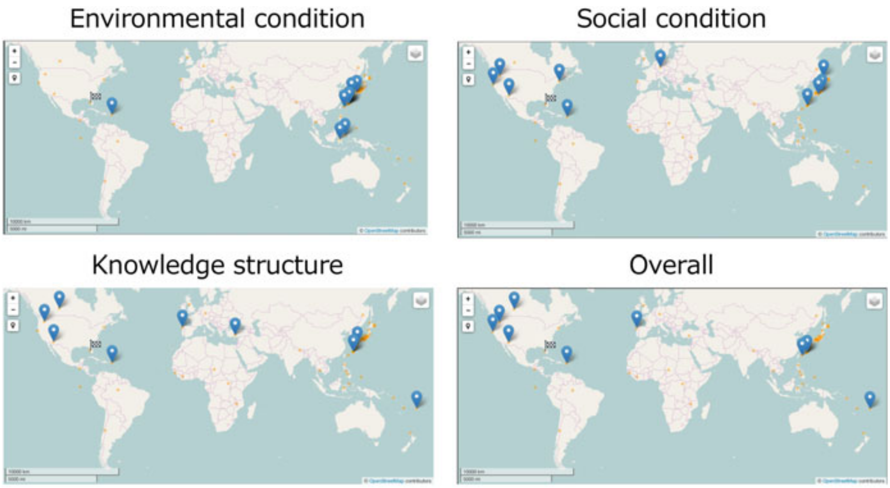


Fig. 19.5 Geographical distribution of similar case studies from the case study of Florida, United States

extracted in terms of the environmental conditions, social conditions, knowledge structures and overall evaluation. Table 19.1 shows the extracted case studies and their respective degrees of similarity.

In terms of environmental conditions, case studies from warm coastal areas are extracted, and case studies from developed nations like Japan are extracted based on social conditions. In terms of knowledge structures, we explain the detailed analysis in the next section. The high-ranking cases in the overall evaluation are those which have a high degree of similarity in terms of environmental and social conditions and knowledge structures. In this instance, the case study which resembles Florida the most is the Virgin Islands in the United States.

19.3 Semantic Network Analysis

In cases where the quality and quantity of text data are sufficient, it is possible to gain a more detailed understanding of the knowledge structures using semantic network analysis. Semantic network analysis interprets and visualizes knowledge structures as "concepts constituting knowledge and the network structures between these concepts" (Fig. 19.6). In this network, each node represents concepts which appear in texts, and the links represent co-occurrence of the two concepts in the same paragraph. The direction of the links is defined as moving towards a concept more characteristic of a certain paragraph from a concept having higher commonality with

Table 19.1 List of similar case studies extracted from the case of Florida, United States

	Environmental condition		Social condition		Knowledge structure		Overall	
Rank	Location name	d_{env}	Location name	d_{soc}	Location name	d_{knw}	Location name	d_{all}
1	US Virgin Islands, USA	0.249	US Virgin Islands, USA	0.710	Arizona State Univ. (DCDC), USA	0.512	US Virgin Islands, USA	1.460
2	INO (NPO), Okinawa, Japan	0.225	Arizona State Univ. (DCDC), USA	0.569	US Virgin Islands, USA	0.502	Arizona State Univ. (DCDC), USA	1.233
3	Onnason Village, Okinawa, Japan	0.221	The catchment of the Columbia River, USA	0.560	Coral reefs, Republic of Fiji	0.477	The catchment of the Columbia River, USA	1.131
4	Shiraho, Ishigaki Island, Okinawa, Japan	0.213	The catchment of the Mattole River, USA	0.557	The catchment of the Columbia River, USA	0.453	The catchment of the Mattole River, USA	0.858
5	Yoron Island, Kagoshima, Japan	0.207	Massachusetts, USA	0.535	Redberry Lake, Saskatchewan, Canada	0.366	Coral reefs, Republic of Fiji	0.725
6	Kunigami village, Okinawa, Japan	0.205	Rhön, Germany	0.237	Karapinar, Konya Province, Central Anatolia, Turkey	0.341	Onnason Village, Okinawa, Japan	0.693
7	Bunaken, Indonesia	0.198	Kumanonada coastal region, Mie, Japan	0.216	Vigo, Spain	0.335	INO (NPO), Okinawa, Japan	0.691
8	Karatsu and Kashima Cities, Saga, Japan	0.190	Sano City and Motegi Town, Tochigi, Japan	0.216	Onnason Village, Okinawa, Japan	0.257	Vigo, Spain	0.682
9	Hinase, Okayama, Japan	0.190	Onnason Village, Okinawa, Japan	0.216	INO (NPO), Okinawa, Japan	0.251	Shiraho, Ishigaki Island, Okinawa, Japan	0.667
10	Sulawesi, Indonesia	0.187	Ishiri Island of northern Hokkaido, Japan	0.216	Aya Town, Miyazaki, Japan	0.251	Redberry Lake, Saskatchewan, Canada	0.665

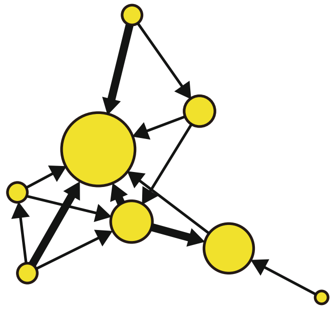


Fig. 19.6 Conceptual diagram of the semantic network. The circles represent important concepts that have appeared in text, and the lines represent co-occurrence of two different important concepts. The size of the circles shows the *tf***idf* value, and the thickness of the lines shows the degree of similarity (the Jaccard index) between two concepts (Alexandridis et al. 2018)

other paragraphs, and the weight of the links is given by the degree of similarity (i.e., the Jaccard index) between two concepts (Alexandridis et al. 2018).

Here we present an example of semantic network analysis. In this example, we analyzed a bundle of text data written by a member of the ILEK Project. He had lived in Shiraho Village, Okinawa Prefecture, Japan, and working as members of the local community to tackle with various local problems (specifically, the conservation of coral reefs and community development; see Chap. 11). The text data have been obtained from his publications (Total: 221 texts, 4174 paragraphs, and 7463 sentences) such as newspapers, blog articles, magazines, reports, academic papers and books about activities in Shiraho Village.

The semantic network obtained by this analysis is shown in Fig. 19.7. This network is split into seven clusters (A–G). Cluster A includes such concepts as "village development," "Shiraho Community Center," "the charter," and "drawing up plans," and can be considered to be in connection with "local rules." Cluster B includes such concepts as "traditional," "stone walls," "stone tidal weirs," "the fukugi tree (*Garcinia subelliptica*)," and "restoration," in connection with "the restoration of traditional townscapes." Clusters C and D include such concepts as "coral reefs," "daily life," "culture" and "blessings," in connection with "coral reef culture." Cluster E includes such concepts as "community development," "WWF Japan Coral Reef Conservation and Research Center," "collaboration," and "initiatives," and can be interpreted to be connected to "community development." Clusters F and G include such concepts as "Shiraho," "coral," "biodiversity," "agricultural land," "red clay" and "impacts," closely related to "coral reef conservation." We emphasize that these clusters are extracted automatically by an algorithm that detects closely connected nodes in the network and divides the network into clusters (Fig. 19.7).

From the structure of these clusters, we can deduce that there is little direct relevance in the knowledge structure between "coral reef conservation" and "local rules" which have a low frequency of co-occurrences in the same paragraph (context), and that the clusters of "the restoration of traditional townscapes," "coral reef

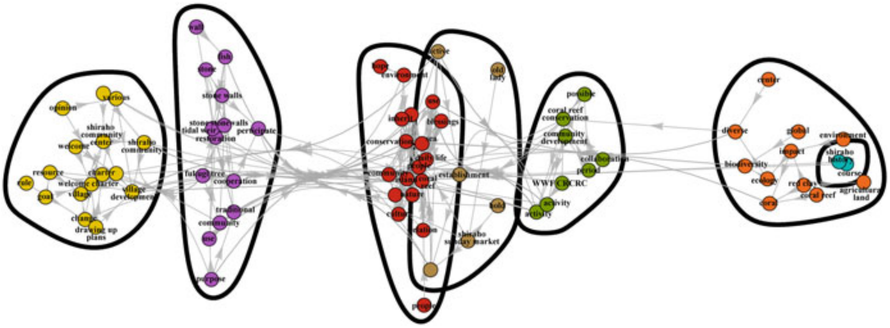


Fig. 19.7 Knowledge structure represented in the texts written by a project member regarding activities in Shiraho Village, Ishigaki Island, Okinawa Prefecture. Nodes without labels indicate that the concepts extracted by natural language processing from the texts in Japanese did not have appropriate matching with English words

culture" and "community development" play a role to link "coral reef conservation" and "local rules." In this way, simple algorithms can be used to visualize knowledge structures and provide a detailed understanding of the interrelationship of concepts constituting knowledge.

In the cases with sufficient quality and quantity of text data, it is possible to visualize knowledge structures by using semantic network analysis and provide these information as output in the ILEK-SIM. The users of the ILEK-SIM can refer to knowledge structures related to similar case studies and compare them with the knowledge structures of other case studies.

19.4 Future Development and Challenges

The ILEK-SIM has been built up through discussions between diverse project members throughout the world acting as bilateral knowledge translators in communities that are endeavoring to achieve local sustainable development centering on natural resource management. The ILEK Project is made up of more than 200 project members who belong to various organizations and affiliations, including international organizations (UNESCO etc.), NPOs and NGOs working at broader scales (WWF, IUCN etc.), administrative bodies (national government of Japan, prefectural governments and municipalities), research institutes (universities etc.), educational sectors (museums, schools etc.), local organizations (senior citizens' clubs and housewives' clubs, local committees, community-based NPOs, etc.), livelihood organizations (agricultural cooperatives, fishery cooperatives etc.), businesses (local companies etc.), communities of indigenous peoples. Looking back over the development processes of ILEK-SIM, it becomes apparent that dialog and collective thinking between project members have been facilitated through a series of tumultuous debates and discussions with the ILEK framework, focusing on the following central question: “What is the nature of knowledge that helps solve environmental problems in local communities?” In other words, the collaborative production of knowledge among diverse project members during the course of the ILEK Project has served to refine the concepts behind the ILEK-SIM and its functions, leading to the development of a boundary object that implements the framework of ILEK.

In this chapter, we described development processes of the ILEK-SIM, a boundary object which aims to promote dialog and collective thinking between people through use of information obtained from case studies in the process of solving local problems. The ILEK-SIM employs GIS data analyses of environmental and social conditions and automatic processing techniques to analyze text data obtained from the case studies to reorganize the information related to the case studies from around the world by evaluating the commonalities between case studies that have been gathered. The users can obtain information on a range of case studies around the world that are similar to the communities in which they are involved. Users who are already acting as bilateral knowledge translators in communities can utilize the ILEK-SIM to promote dialog and collective thinking between people in connection with the problems that the communities are experiencing to find balanced decision making and action as a community from the perspectives of saliency, credibility and legitimacy. The ILEK-SIM can be used by the potential bilateral knowledge translators and organizations seeking capacity development of the translators to train the next generation of people by learning about collaborative knowledge production processes from case studies around the world that bilateral knowledge translators have been involved.

However, the ILEK-SIM still faces various challenges. With the current method of evaluating the degree of similarity, environmental conditions, social conditions and knowledge structures are assumed to contribute equally to the degree of similarity. Validity of this assumption and degree of accuracy of the similarity evaluation have not been examined sufficiently. One reason for this is the insufficient data for evaluating the accuracy. Therefore, in the future, we hope to be able to improve the accuracy of search algorithms and make the degree of similarity more appropriate by collecting data from other cases which are not included in the current analyses. We also need to evaluate how useful the information provided through the ILEK-SIM is to the users, and whether the information selected by the users is balanced for communities from the perspectives of saliency, credibility and legitimacy. We need to make the ILEK-SIM open for the public to collect data on usage and user satisfaction to tackle with this challenge to improve the ILEK-SIM. If we can accumulate such information from potential users, we may be able to apply machine learning mechanisms from ever developing field of information science to verify whether the information provided through the ILEK-SIM is balanced for communities from saliency, credibility and legitimacy perspectives.

While ILEK-SIM is still under the stages of development, its concepts and search algorithms are simple and can be applied to existing databases which have collected data of case studies from around the world. For example, in the Social-Ecological Systems Meta-Analysis Database (SESMAD) Project (SESMAD 2014) of the Dartmouth College, a range of activities from communities throughout the world have been classified into categories including responsible organizations of the activities, management and governance systems and targets of activities, together with relevant references. Also, in the case of IMBER-ADApT by Integrated Marine Biogeochemistry and Ecosystem Research: IMBER (Bundy et al. 2016) is focusing at case related to marine ecosystems to accumulate diverse information to provide effective support for decision making. These existing databases differ with regard to the purposes and background behind their construction. However, we believe it would be possible to integrate these existing databases by analyzing and reconstructing these databases based on the perspectives of the bilateral knowledge translators in the communities, the principal users of the information highlighted in this chapter, who endeavor to achieve local sustainable development. Such a trial is expected to contribute to the networking of people engaging in sustainable community development based on natural resource management throughout the world, and to promote dialog between people toward sustainable futures using the ILEK-SIM, eventually co-creating countermeasures of local challenges by learning together with diverse local actors.

Box 19.1: The Technical Methodologies and Theory that Form the Core of the Implementation of ILEK-SIM

1. Environmental conditions and Social Conditions

The Construction of a GIS Database The GIS data used in the development of the algorithm is shown in Table Box 19.1. As for the environmental conditions, we used the monthly average precipitation and monthly temperature provided by WorldClim as indices related to climate (Hijmans et al. 2005), and data from the Global Land Cover Map provided by the National Institute for Environmental Studies, Japan as indices related to vegetation (Iwao et al. 2006).

As GIS data for social conditions, we used GDP, GDP per capita and GNI per capita from the HDI Report 2013 (UNDP 2013) provided by UNDP as indices related to the economy, the predicted number of years of schooling and number of years of schooling as indices related to education, and life expectancy at birth as an index related to health. In addition, we used the percentage of Christians (Johnson and Grim 2008) provided by Harvard University's WorldMap as an index related to culture and religion, and population density data (CIESIN and CIAT 2005) provided by Columbia University's Socioeconomic Data and Application Center (SEDAC) as an index related to population.

We stored these GIS data in a GIS database constructed on a cloud server using PostGIS (PostGIS Project 2016).

Calculating the Degree of Similarity based on Environmental Conditions and Social Conditions By constructing a GIS database using a GIS

(continued)

Box 19.1 (continued)
software, it allowed to superimpose multiple data sets (e.g. environmental condition and social conditions) and to identify relationships them (Clarke 1997). This GIS operation is called overlay. We applied this GIS operation to calculate the degree of similarity based on environmental condition and social condition.

The data set obtained through the program we developed comprises of 30 variables for environmental conditions and 8 variables for social conditions. Let us denote the environmental conditions for the research sites for the case studies P, Q as (p_1, p_2, . . ., p_{30}) and (q_1, q_2, . . ., q_{30}), respectively. Note that each of the variables has been standardized appropriately. The Euclidean distance l_{env} for the environmental conditions between the research sites for case studies P, Q is given as follows:

$$\begin{aligned} l_{\mathrm{env}}(P,Q) &= l_{\mathrm{env}}(Q,P) \\ &= \sqrt{(q_1-p_1)^2+(q_2-p_2)^2+\ldots+(q_{30}-p_{30})^2}, \end{aligned} \qquad (19.1)$$

The degree of similarity d_{env} of the environmental conditions is defined as follows:

$$d_{\mathrm{env}}(P,Q) = 1 - \frac{l_{\mathrm{env}}(P,Q)}{\max\{l_{\mathrm{env}}\}}, \qquad (19.2)$$

where $\max\{l_{\mathrm{env}}\}$ denotes the distance between the least similar case studies. For the degree of similarity, the lowest value is 0 and the highest value is 1. The value increases as the cases exhibit more similarities. The degree of similarity for social conditions d_{soc} is defined in the same way. Similar case studies are extracted based on the calculated degree of similarity d_{env}, d_{soc}.

2. Knowledge Structures

We assume that knowledge structure is expressed in text data, and perceive these knowledge structures as "concepts structuring knowledge and combinations of these concepts." It is possible to extract knowledge structures using this framework by automatic processing methods from vast volumes of text data.

Construction of a Text Database We obtained text data for extracting knowledge structures from video and audio data such as recording of lectures and interviews stored in the Integrated Local Environmental Knowledge Project Database (https://ilekdb.org/ILEKDB/ActivitySelect.aspx), as well as from publications. We acquired text data from video and audio data using transcription, and text data from publications in such formats as Word and

(continued)

Box 19.1 (continued)
PDF from files using text extracting softwares. We then confirmed whether or not the extracted text data was related to any of the research sites for case studies and, if so, which, and deleted text data that was not related to any of the research sites for case studies from the database. As a result, we constructed a database comprising of text data for 38 case study sites.

The Extraction of Concepts constituting Knowledge Structures The text data in the database is broken down to words using a natural language processing technique. In this research, we classified the words using IBM's SPSS Modeler Premium Version 16.0 Text Analytics for Survey. Then, the frequency of each word (Japanese: nouns; English: nouns and verbs) appearing in each paragraph is totaled up. Next, the extracted words are weighted using the index called *tf*idf* (term frequency - inverse document frequency) (Ai et al. 2010). In regard to a word *w* in certain paragraphs *T*, *tf*idf (T, w)* is defined as follows:

$$tf^*idf(T,w) = tf(T,w) \times idf, \tag{19.3}$$

$$tf(T,w) = \frac{[\text{Frequency of appearance of the word } w]}{[\text{Total number of words in paragraph } T]}, \tag{19.4}$$

$$idf = \frac{[\text{Total number of paragraphs}]}{[\text{The number of paragraphs in which the word } w \text{ appears}]}, \tag{19.5}$$

A good index for characterizing paragraphs is the words appearing frequently only in certain specific paragraphs and which do not appear in paragraphs other than these and it is required to extracts these words by gives larger weights. As is apparent from Eq. (19.4), the *tf* gives heavy weight to words which appear frequently. On the other hand, as shown by Eq. (19.5), the *idf* reduces the weight of general words which appear in large numbers of paragraphs (please note that the *idf* of words which appear in all paragraphs is 0.). Therefore, as you can see, *tf*idf* as defined by the product of these two factors, is an index for words which have satisfied the requirements.

By selecting the 100 words with the greatest total sum of *tf*idf* from sets of text relating to each case study site, a group of important concepts $\{w\} = \{w_1, w_2, \ldots, w_{100}\}$ are determined in the text data collected at each site.

Calculation of the Degree of Similarity based on Knowledge Structures The degree of similarity d_{knw} between research sites for case studies *P*,

(continued)

Box 19.1 (continued)
Q based on knowledge structures is defined by degrees of overlaps between important concepts extracted from P and Q:

$$d_{\mathrm{knw}}(P, Q) = \frac{[\text{Total number of common concepts } \textit{in P and } Q]}{[\text{Total number of concepts appearing in } P \textit{ or } Q]} \tag{19.6}$$

Equation (19.6) is called the Jaccard index and is standardized to $0 \leq d_{\mathrm{knw}} \leq 1$. Here, in order to calculate the degree of similarity, a method was employed called 2-gram (bi-gram). In addition, an index was created using pg bigm (NTT DATA Corporation 2016), a module which provides a full text search function on PostgreSQL. By using this index for full text searches, it is possible to search the case study including optional keywords.

3. Calculation of the Overall Degree of Similarity

The overall degree of similarity d_{all} of case study sites P and Q is defined as the sum of each degree of similarity:

$$d_{\mathrm{all}}(P, Q) = d_{\mathrm{env}}(P, Q) + d_{\mathrm{soc}}(P, Q) + d_{\mathrm{knw}}(P, Q) \tag{19.7}$$

Table Box 19.1 GIS data used for calculating the degree of similarity based on environmental and social conditions

Category	Sub category	Name	Unit	Source
Environmental condition	Climate	Monthly average temperature (°C)	1 km	WorldClim (Hijmans et al. 2005)
		12 variables (Jan. – Dec.)		
		Monthly average precipitation (mm)		
		12 variables (Jan. – Dec.)		
	Vegetation	Percentage of land cover (%)	1 km	Global Land Cover Map (Iwao et al. 2006)
		6 variables (Forest, Grassland, Farmland, Residence area, Water, Barren land)		
Social condition	Economic	GDP (2005 ppp $)	Country	HDI Report 2013 (UNDP 2013)
		(Sum of gross value added by all resident producers in the economy, expressed in 2005 international dollars using purchasing power parity rates)		

(continued)

(continued)

Box 19.1 (continued)

Table Box 19.1 (continued)

Category	Sub category	Name	Unit	Source
		GDP per capita (2005 ppp $)		
		(Sum of gross value added by all resident producers in the economy, expressed in international dollars using purchasing power parity rates and divided by total population during the same period.)		
		GNI per capita (2005 ppp $)		
		(Aggregate income of an economy generated by its production and its ownership of factors of production, converted to international dollars using PPP rates, divided by midyear population)		
	Education	Expected years of schooling		
		(Number of years of schooling that a child of school entrance age can expect to receive)		
	Health	Life expectancy at birth		
	Culture	Percentage of Christians (%)	State/ area	World Religion Map (Johnson and Grim 2008)
	Population	Population density	State/ Area	Gridded Population of the World, Version 3 (GPWv3) Data Collection (CIESIN and CIAT 2005)

References

Alexandridis K, Takemura S, Webb A, Lausche B, Culter J, Sato T (2018) Semantic knowledge network inference across a range of stakeholders and communities of practice. Environ Model Softw 109:202–222. https://doi.org/10.1016/j.envsoft.2018.08.026

Bundy A, Chuenpagdee R, Cooley SR, Defeo O, Glaeser B, Guillotreau P, Isaacs M, Mitsutaku M, Perry RI (2016) A decision support tool for response to global change in marine systems: the IMBER-ADApT (assessment based on description and responses, and appraisal for a typology) framework. Fish Fish 17:1183–1193

Cash D, Clark W, Alcock F, Dickson N, Eckley N, Jäger J (2002) Salience, credibility, legitimacy and boundaries: linking research, assessment and decision making. KSG Working Papers Series, RWP02–046

Cash DW, Clark WC, Alcock F, Dickson NM, Eckley N, Guston DH, Jäger J, Mitchell RB (2003) Knowledge systems for sustainable development. Proc Natl Acad Sci 100:8086–8091

Guston DH (2001) Boundary organizations in environmental policy and science: an introduction. Sci Technol Hum Values 26:399–408

Integrated Local Environmental Knowledge (ILEK) Project (2013) Integrated local environmental knowledge database. https://ilekdb.org/ILEKDB/ActivitySelect.aspx. Accessed 9 July 2015

Makino M, Hirota M, Machiguchi Y (2011) An application of the management tool box to coastal fisheries – a case of sea cucumber fisheries (管理ツールボックスを用いた沿岸漁業管理の考察-ナマコの場合-). Fisheries biology and oceanography in the Kuroshio 12:25–39 (in Japanese)

SESMAD (2014) Social-ecological systems meta-analysis database: background and research methods. http://sesmad.dartmouth.edu/. Accessed 9 July 2015

White DD, Wutich A, Larson KL, Gober P, Lant T, Senneville C (2010) Credibility, salience, and legitimacy of boundary objects: water managers' assessment of a simulation model in an immersive decision theater. Sci Public Policy 37:219–232

References for Box 19.1

Ai D, Zheng Y, Zhang D (2010) Automatic text summarization based on latent semantic indexing. Artificial Life and Robotics 15(1):25–29

Center for International Earth Science Information Network (CIESIN), Centro Internacional de Agricultura Tropical (CIAT) (2005) Gridded Population of the World, Version 3 (GPWv3): population grids. SEDAC, Columbia University, New York. http://sedac.ciesin.columbia.edu/gpw. Accessed 9 July 2015

Clarke KC (1997) Getting started with geographic information systems. Prentice Hall, Upper Saddle River

Hijmans RJ, Cameron SE, Parra JL, Jones PG, Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. Int J Climatol 25:1965–1978

Iwao K, Nishida K, Kinoshita T, Yamagata Y (2006) Validating land cover maps with degree confluence project information. Geophys Res Lett 33:L23404

Johnson TM, Grim BJ (eds) (2008) World religion database. Brill, Leiden/Boston. https://worldmap.harvard.edu/data/geonode:wrd_province_religion_qg0. Accessed 9 July 2015

NTT DATA Corporation (2016) pg_bigm. http://pgbigm.osdn.jp/index.html. Accessed 9 July 2015

PostGIS Project (2016.) http://postgis.net. Accessed 9 July 2015

UNDP (2013) HDI Report 2013. http://hdr.undp.org/en/2013-report. Accessed 9 July 2015

Chapter 20
Institutional Support for Combining Multiple Knowledge Systems in Planning for Community Resilience to Natural and Anthropogenic Hazards

Jennifer Helgeson

Abstract A given community may be considered as a system of systems (i.e., socio-economic networks and supporting physical infrastructure); if there is failure in one part, it is likely that the entire system will be disrupted. Planning and preparations for and response to natural, human-made and technological hazards often competes with other community priorities. Resilience planning challenges actors relevant to the decision-making process across knowledge systems relevant to the community which span the technical/scientific (e.g., transport networks, utilities), faith-based, NGO, local government, and media, among other sectors. The National Institute of Standards and Technology (NIST) has developed a six-step process that provides a practical and flexible approach to help community actors to jointly set priorities and allocate resources to manage risks facing the community. This process helps communities think through and plan for their social and economic needs, their hazard risks, and recovery of the built environment by encouraging co-production of knowledge and solutions throughout the resilience planning. This chapter overviews that six-step process and illustrates the first three steps using a case study example in Colorado, USA. The NIST "Economic Decision Guide for Infrastructure Systems" (EDG) is also introduced, as its seven-step process helps the collaborative resilience planning team in a community decide among possible resilience planning alternatives, including market and non-market values. It also introduces the importance of including the *co-benefits* that accrue to the community as a product of planning for resilience, even when a disaster has not yet occurred.

J. Helgeson (✉)
National Institute of Standards and Technology, Gaithersburg, MD, USA
e-mail: Jennifer.helgeson@nist.gov

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_20

20.1 Introduction/Background

Historically, resilience planning in the research areas of engineering and economics has largely dealt with analyses based on single buildings or infrastructure projects. The NIST "Community Resilience Planning Guide for Buildings and Infrastructure Systems" (CRPG) encourages communities to fold the concept of resilience into other community goals and plans (e.g., community business plans and disaster preparedness plans) (NIST 2016). Planning related to increasing resilience at the community scale, as opposed to restricting attention only to structures and operations, addresses the interconnectedness of the structural, social, and natural systems that underlie a community's functions. The term community can be defined in various ways on the local and national scales. This chapter considers communities to refer to "a place designated by geographical boundaries that function under the jurisdiction of a governance structure" (e.g., town, city, county) (NIST 2016). However, resource challenges can arise when planning for resilience at the community level if such projects compete with other capital and social investments. This is especially difficult if potential benefits (i.e., avoided losses) accrue only when a disruptive event occurs.

The U.S. National Research Council (2012) defines resilience as "the ability to prepare and plan for, absorb, recover from or more successfully adapt to actual or potential adverse events."

A critical part of improving community-level resilience is acknowledging and prioritizing actions or projects for the buildings and infrastructure systems that support important social functions. A given community may assess the hazards it most readily faces and in turn prepare, mitigate risk, and plan recovery narrowly tailored to this assessment. However, it is also important to assess community goals in a broader setting beyond the specific hazard(s) of concern, as well, and ensure that these goals are addressed while planning for increased resilience.

Guidance on improving community resilience in the built environment suggests addressing high-level performance goals for routine, design, and extreme events (NIST 2016). Routine hazard events are more frequent, less consequential events that should not cause significant damage. Design hazard events are used to design structures; design loads are specified in building codes for many natural hazards. Extreme events may also be defined in building codes for some hazards; they are the most likely to cause extensive damage.

In addition to preparing for potential shocks, resilience planning can address long-term community goals for stressors in the community. Stressors are often unrelated to shocks, and include things such as high crime rates, plummeting economic growth, unemployment, and poverty. Resilience actions may also provide improvements that benefit a community without addressing stressors. For instance, elevating and remodeling a bridge may enhance resilience to flooding without reducing commute times or traffic congestion, but the new design may provide increased aesthetic amenity to the community. There is anecdotal evidence of improvements in community budgets, economic diversification, and greater social and economic opportunities for residents from community resilience planning (Rodin 2014).

Communities evaluating investments aimed at improving their resilience face a tradeoff between short-term costs and benefits that may only be realized if a disturbance occurs during the periods of time they have considered in the analysis. Thus, traditional estimates of return-on-investment generally assume a hazardous event occurs within the analysis time frame. Yet, as mentioned, even in the absence of a disruptive incident, resilience investments may produce returns that are valuable to the community in other ways. Resilience investment options that achieve the same primary goal may differ with respect to *co-benefits*. For instance, levees provide flood control, a benefit to the community only in the case of a flood. In contrast, green space in a floodplain can provide a valuable resource to the community (through areas for recreation and increased natural landscapes) in the absence of a flood, while also providing flood control in the event of a flood. Without careful consideration of co-benefits, a community cannot fully evaluate the tradeoffs.

Localized knowledge is important in effectively planning for resilience; however, often planning resilience improvements based on local knowledge is overlooked or undervalued. There are two primary associated reasons: (1) incorporating non-monetary social and ecosystem value in decisions is hard to achieve and (2) many resilience assessments look primarily at scenarios that assume value from resilience planning only arises if a disaster event occurs.

There are major advances in dealing with the first reason, as ecosystem services are increasingly incorporated into resilience planning evaluations (e.g., Schuster and Doerr 2015). An important piece of information that is increasingly realized in assessments is that socio-economic metrics cannot be selected in isolation from ecological metrics. One must simultaneously assess and consider the relevant socio-economic and ecological metrics to ensure that the ecological changes from restoration are linked to changes in socio-economic metrics and vice-versa.

The annualized chance that a natural disaster occurs in a given place may be well below 1% (in many cases it may be much higher) and a compound chance of more than one natural disaster hitting is even lower. This fact makes investing in resilience planning difficult to get into the community budget line, especially for communities that are under-resourced or are facing more imminent stressors. Thus, it important to consider other near- or medium-term gains from resilience planning that may not be explicitly linked to mitigation or adaptation in the case of a disaster. In other words, considering the net co-benefits (i.e., the resilience dividend) associated with planning for increased community resilience is a key element to providing a full picture of the potential net-benefit (net-cost avoided).

The next section of this chapter overviews the NIST CRPG's six constituent steps. Section 20.3 introduces an example community in Colorado, USA and summarizes the community's use of the first three steps of the CRPG. Section 20.4 outlines the constituent steps of the EDG. Section 20.5 then discusses on-going assessment of the NIST CRPG and the accompanying EDG to provide the best implementation guidance possible across varying types of communities. Section 20.6 concludes.

20.2 The NIST Community Resilience Planning Guide

The National Institute of Standards and Technology (NIST), a part of the U.S. Department of Commerce, has proposed a six-step process for planning increased community resilience; the NIST *Community Resilience Planning Guide for Buildings and Infrastructure Systems* (CRPG) (2016) has been adopted by select communities across the United States. The six-step process of the CRPG helps communities to think through and plan for their social and economic needs, risks associated with the hazard(s) facing that area, and recovery of the built environment by:

- Setting performance goals for vital social functions – healthcare, education and public safety – and supporting buildings and infrastructure systems – transportation, energy, communications, and water and wastewater;
- Recognizing that the community's social and economic needs and functions should drive goal-setting for how the built environment performs; and
- Providing a comprehensive method to align community priorities and resources with resilience goals.

The CRPG's proposed six-step process is briefly summarized below (NIST 2016):

1. **Form a collaborative planning team (CPT)** with strong, inclusive leadership to engage public and private stakeholders, and community members.
2. **Understand the situation** by characterizing the existing social functions, buildings, and infrastructure systems of the community, and how they are linked.
3. **Determine goals and objectives** based on long-term community goals and desired social functions, recognizing that community resilience is built over time and that social needs should drive performance goals for buildings and physical infrastructure systems.
4. **Plan development** includes evaluating gaps between the desired, future performance and the anticipated current performance of buildings and infrastructure systems following a disruptive event, and identifying and prioritizing solutions to address the gaps.
5. **Plan preparation, review, and approval** depends on broad dissemination, and transparent engagement with all stakeholders, community leaders and members.
6. **Plan implementation and maintenance** requires regular, transparent reviews and updates to the implementation strategy and solutions.

The process of translating concepts between actors who work with in different fields or varying paradigms throughout the planning process is not explicitly noted in the CRPG. This is the case since it was felt that this translation and shared meaning-making process differs significantly between community types, regarding aspects such as formal and informal governing structures, individuals' characteristics, and the associated Agency–Structure Integration dynamics (i.e., the interplay between individual agency and social structures within which individuals interact) (Sei-Ching

2011). The CRPG's first step is to form a collaborative planning team (CPT) to explore a holistic planning vision identified by the community. This process should ideally not be siloed into areas of concern (e.g., economics, social, political) nor stratified by governance level. The concept is that through discussions and joint negotiations given agreed-upon parameters for planning, the group achieves shared meaning. Yet, the fact that such groups often do not function ideally in the real world, the need for translation processes is acknowledged. In practical application of the process, there is team leadership (often by the community's Emergency Manger if that position exists in the community) who is invested in the importance of mutual learning and achievement of shared perception by members of the CPT. Objective data, such as detailed spatial datasets, are intended to help facilitate the process of obtaining shared meaning towards and agreed upon resilience goal.

In the CRPG, a fictional example is used to illustrate the six-step process and how disaster resilience can be integrated into community planning. In that example, the champion of the planning process in the location called Riverbend is Ms. Smith; she is a citizen who was affected by major floods in the town and believes that Riverbend needs a community resilience plan to prepare for such future flooding. After lengthy discussions with City Council members and the Mayor, a City Hall meeting was called to gauge the public's interest in investing time and effort in creation of a community resilience plan. After additional discussions resident saw the benefit of living and working in a more resilient community and agreed to pursue the planning process. Achieving community resilience requires a broad base of support from stakeholders. As Riverbend would likely need assistance from neighboring communities, regions, and the state, Ms. Smith recognized that she needed to identify and engage public and private stakeholders within the community, as well as from Fallsborough, the city across the river. Ms. Smith established a large work group representing a broad cross section of Riverbend. She made sure to include those who could help define social needs across citizen groups. Her vision for the organization of the planning process included a planning team overseen by the City Council and including seven task groups (see Fig. 20.1), which in turn coordinated to address interdependencies and to achieve a shared vision for resilience priorities.

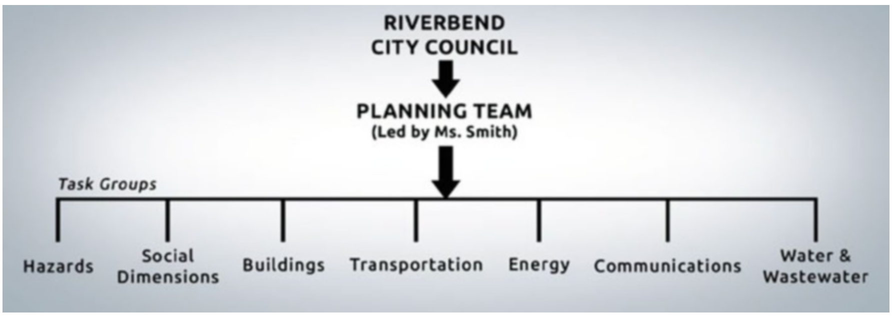


Fig. 20.1 Example Riverbend planning team and stakeholder task groups. (Source: NIST "Community Resilience Planning Guide" (2015))

The CRPG may be updated as NIST researchers learn from the experiences of communities using the guidance document and approach. About ten communities are currently engaged in use of the CRPG in some fashion to move forward their efforts to address increased resilience capacity. Section 20.5 of this chapter reviews high-level experiences from its implementation in a medium-sized college community in Colorado, USA.

The long-term goal of the NIST Community Resilience Program is to improve recovery and minimize disruption to community functions following hazard events.

The CRPG offers a first step toward achieving that goal, by providing a uniform process for developing a prioritized resilience plan that is integrated with existing comprehensive plans, economic development plans, and hazard mitigation plans. To achieve the long-term goal, NIST will work toward achieving the following near term goals:

- Adoption and implementation by early adopter communities;
- Promotion or use of the CRPG by existing federal and state government programs and agencies; and
- Use of the CRPG as a basis or reference in other federal or state guidance and tools.

In the next section, an example community in Colorado, USA is introduced and the community's use of the first three steps of the CRPG is noted.

20.3 The CRPG in Action: Colorado Community Example and Lessons to-Date

Research concerning the use of the CRPG is ongoing and strives to address communities across various categories, as noted in Sect. 20.5 of this chapter.

The U.S. Department of Homeland Security (DHS) runs the Regional Resiliency Assessment Program (RRAP) that provides assessments of critical infrastructure in communities around the country, especially with regards to vulnerability to hazard events. In a recent RRAP assessment conducted in a medium-sized Colorado college community, DHS decided to adopted the NIST CRPG process in the cooperative assessment (between local, county, and state government and other actors). This RRAP will run for a three-year period and has currently completed the first three steps of the CRPG. In this section lessons learned from this RRAP in Colorado to date are summarized. Information for this section was garnered through semi-formal interviews with the community's CPT and the RRAP teams.

As envisioned in the first step of the CRPG, a strong, committed CPT is the foundation for setting direction, ensuring participation and collaboration, and establishing the community's resilience goals and objectives. When the community initiates the CRPG process, the formation of an active, motivated CPT will likely be the norm; where the CRPG is undertaken as part of a process the community perceives as externally-driven, that may not be the case. In either case, many necessary stakeholders may not be aware of the undertaking, and when they become aware they may be skeptical or unsure of what the RRAP and the accompanying use of the CRPG means for them and their organization. Adherence to the CRPG involves surrendering some control to local stakeholders, including control of the pace of the assessment, which led to the observation that "*you are only as fast as your slowest stakeholder*." This can be very slow indeed if stakeholders do not understand the initiative and are not fully aware that local government leaders support it.

This issue, as well as other lessons learned during the first 9 months of the CRPG-RRAP process in this community, forms the basis for the observations outlined below.

Step One: Form a Collaborative Planning Team Community resilience planning is an inherently local activity. Aligned with the Integrated Local Environmental Knowledge (ILEK) approach (Sato 2014; Kitolelei and Sato 2016), experts outside of the community may help co-produce knowledge and subsequent resilience planning options, but do not have the extent of local specialized knowledge to engage in this process unilaterally (without the community's deep engagement). Thus, the RRAP team, in this case as an external leadership team coming in to assist the Colorado community, can execute tasks that measure and assess resilience, but it cannot substitute its resilience standards (e.g., based on national averages) for the community's or ensure the local engagement required to efficiently navigate the six-step process in the CRPG. Optimally, a committed and engaged CPT will be available to establish "commander's intent" through the decision points in the CRPG. The following key findings relate to Step One in the case of the Colorado community example. These findings arise from self-reflection by the RRAP team and the researchers from NIST who observed the process.

The findings are organized in Table 20.1 by highlighting the specific finding in the application of the CRPG process to the community and then describing suggestions to other communities that may provide improved outcomes and processes based on these *lessons learned*.

Step Two: Understand the Situation The key findings and best practice tips identified by the community for Step Two revolve around the need to identify community planning champions to allow flexibility in the order in which sub-steps of the process occur organically within the community.

The findings are organized in Table 20.2 by highlighting the specific experiences in the application of the CRPG process to the community and then describing suggestions to other communities that may provide improved outcomes and processes based on these *lessons learned*.

The overarching finding is that the three principle elements of the CRPG's Step 2 (i.e., (1) Understand the social dimensions, (2) Understand the built environment, and (3) Link the social functions and built environment) (NIST 2016) need not be undertaken sequentially, but rather can be developed concurrently and iteratively. At

Table 20.1 Lessons learned for Step 1: Form a Collaborative Planning Team. *Listed in no particular order*

	Community-specific *Lesson Learned*	Suggested strategies
1	One of the organizations on the CPT, the County Office of Emergency Management (OEM), assigned the emergency management coordinator to work directly with the RRAP team. This individual served as a direct liaison between the CPT and the RRAP team and was an integral member of the RRAP team. Representation from the OEM by someone who worked with diverse stakeholders in the community already helped create trust and facilitated information gathering	Local representation on the team is integral in several areas, including: identifying and establishing relationships with local stakeholders and contacts; providing awareness to the team of local initiatives, practice and procedures; identifying meeting space and setting up meetings; and preventing missteps that might have occurred without local knowledge and counsel
2	Early in the process it was complex to get full buy-in from some potential members of the CPT who were identified as integral to the process. This situation may have arisen from not creating enough context for the RRAP and the importance of the CPT to achieving the CRPG steps	Importance of CPT "buy-in" is of prime importance. The CPT should consist of members who: a. understand and accept the value proposition for community resilience planning; b. are aware of and committed to the process and the outcome; c. are willing to champion the effort and help bring necessary stakeholders into the process
3	Initially some members of the CPT were overlooked who were later brought-into the process. Specific to this community, it was found that the CPT needed to include a representative from water/wastewater, energy, transportation and communications, and emergency management sectors	Each community may need different types of social functions represented on the CPT. CPT members should ideally include local government and community leaders who can effectively organize key representatives from the eight social function groups highlighted in the CRPG. When establishing the CPT, communities may consider whether the CPT should include representation from any of the social function groups
4	Once executive endorsement (e.g., via press releases) was increasingly present and active in the CPT buy-in from other stakeholders was strengthened. Signaling that the resilience planning process is indeed important to the community and taken seriously by leadership appeared to prompt greater interest	Executive endorsement should be present and active. CPT members, as well as other community members who will be involved in the CRPG process, need assurance that local leadership supports the community resilience planning. In a municipality, that may be the mayor or the city manager. A press release or a written statement by leadership will assure local stakeholders that the effort is endorsed by their leadership and that their cooperation is encouraged and expected. Endorsement from senior leadership within key governmental departments may also be needed to secure working level coordination and cooperation
5	Members of the CPT continued to be involved with the resilience planning process when they received updates on the progress of the resilience assessment. The CPT members	Engaged and active CPTs should receive periodic updates on the progress of the resiliency assessment. If possible, enlist the community to host a "Community Resilience

(continued)

Table 20.1 (continued)

	Community-specific *Lesson Learned*	Suggested strategies
	know the community better than the external RRAP team. Thus, it was important to defer to the CPT members' counsel and expertise in managing relationships and to take heed of their feedback when presented with progress reports	Planning" webpage, so that updates can be posted as they occur and citizenry can respond. The briefings and the web postings will help keep the CPT engaged and enable them to intervene to address challenges or problems as they emerge

Table 20.2 Lessons learned for Step 2: Understand the Situation. *Listed in no particular order*

	Community-specific *Lesson Learned*	Suggested strategies
1	Community resilience assessments that follow the NIST CRPG structure should ultimately include an examination of local and regional lifeline infrastructure. This may be in the form of including infrastructure sectors/subsectors, such as water, wastewater, electrical transmission, and surface transportation	Developing a community-specific process that facilitates drawing threads between generalized scientific knowledge and the evaluation and reconstruction of this knowledge from the standpoint of localized users is important
2	The NIST CRPG process increased in effectiveness and efficiency (per the RRAP group) when each social function group had an identified champion. These champions successfully contributed to development of a joint understanding of how the social functions relate to the built infrastructure in the community	For each social function group (identified in Step 1), a champion/champions should be identified to help keep the overall group cohesive, prior to kick-off. Ensure their commitment and understanding of the tasks and processes required by step two relating to the social institution's community functions and the elements of the built environment relied on to deliver those functions. In addition, it is useful to assess their ability to translate local knowledge and skills among stakeholders in the community into a meaning shared by the overall CPT. Discuss potential approaches for accomplishing those objectives, giving deference to the champion's local knowledge and familiarity with the individuals and groups involved
3	A data/information protection policy was only available later in the process. Initial lack of the policy made the CPT assessment process slower and less effective than it may have been	Establish a data/information protection policy early in the CPT assessment process. When requesting data from infrastructure service providers or other assets, be prepared to address concerns about data security and how data will be safeguarded. Collaboration with diverse actors is an inherent opportunity of this process, but without trust that data and information will be kept confidential and respected the process can become challenging

first the community interpreted that the three sub-steps were meant to occur sequentially. Maintaining a process of knowledge production within the CPT and with relevant outside contributors is the ultimate goal of this step. When this is the case there is a natural iterative process; as something new is uncovered from a stakeholder for a built environment element, there may be a need to go back to explore the relevant social functions.

Step Two as it is discussed in the CRPG is a multi-step process that initially focuses on identifying and characterizing functions provided by social institutions, identifying assets required to deliver those functions, and identifying how those assets are supported by existing infrastructure systems. Identifying and characterizing functions of the community's social institutions and the assets critical to delivery of those functions is a uniquely local challenge – one that can result in substantial delay and suboptimal outcomes absent the necessary local buy-in and a clear, but flexible, approach to achieving those objectives. The RRAP Team handled sub-steps two (i.e., "Characterize the Built Environment") and three (i.e., "Link Social Dimensions to the Built Environment") more or less simultaneously. This involved using open source research and information obtained through interviews and facilitated discussions with lifeline sector service providers and social function representatives to begin the process of establishing utility service territories, key roads, highways and transportation pathways, and dependencies of key social function infrastructure on lifeline infrastructure systems serving the community.

Step Three: Determine Goals and Objectives The key findings and best practice tips for Step Three revolve around the use of objective data where possible to motivate discussion among members of the CPT and the wider public within the community.

These findings are organized in Table 20.3 by highlighting the specific experiences in the application of the CRPG process to the community and then describing suggestions to other communities that may provide improved outcomes and processes based on these *lessons learned*.

This pilot community is now at the point of establishing performance goals and determination of anticipated performance. The goal of this analysis is to determine the gaps in the current resilience processes and to see how potential solutions align with community goals outside of that which are hazard agnostic. In other words, to determine potential co-benefits from identified resilience plans is likely to help garner wider support for resilience plans within a given community, especially when results are aimed towards policy-making.

Once a given community reaches Step 4 of the CRPG (i.e., plan development) it is important that the community devises a way to determine which plans are feasible and which they think is most feasible to implement while achieving their agreed upon community goals. It is at this point in the process that the accompanying NIST

Table 20.3 Lessons learned for Step 3: Determine Goals and Objectives. *Listed in no particular order*

	Community-specific *Lesson Learned*	Suggested strategies
1	During the local plan review leading up to the transition from Step 2 to Step 3, it became clear that significant mapping of hazards relative to buildings and social function/lifeline infrastructure had been completed locally.	Use local GIS resources and associated analysis to the extent possible and as early in the NIST CRPG process as feasible.
	The RRAP team met telephonically with the county (which encompasses the community and governs some community-level issues) and the community's GIS teams, which resulted in transfer of data that should prove valuable during step three. The lesson learned was to connect with GIS elements early in the six-step process. This can be a platform that connects different types of data across various types of CPT members (e.g., different sectors, but also different group sizes, and those with different levels of technical GIS expertise)	This allows for a platform for analyzing data effectively and encourages collaboration between CPT members
2	It can be useful to review key facility continuity plans and other stakeholder documents that relate to resilience ahead of formal meetings with the stakeholders. In this particular community, this was not always possible, as sometimes documents were only found at a later date. Yet, when possible it allows for better initial understanding and facilitates planning questions for a given stakeholder group	Government and key facility continuity plans are invaluable assets and significant timesavers during step three, as they can provide insight into recovery time objectives for critical functions, mitigation measures undertaken, and contingency plans in the event a critical function is completely lost. These types of convening documents may also serve to stimulate discussion within the CPT with different members providing their interpretation and understanding of the information
3	Regarding establishment of long-term community goals, this particular community has done extensive long-term planning in the past along social and economic lines (without much explicit concern for resilience). These plans were reviewed by the RRAP team to establish suggestions for long-term goals for the community's consideration	View existing community plans, particularly long-range strategic plans, as validated statements of community goals and objectives regarding the subject matter addressed in the plan. Also, hazard mitigation plans are valuable sources of hazard analysis for the community. Use these plans to avoid duplication of work that has already been done

Community Resilience Economic Decision Guide for Buildings and Infrastructure Systems (EDG) (2016) becomes a useful tool for assessing resilience enhancing options that are on the table and the community is debating for feasibility in the political, social, ecological, and economic realms.

The steps of the EDG are reviewed in the next section.

20.4 The NIST Community Resilience Economic Decision Guide

The *Community Resilience Economic Decision Guide for Buildings and Infrastructure Systems* (EDG) (2016) provides a standard economic methodology for evaluating investment decisions aimed at improving the ability of communities to adapt to, withstand, and quickly recover from disruptive events.

Figure 20.2 provides a schematic of the steps in both the CRPG and the EDG and how they interact. Though the EDG is framed around economic analysis there is the latitude to include non-market valuation and to account for social and political realities and/or constraints.

The EDG offers an easy-to-follow approach that describes the cost and benefits for the variety of resilience options any community may be considering. Non-market considerations are also stressed in the EDG process (see Step 4). The goal is to make the EDG accessible to those involved in the resilience planning process who may not specialize in economics. This is a pertinent concern especially for smaller and/or less wealthy communities that likely do not have an office dedicated to resilience or economic assessments.

The EDG provides a process for assessing and comparing alternatives for increasing community resilience through cost-effective investments in the built environment and other infrastructure systems. It includes a seven-step methodology for analyzing the benefits and costs associated with competing capital improvements and ultimately selecting investment strategies.

The EDG can be used as a standalone tool, but it is most useful as part of a more comprehensive planning process and in combination with the CRPG. Like the CRPG, it aligns with the U.S. National Preparedness System (Leighty et al. 2011).

The methodology described in the EDG frames the economic decision process by identifying and comparing the relevant present and future streams of costs and benefits – the latter realized through cost savings and damage loss avoidance – associated with resilience investments to those generated by the status-quo. Topics related to non-market values, uncertainty, and co-benefits related to investments primarily aimed at resilience improvements are also explored. That includes the importance of considering both positive and negative externalities, which are costs or benefits that impact a third party that are not part of the direct decision to implement a given strategy.

The EDG provides context for increasing communities‘resilience capacity through focusing on those investments that target key social goals and objectives, and providing selection criteria that ensure reduction of risks as well as increases in resilience.

If used in conjunction with the CRPG, the EDG is to be employed after Step 4 of the CRPG.

Fig. 20.2 Steps of the CRPG and the EDG and how they can interact in resilience planning decision-making. (NIST 2017)

The EDG's proposed seven-step process is briefly summarized below:

1. **Select candidate strategies** based on existing studies, computer modeling, and expert judgment. The selection of candidate projects by the community's collaborative planning team (see Step 1 of the CRPG) generally should identify those most likely to have the greatest overall benefit.
2. **Define economic objectives** expected to provide the greatest net benefit accounting for all factors that can be valued**.** A community will want to decide what

additional factors, such as increased access to a quality livelihood, education, and other social welfare resources, are important in choosing between and among alternative strategies. Furthermore, communities may choose a diverse approach to resilience planning that involves specific mitigation actions to reduce risk and steps to transfer risk, such as insurance investments. In this step, communities should identify a time frame for the analysis – the period over which alternatives are compared in terms of costs and benefits that occur. Political, legal, financial, and other considerations will influence which resilience projects a community can undertake, and can be hard to quantify. Nevertheless, it is vital to factor them into planning. Planners also often will need to consider ways to reformulate plans or phase-in constituent activities for a given plan over time. This may be because of monetary constraints, but may also be the product of social constraints identified by the community.

3. **Identify benefits and costs** associated with each candidate resilience strategy. Benefits are determined primarily based on the improvement in performance over the status quo for a hazard event. That includes reductions in the magnitude of damages (e.g., to property and livelihoods) from a disaster as well as lower costs during the response and recovery phases. Benefits also include the positive effects, or co-benefits, from a resilience strategy that improves community function and value even when a hazard event has not occurred.

   Costs to implement a mitigation strategy may occur once or multiple times over a project's life. In addition to initial costs, estimates should include all costs associated with owning, operating, maintaining, and disposing of goods and services related to the project. Non-economic costs, like environmental degradation due to construction, and social disruption due to displacement of a neighborhood or vulnerable population, also should be considered.

4. **Identify non-market considerations.** Externalities and other impacts may or may not be quantifiable. Some non-market considerations carry more obvious dollar values than others. Residents of homes near a transportation project that is part of a resilience plan may suffer from noise, dust, degraded air quality or traffic restrictions during or after construction.

   In clear connection to ILEK there is the need to incorporate stakeholder knowledge of the local context and tenants to get these values. Identical services and resources are often assigned largely divergent (monetary) value equivalent under different cultural contexts (e.g., Becker et al. 2014).

   Economists have several methods for determining and placing a value on this category of costs. They can be determined and considered as "contingent values," based on a survey of homeowners and prospective homeowners in the area, for example. While contingent valuation is based on direct or stated preferences, "hedonic valuation" is an indirect or revealed preference approach to non-market valuation. The EDG offers more options and details, but regardless of the method selected, it is important that communities put their own values on these non-market/non-economic considerations, which may or may not be captured as part of Step 3.

5. **Define analysis parameters** as they relate to the community's needs. Communities considering resilience options that require significant funding need to select a discount rate, which reflects the community's time preference for money in present-day terms. This decision is crucial in selecting candidate resilience strategies; as the time preference for money will affect affordability at a particular point in time.
6. **Perform Economic Evaluation**. The EDG treats extreme hazard events as discrete, relatively rare events with significant long-term consequences. Still, the frequency and hazard level of multiple disruptive events clearly matter and should be factored into economic analysis. In addition, while the economic analysis should consider all possible consequences of an event, the Economic Decision Guide recommends using three hazard levels: (1) routine, (2) design, and (3) extreme to provide key points on the hazard probability distribution.

   Risk aversion may change over time in response to experience and exposure to actual hazard events, and when insurance is considered. Still, some measure of the degree of risk aversion is needed – that is, the level of uncertainty, which the community is willing to accept in expected outcomes, or returns to investments made against hazard events.
7. **Perform economic evaluation** across the identified candidate resilience strategies. The EDG offers several approaches to this step:

   - *Compute Present Expected Value*. This part of the analysis will answer the key question, "How do you value resilience strategies?"
   - *Alternative Formulations*. "Expected utility" is a popular economic strategy for choosing between alternative approaches when there is uncertainty in the potential outcomes. Friedman and Savage (1952) point out that decision-makers do not in fact calculate utilities before making every choice. But utility analysis is useful if decision-makers generally act as if they had compared expected utilities and as if they knew the odds for the economic choices being evaluate.
   - *Evaluate Impact of Uncertainty*. There are many uncertainties in estimating the present expected net benefits for a mitigation strategy outside of the uncertainty associated with whether or not a disaster will occur in a given time period. Examples include: timing and likelihood of future hazards, amount of damage a future hazard will cause, future costs of mitigation strategies, uncertainty about the validity of models used to estimate present expected net benefits, etc.

8. The final is to **rank strategies** for implementation – after accounting for relative net benefits and considering constraints and non-market considerations, such as effects on social cohesion. The optimal choice is the combination of actions whose total cost is affordable and offers the greatest net benefit, in monetary and non-monetary terms.

20.5 Tracking Use of the CRPG and the EDG

The CRPG and the EDG offer a comprehensive, collaborative approach to empower the development of resilience in communities and is especially useful in consideration of projects related to infrastructure. It requires a paradigm shift in current siloed approaches by communities to one that integrates all key stakeholders and inclusion of residents in the planning and implementation processes to achieve progress and impacts that support the long-term goal(s).

As with any new product or approach, there are early adopters of CRPG that, if they perceive the process as successful, will encourage others to try the new approach. Early adopter communities are those that can benefit from resilience planning, have proactive forward-looking community leaders, and resources for planning and implementing resilience solutions. They tend to be mid-sized cities and counties, rather than very large cities or individual small communities.

To understand the early adopter communities in the context of all communities, the types of communities using the guidance will be tracked by population size and type (e.g., urban or rural) governance level, primary hazard by FEMA region, etc.

NIST plans to maintain a relationship with the early adopter communities to support the understanding and implementation of the Guide, identify opportunities to improve or develop new guidance and tools, and develop further guidance based on the communities most successful at implementation of the CRPG steps to develop and execute a resilience plan that can be shared with other communities. Success stories for early adopters can illustrate how the CRPG and the EDG may be implemented across various community types, identify strengths and weaknesses in the process, and its benefits.

Early adopter communities will be targeted for initial CRPG use and their use of the EDG (since this is relevant only at the fourth step in the CRPG, most communities are not yet at a stage advanced enough to use the EDG). During the outreach process, barriers to using the CRPG and the EDG will be identified to improve both outreach, messaging, and other tools that can support or improve their use by communities.

The CRPG and the EDG were developed for use by any community and for all community-scale hazards. To better understand the type of communities using this guidance, as well as how it is being implemented, the following criteria (see Table 20.4) will be used to guide and monitor NIST outreach and implementation efforts.

In 2012, 38,917 local governments existed in the United States, which included 3031 counties, 19,522 municipalities, and 16,364 townships (U.S. Census 2012). While local communities are the primary target audience for the CRPG, states may also use the Guide to improve collaboration and communication between state and local governments for resilience planning and implementation activities. Regional governmental organizations also may use the NIST guidance to facilitate their work with communities.

Table 20.4 Example pilot community types/characteristics

Population type (urban/rural)	UL – Urban Urbanized Areas (UAs) of 50 000 or more people;
	Urban Clusters (UCs) of at least 2500 and less than 50,000 people.
	"Rural" encompasses all population, housing, and territory not included within an urban area. Most US communities with municipal governments have populations below 50,000
Community size (by population)	UVL – Urban Area, Very Large – Population over 300,000. (59 U.S. communities)
	UL – Urban Area, Large – Population between 50,000 and 300,000 (620 U.S. communities)
	RM – Rural Area with Urban Clusters, Medium – Population between 2500 and 50,000. (5937 U.S. communities)
	RS – Rural Area, Small – Population less than 2500. (12,876 U.S. communities)
Community governance types	Municipality/Township, County, and State

Community size will be tracked to ensure that a range of community sizes under the three noted governance types are represented. The population ranges are based on the Census Bureau definitions for urban and rural populations, and the population groupings given for municipal governments.

The CRPG and the EDG were developed to be applicable to all community-scale hazards. The primary hazards addressed by each community using the Guide will be identified. The types of hazards listed in the Guide that communities may address when improving resilience include, but are not limited to:

- Wind – wind storms, hurricanes, tornadoes;
- Earthquake – ground shaking, ground faults, landslides, liquefaction;
- Inundation – river flood, flash flood, coastal flood, tsunami;
- Fire – urban/structure, wildfire, and fire following another hazard event;
- Snow or Rain – snow storms, ice storms, blizzards, drifts, ice dams, freezes or thaws, rain storms that overwhelm drainage systems; and
- Technological or Human-caused – blasts, vehicular (including rail) impacts, toxic environmental contamination because of industrial or other accidents as well as due to clean-up/disposal methods after a hazard event; these include purposeful or unintended actions

NIST will use data on the implementation of the CRPG and the EDG to support the development of use cases and inform future versions of both Guides and Implementation Guidelines, and to provide input to the Community Resilience Panel on Buildings and Physical Infrastructure Systems and NIST-supported Center of Excellence.

The resilience planning process will be led by the community and its CPT. For early adopters, NIST researchers' roles are limited to data collection, and when needed, answering questions on the application of the CRPG and the EDG, with the objective of identifying areas for improvement and developing use cases to encourage more widespread use of the guidance.

20.6 Moving Forward

When implementing new approaches, especially ones that strive to span a variety of community types there is a steep learning curve as to what formulation works best for a given community. There is an inherent tension between working on the local community level and providing more generalized guidance for communities to use in structuring their resilience planning and/or policy. Furthermore, it takes time to plan, especially in a well-structured manner that requires a CPT and other key milestones be addressed.

Through the ILEK lens the constituent steps of the CRPG and the EDG strive to provide the latitude to guide a process of resilience planning that is predicated on the community level with contributions made by community members and key actors within the community, spanning infrastructure systems to faith-based organizations. The process of creating a shared understanding of gaps in the community's current approach to resilience and agreeing to potential plans to increase resilience to disasters, as well as those that hold co-benefits for the community daily is founded in the ILEK approach to societal change. The hope is that the EDG provides a good supplement to communities using the CRP that are choosing between or among proposals. There is potentially a convening factor between community players in such an analysis that structures net-benefits and net-costs (not just those that are market-related) into a shared framework among diverse stakeholders, which in turn can be used as a common means of expressing options and values between sectors and community roles.

There is the need for implementation guidelines for the CRPG because communities are so variable in their underlying characteristics and range widely in their geographic features, population characteristics, available social systems, and the hazards they face. Such implementation guidelines are planned, but will require inductive studies across a series of communities' findings, such as those noted in Sect. 20.3 of this chapter.

References

Becker N, Helgeson J, Katz D (2014) Once there was a river: a benefit–cost analysis of rehabilitation of the Jordan River. Reg Environ Chang 14(4):1303–1314

Friedman M, Savage LJ (1952) The expected-utility hypothesis and the measurability of utility. J Polit Econ 60(6):463–474

Gilbert SW, Butry D, Helgeson J, Chapman R (2016) Community resilience economic decision guide for buildings and infrastructure systems. NIST Special Publication, 1197. Available at: https://doi.org/10.6028/NIST.SP.1197

Kitolelei JV, Sato T (2016) Analysis of perceptions and knowledge in managing coastal resources: a case study in Fiji. Front Mar Sci 3:189. https://doi.org/10.3389/fmars.2016.0018

Leighty W, Cigler B, Dodge W, Hatry H, Raub W, Springer C, Springer E (2011) Improving the national preparedness system: improving the national preparedness system. Available at: http://www.napawash.org/wp-content/uploads/2012/06/11-07.pdf

National Institute of Standards and Technology (2017) NIST community resilience economic decision guide for buildings and infrastructure systems brochure. Available at: https://www.nist.gov/sites/default/files/documents/2017/01/23/nist_communityresilience_brochure-11b_finaldec2016.pdf

National Research Council (2012) Disaster resilience: a national imperative. The National Academies Press, Washington, DC

NIST Special Publication 1190 (2016) Community resilience planning guide for buildings and infrastructure systems, vols I and II. Available at: https://doi.org/10.6028/NIST.SP.1190v1 and https://doi.org/10.6028/NIST.SP.1190v2

Rodin J (2014) The resilience dividend: being strong in a world where things go wrong. Public Affairs, New York

Sato T (2014) Integrated local environmental knowledge supporting adaptive governance of local communities. In: Alvares C (ed) Multicultural knowledge and the university. Multiversity India, Mapusa, pp 268–273

Schuster E, Doerr P (2015) A guide for incorporating ecosystem service valuation into coastal restoration projects. The Nature Conservancy, New Jersey Chapter, Delmont

Sei-Ching JS (2011) Chapter 8 towards agency–structure integration: a person-in-environment (PIE) framework for modelling individual-level information behaviours and outcomes. In: Spink A, Heinström J (eds) New directions in information behaviour, Library and information science, vol. 1. Emerald Group Publishing Limited, Bingley, pp 181–209

U.S. Census Bureau (2012) Census Bureau Reports there are 89,004 local governments in the United States. Available at: https://www.census.gov/newsroom/releases/archives/governments/cb12-161.html

Chapter 21
Sources and Uses of Knowledge in Co-designing Sustainable Futures in the Arctic

Ilan Chabay

Abstract The challenges for human society of rapid, unprecedented global change are nowhere more evident now than in the Arctic, where climate change and its biophysical manifestations and social impacts are seen and felt most strongly. In the context of local change and global implications, this chapter focuses on transdisciplinary research with actors in the Arctic regions and stakeholders outside the Arctic boundaries. The research described constitutes initial steps in developing processes that enable effective decision-making on relevant issues by and for the Arctic rights-holders and stakeholders. The approach was initially developed in two prior projects and is now used to inform the societal engagement process in a new European Commission Horizon 2020 project. The goal is to catalyze and support transformation to sustainable futures in appropriate contexts and simultaneously to learn how this can be done well. This involved a long-term process of developing trust, relationships, and co-design of research with a wide range of actors within and beyond the Arctic regions. It involved the establishment of multiple dialogues in which mutual learning and bi-directional knowledge translation occurred between the rights-holders/stakeholders and the scientists, but also importantly among the participating scientists who were grounded in different disciplinary domains and traditions.

21.1 Introduction

Awareness of the global significance of the Arctic region for climate change, economics, and geopolitics has increased markedly, especially in the past decade. The Arctic has been defined in different geographic and political terms, but for the purposes of this chapter, it refers to the portion of the planet which lies at latitudes above which average temperature in the warmest month of the year (July) is below 10 °C. The reasons for this increased awareness and attention to the region's

I. Chabay (✉)
Institute for Advanced Sustainability Studies, Potsdam, Germany
e-mail: Ilan.Chabay@iass-potsdam.de

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_21

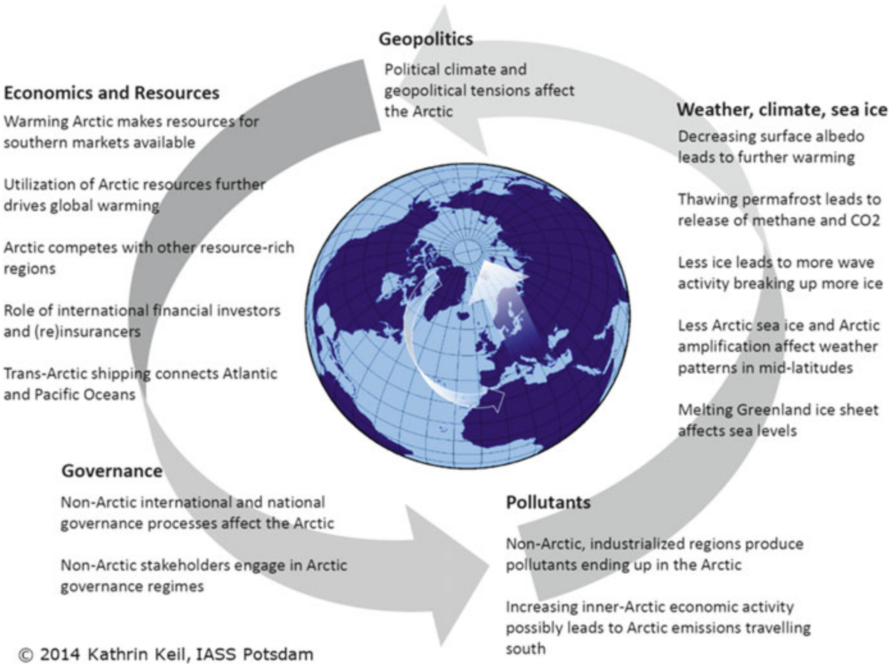


Fig. 21.1 Global-Arctic Interdependencies

significance for the entire world lie in multiple bidirectional feedback loops linking the Arctic with lower latitude regions especially through climate change and air pollution processes and economic resource demand and use. These links between multiple regions and processes have immediate and long-term effects on the physical conditions both in the Arctic and lower latitudes. These effects are inextricably tied to social, cultural, political, and economic consequences for the indigenous and immigrant populations in the Arctic, as well as on influences in many other parts of the world, including climate, air pollution, sea levels, weather, economics, and health.

Conditions in the Arctic and feedback loops with the lower latitudes are undergoing rapid and profound changes due to climate change (Sommerkorn and Hassol 2009; National Research Council 2015). With the changing ecological and physical conditions, demand for Arctic resources (oil, gas, minerals, fishing, cargo shipping routes, tourism destinations) has increased, particularly from many non-Arctic regions (Acia 2004; Koivurova 2012; Arctic Council 2009; Budzik 2009; Claes 2010; Glomsrød and Aslaksen 2009; Keil 2013, 2015; National Petroleum Council 2011). These social, physical, ecological, and economic changes in the Arctic regions are embedded in feedback loops and interdependencies with many parts of the non-Arctic world (Fig. 21.1). These feedbacks and interdependencies occur across the dimensions of economics, resource demand, geopolitics, biological and physical conditions, and governance mechanisms and processes. The deterioration of Arctic physical and biological systems has profound implications for social, cultural, economic wellbeing of people in the Arctic, as well as impacts on non-Arctic communities (Sommerkorn and Hassol 2009; National Research Council 2015; Alessa et al. 2015). This has heightened a sense of urgency and importance for Arctic actors, as well as stakeholders based outside the Arctic, to make informed and effective decisions on governance and management of resource extraction, livelihoods, infrastructure, and transportation in the Arctic (Keil et al. 2014; Johnson et al. 2015).

Indigenous, culturally-embedded traditional knowledge and local inhabitants' experience are important in documenting and monitoring social, cultural and ecological changes and current trends (Fidel et al. 2014; Allessa et al. 2015), which in turn are essential for informing decisions being made at all governance levels and spatial scales. The collective memory of humans in the Arctic holds information about past environmental variability, which complements the knowledge produced in formal, widely-recognized empirical and theoretical science. Community-based observing networks (CBONs) (Alessa et al. 2015), the Community Adaptation and Vulnerability in the Arctic Regions (CAVIAR) project (Smit et al. 2010), the Exchange for Local Observation and Knowledge of the Arctic (ELOKA) (Pulsifer 2015), and the Sustaining Arctic Observing Networks (SAON) (Larsen et al. 2016) are other examples of partnerships and networks that seek to encourage and develop capacity for people in communities in the Arctic to observe and report on trends on a daily basis. These observations can support intervention strategies that are acceptable in and compatible with local, cultural contexts (Alessa et al. 2015). Partnerships or collaborations that are perceived as legitimate, relevant, and which encourage ownership of the outcomes by all participants are crucial for integrating and co-producing knowledge with indigenous and immigrant communities, scientists working in a wide range of disciplines, and representatives of the range of interested parties from business, governments, and NGOs.

There are important connections and some distinctions to make in the context of this book and its attention to resident researchers and knowledge translators. In the work described in this chapter, there were no designated resident researchers, nor were there specific knowledge translators. Nevertheless, both functions were fulfilled in valuable ways. Some local indigenous people were also formally educated scientists conducting research on issues of importance to their communities. Most of the Arctic rights-holders and stakeholders with whom we engaged repeatedly over the past 3 years were resident in the regions of interest and had very deep knowledge of the past and current local and regional conditions. In our dialogues with them, they and we became mutual translators of their contributed knowledge and relevant formal scientific knowledge through repeated iterations of seeking shared understanding of the terms and issues in focus. It is important to note that since indigenous people in some regions hold legal rights by law and treaty to traditional livelihoods, land, and intellectual property, they self-identify and are generally referred to as rights-holders, rather than stakeholders, who have interests or influence, but not inherent rights.

However, the involvement of local communities and other relevant actors alone does not necessarily lead to the production of useful and relevant information and sustainable actions. Equally important to transformations to sustainable futures is the relevance and scope of the questions being considered and addressed. Kates identified seven fundamental questions that sustainable science needs to address (Kates 2011). The frame of the questions posed by Kates and the relationships and interactions among local and remote stakeholders and indigenous people in co-designing and co-producing knowledge are key to managing transformations in the Arctic and ensuring sustainable futures (Johnson et al. 2015; Nilsson et al. 2013). Meaningful and actionable research must encompass the diversity of knowledge, perceptions, and perspectives of different indigenous groups and immigrant communities and recognize the unique geographical and cultural aspects, language and worldviews in play in the highly differentiated local and regional contexts of the circumpolar area. Misunderstanding and miscommunication among actors can lead to gaps in data and knowledge, unpredictability of participants' engagement or collaboration, lack of reliable sources of funding for projects, ethical issues in data access, management, and use in the decision-making process (Alessa et al. 2015; Pulsifer et al. 2014), all of which need to be addressed in coordination and cooperation with relevant actors within and beyond the Arctic.

21.2 Transdisciplinary Research in and for the Arctic

The diversity of actors involved in and affected by the rapid changes in the Arctic and the complexity of interdependent issues requires a collaboratively designed (i.e., co-designed) research and intervention strategy in contrast to traditional research approaches. As Nilsson et al. (2013) assert, "[i]t is not enough to gather information from each of these sources [disciplines] in isolation. Rather . . . there is an urgent need for dialogue across knowledge traditions . . . [including] seeking to better understand the roles that local and traditional knowledge can play both for analysing resilience and for building adaptive capacities." This perspective was echoed by Professors Julie Cruikshank and Oran Young in their addresses to the eighth International Congress of the Arctic Social Sciences Association. They acknowledged the progress made by physical science in laying out the current and foreseen challenges to humanity and the planet, but emphasized the need for building bridges to connect the knowledge from all relevant stakeholders, including social science and humanities, local, and indigenous populations (Northern Sustainability 2014). Indeed, there is growing recognition of linkages between social, economic, and environmental forces at work in the Arctic and beyond and therefore the need to develop inclusive trans- and interdisciplinary research leading to better strategies for coping with the emerging challenges (Lang et al. 2012).

Other literature highlights the need for transformative, integrative, inclusive and sustainable research focused on generating knowledge that reflects the interaction of various disciplines, actors, and regions and which "recognizes that [Arctic] local changes are nested in large-scale processes" (Beveridge et al. 2015). The guidelines to achieve Sustainable Development Goals (SDGs) also reinforce the need for multi-stakeholder global partnerships in mobilizing and sharing knowledge to secure sustainable livelihoods and enhanced wellbeing for people and the planet (General Assembly, United Nations 2015). Concerning the Arctic specifically, the 2013 Arctic Resilience Interim Report calls for the development of a framework that provides an integrative and collaborative approach for assessing linked social and ecological challenges and opportunities to build capacity to respond to changes that protect humanity and the environment (Artic council 2013). Nilsson et al. (2013) address the need for "integrative concepts and models" that can aid systemic understanding of the Arctic, while Kates (2011) addresses sustainability science noting that sustainable transformative knowledge development needs "methodological framing beyond the topics of individual research. . . . [And] themes that transcend local or sectorial problems." Knowledge generated though such a process and which incorporates and integrates different knowledge systems (Cornell et al. 2013; Tàbara and Chabay 2013) has the potential to contribute to more relevant and context-aligned decision-making and planning processes that support sustainable interventions for securing livelihoods for current and future generations, while protecting the environment. Open integration of multiple knowledge sources and the utilization of that expanded knowledge base is central to an effective and appropriately informed decision making process. But knowledge integration alone is insufficient without the strong engagement of Arctic actors in the design and use of the knowledge for decisions and actions.

21.3 Building Collaborations for Co-design

In an effort to address the challenges of knowledge sources, uses, and contexts outlined above, the work on the project described herein brought together the 2013–2016 Sustainable Modes of Arctic Resource-driven Transformations (SMART) project of the Institute for Advanced Sustainability Studies (IASS) on Arctic governance in global contexts with work on the Scenarios and Tools for Arctic Transformations to Sustainability (STARCTIC) project that was conducted from September 2014 through March 2015 under a seed grant from the International Social Science Council (ISSC) on Transformative Knowledge Networks. The STARCTIC project aimed to co-design and co-develop tools and processes for informed and effective decision making by and for rights- and stakeholders toward sustainable futures, and was focused primarily on western Russia and Norway – the Eurasian Arctic.

The research team engaged with members of existing Arctic-relevant knowledge networks, including the Arctic Council and its working groups, the International Arctic Science Committee, and the World Wildlife Fund, to help rapidly identify and contact rights- and stakeholder groups and with them to address the diversity of needs and aspirations of Arctic rights- and stakeholders, including Arctic stakeholders based in non-Arctic regions. The knowledge co-produced with diverse actors provided the basis for co-design of scenarios as tools for decision-making processes. The aim of co-designing and co-developing scenarios with options and consequences of choices among plausible options in light of climate change in the Arctic is to facilitate transformations toward sustainable futures in local and regional contexts.

A substantial portion of the work accomplished to date in this project consisted of "mapping" the categories or groups of rights- and stakeholders, building relationships with representatives of the groups, and exploring issues of concern for them. This involved first identifying the influential and affected groups (e.g., indigenous peoples' associations, mining and oil/gas extraction companies, shipping companies, fishing and reindeer herding associations, government agency representatives at various levels, environmental NGOs, and researchers from different disciplines working in the Arctic) in different countries within and beyond the Arctic. Then we contacted representatives of those groups – which often led to further suggestions for contacts – and assessed the relationships between members of the different stakeholder groups and the individuals within the group (Keil et al. 2014).

Crucial to this process is the establishment and maintenance of trust among the researchers, rights-holders, and stakeholders. A series of bilateral and small group meetings and larger workshops involving 20–40 participants were held in St. Petersburg and Moscow, Potsdam (Germany), Reykjavik, Whitehorse (Canada), Berlin, Paris, Ottawa, and Toyama (Japan). In this process we reached out to over a hundred producers and users of Arctic-related knowledge at seven international meetings on three continents. The workshops were conducted with individuals who often had quite divergent views on the current state and future development of the circumpolar North or at least their part of the Arctic. This necessitated care in eliciting and incorporating diverse forms of knowledge, in framing questions for discussion, and in facilitating the dialogue among the entire set of participants.

For example, one of the workshops was conducted during the Arctic Circle meeting in Reykjavik, Iceland in November 2014. The three-hour long workshop with about 35 participants began with very short impulse statements by the eight invited speakers addressing the following three questions: (1) What knowledge do different actors currently *have* with which to take sustainable decisions for the Arctic? (2) What knowledge do different actors *lack* to take sustainable decisions for the Arctic? (3) What are the various challenges related to producing and sharing knowledge for sustainable Arctic futures? The invited participants were Paul Holthus (World Ocean Council), Tom Paddon (Baffinland mining company), Gunn-Brit Retter (Saami Council), Shardul Agrawala (OECD), John Crump (GRID Arendal), Nina Poussenkova (Russian Academy of Sciences), Jim Gamble (Aleut International Association), and Laurence Smith (University of California, Los Angeles). Their opening statements led to a discussion among all participants and then to voting for their choices for best responses to the three questions. The responses that garnered the most votes were clustered around resource availability and the desirability of developing or extracting them, importance of understanding and balancing power relationships (i.e., among actors with very different economic and political resources), the need for long term sustainable development of the region for healthy communities, inadequacy of scientific knowledge of future trends in the Arctic biosphere and ecosystems, and the lack of credible predictions of global demand for Arctic resources, including commodity prices. While no resolution of these concerns was reached, nor was it expected, what did emerge was a more nuanced and inclusive perspective on several of the concerns that reflected the diversity of views presented. An example was that several participants informally acknowledged a greater recognition of the complex interplay of local and global actors with divergent, but legitimate agendas. This interplay must be reflected as shaping options and consequences when designing meaningful scenarios for use by and for the rights-holders and stakeholders.

We also had several informative meetings with Indian, Chinese, and European colleagues, who brought perspectives of some of the non-Arctic Observer States to the Arctic Council and we participated in four meetings of the Sustainable Development Working Group (SDWG) of the Arctic Council. These meetings and workshops resulted in substantial mutual learning and development of trust that provided the essential basis for collaboration in all aspects of the co-design and co-development of contextually-rich scenarios, which are the basic tool that will be co-developed for decision making by and for rights- and stakeholders.

Decisions are made not only on the basis of information and knowledge, but are also strongly influenced by the framing of the questions under consideration. Thus, in a transdisciplinary process it is essential that the questions are co-designed by the relevant stakeholders and are grounded in their perceptions of current and future desirable conditions (Hirsch Hadorn et al. 2006). Workshops, such as the one at the 2014 Arctic Circle described above, helped us to focus on the issues and framing of them that were most relevant to the rights- and stakeholders with whom we collaborated. Through engagement with these actors, their perspectives on resilience and sustainability in the Arctic, particularly in terms of resource extraction scenarios in the Arctic, become integral in the design and development of scenarios for decision making.

From the outset of the project in which we focused on collaboratively developing solutions to complex global challenges, it was clear that the basic competence of the research group(s) (and the available funding) must align in a broad vision and basic principles of the project that comprises what the researchers have the capacity and funding to address and are also of interest to and address concerns of stakeholders (including researchers as stakeholders). The competences generally are in disciplinary domains that provide the expertise from natural or social science or the humanities. While these are clearly necessary in different constellations, depending on the area of research and the societal issue to be addressed, that expertise is not sufficient to lead to societally valuable outcomes unless the expertise, concerns, and perspectives of various societal stakeholders (affected by Arctic transformations and/or affecting it) are incorporated into the project.

Consequently, employing a transdisciplinary process is essential to the purposes of the projects. The process is indicated schematically in Fig. 21.2. The two blue

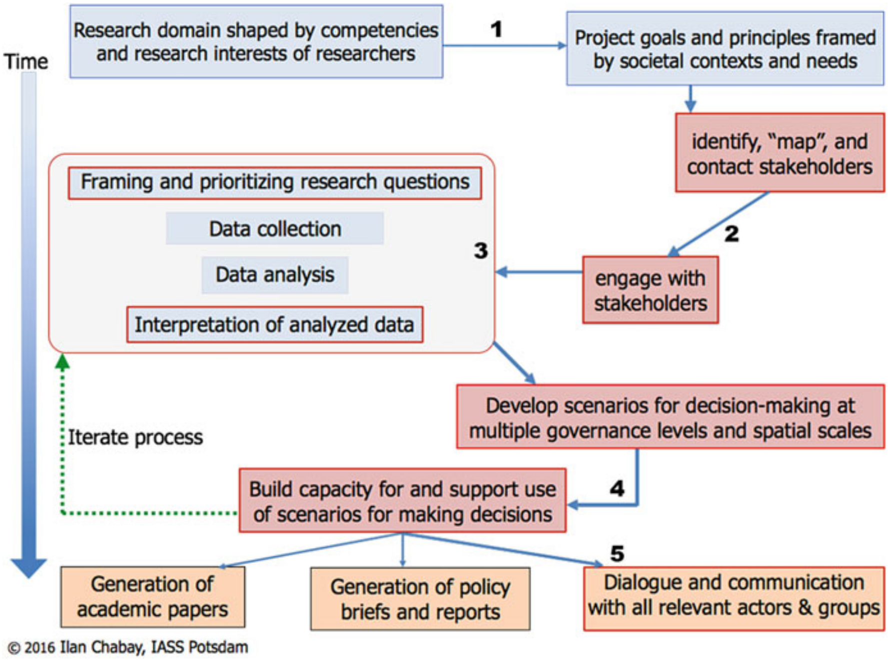


Fig. 21.2 Schematic of collaborative rights- and stakeholder engagement throughout the project in a transdisciplinary research approach

boxes (#1) are the steps that the researchers take in initiating a project in which they situate their research between their own competence areas and the needs and contexts of the areas or communities relevant to their interests. It is important to be clear that a research project is grounded in the researchers' interests and competences, as well as available funding. Given that basis, then the process moves to the two red boxes near #2. In these boxes are the steps in which stakeholders and rights-holders are identified, mapped, and engaged in dialogues with researchers. The "mapping" or characterization was a process that started before the dialogues and meetings, but which was substantially augmented during and after them as the landscape of relationships, interests, and capacities became more evident. Actors could then choose to become engaged with the research. Box #3 indicates ways that they may be engaged in the research. As mentioned earlier, inviting collaboration and participation of actors in the framing of the research questions that specifically define the approach and scope of the project within the competences, goals, and principles of the researchers is crucial at the outset. Of equal importance is the interpretation of the data. It is only if the results are meaningful, credible, and legitimate for the stakeholders (Hirsch Hadorn et al. 2006; Renn and Schweizer 2009) that they can develop the sense of ownership to support effective long-term solutions. That means the information must be presented and discussed with appropriate representations, for example as visual or verbal representations that are readily accessible and allow them to make meaning of the information in their context. The representations are boundary objects that allow more effective learning (Guston 2001). Stakeholder engagement in the process of data analysis and interpretation allows them to better assess if the results are arrived at transparently. While transparency does not eliminate bias, it does allow more open dialogue on the origins of the bias and their implications (Lang et al. 2012). In the boxes adjacent to #4 are the development of the scenarios from the interpreted research and rights-holder and stakeholder assignment of desired future states and priorities, as well as the steps needed to learn how to make effective use of scenarios for making decisions. Depending on the available funding, time frame, and assessment of the scenarios, the process can be improved by iterating steps 3 and 4. Finally box #5 indicates communication of the output of the decision-making process with the wider community of rights-holders and stakeholders, including those who were not involved actively in the preceding steps. Publication of documentation of the outcomes of the process in academic and policy channels can be done then in parallel with #5.

This iterative transdisciplinary process was designed to lead to scenarios for meaning making and decision making on complex systems, in which difficult choices must be made in the prevailing uncertainty of future condition, ambiguities, and incomplete information. Uncertainty and ambiguity are important factors as bounds on the plausible scenario conditions. Those bounds are also informed by the traditional and local depth of knowledge and insights into conditions, past and present. In this way, the traditional, local, and scientific knowledge can be woven together in fashioning scenarios that are meaningful, legitimate, and salient for decision-making in local contexts.

21.4 Inter- and Transdisciplinary Processes

One of the challenges that was apparent from the beginning of this project and remains a concern is the differences in the perspectives of scientists regarding the inclusion of rights- and stakeholder knowledge and priorities in co-design of the project. The challenge is to form genuine collaborations among researchers and stakeholders to co-design the research without an *a priori* bias or privileging one form of knowledge over another. There is also tension between the social and natural scientists in which the latter often expressed their view that the primary scientific issue was the measurement of current conditions and modeling of likely future bio-geo-physical conditions in the Arctic and social concerns could only follow from that, rather than being integrated, co-developed, and iterative. Integration and co-development means that the research questions are ones that are relevant and the process transparent and meaningful for the target communities. Developing sufficient trust and a workable process takes considerable patience and repeated discussions of the purpose of the collaborations. It was essential to maintain frequent communication among the natural and social scientists, legal and humanities scholars, and with the Arctic actors, avoid disciplinary jargon or clarify its meaning, and pay close attention to understanding the meaning and significance of the words chosen. In this, the notion of knowledge translators took on significance even within the scientific community, as well as between the scientists and rights-and stakeholders.

The importance of substantive engagement with stakeholder communities in transdisciplinary research is gaining ground in some quarters, for example through new high level efforts to establish close collaboration between natural science and social science researchers. For example, a new European Commission Horizon 2020 grant, starting in January 2017 and coordinated by the Danish Meteorological Institute, includes a four-year transdisciplinary case study on “Oil and Gas Development in the Russian Arctic” that will be conducted by IASS. The aim is to improve the capacity in the Arctic for adapting effectively to changing conditions and opportunities using improved natural science predictive methods and knowledge. The focus for the new IASS study, led by Dr. Kathrin Keil, will be on potential social, economic and environmental impacts arising from opportunities and risks due to climate change and energy resource development in the Western Russian Arctic, for which improved climate and weather predictions are very important. Rather than being a “communication to stakeholder” exercise, the approach is to engage with rights-holders and stakeholders from the start to develop an iterative transdisciplinary process that will enable better utilization of new predictive science, while simultaneously improving the spatial and temporal focus and scope of information that the meteorological research develops. The development of relationships and trust with rights-holders and stakeholders within and beyond the Arctic that began in 2013 with the IASS SMART project and was joined in 2014 with the STARCTIC project mentioned earlier is the foundation on which this new case study will be built.

However, in looking toward the future and dealing with the uncertainties in both natural and social systems and their complex interaction, significant challenges will remain in assembling and interpreting information from the different sources and provenances of data, both quantitative and qualitative, and differences in interpretation of the data and models. There are likely to be significant differences in the way the questions and issues are framed by different stakeholders, inadequate or incomplete data from some areas, uncertainty in the data, and ambiguity in interpretation of data and model outputs (Pulsifer 2015).

21.5 Conclusion

In the course of two prior projects (SMART and STARCTIC), we made substantial progress in the rather slow, but critical initial process of building trust and engaging with the wide range of actors in order to co-design and co-produce knowledge needed for informed decision making. The next step is the development of composite scenarios as the primary tools for decision making by stakeholders on complex social transformations. These scenarios must be bounded by sound scientific analysis of current and plausible future conditions, as well as by the knowledge and expectations of various stakeholder groups. The former is the purpose of the meteorological measurement and predictive modeling groups in the new Blue Action Horizon 2020 project. If co-designed with this combination of knowledge sources, scenarios can function as tools to improve the process of understanding and making decisions at multiple governance levels and geographic scales on the complex issues of Arctic transformations. It is worth noting that these scenarios are intended to focus on a specific issue at a more granular and localized context than large-scale integrated assessments, but without losing sight of global interactions.

While scenarios on different issues (ranging from sea ice, weather and pollution predictions), technological developments, economic and political factors to law and governance developments) will be developed, they are meant to be combined to address concrete geographical and temporal contexts. This must be done in a way that is accessible and understandable to the rights- and stakeholder groups who choose to use them for facilitating their own decision-making process. Similarly, the understanding of the consequences of these combined (and of single) scenarios in specific contexts will need to be developed, assessed and discussed with the engaged groups to arrive at meaningful and practical tools for decision making in moving toward sustainable futures in local contexts, which has been and remains the goal of IASS research.

References

ACIA (2004) Impacts of a warming arctic: arctic climate impact assessment. ACIA Overv Rep 2004. https://doi.org/10.2277/0521617782

Alessa L, Kliskey A, Gamble J, Fidel M, Beaujean G, Gosz J (2015) The role of Indigenous science and local knowledge in integrated observing systems: moving toward adaptive capacity indices and early warning systems. Sustain Sci. https://doi.org/10.1007/s11625-015-0295-7

Arctic Council (2009) Arctic marine shipping assessment 2009 report. Arctic 1–194. Available at: http://www.pmel.noaa.gov/arctic-zone/detect/documents/AMSA_2009_Report_2nd_print.pdf

Arctic Council (2013) Arctic resilience interim report. Environmental Institute/Stockholm Resilience Center, Stockholm, pp 1–134 Available at: www.arctic-council.org/arr

Beveridge L, Fournier M, Pelot R (2015) Maritime activities in the Canadian arctic: a tool for visualizing connections between stakeholders. In: Arctic Yearbook 2015, Arctic Governance and Governing, pp 1–16

Budzik P (2009) Arctic oil and natural gas potential. US Energy Information Administration. Office of Integrated Analysis and Forecasting, Oil and Gas Division

Claes DH (2010) Global energy security: resource availability, economic conditions and political constraints. Panel: contextualizing energy security and transition. In: Concepts, framing and empirical evidence SGIR 7th Pan-European International Relations Conference 911.9

Cornell S, Berkhout F, Tuinstra W, Tàbara JD, Jäger J, Chabay I, de Wit B, Langlais R, Mills D, Moll P et al (2013) Opening up knowledge systems for better responses to global environmental change. Environ Sci Pol 28:60–70

Fidel M, Kliskey A, Alessa L, Sutton OP (2014) Walrus harvest locations reflect adaptation: a contribution from a community-based observation network in the Bering Sea. Polar Geogr 37:48–68

General Assembly, United Nations (2015) Transforming our world: the 2030 agenda for sustainable development. A/RES/70/1:1–41. Available at: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf
Glomsrød S, Aslaksen J (2009) The economy of the North. Statistics Norway. Available at: https://oaarchive.arctic-council.org
Guston DH (2001) Boundary organizations in environmental policy and science: an introduction. Sci Technol Hum Values 26:399–408
Hirsch Hadorn G, Bradley D, Pohl C, Rist S, Wiesmann U (2006) Implications of transdisciplinarity for sustainability research. Ecol Econ 60:119–128
Johnson N, Alessa L, Behe C, Danielsen F, Gearheard S, Gofman-Wallingford V, Kliskey A, Krümmel EM, Lynch A, Mustonen T et al (2015) The contributions of community-based monitoring and traditional knowledge to arctic observing networks: reflections on the state of the field. Arctic 68:1–13
Kates RW (2011) What kind of a science is sustainability science? Proc Natl Acad Sci 108:19449–19450 Available at: http://rwkates.org/pdfs/a2011.03.pdf
Keil K (2013) Cooperation and conflict in the arctic: the cases of energy, shipping and fishing. PhD thesis, Freie Universität, Berlin
Keil K (2015) Economic potential. In: Jokela J (ed) Arctic security matters. European Union Institute for Security Studies (EUISS), Brussels, pp 21–31
Keil K, Wiertz T, Chabay I (2014) Engaging stakeholders in interdependent arctic and global change. Developing the SMART research project. IASS working paper. https://doi.org/10.2312/iass.2014.007
Koivurova T (2012) New ways to respond to climate change in the Arctic. Am Soc Int Law 16(33). https://www.asil.org/insights/volume/16/issue/33/new-ways-respond-climate-change-arctic
Lang DJ, Wiek A, Bergmann M, Stauffacher M, Martens P, Moll P, Swilling M, Thomas CJ (2012) Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustain Sci 7:25–43
Larsen RJ et al (2016) The Sustaining Arctic Observing Networks (SAON). Arctic observing summit papers on SAON 2016. Available at: http://www.arcticobserving.org/publications
National Petroleum Council (2011) Arctic oil and gas. Retrieved from www.npc.org/Prudent_Development-Topic_Papers/1-4_Arctic_Oil_and_Gas_Paper.pdf
National Research Council (2015) Arctic matters: the global connection to changes in the arctic. National Research Council of the US National Academies, 1–36. Available at: http://nassites.org/americasclimatechoices/more-resources-on-climate-change/arctic-matters-the-global-connection-to-changes-in-the-arctic-2/
Nilsson, AE, Wilkinson C, Sommerkorn M, Vlasova T (2013) Background, aims and scope. In: Arctic Council (ed) Arctic resilience interim report. Arctic Council, pp 3–13
Northern Sustainability (2014) Keynote presentations and other highlights from the eighth international congress of arctic social sciences. In: Wilson GF, Gary N (eds) International Arctic Social Sciences Association, Umeå, vol 8, pp 1–180. Available at: http://iassa.org/publications
Pulsifer P (2015) Indigenous knowledge: key considerations for arctic research and data management (By participants of the sharing knowledge: traditions, technologies, and taking control of our future workshop, Boulder, Colorado) Organized by the Exchange for Local Observations and Knowledge of the Arctic (ELOKA). Available at: http://www.arcticobservingsummit.org/sites/arcticobservingsummit.org/files/Pulsifer-ELOKA%2D%2DExtended_Sharing_Knowledge_statement.pdf
Pulsifer P, Huntington HP, Pecl GT (2014) Introduction: local and traditional knowledge and data management in the arctic. Polar Geogr 37(1):1–4
Renn O, Schweizer PJ (2009) Inclusive risk governance: concepts and application to environmental policy making. Environ Policy Gov 19:174–185
Smit B, Hovelsrud GK, Wandel J, Andrachuk M (2010) Introduction to the CAVIAR project and framework. In: Hovelsrud GK, Smit B (eds) Community adaptation and vulnerability in arctic regions. Springer, Dordrecht, pp 1–22

Sommerkorn M, Hassol SJ (2009) Arctic climate feedbacks: global implications. Arctic 2009:1–100

Tàbara JD, Chabay I (2013) Coupling human information and knowledge systems with social–ecological systems change: Reframing research, education, and policy for sustainability. Environ Sci Pol 28:71–81

Part VI
Conclusion and Way Forward

Chapter 22
Conclusion and Way Forward

Tetsu Sato, Ilan Chabay, and Jennifer Helgeson

Our world has attained a level of civilization underpinned by sophisticated sciences and technologies. And yet, contemporary societies continue to face a range of complex and "wicked" problems. We still have a long way to go in redressing our increasingly degraded global environment, as well as eradicating the disparities of equity that continue to polarize societies around the world. Actively addressing these issues is likely to fundamentally shake the foundation of human existence. Efforts to effect a societal transformation toward sustainable futures have thus far been largely insufficient, but progress has been made. To date, a number of serious root causes limit progress towards societal transformations. For example, the fundamental structure of political and social systems throughout societies are limiting. These structures are further strained by the population explosion and the overexploitation of resources and ecosystem services, which are pushing the earth beyond its limits to support the well-being of society. In an effort to achieve a breakthrough that will help overcome this grave situation, we have investigated forms of knowledge and knowledge co-production processes with the potential to provide effective support for decision-making toward sustainability and contribute to resolving difficult challenges at a range of spatial scales and governance levels from the local to the global. Conventional science, which is driven largely by the intellectual curiosity of

T. Sato (✉)
Research Institute for Humanity and Nature, Kyoto, Japan

Ehime University, Matsuyama, Japan
e-mail: tetsu@chikyu.ac.jp

I. Chabay
Institute for Advanced Sustainability Studies, Potsdam, Germany
e-mail: Ilan.Chabay@iass-potsdam.de

J. Helgeson
National Institute of Standards and Technology, Gaithersburg, MD, USA
e-mail: Jennifer.helgeson@nist.gov

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0_22

scientists and subdivided into individual research fields, does not appear to do enough to address these challenges, which are defined by their complexity and uncertainty, often exceeding the bounds of individual research fields.

A main question throughout this book is what new kinds of science as knowledge production systems are needed to address the complex and difficult challenges facing societies? One of the answers to this fundamental question is the form of transdisciplinary science with knowledge co-creation processes which we have pursued and illustrated through the case studies presented in this book. We endeavor to reveal the characteristics of such a transdisciplinary science using case studies highlighting various forms of knowledge co-creation that are being put into practice in many instances across the world.

The most significant characteristic of transdisciplinary knowledge co-creation is that the research agenda is designed, carried out, interpreted, and communicated with the engagement of local stakeholders and driven primarily by their identification of significant local challenges. The case studies presented highlight processes under which scientists and diverse stakeholders deliberated to co-create research targets and methodologies in the light of challenges facing local communities. In such processes, hypotheses and research questions constructed by scientists based on their own academic backgrounds and observations of local conditions sometimes undergo major modifications through interactions with other people – they may be even completely overturned – which results in new research questions that scientists had not anticipated. As such, scientists involved in this process are required to be "interdisciplinarians" who can consider and develop research that transcends the frameworks of their own individual fields of expertise. Simultaneously, these scientists are also required to be "transdisciplinarians," which implies being prepared and willing to collaborate in mutual learning processes with local stakeholders, in order to deal with complexity, uncertainty, and specific contexts of local challenges. Furthermore, as there are limits to what individuals can do to tackle complex issues alone, this inevitably means they are compelled to build transdisciplinary alliances of purpose. These refer to groups of people who combine their efforts to achieve a common purpose or objective, despite that they do not necessarily have similar power, resources, ideologies, rationales, or practices. In the case studies introduced in each chapter, many of the initiatives that have been taken include learning from efforts to *co-design research in a transdisciplinary process.*

These knowledge co-creation processes take the form of the co-production of knowledge by a transdisciplinary community made up of scientists and a diverse group of other stakeholders (e.g., farmers and fishers, local governments and policy makers, NPOs and other organizations, business sectors and the general public. See Fig. 1.1 of Chap. 1). In the process of knowledge production depicted in each chapter, not only scientists – but also a variety of local stakeholders – develop a process of shared meaning-making that allows them to blend and unite their knowledge through interaction in an effort to tackle issues facing the alliance of purpose or community of practice. This reorganizes multiple knowledge sources of integrated knowledge (integrated local environmental knowledge: ILEK), which can serve as a basis for decision-making. In addition, during these encounters with different forms of knowledge and interaction between people, all of the individuals in the community who participate in knowledge co-production: (1) learn from each other and produce new knowledge, (2) transform their own existing knowledge, and (3) reincorporate this as part of integrated local environmental knowledge. It is these processes that enable integrated knowledge to dynamically alter the typical discourse. In complex local social-ecological systems, it is not only difficult to specify an order of priority for challenges to be addressed but, even supposing this is achieved, there is a great deal of scientific uncertainty to find the optimal solution. Initiatives aiming to achieve a single solution on the basis of "we should just do this" have generated widespread discordance in local communities, and their limitations are apparent. Therefore, knowledge and technologies that may prove valid for solving certain issues are taken on board as "hypotheses," and a diverse range of stakeholders (including scientists) can take actions by working together to test these hypotheses, particularly considering local values. Adaptive processes in which knowledge and technologies are refined by learning from the results of these trials are essential. *Dynamic and adaptive knowledge co-production and transformation* is another important characteristic and strength of transdisciplinary knowledge co-creation. Readers will no doubt be able to get a sense of the importance of this process from many chapters in this book.

During the processes of the co-design of research and co-production of knowledge, scientists are also faced with the need to reflect on and perhaps transform their own attitude toward and practice of their research. Those who participate in transdisciplinary knowledge co-creation have chosen to transform their stance through increased awareness of the values and potential functions of diverse knowledge systems originating from different interests and perspectives in human society. This kind of *fundamental transformation of attitudes and practice of scientists and knowledge producers* is also a major characteristic of transdisciplinary knowledge co-creation, which many authors in this book enjoyed from their experiences, and probably many scientists dealing with complex social-ecological challenges have learned through collaborating with diverse actors in society.

However, this is not an easy task for many professional scientists who, over the course of history, have been accorded a special status and authority as the pre-eminent producers of knowledge. The "deficit model," which assigns blame for the difficulty in solving various social issues on a lack of scientific literacy among those who are not scientists, remains strongly rooted in the mindset of many scientists. Stakeholders other than scientists also often maintain a deep-rooted sense of distrust that the statements made by scientists attempting to deal with problems in complex social-ecological systems sometimes lack integrity, that scientists are prone to vacillating or qualifying results with uncertainty and the need for further study, and at times reach completely contradictory conclusions. To counteract this perspective, what kinds of impetus do we need to abandon this amply-discredited deficit model (e.g., Miller 2001) and rather place the emphasis on developing processes of co-production of knowledge from different standpoints and realize collaboration based on mutual learning to more effectively address the complex societal challenges?

Readers will no doubt have noticed that throughout this book, the authors, who are scientists, have received stimuli from the concepts, ideas and practices of people who are not characterized as scientists during their practice of transdisciplinary knowledge co-production, and how their experiences have transformed their own stances and approaches. For scientists, encounters with new ideas and perspectives should, more than anything, serve to stimulate their intellectual curiosity and broaden their own thinking. If scientists maintain an open mind to worlds which differ to their own and in doing so, also recognize the normativity of science and acknowledge science as functioning through a social contract – to put it differently, if they adopt an attitude of humility towards ideas and knowledge system that differ to their own (Jasanoff 2003) – then collaboration with stakeholders should prove to be an extremely meaningful experience steeped with intellectual stimuli. And coming into contact with the rich ideas and creative activities of stakeholders other than scientists and having experiences to shake up one's own thought patterns will provide scientists with an important opportunity to nurture an attitude as "humble scientists". Knowledge co-creation processes with stakeholders provide experiences that will stimulate the intellectual curiosity of scientists through mutual learning and open a new vista of knowledge through the acquisition of unexpected perspectives. Among those scientists who fortunately have encountered such processes, there are those who will develop into transdisciplinarians with the capability of enjoying transdisciplinary science from the heart. This *mutual learning and emergence of humble scientists* encouraged through collaboration with diverse stakeholders can be seen as another characteristic of transdisciplinary knowledge co-creation.

Transdisciplinary knowledge co-creation contributes to the solution of challenges at the local level as its starting point, but this does not mean that it consists solely of research and other activities that are based on specific local communities. Local communities are an open system with diverse linkages with other areas, both on the spatial and governance scales. Knowledge, values, ideas and options related to the solution of challenges at various scales, from local to global, constantly flow into local communities and impact people's decision-making processes and actions. Disseminating values of local practices to the broader world sometimes has a ripple effect on decision-making even at the global level. We have focused on important actors who mediate interaction between local and broader spatial scales and governance levels, including "residential researchers" who live in local communities and conduct research that leads to solutions to local issues, and "bilateral translators of knowledge" who promote the translation and unification of diverse knowledge systems from both inside and outside the communities. These actors have been featured throughout the chapters of this book, so we need not discuss them again in detail here. Among these, it is "cross-scale knowledge translators" in particular who tend to play an important role in promoting interaction between local and broader community scales (e.g., global). Knowledge circulation across different scales and levels by cross-scale translators has served to bridge the global with the local to mobilize collaborative actions across the scales.

Investigating *mechanisms of knowledge circulation and collaboration across scales and levels* is also an important challenge in transdisciplinary knowledge co-creation. While we were not able to examine this in detail in this book, we have obtained insights through case studies from across the world of the importance of diversity of knowledge translators functioning across different spatial scales and levels of governance have been effective in promoting collaborative actions at not only locally, but also across greater spatial scales and governance levels. Furthermore, it is also becoming clear that "bottom-up type translators" promoting the circulation of knowledge from the local level to broader scales and levels play critical roles in this process.

The analysis of the practice of transdisciplinary knowledge co-creation depicted in each chapter provided us with valuable insights regarding the systems of integrated knowledge production, which can contribute to societal transformation toward sustainable futures. However, transdisciplinary knowledge co-creation does not only aim to accumulate basic knowledge for promoting transformation of social-ecological systems. In addition to deepening our understanding of the systemic transformation mechanisms, another important element of transdisciplinary knowledge co-creation is facilitating the co-production of knowledge to reach decisions and produce real actions to tackle the complex challenges. Another characteristic of transdisciplinary knowledge co-creation is the production not only of knowledge regarding actual states (systems knowledge) and goals (target knowledge), but knowledge of mechanisms and paths toward achieving these goals (transformative knowledge) (Wiek and Lang 2016), as well.

In order to make this possible, we constructed a conceptual model of the mechanisms of knowledge-driven societal transformation (ILEK Triangle) and have investigated the factors that influence the processes of societal transformation stemming from the co-production of knowledge. This *clarification and application of the societal transformation enablers* is also a vital aspect of transdisciplinary knowledge co-creation. The five categories of enablers are as follows: (1) Identify and visualize values, (2) Build new linkages, (3) Provide options and opportunities, (4) Facilitate collective actions, and (5) Encourage multiple translators and viewpoints. These categories of enablers have been discussed in various forms throughout this book. And what has become clear throughout this book is that each of these categories of enablers does not function independently in isolation, but are deeply linked with each other, working together as a whole to promote dynamic societal transformation. An example is the case study featured in Chap. 7, in which an environmental icon (i.e., endangered Blakiston's fish owl), which symbolizes local ecosystem services, has been instrumental in visualizing the values of the sustainability of dairy farming and fisheries, the key industries of the area. Many collective actions have been mobilized, such as the regeneration of riparian forests, and have in turn generated opportunities for participation and creating new linkages among different actors, and the knowledge and skills that people have developed in their livelihoods have created diverse options for sustainable management of local resources. A range of translators, including members of local communities and residential, as well as external, scientists functioned in various ways. The multiplicity and diversity of these translators have contributed to forming collaborations at the level of the river basin, which transcend the boundaries of jurisdictions, and generating values for people's practices that resonate at broader spatial scales and at the international level. In this way, by adapting to the complexities of challenges facing local communities, a wide range of enablers functioned together to promote emergence of collective actions. In general, a key to bringing about societal transformation toward sustainable futures may be the process of identifying and prioritizing practices to mobilize and dynamically utilize all five categories of enablers in accord with local conditions.

Finally, a range of different social systems and institutions are often required to facilitate societal transformation processes. A major gap exists between knowing what the goals are, how to proceed, and actually translating knowledge into action. What kinds of contrivances and mechanisms do we need if we are to make the process of decision making and actions toward sustainable futures easier or quicker in each context or culture? In addition to the role of producing an integrated knowledge base, transdisciplinary knowledge co-creation also entails the *co-design and co-creation of formal and informal institutions and systems* for achieving the envisaged visions and processes. In other words, it also involves aspects of practice in which a range of social processes for mobilizing people and effecting changes of social systems are developed, put into practice, tested and improved, as an important element of a transdisciplinary science. Part V provides some examples of such formal and informal institutions and systems at work, including a range of boundary objects for promoting decision-making through dialogue and deliberation between people, systems for supporting decision-making at the policy level, and workshops for facilitating multifaceted cooperation between extremely diverse stakeholders extending throughout the globe.

Of course, working towards societal transformation extends beyond that which is illustrated in this book. In order to realize the visions and processes of societal transformation that have been systematized under the banner of transdisciplinary knowledge co-creation, it is vital for diverse options to be visualized, tested out on the ground in communities, put to use and improved, something that can only be achieved by developing a range of creative social technologies in cooperation with a range of stakeholders. The outcomes of these practices are fed back into the co-production processes of integrated local environmental knowledge, and new forms of knowledge are co-created and utilized. It is this endless loop of adaptive processes that deepens our understanding of complex social-ecological systems, and leads to the evolution of social innovation, leading to societal transformation toward sustainable futures. This is the meaning of transdisciplinary knowledge co-creation as a new form of transformative science and is what also makes it truly exciting and stimulating.

Over the period of 5 years, the "Creation and Sustainable Governance of New Commons through Formation of Integrated Local Environmental Knowledge (ILEK Project)" at the Research Institute for Humanity and Nature, represented a process of dynamic evolution of the transdisciplinary science in the form of knowledge co-creation with diverse societal actors. Capturing the entire picture of transdisciplinary knowledge co-creation has been an extremely challenging task. This is partly because our attempt in systematizing transdisciplinary knowledge co-creation has in itself entailed emergence and evolution of new academic practices. The attempt to present an overall and encompassing illustration for an academic practice which is subject to such ongoing dynamic change is destined to become obsolete as soon as it is completed. But even so, the very act of attempting to depict a snapshot of the entire achievement of this project at this particular moment in time has huge significance in the sense that it will allow us to gain feedback to this ongoing process from even broader perspectives through the contribution of a wide range of readers. Those readers who have picked up this book are akin to members of a community of knowledge in this transdisciplinary process.

The process of gathering chapters and learning about the examples of transdisciplinary knowledge co-creation has been informative for us, the editors who participated in the ILEK project. We have learned a great deal about transdisciplinary co-creation of shared futures towards sustainability and are inspired to continue our own research and related efforts in local communities throughout the world. The ILEK project was completed in March 2017 with an accumulation of diverse case studies and theoretical development of transdisciplinary knowledge co-production processes, as depicted and discussed in this book. The transdisciplinary processes and mechanisms underpinned by compelling case studies evolved into a new three-year research project starting in April 2017, which is funded by the Research Institute of Science and Technology for Society, Japan Science and Technology Agency, and titled “Transdisciplinary Study of Natural Resource Management under Poverty Conditions Collaborating with Vulnerable Sectors” (TD-VULS project). This project endeavors to develop theory and methodologies of transdisciplinary knowledge co-production and co-delivery of its outcomes partnering with marginalized and vulnerable sectors in diverse local communities of developing countries. Its final goal is to alleviate poverty and improve human well-being through sustainable management and use of natural resources, contributing to several targets of the UN Sustainable Development Goals.

The lessons learned from these case studies and preparing this book have benefited from and are also inspirations for the KLASICA.org project at the Institute for Advanced Sustainability Studies (IASS). KLASICA seeks to understand social dynamics of transformations to sustainable futures with a focus on enriching the understanding of affective expressions of narratives of vision (pathways and guidelines) and of identity (individual and collective motivation) in local contexts and cultures. Furthermore, there is scope to continue to implement narratives of vision and identity for sustainable futures within the context of community resilience planning and co-creation of knowledge that recognizes the importance of co-benefits and positive by-products of that process.

We hope that this book will stimulate new ideas and approaches in seeking to bring about sustainable futures for all by allowing readers insights into processes of collective thinking and mutual learning and experiences of knowledge co-creation. This, after all, is the nature of the transdisciplinary co-creation of knowledge proposed in this book as truly creative intellectual practices.

References

Jasanoff S (2003) Technologies of humility: citizen participation in governing science. Minerva 41 (3):223–244

Miller S (2001) Public understanding of science at the crossroads. Public Underst Sci 10 (1):115–120

Wiek A, Lang DJ (2016) Transformational sustainability research methodology. In: Heinrichs H, Martens P, Michelsen G, Wiek A (eds) Sustainability science. Springer, Dordrecht, pp 31–41

List of Acknowledgements

The editors and chapter authors wish to acknowledge the excellent contribution and support made by a number of people and organizations to this book. We hereby provide a short list of their names to express our gratitude. (listed in alphabetical order)

Ata, Zihan
Bese, Tareguci
Bukarau, Salanieta
Chaturvedi, Sanjay
Chief Makanjira Mangwere, Mohammed Namputu
Donda, Steven
Edpalina, Rizalita Rosalejos
George, Ann
Gerasimchuk, Ivetta
Godmaire, Hélène
Guertin, Marc-André
Guo, Peiqing
Gutscher, Heinz
Hashimoto, Mitsuji 橋本光治
Higa, Yoshimi 比嘉義視
Huttel, Anna
Ishimura, Gakushi 石村学志
Ito, Koji 伊藤浩二
Kassam, Daud
Kawabata, Heiichi 川畠平一
Kawano, Kozo 河野耕三
Kent, Dan
Kikuchi, Shun-ichi 菊池俊一
Kohsaka, Ryo 香坂 玲
Koji, Shinsaku 小路晋作

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0

Kubunavanua, Eferemo	
Maekawa, Satoshi	前川 聡
Makocho, Paul	
Matewere, John Banana	
Mbungu, Grace	
McKinney, Carman	
Merdane, Hayri	
Miura, Shizue	三浦静恵
Muzyczka, Zoe	
Nakajima, Kenzo	中嶋健造
Nakamura, Shinsuke	中村真介
Njaya, Friday	
Okahashi, Kiyotaka	岡橋清隆
Parada Lizano, Monica Paola	
Radikedike, Pio	
Roy, Michael	
Rusuwa, Bosco	
Shiraiwa, Takayuki	白岩孝行
Shumiya, Takeharu	朱宮丈晴
Soscia, Mary Lou	
Stephen, Kathrin	
Suzuki, Wajiro	鈴木和次郎
Takahashi, Toshimori	高橋俊守
Takeuchi, Amane	竹内 周
Tate Sadayoshi	舘 定宣
Tawake, Alifereti	
Uno, Fumio	宇野文夫
Wakamatsu, Nobuhiko	若松伸彦
Wilson, Alex	

Agricultural Chamber of Karapinar	Karapinar Ziraat Odasi
Association for the Promotion of Self-Employed and Self-Harvesting Sustainable Forestry in Harmony with Environment	NPO法人持続可能な環境共生林業を実現する自伐型林業推進協会
Canadian Biosphere Reserves Association members and partners	
Canadian Commission for UNESCO	
JF Zengyoren	全国漁業協同組合連合会
Kushiro Nature Conservation Office	釧路自然環境事務所
Local Offices of Biosphere Reserves in Japan	各生物圏保 存地域事務局(日本国内)
NPO Natsupana	特定非営利活動法人夏花
Nijibetsu Kor Kamuy Society	虹別コロカムイの会
Noto Satoyama Satoumi Meister Training Program members and partners	能登里山里海マイスタープログラム関係者

Onna Village Fisheries Cooperative Association	恩納村漁業協同組合
Rausu Fisheries Cooperative Association	羅臼漁業協同組合
Shiraho Community Center	白保公民館
Shiraho Conservation Council for Bountiful Seas	白保魚湧く海保全協議会
Shiraho Sunday Market	白保日曜市
Shiraho Yurateiku Charter Promotion Committee	白保村ゆらてぃく憲章推進委員会
Shiretoko Nature Foundation	知床財団
Shiretoko World Heritage scientific council	知床世界自然遺産地域科学委員会
WWF Coral Reef Conservation and Research Center	WWFサンゴ礁保護研究センター
Yokohama City Fisheries Cooperative Association	横浜市漁業協同組合

Index

T. Sato et al. (eds.), *Transformations of Social-Ecological Systems*, Ecological Research Monographs, https://doi.org/10.1007/978-981-13-2327-0

S