

Chapter 1

Framing in Sustainability Science



Shogo Kudo and Takashi Mino

Abstract This chapter discusses multiple understanding of sustainability by examining the process to identify what must be framed as sustainability challenges. The chapter first provides a summary of past development of sustainability science as a new interdisciplinary field that sets its primary purposes in understanding complex human-nature system and academic knowledge contribution to the pursuit of sustainable development. To elaborate some of the educational features of sustainability science, brief history and curriculum design of Graduate Program in Sustainability Science – Global Leadership Initiative (GPSS-GLI) of The University of Tokyo is introduced. One central question in sustainability science is “what to frame as sustainability challenges?”. The chapter employs the concept of framing to examine what topics to be included and how they should be discussed in sustainability science. Framing explains how people perceive and interpret particular topics or events with the social norms, values, and assumptions that they apply in all situations. Being self-aware about what type of framing is used when discussing particular sustainability challenge is critically important. At the last, the chapter proposes a conceptual framework that includes holistic treatment, resilience, and trans-boundary thinking to depict multi-level dynamics of sustainability challenges. This framework serves as a guideline to (i) analyze the complexity of sustainability issues through multiple framings, (ii) apply holistic treatment and trans-boundary thinking in the process of developing action plans, and (iii) evaluate the proposed

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actions from the perspectives of both top-down approaches and bottom-up approaches. The authors believe that sustainability experts must be trained with knowledge and skills to utilize this framework in sustainability research and action projects.

Keywords Framing · Sustainability science · Holistic treatment · Resilience · Trans-boundary thinking

1.1 Emergence of Sustainability Science

The idea of sustainable development—fulfilling and enhancing human well-being while sustaining the life-support system of the earth—was introduced globally by the report of the World Commission on Environment and Development, *Our Common Future*, in 1987 (WCED 1987). The United Nations Conference on Environment and Development in 1992, also known as the Rio Summit, reached agreement on the commitment of academia to actively engage in addressing development and environmental problems (UNESCO 2000; Lubchenco 1998). Supported by these international conventions, the idea of sustainable development was recognized as the main direction of development for the twenty-first century.

What is required to create a transition of human society towards sustainable development is a fundamental understanding of the relationships between humans and nature, and of the methods to transform such knowledge into actions (Phillips 2010). In response to the sustainable development discourse, sustainability science has emerged as a new academic field that sets its primary aim as advancing the understanding of the complex interactions between social systems and natural systems (Clark 2007; Kates 2001; Martens 2006; Ostrom et al. 2007; Swart et al. 2004). Sustainability science aims at understanding “how social change shapes the environment and how environmental change shapes society” (Clark and Dickson 2003). Komiyama and Takeuchi (2006) introduced a similar perspective by explaining sustainability science as a field of comprehensive studies on the multi-scale and complex interactions among three sub-systems: global, social, and human systems (Komiyama and Takeuchi 2006).

Reflecting the focus on the interactions between social systems and natural systems, sustainability science addresses challenges that include complex structures within themselves. Being complex, in this context, refers to the presence of dynamic system-subsystem relationships in a human-nature system. These interactions exist across multiple spaces, times, and scales from local to global; and each subsystem has its own particular qualities and properties (Rosen 2005; Satanarachchi and Mino 2014). Systems dynamics perspectives play an important role in sustainability science illustrating such complex interactions in system-subsystem relationships (Fiksel 2003; Kinzig et al. 2006; Morse 2010; Vries 2013). Complex challenges in sustainability science are exemplified by climate change, biodiversity loss, deforestation, rapid urbanization, poverty and hunger, epidemics, and natural disaster

management to name a few (Jerneck et al. 2011; Leeuw et al. 2012; Rosen 2005). These sustainability challenges are constantly changing over time; hence, actors must often develop temporal approaches to the problems simultaneously in analyzing the problem structures when addressing sustainability challenges (Hiramatsu 2012; Komiyama and Takeuchi 2006; Sterman 2012).

To analyze the complexity of sustainability challenges and guide the current human-nature system to pathways to a sustainable state, sustainability science must differ in its structure and approaches from conventional science based on a reductionist perspective, and must also incorporate adaptive management, problem-based and action-oriented perspective, and social learning approaches (Clark 2007; Kates 2001; Weinstein and Turner 2010). Reflecting these characteristics, sustainability science is an interdisciplinary field in which different bodies of academic knowledge are integrated. Furthermore, sustainability science is presented as a transdisciplinary field that combines knowledge not only within academia, but also with various social actors (Kajikawa 2008; Lang et al. 2012). This transdisciplinary orientation implies designing a transformational change of the current situation to lead our society to a sustainable pathway (Chapin et al. 2011; Leeuw et al. 2012; Wiek et al. 2012). Such an idea of producing collaborative knowledge and implementing action is not limited to sustainability science; however, some experts in sustainability science explicitly emphasize its nature as being *transformational science* (Wiek and Lang 2016). Pre-1987 literature illustrates the emergence of sustainability science both quantitatively and qualitatively.

Some bibliometric studies that analyzed the publication and co-authorship in the field of sustainability research (Bettencourt and Kaur 2011; Kajikawa 2008; Kajikawa et al. 2014; Kates 2011; Schoolman et al. 2012) found a steady increase in sustainability research not only by the number of publications, but also by the increase in thematic coverage. One major research theme identified is *resilience* (Kajikawa et al. 2014). In the studies that examined sustainability science more qualitatively, sustainability science can be subdivided into science *for* sustainability and science *of* sustainability (Spangenberg 2011). Science *for* sustainability provides more technical approaches to offer possible solutions to sustainability challenges, and implies a basic scientific method based on problem-based and interdisciplinary approach. The science *of* sustainability, however, aims to develop a conceptual and methodological discussion of sustainability, the observation of which “can be understood as a new step in the evolution of science” (Spangenberg 2011).

While some scholars treat sustainability science as an independent discipline, others argue that sustainability science is rather a discipline that accommodates diverse interactions among different academic disciplines (Clark and Dickson 2003). Shahadu (2016) claims sustainability science is an “umbrella science” that fills the gaps among different research traditions based on different ontologies and epistemologies (Shahadu 2016). Acknowledging such multiple understandings of the concept of sustainability and facilitating interdisciplinary communication are necessary steps for sustainability science to recognize its pluralistic nature (Olsson et al. 2015).

Despite the evolvement of sustainability science as a new academic field, some major challenges remain in its conceptual and methodological developments as well as in its establishment of institutional structures that fit its inter- and trans-disciplinary orientation (Yarime 2013). Further development of the field is expected in the direction of realizing multiple understandings of the concept of sustainability and manifesting such ideas into institutional arrangements. This chapter aims to contribute to enhancing multiple understandings of sustainability by examining the process to identify what must be framed as sustainability challenges. To conclude the chapter, the authors propose their conceptual framework of key elements for visualizing transformation to a sustainable society. The next section introduces the sustainability science program at The University of Tokyo to present some of the key features of sustainability science education.

1.2 Educational Challenge in Sustainability Science at UTokyo

The Graduate Program in Sustainability Science–Global Leadership Initiative (GPSS-GLI) (<http://www.sustainability.k.u-tokyo.ac.jp>) is a combined Master's and Doctoral degree program based at The University of Tokyo (UTokyo). The program offers an interdisciplinary education over five years – generally two years for a Master's degree, and three years for a Doctoral degree – and aims at fostering leaders for developing sustainable societies. The integrated character of the two degree programs allows participants to acquire a wide range of knowledge and skills related to sustainability. What is more, the Master's course described is complemented with international experience, and the Doctoral course is complemented with training in and opportunities for practical reinforcement in the field.

The program started in 2005 as a two-year Master's course; its three-year doctoral course was created in 2007. As of October 2017, 36 students are enrolled in the Master's course and 36 students in the Doctoral course. The program has had students from more than 50 countries from all over the world. GPSS-GLI students also come from diverse academic backgrounds ranging from biology, civil engineering, economics, development studies, urban and rural planning, and numerous others. The program was established in the Graduate School of Frontier Sciences where new academic challenges are being developed through inter- or trans-disciplinary approaches, and collaborates very closely with the Integrated Research System for Sustainability Science (IR3S) based in The University of Tokyo. GPSS was reformed into GPSS-GLI in 2012 when the program was selected for Leading Graduate School Programs and started receiving a new funding from MEXT (the Japanese Ministry of Education, Culture, Sports, Science and Technology).

The type of education that GPSS-GLI offers is described as a T-shape education in which the horizontal line of “T” represents the breadth of knowledge on sustainability issues as well as practical skills for implementing projects, and the vertical

line of “T” corresponds to the depth of knowledge specializing in one academic discipline obtained through a Master’s thesis or Doctoral dissertation project. The program curriculum is designed in such way that the participants constantly revisit the T shape to avert becoming narrowly focused. The program believes this is necessary training for sustainability experts to become able to consider multiple dimensions of sustainability. Such training is done by courses on diverse topics in sustainability, by the advisory process by supervisors, and by the weekly GPSS-GLI seminar in which all participants have regular opportunities of mutual learning from the research progress presentations of others and of contributing to discussions in diverse disciplines.

More specifically, the GPSS-GLI program revolves around three key perspectives: wholistic, resilient, and trans-boundary. The holistic perspective implies a bird’s-eye view that provides a combined view of an overarching perspective and in-depth understanding of the human-nature relationships. The resilient perspective employs flexibility in process governance that enables both long-term concerns (e.g. climate change) and short-term concerns (e.g. natural disasters) to be addressed concurrently. Lastly, trans-boundary perspective provides a comparative approach from a global scale to a local scale bringing diverse people together to jointly address sustainability issues.

The GPSS-GLI curriculum consists of three core components: (i) lecture courses focusing on theories and concepts, methodologies, and a wide range of topics related to sustainability; (ii) practicum courses aiming at developing interpersonal skills, systems thinking perspectives, and field survey methods; and (iii) a comprehensive research process beginning with identifying a research problem, developing research framework, implementation and data collection, all of which are compiled into a Master’s thesis or Ph.D. dissertation.

Among the three main components of the GPSS-GLI curriculum, field-based training units in practicum courses are unique. Students travel to locations where actual sustainability issues are ongoing where they gain on-ground experience as well as practical skills in understanding the complex structure of the issue, identify possible leverage points, and design possible interventions. These field-based courses have covered mercury poisoning caused by rapid industrialization, rural sustainability in an aging society, natural disaster management in coastal areas, poverty and nutrition issues, and smart city development to name a few.

How to deliver contents that facilitate program participants’ obtaining holistic, resilient, and trans-boundary perspectives has been the major challenge for GPSS-GLI since its establishment. The authors, however, have observed informational changes among the participants throughout the history the program, field-based training, and individual thesis research activities for more than 10 years. Especially, their worldviews are challenged in the program-wide weekly seminar that contributes to examining the application of framing of sustainability issues in student research projects.

1.3 What to Frame as Sustainability Challenges

Sustainability science is a problem-based or solution-oriented science (Clark and Dickson 2003; Kates et al. 2001), and this implies that a process to define what to frame is a challenge that exists in all sustainability research. Sustainability is “a fundamentally ethical concept raising questions regarding the value of nature, responsibilities to future generations, and social justice” (Norton 2005), yet a limited discussion has been held on these normative dimensions of sustainability in sustainability science research. Those challenges related to problem-based or solution-oriented dimensions such as climate change, biodiversity loss, and resource depletion have undoubtedly been framed as key sustainability issues because these problems will result in serious threats to human beings. However, a new set of challenges has been observed that are more related to human society, and the emergence of these challenges can be seen as a result of socioeconomic development such as rapid urbanization, mass production and consumption, and heavy transportation. Although these challenges are included in the UN’s Sustainable Development Goals (SDGs), reviewing what we are framing as sustainability concerns in these challenges is critical to better understand what we are aiming to achieve through sustainable development.

The state of being sustainable tends to be seen as an absolute state of society that takes a balance between human system and nature systems (Giampietro 2002). When such a static perspective to sustainability is applied, a belief that lowering consumption of goods and services or reducing carbon emissions from our daily lives eventually leads our society to a sustainable state is commonly shared. Solution-oriented approaches tend to employ this static perspective and consider that sustainability can be achieved by designing systems in which agents follow the structured rules of the system. In reality, however, what sustainability means is to change gradually over time as people’s value orientations change. Therefore, sustainability should not be seen as a fixed goal of our society, it is rather a process, and people only sustain what they frame as valuable based on their value propositions.

1.4 What Is Framing?

Framing is a common concept in many academic disciplines such as psychology, linguistics, sociology, communication and media studies, and political science. Framing explains how people perceive and interpret particular topics or events with the social norms, values, and assumptions that they apply in all situations (Benford and Snow 2000; Goffman 1974). When a majority of the general public applies one particular framing to one particular topic, then it provides explanations of why this topic matters, who is responsible, and what measures should be taken (Gamson et al. 1989; Price et al. 2005). Utilizing such characteristics of framing, reframing is sometimes used to set alternative perspectives to topics and events with particular meaning that the person or group would like to propose (Jarratt and Mahaffie 2009).

One main premise of framing theory is based on a constructivism perspective which realizes multiple ways of viewing and constructing the world (Chong and Druckman 2007). Hence, multiple framings by different groups of people in our society always exist, and how the concept of sustainability is framed is also multiple. To integrate such multiplicity of framing present among different actor groups, sustainability scientists facilitate collaborations through broad inter- and trans-disciplinary initiatives (Bammer 2005; Leach et al. 2010).

In sustainability science, framing is an important concept that examines the process to determine what is worthwhile to sustain in line with the direction of sustainable development. Sustainability fundamentally contains a normative dimension, and such framing is built upon social values and individual beliefs. Answering the core questions of sustainability—sustain what, for whom, how long, and at what cost—reflects our orientations in the framing process of particular topics. In order to move the discussion on framing in sustainability science forward, developing a conceptual framework that cautions us of key elements to consider is critical. To conclude the chapter, the authors propose their conceptual framework of key elements for visualizing transformation to a sustainable society.

1.5 Framework to Visualize Transformation to a Sustainable Society

Based on the experience of operating the GPSS-GLI program over the last ten years including the initial three years as GPSS, the authors have developed a conceptual framework that encompasses key elements that must be examined when discussing transformation towards sustainable society in a research or action plan. Fig. 1 summarizes those key elements for framing sustainability issues (shown as (1) *Framing complexities*) and suggests possible means (shown as (2) *Transformation channels*) to lead the current state of society to a sustainability pathway.

When addressing one sustainability issue, the authors argue that Holistic Treatment (top-down approaches) and Trans-boundary Thinking (bottom-up approaches) need to be applied jointly in order to (i) analyze the embedded complexity within the structure of the issue, (ii) develop action plans towards a sustainable society incorporating the uncertainty in this action planning process, and (iii) evaluate the entire framing process from issue identification, action plan development, and implementation. Holistic treatment and trans-boundary thinking are perspectives that support each other, an interaction which is necessary for examining one sustainability issue from multiple angles and for visualizing how proposed actions will unfold.

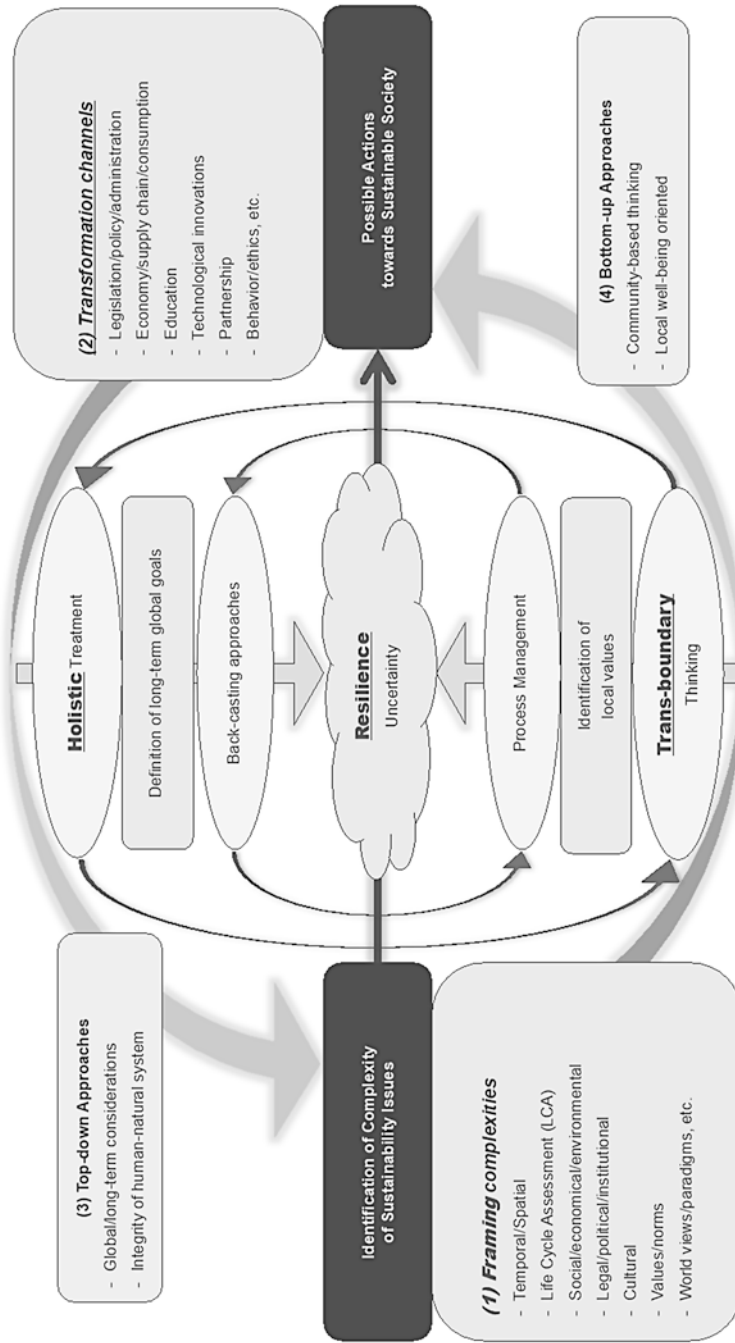
Holistic Treatment, which represents the upper half of the framework, is based on a systems perspective and depicts cause-and-effect relationships among the factors and agents related to an issue. In contrast, the Trans-boundary Thinking, which represents the bottom half of the framework, is based on individual-case perspectives that reflect the locality of a particular community or stakeholder group.

Such local perspective often does not match well with the global and national level sustainability goals. Therefore, the process to articulate local perspectives and reinterpret the global sustainability manifestations in individual cases is an important process when linking the Holistic Treatment and the Trans-boundary Thinking. Sustainability experts are expected to facilitate the communication among diverse stakeholder groups and supplement relevant information and knowledge to ensure the convergence of Holistic Treatment and Trans-boundary Thinking perspectives.

When a group of stakeholders addresses one sustainability issue, analyzing the complexity embedded in the issue is the first step. Complexity is understood as a system with parts, feedback, and non-linear and linear relationships (Ladyman et al. 2013). To frame the complexity of sustainability issues, several key factors must be examined. For example, the authors' framework suggests temporal and spatial dynamics of the issue (temporal diversity to long-term trends, local to global perspectives), legal, political, and institutional dimensions of the issue (intergenerational equity, institutional structure for concrete actions), world views and paradigms (differences in how to understand reality) [shown as (1) in Fig. 1]. Which framing becomes more helpful in analyzing the complexity depends on the nature of the discussed issue. Paying close attention to what kind of framing to be applied during issue identification, however, is critically important. This is because every framing process applies different assumptions, principles, and views to the issue; and it sets what topics are to be viewed as important, and what topics should be addressed or not. Those stakeholders who initiate actions aiming for a sustainable society must be able to see an issue from different angles by applying multiple framings.

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Once the structure of the issue is analyzed, possible actions for achieving a sustainable society are proposed. Yet, the authors argue that there are many steps in between the issue identification and action planning as shown in Fig. 1.1. The process of proposing actions must be done by combining a backcasting approach based on Holistic Treatment and process management base on Transboundary Thinking. A backcasting approach requires clear images of ideal goals or states, often they can



Modified from Mino T et al. (2016) in "Sustainability Science: Field Methods and Exercises", Springer International Publishing Switzerland, Esteban M et al (Ed)

Fig. 1.1 A Conceptual framework of key elements for visualizing transformation to a sustainable society

be linked with the global sustainability agenda such as the Sustainable Development Goals (SDGs). In contrast, process management aims at enhancing local values shared by fixed members, and these values can be identified by a Trans-boundary Thinking approach. The authors argue combining Holistic Treatment based on systems perspective and Trans-boundary Thinking based on the local perspective of each case is an essential methodology to incorporate the global sustainability agenda and the relevance in individual cases. This methodology enables researchers and stakeholders to develop a more resilient action plan that is ready to accommodate uncertainty.

Those proposed actions to achieve a sustainable society appear in various forms. Some of the Transformation channels are registration, policy and administration; economy, supply chain; and consumption, and technological innovations (shown as (2) in Fig. 1.1). These channels are further narrowed down to concrete actions to respond to identified challenges.

After actions are proposed through particular transformation channels, the framework suggests additional steps to examine how the proposed actions can be situated within factors in top-down approaches (global/long-term consideration, integrity of human-natural system) [shown as (3) in Fig. 1.1]. This process not only makes the linkage with global sustainability agenda (e.g. SDGs) explicit, but also verifies the transferability of the proposed actions. Following this verification step by holistic treatment perspective, the proposed actions must also be checked by the factors in the bottom-up approaches (community-based thinking, local well-being orientation) [shown as (4) in Fig. 1.1]. These two steps functions simultaneously and serve as an evaluation part for the entire process and its possible influence at various scales.

In summary, the framework serves as a guideline for researchers and stakeholders to (i) analyze the complexity of sustainability issues through multiple framings, (ii) apply holistic treatment and trans-boundary thinking in the process of developing action plans, and (iii) evaluate the proposed actions from the perspectives of both top-down approaches and bottom-up approaches. In many of the actual cases, the sustainability issues are already analyzed and action plans are being implemented by the time a theoretical framework is applied. Therefore, the proposed framework is to be introduced into the process at any time. For example, the framework can be used to evaluate the outputs of conducted actions first, then further utilized to re-examine the applied framing to understand the complexity to the addressed issue before the second round of concrete actions is taken. The authors believe this framework incorporates key elements of framing in sustainability science thus far. This framework, however, must still incorporate the concept of resilience in its goal-setting process and in the uncertainties in the process management, which have not been discussed in detail in this paper. Sustainability experts must be trained with knowledge and skills to perform the suggested steps when utilizing this framework in sustainability research and action projects.

1.6 Scope and Structure of this Book

This book aims at examining different types of framing applied by scholars to sustainability research. In so doing, this book provides an overall picture of sustainability research by scholars from different academic backgrounds (i.e., representing different ontologies and epistemologies). As efforts continue in achieving sustainable development goals and trying to guide society to sustainability, realizing different intentions behind each framing and being open to negotiation as well as cooperation are important for sustainability experts. The first step in starting such an approach is gaining understanding of one another's framings.

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