Chapter 15
Closing the Gap Between Knowledge and Implementation in Conservation Science: Concluding Remarks

Cornelya F. C. Klütsch and Catarina C. Ferreira

Contents

15.1 Valuable Lessons Learned 458
15.1.1 The Importance of Multi- and Interdisciplinary Knowledge Sources and Co-production 458
15.1.2 Improving Science Communication and Spatial–Temporal Connectivity of Various Societal Groups for Evidence-Informed Decision-Making 459
15.1.3 A Global Review of the Knowledge–Implementation Gap 460
15.2 What's Left to Uncover? 463
15.2.1 The Critical Contribution of Social Sciences to Closing the Knowledge–Implementation Gap 463
15.2.2 Information Flow Analysis for a Better Understanding of Social Structure and Knowledge Transfer in Local Communities 464
15.2.3 Trade-Offs Between Environmental and Socio-Economic Development Goals Impact Conservation Implementation 465
15.3 Ways Forward 469
References 470

C. F. C. Klütsch (✉)
Division of Environment and Natural Resources, Norwegian Institute of Bioeconomy Research (NIBIO), Svanvik, Norway
e-mail: cornelya.klutsch@nibio.no

C. C. Ferreira
Department of Conservation Biology, Helmholtz-Zentrum für Umweltforschung – UFZ, Leipzig, Germany

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15.1 Valuable Lessons Learned

Life on Earth is facing severe challenges. Human action is leading to deterioration of natural resources and ecosystems, with over 35,000 species threatened with extinction worldwide (IUCN 2020) and widespread declines documented systematically among populations of wild species (WWF 2020). This presents a severe threat to humanity by undermining the capacity of biodiversity to support human livelihoods and well-being. There is, counter-intuitively, an ever-growing body of literature showing that knowing more about this crisis does not lead to more action to abate it. In addition, research has shown that ecological knowledge is often misused during the implementation of policy instruments (for example, when deciding where to best place protected areas) in part driven by a lack of understanding of the mechanisms underlying the policy-making process (Chassé et al. 2020). The consequences of not using scientific evidence when making decisions about conservation interventions can be damaging, both in terms of wasting limited human and financial resources and failing to meet biodiversity objectives (Pettorelli et al. 2020). Therefore, effective use of biodiversity knowledge to elicit successful decision-making and implementation of conservation actions needs political, societal, and behavioural incentives that can only be instigated through good knowledge brokerage and science diplomacy, underpinned by strong collaborative and interdisciplinary endeavours.

15.1.1 The Importance of Multi- and Interdisciplinary Knowledge Sources and Co-production

With this book, we set out to explore the depths of the knowledge–implementation gap in conservation science around the world and from various socio-economic, cultural, and political perspectives. To understand the flow of knowledge from the stages of (co)production to implementation, we dedicated the first part of the book to describing the major knowledge sources available to inform environmental decision- and policy-making processes, including some that have been traditionally underutilized and/or overlooked. One of the main take-aways from the book is that there are major challenges in integrating western science with indigenous and local knowledges, particularly in culturally diverse regions, although this is pivotal to advance conservation knowledge implementation. Multi- and interdisciplinary research integration will require changes in governance and funding schemes to incentivize different stakeholders to participate in co-designed research. This section emphasized the importance of considering multidisciplinary sources of knowledge, which are based on various knowledge generation models (e.g., academic, traditional and local knowledge, and citizen science), when engaging and informing stakeholders (including civil society) on conservation rationales and decisions, while highlighting the value, relevance, and cultural significance of certain streams of knowledge generation. This realization opposes the still widespread paradigm that

scientists are the sole knowledge producers and providers and that they do it in a linear or top-down fashion to the public and decision-makers (otherwise known as the information-deficit model; Toomey et al. 2017). Rather, it underscores knowledge production as a collaborative, societal, and multidimensional process that connects different knowledge holders to different publics. Environmental challenges as complex as the ones we are dealing with daily cannot be effectively tackled with a unidimensional lens of knowledge. Indeed, a greater recognition of citizen science and traditional ecological/local knowledge as legitimate conservation knowledge sources is a testament to this need and promotes the democratization of science by opening up the knowledge (co)production process to previously largely excluded societal groups (Turini et al. 2018). The participation of these groups has additionally the potential to facilitate the expansion of environmental democracy and decision-making (Kiss 2014) as well as the integration of human behaviours and social dimensions in the conservation process (Bennett et al. 2017).

15.1.2 Improving Science Communication and Spatial–Temporal Connectivity of Various Societal Groups for Evidence-Informed Decision-Making

One critical element of knowledge brokerage in biodiversity conservation is effective science communication and increasing connectivity between different societal groups. Effective science communication can change perceptions and beliefs and ultimately trigger actions by different audiences, hence being a key element in closing the knowledge–implementation gap. In that spirit, the second part of this book was dedicated to addressing the barriers and identifying opportunities for science communication to reach different audiences with empowering, engaging, and effective messaging as well as the role of boundary and bridging organizations and decision support systems in these efforts.

Challenges around effective science communication are mostly twofold: (1) the lack of time, funding, and career incentives for scientists to engage more regularly in these activities, and (2) that scientists are often more concerned with knowledge transfer in traditional formats rather than adjusting it to different audiences, an aspect linked to a lack of formal training in science communication. Strategies for better science communication include adequate reflection on who the audience is and what the communicator is trying to achieve, and a focus on connecting to the audience (e.g., by storytelling and inclusion of personal experiences) rather than delivering pure facts (through traditional lecturing, for example). Modern communication tools like social media platforms are increasingly utilized as a two-way street of science communication, biodiversity conservation research, and public outreach (Sbragaglia et al. 2020; Toivonen et al. 2019), as news media are able to increase discussion on policy topics on social media platforms and webpage forums by ~63% (King et al. 2017). Thus, news outlets and social media platforms offer a communication channel

for public discussions of environmental and conservation issues with its full potential probably yet to be realized by a large proportion of scientists and practitioners in conservation science.

Scientists are also insufficiently engaged in science communication because of an ongoing debate about whether scientists can/should be activists, and/or engaged in political actions (Muir 2020). The conception that science should be an apolitical separate endeavour and that scientists are providers of objective and value-free knowledge leads many scientists to avoid commenting on impacts or applicability of their work beyond scientific publications. In addition, systematic muzzling of government scientists in several regions of the world, typically under conservative governments, has prevented scientists from communicating their research results on issues like climate change, deforestation, shark conservation, etc. (Rapp Learn 2017). In Canada, despite an elected liberal government in 2015 that promised to reverse this situation, in 2017, 53% of government scientists still considered that they could not freely speak about their science to the media (Owens 2018). This example suggests that even in comparatively progressive countries, under such a constraining climate, the proportion of scientists engaging in science communication will remain low. There has been a call to strengthen whistleblower protection laws and proactive measurements to encourage a cultural change in government organizations in Canada (Owens 2018). Similar actions may be desirable at a global scale.

A second key element for improved knowledge flow is increasing connectivity among the different parties that make, and are potentially affected by, conservation decisions. Scale and network boundaries are important components to consider in knowledge networks with bridging organizations playing an important role as multipliers of brokerage efforts, amplifying information flow through space and time. They can also help to link global science to local implementation, by facilitating the establishment of science–management partnerships and, consequently, the conversion of scientific research into local action. This is particularly critical in the case of abstract environmental issues, like climate change, where knowledge mobilization needs to operate within matching scales and relevance to local communities. Decision support systems can also aid in the implementation of conservation actions by taking into account uncertainty and complex socio-environmental factors with competing interests among stakeholders. Decision support systems can increase knowledge flow to decision-makers if they are well-designed and maintained and if they are tailored towards the need of decision-makers in conservation science. However, these systems remain underutilized in conservation science and more research and development is necessary to fully integrate them for this purpose.

15.1.3 A Global Review of the Knowledge–Implementation Gap

The third and last section of the book provided state-of-the-art summaries on the status of the knowledge–implementation gap in different parts of the world and on

what solutions are being offered as feasible in these different regional settings to close the gap. These contributions were provided, to the extent possible, by native regional authors to ensure that descriptions of regional initiatives were backed up by strong local expertise. This proved to be a challenge for numerous reasons, among which the prevalence of non-native authors dominating the research field is probably the common denominator. Further, language barriers and hard-to-find expert contact details added to the difficulty of finding local and regional experts. More support in the form of funding (e.g., long-term employment opportunities for young professionals in the field), additional training opportunities and probably most importantly, inclusion of (non-English speaking) native scientists and knowledge holders in scientific research outputs (research papers, conference posters, etc.) are needed to achieve better integration of local perspectives and people at the knowledge production stage. This will also have the added advantage of gaining a better insight into local socio-economic factors inhibiting or competing with conservation action (see also Sect. 15.2.3).

Several common barriers to turning ecological knowledge into conservation action are shared across regional contexts. For example, mismatches between the research scope, its temporal and spatial coverage, and its relevance to address conservation issues are common challenges. A general lack of interest from scientists in policy, low political priority of biodiversity conservation issues, and a low accessibility and uptake of scientific evidence by decision- and policy-makers were additionally systematically pointed out as major contributors to the knowledge–implementation gap worldwide. Little is known about the cost and effectiveness of efforts aimed at narrowing the gap in certain regions of the world, such as Asia, Africa, and South America. In these contexts, regional and global initiatives, as well as international agreements, are critical to align national development goals and biodiversity protection priorities and underpin the development of local initiatives (for example, capacity building and development of standards) that support biodiversity mainstreaming efforts.

Other major barriers to the uptake of ecological data in conservation decision-making processes in some parts of the world include a complete absence of knowledge of some taxonomic groups (like insects and plants). Some of these geographic and taxonomic knowledge gaps could be filled with an increased utilization of standardized data collection methods and citizen science projects that would also allow to upscale conservation efforts. In addition, an increasing involvement of the private sector in biodiversity monitoring and the achievement of biodiversity strategic goals are warranted as pointed out in several book chapters and elsewhere (e.g., de Silva et al. 2019; Krause et al. 2021; Smith et al. 2018, 2020). Partnerships between the private sector and other stakeholders have often been problematic, mostly because of conflicting interests related to economic and conservation goals. However, biodiversity loss has been identified as a risk to business in 2005 by the World Economic Forum, and since then moved from ‘a potential concern’ to ‘critical issue’ in about 15 years (WEF 2019), suggesting a growing awareness of the interdependencies between business and biodiversity status. Nevertheless,

engagement of private companies with strategic biodiversity goals and sustainable development goals varies widely (Smith et al. 2018, 2020), with business representatives struggling to pinpoint how they can include targeted actions into business plans (CBD 2018). This situation feeds further into the conservation knowledge–implementation gap and needs addressing to ensure all parts of society are engaged in solving the biodiversity crisis. The winning formula to get the private sector on board to commit to biodiversity protection will likely be a combination of stronger governmental environmental regulations and ecological knowledge transfer to business by scientists and practitioners, outlining clear links to biodiversity strategies and sustainable development goals as well as the strengthening of Open Access principles that in the case of private companies probably need to be legally enforced. Finally, science-based criteria are needed to measure the private sectors' commitment to halt biodiversity loss and force companies to outline specific, measurable, and time-bound action plans and business practices (de Silva et al. 2019).

While the original goal of this book was to describe both success stories and failures of the knowledge–implementation flow in biodiversity conservation and investigate which strategies are more successful across different geographic, economic, and social settings, it soon became evident that well-documented failures and associated consequences are much harder to find, likely because they are reported less frequently (but see Aganyira et al. 2019; Catalano et al. 2018; Giakoumi et al. 2018; Godet and Devictor 2018). For this reason, the book focused more on the positive messaging of successful attempts to close the knowledge–implementation gap. However, there is much to be learned from analysing and publishing failed conservation (research) initiatives as they could give an insight on the role played by different stakeholders and local communities, as well as improve understanding of interpersonal relationships, in the context of knowledge flow. The one-sided reporting of perceived success stories and reliance on this knowledge can lead to confirmation bias, overconfidence, and false determination of causal relationships, sampling error, and reduced impetus to look for alternative options (Catalano et al. 2018), particularly in understudied contexts. The major social and economic causes for conservation failures identified by Catalano et al. (2019) include communication difficulties between stakeholders and local communities, psychological reactions, and previous (negative) experiences by people involved in a conservation project. Further, economic constraints including lack of funding, mismanagement (e.g., corruption), and donor conflicts as well as missing incentives for conservation actions and lack of alternative income strategies are predominating reasons for conservation failures. Finally, lack of political support and shifting political priorities can lead to offsetting conservation goals. When properly addressed, all these variables have been identified by the contributing authors of this book as potential catalysts for closing the knowledge–implementation gap in conservation science across diverse socio-economic and cultural contexts.

15.2 What's Left to Uncover?

With this book we offer potential cross-cutting broad solutions to close the knowledge–implementation gap in conservation science around the world. While we have covered an important portion of the subject matter, there is a lot still to be explored. The book has focused substantially on how we can further improve the mainstreaming of scientific evidence into the environmental decision- and policy-making arenas, namely through better communication and public engagement. However, a major goal of all of these efforts is ultimately to change human behaviour because only then can we as a society shift to a sustainable bioeconomy (Crowling 2014). Understanding which socio-economic-cultural factors hinder/support the success of conservation actions, and how information flow varies across different social structures, are important aspects that we would like to expand on here a bit more. Moreover, including the social dimension in this conversation is a critical piece to generate additional knowledge about resource use and impacts of conservation actions on different societal groups as well as various human behaviours (de la Torre-Castro et al. 2017; Martin and Hall-Arber 2008).

15.2.1 The Critical Contribution of Social Sciences to Closing the Knowledge–Implementation Gap

Traditionally, the natural sciences have been the main knowledge provider for guiding the implementation of conservation action (Bennett et al. 2017; Moon and Blackman 2014). However, there is an increasing recognition of the importance of social sciences as a complementary field of expertise, alongside other emerging fields like citizen science and traditional ecological and local knowledge, in successful conservation planning and action (Bennett et al. 2017; Moon and Blackman 2014; Moon et al. 2019; Sandbrook et al. 2013). The main barrier for the integration of social sciences into conservation policy and management appears to be a lack of awareness on the side of practitioners and scientists regarding the potential contributions, sub-disciplines, and objectives of the field (Bennett et al. 2017). In a recent review, Bennett et al. (2017) identified 18 sub-disciplines of conservation social sciences that represent social sciences contributing to biodiversity conservation. For instance, conservation or social marketing research investigates the possibility of applying marketing strategies, including concepts and methods, to change the behaviour of target audiences and make it more environmentally friendly (Green et al. 2019; Kidd et al. 2019; Veríssimo 2019; Wright et al. 2015). The recent emergence of social marketing as a research field is the consequence of the realization that awareness-raising initiatives or environmental education programmes alone generally do not result in behavioural changes (Green et al. 2019). Social marketing aims to develop engaging and attractive campaigns that enable behaviour change in society, and a meta-analysis of 84 conservation social marketing campaigns showed

that they were successful in changing behaviours by approx. 9% (Green et al. 2019), reinforcing the potential for this subdiscipline to help close the conservation knowledge–implementation gap (David et al. 2019; Tapp and Rundle-Thiele 2016). More broadly, conservation social sciences can investigate and provide local social, economic, cultural, and governance context to increase our understanding of the needs, challenges, successes, and potential impacts of conservation actions (Bennett et al. 2020). They can also help with adaptive co-management practices as well as stakeholder engagement, and hence are instrumental to develop socially equitable and just conservation actions and outcomes (Bennett et al. 2017). Below, we provide a few examples of how social sciences can help to close the knowledge–implementation gap and support long-term societal support of conservation implementation.

15.2.2 Information Flow Analysis for a Better Understanding of Social Structure and Knowledge Transfer in Local Communities

An alternative way to look at information flow is to consider how information travels within a community (i.e., interpersonal communication) and how social structures impact information flow and influence behavioural change (de Lange et al. 2019). Information flow within a society will be affected by the identities, personalities, and relationships of communicators that try to spread a message. At the receiving end, acceptance of the message will depend on the relationship of the two individuals (e.g., an elder communicates to a younger person), the credibility of the source (i.e., trustworthy source of information), power structures, and social norms (de Lange et al. 2019 and references therein). Individual resistance to messaging is connected to several social phenomena, including *uncertainty of outcome*, which is the reluctance to implement change until benefits of the action are clearly visible in society and/or that change is socially acceptable. Hence, understanding these factors better can make messaging more targeted and improve communication efficiency in conservation efforts to solicit behavioural change and adoption of new practices.

Social network analysis (SNA) is an analytical method to assess social structures within communities by considering individual nodes that are connected via links, representing their relationships to other individuals in society, often including a measurement of closeness of relationship (for example, shorter distances for kin relationships than for acquaintances). Improving our understanding of societal information flow may aid in identifying key people with high connectivity to other individuals in the community (i.e., centrality); thereby improving information flow and enhance behavioural change. It may be also important to understand different communication tools as these are context-dependent (e.g., if no access to internet is available, then interpersonal communication might be the sole way for information

flow). Identification of individuals that connect two or more societal subgroups may facilitate increased information flow if these individuals are trusted by both groups.

SNA has been used to analyse societal relationships at different levels including organizations from various sectors (i.e., academia, government organizations, NGOs, etc.; Adán et al. 2020; Bixler 2021; Riggs et al. 2020) and more fine-scale analyses investigating and identifying information flows among individual local community members (Arlidge et al. 2020). For example, a network analysis revealed that information flow for sea turtle bycatch information differed significantly from information networks concerning other topics (e.g., fishing gear, fishing location network, etc.), although fishing information-sharing networks were predictive to a certain extent of how information about sea turtle bycatch is shared within the community (Arlidge et al. 2020). This demonstrates that information flow is difficult to predict and that it needs to be determined on a case-by-case basis for best implementation.

15.2.3 Trade-Offs Between Environmental and Socio-Economic Development Goals Impact Conservation Implementation

There is an ongoing debate about the trade-offs between environmental and socio-economic development goals that can determine long-term success or failure of conservation actions and that is not sufficiently considered when planning conservation strategies (Oldekop et al. 2016). Socio-economic dimensions are key drivers of local communities buying into implementation of conservation strategies. This is because acceptance of conservation implementation largely depends on personal considerations, for example, the question of how implementation of conservation measures will impact income and livelihood for different demographics (e.g., gender, rural communities, etc.). Thus, even if knowledge flow among different actors and stakeholders is achieved, competing interests among these stakeholders can hamper conservation actions. Therefore, knowledge about resource users is crucial to increase conservation effectiveness (de la Torre-Castro et al. 2017).

15.2.3.1 Trade-off Between Conservation Impact and Livelihoods of Local Communities

This book largely focussed on the identification of barriers and solutions to closing the knowledge–implementation gap. However, what happens after implementation of conservation actions and are there any negative consequences associated with them? What supports successful long-term implementation and what can we learn from existing initiatives to reduce negative impacts of conservation action? And how do these feed retroactively into and affect the knowledge–

implementation gap? Most of the knowledge on this topic has been generated studying established protected areas (PAs) and their socio-economic impacts and therefore, we will highlight a few examples from those studies below. This knowledge can be used to refine future conservation plans to avoid/mitigate negative consequences and increase acceptance and support of conservation actions by local communities. Ultimately, we can consider the knowledge–implementation gap only truly closed, if the conservation action is supported and respected and if compliance with conservation guidelines is achieved.

The selection of geographic regions for the establishment of PAs may have both positive and negative impacts on local communities (Friedman et al. 2018; Jones et al. 2020; Mizrahi et al. 2018; Ward et al. 2018; Table 15.1). For example, a PA might reduce/prohibit hunting and harvesting thereby potentially lowering sustenance use of the area for the local community. Without mitigation measures like, for example, provision of complementary income and food sources, local communities will be unwilling to follow guidelines and respect the boundaries of the PA, leading to unsuccessful implementation and lowering the efficiency of the PA. Probably as a consequence of that, protected areas are often placed in spaces which are considered economically less valuable; side-stepping the human conflict but also reducing the impact of conservation action, as regions that have a lower human footprint likely have more intact ecosystems (Geldmann et al. 2019; Mizrahi et al. 2018). Qualitative assessments of protected areas and their potential impact on long-term conservation are largely missing at a global scale (Geldmann et al. 2019; see also Chap. 13; Horgan and Kudavidanage 2021 in this book for examples from Asia).

Additional examples are summarized in Table 15.1 to highlight some of the positive and negative consequences of conservation implementations that are

Table 15.1 Some examples of how conservation action can have positively and negatively socio-economic impacts. Importantly, some, if not most, of these can have both positive and negative effects

Positive impacts of conservation actions	Negative impacts of conservation actions	References
Livelihood provision through tourism development	Displacement of local communities	Naidoo et al. (2019)
Participation in governance Empowerment of local natural resource management	Exclusion from decision-making processes and governance	
Protection of historic sites	Access to spiritual sites restricted	
Reduction of poverty	Increase of poverty	Andam et al. (2010), Mammides (2020)
Long-term protection of resources	Access to resources restricted	
Increased income due to, for example, eco-tourism	Unbalanced cost and benefit distribution	Holmes and Cavanagh (2016)
Health benefits like normal child growth		Naidoo et al. (2019)

affecting socio-economic developments of local communities. This list is incomplete and more research on the topic is needed to increase the success of conservation actions.

One possible solution to mitigate the above-mentioned trade-offs (Table 15.1) could be the integration of social impact assessments into adaptive conservation management that evaluate both positive and negative socio-economic, health, cultural, and governance changes to local communities caused by conservation initiatives (Kaplan-Hallam and Bennett 2018). Improving knowledge about potential negative impacts of conservation can help mitigating these negative consequences earlier and in a more targeted way, while positive impacts can be further enhanced to maximize the benefits of conservation. In addition, both positive socio-economic and conservation results are more likely to be achieved when a co-management system with local communities is put in place as this leads to engagement and empowerment of those communities while strict management excluding local communities lead to less efficient conservation and socio-economic developments (Oldekop et al. 2016). Importantly, here again, recognition and acceptance of failures and unexpected outcomes are crucial components for the successful implementation of these adaptive management initiatives. Equally, most of the interpersonal and communication skills mentioned in Sect. 15.1.2 are essential to conduct these types of adaptive management practices.

15.2.3.2 Social Equity

Social equity, a multidimensional concept of ethical issues referring to fairness, is increasingly recognized in the conservation literature and international conservation policy as a pivotal component in closing the knowledge–implementation gap (CBD 2011; Friedman et al. 2018).

Impacts of conservation efforts are unequally distributed in a society and affect local scales more than national or international scales (Adams et al. 2004; Holmes 2007; Oldekop et al. 2016; Ward et al. 2018). Within local societies, the impacts of conservation actions are also felt differently across classes/castes, ethnicities, and gender, with benefits normally accumulating towards affluent members of the society while costs mostly affecting the poorest faction with the least power (Holmes 2007; Dawson et al. 2018). For example, wealthier households can take more risks violating rules (i.e., paying fines) and negotiate permissions for access to PAs, while poorer households cannot, leading to unequal land ownership close to PAs (Dawson et al. 2018). As a consequence, poorer households may resent PAs and associated rules and demand more transparency about land allocation (Dawson et al. 2018). Inclusion of this feedback into adaptive co-management processes would be a step towards a higher level of equity. In turn, this can increase conservation effectiveness.

At larger geographical scales, PAs in Africa and southern Asia led to higher displacement of local communities than in other regions (Oldekop et al. 2016). Similarly, more conflict was associated with PAs in Africa, southern Asia, South-East Asia, and Oceania than other geographical regions (Oldekop et al. 2016).

Recognizing the importance of social equity for successful long-term implementation of conservation actions, the Convention on Biological Diversity states that PAs should, at the minimum, not negatively impact local communities or they should be compensated, but ideally lead to reduction in inequity (CBD 2010). However, a recent analysis suggests that challenges remain in connection to loss of rights over natural resources, inadequate access to mechanisms solving disputes, and lack of transparency of decision-making (Zafra-Calvo et al. 2019). Further, in both community-managed and strict conservation PAs, actions taken to mitigate burdens associated with PAs were considered inadequate to achieve equitably managed PAs (Zafra-Calvo et al. 2019). Finally, geographical differences in transparency and rights existed at the continent level with rights performing best in Europe and worst in Africa and Oceania (Zafra-Calvo et al. 2019). These results suggest that more work is required to fully integrate equity into conservation decision-making processes and implementation. Doing so will further contribute to close the gap as conservation implementation is expected to be more widely accepted if societal groups directly affected by these actions are offered alternative livelihoods and income.

15.2.3.3 Gender

As mentioned above (Sect. 15.2.3.2), different societal groups may be disproportionally affected by conservation action and excluded from decision-making processes; thus, ignoring the potential for these groups to aid in successful implementation of conservation strategies and understanding the way these groups use resources (Cook et al. 2019; de la Torre-Castro et al. 2017). In many rural communities, men are the predominant decision-makers over natural resources (e.g., forests, fisheries, etc.) with women having no or very limited influence (Coleman and Mwangi 2013). Paradoxically, behavioural research into gendered decision-making suggests that women, on average, are seeking more equality and are more willing to share than men (Cook et al. 2019; Eckel and Grossman 1998).

There is a lack of knowledge concerning gender aspects in natural resource management and conservation, but it is increasingly becoming apparent that men and women are holders of different knowledge and expertise (Arora-Jonsson 2014; de la Torre-Castro et al. 2017; Kleiber et al. 2015). For example, in coastal areas of Zanzibar, men know more about fishery-associated ecosystem services than women while women know/value more the oxygen production of coastal forests than men (de la Torre-Castro et al. 2017). This can be at least in part explained by labour divisions between the genders, with men being more involved in fishery activities while women mainly work near the coastline and forest (e.g., seaweed farming and collection of firewood). This introduces also a spatial divide of knowledge that can influence the outcomes of conservation actions if not properly identified and addressed (de la Torre-Castro et al. 2017). Therefore, in order to implement holistic conservation action, it is critical to collect local knowledge of both men and women.

Gender has also emerged as one of the most central stratifying factors influencing vulnerability to climate change and natural resource use (Call and Sellers 2019; Yadav and Lal 2018). Intersectionality of gender and other factors (like poverty, discrimination, geography, race, health status, and education level) need to be considered to gain a better understanding into the impacts of gender issues on the success of conservation actions (Arora-Jonsson 2011; Call and Sellers 2019) and their role in widening the knowledge–implementation gap. This is not to say that men and boys do not face challenges but to emphasize that in order to achieve equity for all members of society it is important to consider specific circumstances of individuals or societal groups like gender.

This non-exhaustive list of examples shows that there is an urgent need to plan conservation and sustainability programmes that consider gender and intersectionality in their designs. Some initiatives to reduce greenhouse emissions have introduced gender quotas with the aim of achieving gender balance to increase equal rights and benefits from decision-making of collective payment for ecosystem services (PES) interventions (Cook et al. 2019). Payment for ecosystem services interventions target collectively owned forest, which is forest owned by communities rather than individual owners. However, collective payments may lead to inequalities in benefit-sharing and more research is needed to understand how this hinders long-term conservation implementation. In a randomized experimental field trial, in which 440 forest users from Peru, Tanzania, and Indonesia participated in a hypothetical scenario of a collective payment that should be distributed among the collective owners, a balanced gender quota of 50% was introduced. This resulted in an increased decision-making towards reduced deforestation by about 50% and increased benefit-sharing in groups that had a gender-balanced group composition in comparison to groups with fewer women.

15.3 Ways Forward

The compilation of perspectives and case studies included in this book has provided an opportunity to assess the different dimensions of the knowledge–implementation gap in conservation science around the globe and identify potential ways to bridge it. Moving forward, it will be important to continue studying the gap in order to understand it increasingly better and to enable more targeted and informed actions to close this gap. This book has offered a baseline and a functional framework for future work on the gap while suggesting a plethora of research directions that could contribute to further close it. Raising awareness of the gap and educating the newer and future generations of conservation scientists in how to address it creatively and across socio-economic and cultural contexts will require substantial investment (financial and human capital) that needs to be prioritized by public ventures and mobilized also by involving the private sector. Ultimately, closing the gap will only be possible if there is enough adequately trained capacity to integrate various co-generated knowledges through a multitude of ways involving different

perspectives and package it in a format that is useful and accessible for environmental decision- and policy-making. To build this capacity, cross-sectoral and interdisciplinary role models and mentors, who currently work at various intersections and who can guide the newer generations into effective and honest knowledge brokerage, will be instrumental to motivate more and more individuals to become a part of this movement. This is of particular importance because knowledge generation in conservation science is moving further and further from academia to governmental organizations and NGOs, leading to a diversified landscape that offers new opportunities but also requires new and comprehensive skillsets. In the Anthropocene, the co-creation and brokering of several forms of knowledge and the ability to turn it into narratives with implications for environmental decision-making and policy will have to become the norm if we aspire to overcome the biodiversity crisis.

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