9 Conclusions

Ecosystems are being degraded or destroyed at an alarming rate, jeopardizing their vital services, including food, water, clean air, soil, and forests (Daily & Matson, 2008; Millennium Ecosystem Assessment, 2005). In response, various green initiatives, including payments for environmental services, have been developed and implemented for decades, providing incentives to various stakeholders (e.g., ecosystem service providers, landowners, or users in most cases) to take actions or to refrain from harmful actions. In the domain of generic conservation policy, scholars have started to consider policy coordination among a mix of policies (i.e., a policy-mix), which may include command-and-control (e.g., protected areas), economic incentives in the form of cash transfers (e.g., payments for environmental services), and capacity building (e.g., forest management support and community enterprises) policies. Surprisingly, concurrent green initiatives, especially the spillover effects, have seldom been addressed. Consequently, green initiatives are rarely coordinated with one another despite the increasingly recognized need to do so. In this book, we collected data from sites or countries worldwide to demonstrate the urgency of this largely overlooked phenomenon.

9.1 Green initiatives worldwide

We examined empirical data for concurrent active green initiatives worldwide in this book. The geographic scopes of these green initiatives range from global scale (e.g., the Green Climate Fund and the REDD+ program) to continental scale (e.g., European Green Deal) to national scale (e.g., the CRP in the USA and the GTGP in China) and local scale (e.g., the Jordan Lake water quality in North Carolina, USA). Many of the green initiatives we identify have concurrent green initiative(s) that are being implemented simultaneously at the same location and/or benefiting the same people. Each of these green initiative policies aims to change some behaviors of the stakeholders to gain the desired outputs. The changes in the behaviors range from increase or maintenance of an existing positive behavior (e.g., planting more trees or maintenance of existing tree cover), to the reduction of harmful behavior (e.g., using fewer fertilizers or pesticides), to stimulating a new positive behavior (e.g., diversifying livelihood options to reduce reliance on

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natural resources). Diverse policy environmental outcomes are sought from these green initiatives, including enhancement of carbon sequestration (e.g., the global REDD+ program) for global warming mitigation, habitat preservation for biodiversity conservation (e.g., Australian environmental planting program), soil and water conservation (e.g., China's GTGP program and the US CRP program), and water quality improvement (e.g., the US EQIP and the N and P reduction program in the Baltic Sea).

The *Policy–Behavior–Goal* scheme designed in one policy may have hidden spillover effects on the *Policy–Behavior–Goal* of another concurrent green initiative during policy development and implementation stages. Some hidden spillover effects are synergistic, i.e., implementation of one green initiative helps the other initiative achieve its goals, whereas other hidden spillover effects are deleterious, i.e., implementation of one green initiative compromises the other green effort achieving its goals. Moreover, such interactions are multi-faceted and complex. Both synergistic and deleterious interactions may exist among the same concurrent green initiatives. We must identify how these interactions happen to design new green initiatives that maximize the synergies among the existing green initiatives or cost-effectively fine-tune the existing concurrent green initiatives to gain the best desired environmental outcomes.

In the 26th Conference of Parties (COP 26) of the United Nations Framework Convention on Climate Change in Glasgow, Scotland, in 2021, the party recognized global warming as an existential threat to humanity. Many countries pledged more green initiatives to reduce carbon emissions or enhance carbon sequestration. The European Union rolled out the European Green Deal, which aims at reducing carbon emissions by 50% by 2030 and net-zero carbon emissions by 2050. The US government made a similar pledge, i.e., 50% carbon emission reduction by 2030 and net-zero carbon emission by 2050. A New Green Deal bill had been proposed in the US Congress to address climate change and sustainable development. Although the New Green Deal has not passed the US Congress as we write this book, the passage of such a bill in one name or another is a matter of time because there is no viable alternative sustainability mechanism. Unlike the previous 25 meetings, the developing countries also pledged to the carbon reduction target in COP 26. Two of the largest carbon emitters in the developing world, China and India, pledged to reach net-zero carbon emissions by 2060 and 2070, respectively. Moreover, more than 130 countries pledged to stop deforestation by 2030 at the 2021 global climate summit.

We can expect many new green initiatives in the coming decades to achieve the goals of the pledges made by various countries. These new green initiatives will inevitably interact with the existing green initiatives. The mechanisms of spillover effects among concurrent green initiatives we identify in this book are vital to designing cost-effective new green initiatives. By maximizing the synergistic spillover effects among the new green initiatives and minimizing deleterious ones, policymakers can design new green initiatives to achieve faster and cheaper emission reduction goals.

9.2 Losses and gains in concurrent green initiatives

The no-spillover presumption is prevalent in an era of global change when "[t]he biosphere, upon which humanity as a whole depends, is being altered to an unparalleled degree across all spatial scales", according to the most recent IPBES report (IPBES, 2019). One example of such global change is species extinction, which is occurring at an alarming rate that far outpaces losses in the fossil record, which—if not averted—will likely lead to the Earth's sixth mass extinction (Hooper et al., 2012). In response, governments and non-government organizations have committed considerable resources worldwide to combat such global change through various agreements such as the Convention on Biological Diversity (CBD) and United Nations Sustainable Development Goals (SDGs). Under the no-spillover effect presumption, conservation efforts have rarely been coordinated among programs and/or agencies despite the increasingly recognized need (Barton et al., 2013; Ezzine-de-Blas et al., 2016). This defect, and other deficiencies, such as inadequate finance and poor institutional arrangements, may account for many "non-optimistic outcomes" of the SDG and CBD endeavors (Quétier et al., 2014). For instance, the 2010 CBD target was not achieved (Waldron et al., 2017), and the 2020 Aichi biodiversity targets were not accomplished (Secretariat of the Convention on Biological Diversity, 2020, p. 5).

Our conceptual green initiative analytical framework (Figure 1.3) aims to uncover spillover effects among concurrent payments for ecosystem services, improving the effectiveness of conservation payments, programs, or policies. Our analysis under this framework testifies against the prevalent no-spillover effect presumption, suggesting that essential relationships exist among concurrent green initiatives—and very likely among many (if not all) other types of concurrent conservation efforts worldwide. With such hidden spillover effects made explicit, scientists, conservationists, policymakers, and other stakeholders will be able to track the cascading co-benefits or hidden losses of specific conservation policies or payments. For instance, implementing FEBC payments has likely generated 8.25% and 8.87% more GTGP land enrollment between 2000 and 2010 at Fanjingshan and Tianma reserves, respectively (Section 5.4). Extrapolating the average rate (8.56%) to the whole country due to their spatial concurrency in China (Table 4.1), China should have gained 6.93 million ha "additional" GTGP farmland as an FEBC-induced co-benefit, which could have translated (conservatively) to 1,435,850 million metric tons of carbon sequestration per year.

However, if implementing a hypothetical GTGP policy (see Section 8.8 for *Time–Time* spillover effects), the FEBC payments will likely reduce possible enrollment in GTGP by 0.1653 million ha, corresponding to a reduction in carbon sequestration of 503,173 million metric tons (Section 5.4). In the USA, the Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Program (CRP) have coexisted since 2002 as concurrent payments for environmental services (PES) programs (Chapter 3), bearing a considerable overlap in their goals: preserving water, soil, and wildlife habitat. Between 2020 and 2022, a total of 12.4 million acres of CRP land will expire (United States Department

of Agriculture & Farm Service Agency, 2019), accounting for a total of US$1.01 billion in annual CRP payments assuming that a total yearly CRP investment of US$2 billion (USDA Farm Service Agency, 2016) and CRP acreage of 22,609,492 (United States Department of Agriculture & Farm Service Agency, 2019). However, the US House Agriculture Committee passed the 2018 Farm Bill, which "allows a landowner to enroll in EQIP during the last year of a CRP contract". Aside from ignoring a reported offsetting spillover effect (i.e., EQIP payments decrease CRP participation), this decree might also open the potential for "double-dipping" as occurred in the Neuse (North Carolina, USA) case.

Spillover effects between green initiatives appear to be prevalent globally (Tables 1.1–1.3), generating substantial negative and positive consequences. Surprisingly, such effects were primarily ignored in green initiative policymaking and implementation. In both academia and conservation practice arenas, there have been many calls to explore the connections between policies (e.g., policy-mix and policyscape (Ezzine-de-Blas et al., 2016)), between different regions (e.g., telecoupling (Liu et al., 2013)), and between multiple goals (e.g., impacts of the intervention on non-targeted services (Naeem et al., 2015)). There existed literature to call for links between policy designs (e.g., avoiding oversimplified design and implementation (Wunder et al., 2018)) and the bundling and stacking of relevant payments for environmental services (Gren & Elofsson, 2017; Program Evaluation Division, 2009). Surprisingly, concurrent green initiatives are rarely coordinated with one another (Barton et al., 2013; Ezzine-de-Blas et al., 2016).

Examining and leveraging such spillover effects should uncover hidden losses or undocumented co-benefits. Doing so may help reduce the negative impacts on the environment due to budget cuts. If scientists can identify significant co-benefits of green initiatives such as the Green New Deal, lawmakers may have better standing to defend them. Similarly, green initiatives with significant negative spillover effects can be successfully suspended.

9.3 Why is there no attention to spillover effects

The no-spillover presumption, along with the corresponding green practice, has surprisingly coexisted for a long time with an emerging literature that calls for exploring connections between policies (e.g., policy-mix and policyscape (Ezzine-de-Blas et al., 2016)), between geographic areas (e.g., telecoupling (Liu et al., 2013)), and between PES designs (e.g., bundling and stacking (Gren & Elofsson, 2017); Program Evaluation Division, 2009).

The existing literature does not fully recognize the existence of concurrent green initiatives (e.g., PES programs), although policies (regarding payment schemes) are usually embedded with other policy tools known as policy-mixes (Börner et al., 2017; Yost et al., 2020). The spatial representation and expression of a certain policy-mix, named a policyscape, have received attention in the last decade because the capacity of a policy-mix to achieve various goals depends on the degree to which policies within the policy-mix align with one another spatially

(Barton et al., 2013). Barton et al. used a case in Norway to assess the spatial distribution of forest policies and argue why such a spatial representation can help more efficient planning. Ezzine-de-Blas et al. further developed the concept of *policyscape* to study the spatial and temporal articulation of the Mexican PES with other policies such as agricultural incentives and protected areas (Ezzine-de-Blas et al., 2016). They found some coordination between projects within the same agency but little coordination between agencies.

The paucity of studies on exploring and testing the spillover effects among concurrent green initiatives may stem from the following three aspects: the lack of general framework, the lack of policy design with more than one tool taken into account, and the lack of data and methodologies for examining such concurrent programs.

First, it is in dire need to review the existing knowledge on concurrently implemented programs to better frame and test the theoretical understanding of the concurrent programs with their spillover effects. Previous studies have rarely recognized the hidden spillover effects between the policies, the behavioral changes the policies intend to incentivize, and the potential achievement of goals or gains resulting from the changes in policies and/or behavioral patterns. The interactions across institutional, socioeconomic, and ecological scales are largely missing in the current literature for evaluating the policy outcomes, making the modeling effort incomplete.

Second, there is a lacuna in designing concurrent policies or programs from a governmental perspective. Policymakers often treated one single policy as a tool independent from others; even these programs targeted the same regions or involved the same group of recipients. For instance, in GTGP and FEBC, the design of the enrollment of farmland to forest under the GTGP seldom considered how farmers change their activities to use natural forests under the protection of FEBC in adaptation to the loss of farmland. Case studies in Tianma and Fanjingshan (China) found strong evidence that participation in FEBC increases the likelihood of participation in GTGP (Chapters 5 and 6). Furthermore, few studies adopted methodologies specific to the investigation of the interrelationships between concurrent programs, making available data scarce to examine spillover effects. The lack of panel datasets with baseline information for policy evaluation likely increases the difficulty of assessing more than one program. Although spatial data such as satellite observations may overcome this limitation, socioeconomic data that are often obtained from household surveys require much more effort to fully capture the cross links along the *Policy–Behavior, Behavior–Goal,* and *Goal–Policy* pathways and the evolving effects through time.

Taking biodiversity conservation as an example, conserving biodiversity requires the integration and synergy of many policy instruments in a "policy-mix" because environmental issues often have a mix of values and externalities that are addressed individually and separately in policy frameworks. Policy-mix is defined as "a combination of policy instruments which has evolved to influence the quantity and quality of biodiversity conservation and ecosystem service provision in public and private sectors" (Ring & Schröter-Schlaack, 2011). These mixes seek to build upon or complement existing regulatory, economic,

and informational instruments across multiple objectives in addressing multiple and compounding factors contributing to environmental problems (Ring & Barton, 2015). Assessing the efficacy of PES programs to achieve biodiversity goals contains some level of uncertainty, where a PES policy instrument or a mix of instruments often amplifies similar goals from different angles (Ring & Schröter-Schlaack, 2011). The focus of policy-mix analysis is often to identify the most effective instruments and examine the role of individual policies in the mix, examining complementary combinations, counterproductive combinations, sequencing instrument combinations, and context-specific combinations to work apart from the networked character of implementing policies across levels and scales (Ring & Barton, 2015). Ring and Barton (2015) argue that overlap or redundancy of instruments can increase resilience. There is uncertainty about policy efficacy for biodiversity conservation, deeming this overlap as precautionary rather than inefficient (Barton et al., 2011; Ring & Barton, 2015; Ring & Schröter-Schlaack, 2011). However, these overlapping programs do not always have better effectiveness for conservation.

Furthermore, multiple issues involve complex systems of multi-level multi-actor governance where policies are created at different scales which address the same issues utilizing different forces of organizational power. For example, heavily subsidized agricultural or infrastructure investments may negatively impact biodiversity, leading to policy failure. The failure can be addressed through subsidy removal as an element of the policy-mix (Ring & Schröter-Schlaack, 2011). For example, Kubo et al. (2019) performed research highlighting the need to dissect the interactions between environmental, economic, and business development-related instruments into a multi-stakeholder policy-mix to mitigate anthropogenic disturbances on the national park conservation in Indonesia (Kubo et al., 2019). Gebara et al. (2019) addressed a "landscape approach" to tropical deforestation with diverse interactions between the natural and social space, commenting on the ineffectiveness of command-and-control policies, indicating that the failures were in ignoring cross-linkages in forestry, culture, conservation, and social development, highlighting an example from REDD+ in the Amazon (Gebara et al., 2019)

When applying a mix of policies across a landscape, where spatially explicit decisions are to be made, the term "policyscape" is applied (Barton et al., 2011, 2013). When considering the spatial distribution of policy on the landscape, there are many challenges in translating national and global level policy to the local land at subnational levels because of the uneven distribution of conservation priorities and economic sectors such as wildlife, forestry, and agriculture that may have higher costs than others (Ring & Barton, 2015). Evaluations for green initiatives—PES programs, for instance—have included prospective analyses using site selection models and post-assessment analyses using impact evaluation methods, which generally include spatially explicit features of the policy-mix, such as policy rights and financial incentives, to understand the cost–benefit scenarios of effectiveness (Barton et al., 2011). For example, studies investigating forests with high conservation value in Norway have shown that spatially overlapping policy instruments protected some types of forests between multiple policies, and other

areas of high biodiversity value were not covered at all (Sverdrup-Thygeson et al., 2014). Another study investigated whether multi-level policies implemented by multi-stakeholder groups meant to address protecting forests of high deforestation risk were efficient or not, having operated in overlapping regions, finding that communities with large forests and low deforestation risks were actually enrolled, not areas of high deforestation risk, with some policies in the mix doing a better job than others in addressing the deforestation risk (Ezzine-de-Blas et al., 2016).

9.4 Outlook

Hidden spillover effects among concurrent green initiatives are prevalent worldwide despite geographic region, size, urban–rural gradient, developed–undeveloped spectrum, PES funders, payment stacking types, and so on. However, categorizing, detecting, and accounting for such spillover effects have a long way to go. The identified spillover effects in all selected cases are only a tiny subset of all potential ones, and except for the Fanjingshan and Tianma cases, all the spillover effects discussed herein were uncovered by researchers unintentionally. Uncovering these spillover effects remains difficult, if not impossible, in many other instances when spillover effects are not intentionally explored—as in the case of the Yucatán and Chiapas, where too many "no-data" records prohibited further exploration of the positive yet insignificant ($p = 0.14$) spillover effect.

Henceforth, our aim in this book is to raise awareness of the surge of concurrent green initiatives, paying attention to spillover effects that are often hidden or overlooked, even in many seemingly "successful" green initiatives worldwide. We call for robust scientific research on the magnitude, direction, and integrated effects of such hidden spillover effects, and the corresponding mechanisms and socio-ecological consequences. Such knowledge might provide crucial insights into many theoretical and practical issues in green initiative design, implementation, and evaluation. Also, such knowledge should be instrumental to maintaining many ecosystems and their vital life-support services (Díaz et al., 2019).

Global green initiatives face many theoretical and practical challenges—opportunities at the same time—in an era when "[t]he biosphere, upon which humanity as a whole depends, is being altered to an unparalleled degree across all spatial scales" (IPBES, 2019). By leveraging the widespread yet hidden spillover effects, governments and other relevant organizations can make these green initiatives more resilient to socioeconomic and biophysical crises such as the COVID-19 pandemic, effectively sustaining the environment.

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