Chapter 27
Conclusions: Challenges and Opportunities in Implementing Biodiversity Islands

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Abstract This concluding chapter presents the lessons learned from the chapters in the four previous parts of this book: (I) Introduction; (II) Biodiversity Islands Establishment and Management: Challenges and Alternatives; (III) Biodiversity Islands Across the Globe: Case Studies; and (IV) Safeguarding the Environmental, Social, and Economic Benefits of Biodiversity Islands. Constraints limiting the adoption of Biodiversity Islands (BI), include conceptual, biophysical, economic, political, social, and cultural factors. Opportunities for increasing the implementation of BI are presented, particularly chances for working with groups from private conservation initiatives, such as those representing local communities, indigenous peoples, and conservation organizations. Examples of policies promoting agroecology are discussed, as well as current trends in conservation which support the BI concept. Despite the challenges posed to BI, local motivation, political will, and the right educational campaigns, can allow economically prosperous human communities and biodiversity to thrive harmoniously within shared landscapes. Many international efforts are currently underway, creating sustainable and dynamic BI within human-dominated environments. BI are a critical strategy for conservation in the twenty-first century while having the added benefit of contributing to climate adaptation and resiliency solutions. This book serves as a tool for policy makers, practitioners, and researchers interested in increasing the implementation of Biodiversity Islands.

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F. Montagnini (ed.), *Biodiversity Islands: Strategies for Conservation in Human-Dominated Environments*, Topics in Biodiversity and Conservation 20,
https://doi.org/10.1007/978-3-030-92234-4_27

Keywords Agroforestry · Biodiversity conservation · Community action · Ecosystem services · Indigenous communities · Private reserves · Social-ecological systems

27.1 Introduction

There are common claims of a "sixth mass extinction" happening today with the loss of species currently at a rate at least 1000 times the background rate (Pimm et al. 2014; Pimm 2021). The direct causes include the loss of habitats, the introduction of invasive exotic species, over-harvesting of biodiversity resources, and homogenization of species in agriculture. The common factor of all these elements is that they are mostly human-driven. The economic and social root causes behind biodiversity loss, include demographic changes, overconsumption and production patterns, economic growth, macro-economic policies and structures, social change, and development (https://www.greenfacts.org/en/global-biodiversity-outlook/l-3/6-threat-biodiversity.htm., https://www.cbd.int/).

Worldwide, industrialized agriculture grows at the expense of natural areas such as forests and savannas, for example through "invading" forests to grow soybeans in Latin America and palm oil in Indonesia. Commercial agriculture generated nearly 70% of deforestation in Latin America between 2000 and 2010 (FAO 2015a; Martin 2020). Southeast Asia, the region in the world that has suffered the greatest rate of deforestation, lost 30% of its forest cover over the last 40 years (Afelt et al. 2018). Tropical cloud forests, one of the world's most species- and endemism-rich terrestrial ecosystems, are threatened by direct human pressures and climate change, with substantial species losses worldwide, especially in readily accessible places (Karger et al. 2021, Newcomer et al. 2022).

Human population as well as per-capita resource consumption are expected to continue to rise, driving expanded urbanization, land use change, increased demand for agricultural land, and deforestation related activities such as unsustainable logging and mining. Industrial agriculture, focused on maximizing production through monocultural cropping engineered to provide maximum yields, continues to expand. However, it is dependent on advanced plant breeding, specialized (and costly) machinery, and agrochemicals for fertilization and control of weeds and pests. This approach contaminates and depletes agricultural soils, resulting often in soil degradation (Bern 2018). The planet is losing ~0.3% per year of its capacity to produce food due to soil degradation, currently jeopardizing the food and nutrition security of one third of the world's population (FAO 2015a).

Deforestation is linked to increased agricultural areas and poorly managed urban growth (Afelt et al. 2018). As forest ecosystems and their habitats are lost, displaced organisms along with their pathogens move from forests to anthropic environments and from animals to humans, thus creating breeding grounds for the emergence of new diseases. The COVID-19 pandemic is a call for attention to the fact that production models prevalent today are contributing, in multiple ways, to this health emergency (Martin 2020).

The "One Health" concept recognizes that human health is connected to animal health and to the environment (Afelt et al. 2018). The modern incursion of humans into the forest, involving changes to natural ecosystems, causes imbalances and frequently leads to the appearance and spread of zoonotic diseases and even pandemics like COVID-19. The main routes of transmission of zoonosis differ widely according to the specific underlying factors leading to emerging infectious diseases (Loh et al. 2015). This knowledge can be used to develop more effective strategies for controlling newly emerged diseases, taking into account the different underlying pressures leading to land use change.

Anthropized rural environments are characterized by a wide diversity of landscapes comprising houses, barns, fields, orchards, and woodlands of differing density, and can provide an acceptable habitat for a large range of small animal species which can carry a variety of pathogens next to human dwellings (Afelt et al. 2018). Anthropized rural environments are also likely to increase human exposure and risk of contracting insect-borne diseases, particularly as changing climate conditions facilitate expanded ranges for disease carrying insects in the tropics. Thus, it is crucial to educate and raise awareness about the risks associated with anthropized environments (Afelt et al. 2018).

The advance of industrialized agriculture also threatens the traditional production systems of indigenous peoples, local communities, and small and medium-sized producers that underpin agriculture. These traditional systems and smaller producers provide food for 70–80% of the world's population, as well as the collection of ancestrally associated knowledge, the preservation of genetic diversity and its territorial management systems (FAO 2015b, 2019; Gadgil et al. 2021; Montagnini and Berg 2019; Pimm 2021). Growing concern about the food and nutritional insecurity of much of the world's population, together with the impacts of the COVID-19 pandemic, have led to the inclusion of this problem in the international political agenda. To this end, it is important to promote alternative ways to produce food, as have been presented in several chapters in this book, e.g. Calle et al., González et al., Levin (a), Montagnini et al., Montagnini and del Fierro, Montes-Londoño et al., Painter et al., and Toensmeier. We must focus on more sustainable agricultural techniques, including regenerative agriculture, to produce food without depleting soil and damaging the climate (Bern 2018). We need a revaluation of traditional cultivation practices which for hundreds of years have given sustainment to local peoples (and continue to do so) with diverse, nutritious, and culturally appropriate foods (Gadgil et al. 2021; Pimm 2021). Likewise, it is important to promote the use of biological controls that can gradually replace the toxic chemicals that are now used in industrial agricultural systems.

It is possible to reconcile agricultural production with biodiversity conservation, when nature is part of human-dominated landscapes, truly sharing space by virtue of coexistence (Calle et al. 2022; Crespin and Simonetti 2019; Levin 2022a; Montagnini and del Fierro 2022; and other chapters mentioned above). Sustainable agricultural management techniques geared toward harmonizing ecosystem productivity and biodiversity conservation can contribute to mitigating or reversing detrimental effects of human impacts on landscapes while ensuring that agricultural productivity can meet the needs of human inhabitants for generations (Montagnini and Berg 2019; Montagnini et al. 2022). To face these issues, today's environmental, social, economic, and political circumstances require innovative responses that are appropriate to the emerging conditions (Berlyn 2021; Mc Neeley 2021).

Biodiversity islands (BI)—ecological refuges where plants and animals thrive without major interference from human activity—can contribute to the provision of ecological, economic, and social benefits at the ecosystem, landscape, and global levels. They can exist in an assortment of human-dominated landscapes (e.g., agricultural, wetland, urban) ranging in size from square meters to many square kilometers. In the following sections we summarize examples presented in this book of BI from throughout the world, discuss their challenges, and suggest viable alternatives in their implementation and management at each scale.

27.2 Key Messages from This Book

27.2.1 Part I, Introduction

The first part of the book establishes the framework for understanding the complexities of biodiversity islands and the variety of strategies that can be used to establish them. The Introduction defines the term "biodiversity island" (BI) as a unique type of ecological refuge whose design depends on its purpose, as well as on the spatial distribution of reserves throughout the landscape, degree of landscape degradation, species present, and location within the urban-rural spectrum. BI can contribute to the ecological strength of a land area and make local agricultural areas more resilient, for example by converting them into agroforestry systems (AFS) using various agroecological strategies. Land use systems in a forestry matrix, as in many indigenous sacred sites and AFS, can also be part of BI.

27.2.2 Part II, Biodiversity Islands Establishment and Management: Challenges and Alternatives

Design strategies for BI depend on landscape use within the matrix of habitat fragmentation. Integrated landscape management (ILM), including sustainable agriculture, agroforestry and community led action, may provide a framework for implementation of BI in complex landscape matrices. An experiment evaluating edge effects by Arroyo-Rodríguez et al. (2022) shows that natural forest patches of all sizes can benefit the ecosystem, and even small patches are valuable for conservation of forest-specialist species. The next chapters discuss AFS strategies, including regenerative agriculture, the integration of agricultural productivity and biodiversity conservation, silvopastoral systems (SPS), incorporating reforestation into livestock farms, and riparian buffers, which safeguard aquatic and riparian environments from harmful agricultural practices. These techniques can lead to agricultural systems containing significantly higher biodiversity than the surrounding area, showing that BI can exist in protected areas as well as in human-managed landscapes. However, the right species should be reintroduced to a landscape during restoration. The section concludes with a chapter by Eibl et al. (2022) stressing the necessity of seed source certification to ensure the quality of genetic material and species reintroduced to a landscape during restoration.

27.2.3 Part III, Biodiversity Islands Across the Globe: Case Studies

The third part presents a total of 11 case studies where varied agroecological strategies were applied in the formation or conservation of BI in human-dominated landscapes. These case studies include (1) forest islands surrounded by flood-prone savannah-dominated landscapes of Paraguayan Chaco utilized for livestock production; (2) secondary forests that have persisted in the highly deforested landscape of the Ucayali region of the Peruvian Amazon; (3) the integrated network of conserved areas in Monteverde, Costa Rica which facilitate species movement across BI; (4) El Hatico Nature Reserve, a model of restoration and utilization of agricultural practices for sustainable production surrounded by a largely monoculture Colombian landscape; (5) Hacienda Pinzacuá, a restored, regenerative agriculture farm in the surrounding treeless central Andes of Colombia; (6) small persisting biodiverse land patches in the British countryside; and (7) the resilient islands of Las Rosas in the Argentinean humid pampas which represent an opportunity to propose diverse agroecosystems and develop local productive and economic strategies. Case studies focused on conservation in urban landscapes include: (8) residential gardens of Panama City; (9) the urban forests and peatlands of Ushuaia, Argentina; and (10) the perennial garden of Paradise Lot in the U.S.A. (Toensmeier 2022). The section closes with a case study (11) describing experiments to attain high genetic diversity in BI in Misiones, Argentina (Niella et al. 2022).

Techniques are discussed for raising livestock in landscapes vulnerable to risks from extreme weather or human-caused encroachment. Through extensive or semi-extensive livestock production or use of live fences, livestock's impact on the landscapes were minimized to allow for the conservation of BI. There may be benefits but also limitations in the use of BI for promoting species migration, leading to efforts to connect islands and allow species to travel greater distances. Where BI are surrounded by monoculture farms or treeless landscapes there may be ecological and economic benefits that they can provide to those regions. Even in urban landscapes BI can be havens for species and nodes in an interconnected network of land patches that allow wildlife to travel and prosper.

The variety of case studies from different types of landscapes from several regions of the world reveals the role BI play in conserving local flora and fauna that has been largely diminished by anthropogenic activities. In addition, these case studies show how these BI are able to strengthen or increase the genetic diversity of a human-dominated landscape, as shown by Niella et al. Furthermore, there are human-centered benefits in BI, from providing a deeper cultural connection to nature to supplying ecosystem services that make BI profitable to farmers and nearby communities.

27.2.4 Part IV, Safeguarding the Environmental, Economic, and Social Benefits of Biodiversity Islands, and Part V, Conclusions

These final two parts of the book further detail the economic, social, political, and cultural aspects of the establishment and persistence of BI in anthropogenic landscapes. A variety of strategies can be used to establish BI, including local laws and legal tools, monetary aid and other financial resources, and local culture, particularly of indigenous communities. All these strategies rely on community-led action to contribute to the development and subsequent management of BI. Different community members' perspectives towards their local ecosystem provide further insights into the deciding factors or various motivations for conservation. For example, the priorities, perspectives and use of a community forest by the people living around Mayagüez, Puerto Rico, led them to be willing to protect the natural forest for its services. In general, community forests are important for protection of lands, reduction of deforestation, conservation of biodiversity, and carbon sequestration while providing socioeconomic well-being to those living around them (Morales-Nieves 2022).

The values that people assign to the forest contribute to its preservation as a BI within a rural-urban landscape, even if biodiversity is not the prime benefit. For example, sacred forests in Ethiopia have survived despite socioeconomic and political pressures increasing deforestation in the adjacent land area. These forests provide vital spaces for religious practice, as well as ecosystem services that contribute valuable resources to the community, further reinforcing the relationship between the community and the forest. Other case studies in Ecuador, Brazil and India underscore the importance of outside partners working directly with local communities when implementing conservation practices, as opposed to leaving local voices and knowledge out of the design process. The role of the community in conservation is further demonstrated through strategies for community-managed AFS that allow land reform to occur in a more sustainable way, maximizing social and economic returns while minimizing forest clearance in the cacao region of Bahia, Brazil.

Biodiversity islands can provide a variety of ecosystem services through the food and resources grown within them, with overharvesting prevented via proper regulation, as shown in the permit-based harvest of ginseng in Appalachian Mixed Mesophytic Forests in the U.S.A. The attitudes of farmers towards various agroecological approaches can determine what strategies farmers are willing to use in order to continue to benefit from their land, as shown in the research focusing on natural regeneration, reforestation and assisted natural regeneration as strategies to establish and maintain silvopastoral farms in the Azuero Peninsula of Panama. Moreover there may be tensions between the restrictions that government control may place on the relationship between the BI and the local community, as shown in Northern Ethiopia, and the positive role local community members can play in establishing and maintaining BI. Social-ecological systems need to be adapted to ensure that rural, restoration-based BI in the region can continue to flourish alongside more pluralistic and democratic political norms and institutions.

Biodiversity islands can provide valuable ecosystem services to the communities or farmers who choose to establish them, helping to maintain or improve productivity while also conserving local flora and fauna. BI should always be tailored specifically to the landscape, needs, and resources of the ecosystem to ensure they are effective at protecting native species and their genetic diversity. To ensure BI are enduring, however, the local community members must be allowed and encouraged to contribute to its design and maintenance. This leads to help people develop a more sustainable relationship with nature. In the remainder of this Conclusions chapter, the lessons learned are presented along with alternatives and suggestions for addressing some of the challenges to establishing or maintaining BI.

27.3 Barriers to Implementation of Biodiversity Islands

While BI offer a promising and practical option for conserving and restoring biodiversity across human-dominated landscapes, they are not without challenges. Several barriers to establishing and proliferating BI at scale have been recognized within the chapters of this book. Some of these are conceptual in nature, relating to theoretical pitfalls of this particular framework, while others have been gleaned from the specific challenges encountered within the case studies examined.

27.3.1 Conceptual and Biophysical

A key challenge in designing and managing BI, articulated first in this book by Montagnini et al., and later in several other chapters (Arroyo-Rodríguez et al. 2022, Clavo Peralta et al. 2022, Esbach et al. 2022, Kirby 2022, Laino et al. 2022, Negret et al. 2022, Santos-Gally and Boege 2022, to name a few), is the question of priorities and tradeoffs, many of which are inherent in any conservation approach.

Designing a BI for the protection of one target species may come at the expense of other species with different habitat requirements. Prescribing a specific BI design without considering its relative priority within the broader landscape or the value of alternative land uses that may be at stake can similarly lead to misguided planning or even undermine wider conservation objectives. BI must be designed and undertaken with careful attention to both broad and local contexts and objectives.

As a land-sharing approach, BI managers may feel pressure or criticism from both sides of the conservation-production spectrum: from one side that they do not do enough to support biodiversity requirements, while from the other side that there is too much conservation at the expense of production and human needs. A similar balancing challenge that applies to BI is what Sigman (2022) calls in her chapter the "Restoration Dilemma". That is, the need for restoration efforts, such as BI, to be highly site-specific and therefore resistant to scaling, while at the same time needing to be scaled up because of the magnitude of the challenge and the need for widespread adoption to realize their full potential benefits. These types of tradeoffs must be reckoned with in endeavoring to establish BI.

When planning BI, design and expectations may not always match with reality. For example with ancient woodland islands in the British countryside, as described by Kirby 2022, the extent and pattern of patches as perceived by researchers—i.e. what is mapped as woodland—may be smaller or larger than the actual patch size used by the species in reality. This may in turn influence the success of the BI.

Certain BI designs may involve specific ecological and physical parameters that prevent them from being replicated elsewhere. For instance, the urban residential gardens in Panama City detailed in Negret et al. occupy a unique proximity to a native forest patch that allowed for the gardens, though small, to function as BI. Efforts to establish similar residential gardens in other urban settings may not be as successful if they do not similarly benefit from a nearby native forest patch.

Designing and managing BI becomes even more difficult in the face of climate change. Newcomer et al. point out that there are many unknowns as conditions alter in the context of climate change, from whether biological corridors will or will not support species migration, to how climate impacts will affect the region's socioeconomic conditions, all of which have implications for the long-term sustainability of a BI.

27.3.2 Economic and Political

Beyond these conceptual and biophysical issues, real economic and political constraints also make BI implementation and management a challenge. As with other ecosystem services, while many of the benefits of BI are enjoyed broadly, the costs are private, potentially making it a less appealing option for land managers without an additional source of funding to compensate for opportunity costs or otherwise incentivize conservation over other land uses. The BI approach seeks to promote integrated land management, but it still faces challenges, similar to other conservation efforts, in competing with more productive, and often less biodiversity friendly, alternatives that may offer faster and, at least initially, more tangible returns.

Establishing BI may have high start-up and operational costs, especially where they involve more labor intensive approaches or ones with specific objectives like maintaining phylogenetic diversity, such as the projects described by Santos-Gally and Boege in their chapter on native tree islands within neotropical silvopastoral systems. The cumulative costs related to seed collection, germinating and transplanting seedlings, establishing a nursery, and then managing the tree islands for competition and protection from cattle were significant in the study and these costs may be prohibitive to other producers, especially those with limited resources. Some of these costs may be recouped in the long run from additional benefits from ecosystem enhancements, but the startup capital required for the initial transition may be a barrier.

Incentive programs themselves may require a minimum level of conservation before becoming sustained, viable approaches. The case study of American ginseng by Sheban is a good example of a promising regulatory conservation tool of permit-based harvesting. However, it can only be effective in supporting the understory ginseng in the BI if supplemented by simultaneous forest farming to sufficiently reestablish populations. Maintaining a BI may require a set of additional mechanisms to be successful, which may be a challenging configuration of approaches to orchestrate.

At a more macro level, the establishment of BI is often in competition with more intensive production systems that have the potential to influence prices or major infrastructure decisions, which in turn create path dependencies that may lock in these less sustainable alternatives. In Laino et al.'s case study of livestock production systems in Paraguay, major roads were being planned in anticipation of higher yielding commodity production in the region, further jeopardizing the prospect of BI establishment and maintenance. Once these types of large-scale investments are made that enable more intensive production systems, it can become even more challenging for a producer to change to a different type of production system not dependent on and often in conflict with such aggressive and intrusive incursions on the landscape.

Conservation decisions are inherently political, and in certain contexts, the political landscape may be even more complex than the biophysical ones. Sigman draws attention to the dynamics in Ethiopia's Tigray region where large scale government-led restoration projects resulting in unique BI enjoyed support from a political "monoculture", i.e., single party leadership, that is now losing favor as the country becomes politically pluralized. The success of the BI is complicated by the complex communal labor realities and motivations that enabled these projects and which may not be available going forward to support restoration, at least in their current form, as the political landscape changes.

Similarly, although the Jupará Agroecological Movement in Brazil demonstrated the feasibility of a unique agroecological model of land reform, its success may be limited to only its local context unless broader historical, geographic and biophysical drivers are accounted for and integrated into supportive public policies (Painter et al. 2022). If the model is not supported by a wider enabling environment, it may continue to only rely on limited and potentially unstable external funding and its potential to scale up to support large-scale conservation of natural forest will be constrained.

27.3.3 Social and Cultural

In addition to these economic and political barriers, cultural and social preferences and norms may sometimes create resistance to BI. Farmers may have different attitudes or preferences that hinder their willingness to try new approaches like BI, including risk aversion, unfamiliarity, or pressure from existing social trends. In Vásquez et al.'s chapter on farmer perceptions of forest restoration practices in Panama, the main management strategy preferred among farmers was land clearing for cattle. Farmers tended to prefer familiar options or ones over which they have more control, such as tree-planting, which was a well-known practice in the region due to its predominance among various restoration programs across the Azuero peninsula.

A related barrier is the lack of necessary information and knowledge dissemination. This applies not only to knowledge of new and innovative approaches or models of BI, but also of past practices. The latter was the emphasis in the chapter by Clavo Peralta et al., where subsequent waves of migration from various parts of the country resulted in varied land uses over time in the Ucayali region of the Peruvian Amazon. While earlier local communities passed along knowledge of different uses of the diverse species maintained in the remaining forest fragments, more recent settlers did not have that same knowledge and therefore undervalued conservation and opted for practices that were more reflective of their originating regions. Several chapters in the book emphasize the importance of indigenous knowledge in supporting BI (Levin 2022a, b; Esbach et al. 2022), but without proper record and dissemination of that knowledge, its relevance risks being lost.

González et al. (2022) have noted in their chapter that the challenge is not simply to influence individual farmers' preferences, but rather to facilitate a deeper structural transformation that would replace the existing paradigm of competition and economic profit with one centered on cooperation and relationships based on mutual solidarity and concern. Switching from conventional systems to more agroecological approaches requires "a completely different mindset" that surrenders control of nature in favor of learning from nature, as Montes-Londoño et al. (2022) describe in their chapter on a silvopastoral case study in the Colombian Andes.

Furthermore, the success of BI is often contingent on a variety of stakeholders coming together around shared, or at least congruous, goals. Baez Schon et al., referring to the sacred natural sites that serve as BI in northern Ethiopia, point out the need for support from different involved/interested groups (e.g. the church, nearby communities, government) if they are going to be viable alternatives in the face of increasing economic and sociocultural pressures. Newcomer et al.'s case study of the Monteverde Reserve Complex in Costa Rica similarly describes the storied history of the multiple local reserves and the various sets of actors who came to be involved in their establishment and management, including Quaker settlers, community-based organizations, NGOs, schools, international research scientists, farmers, and eco-tourism organizations. While the unique constellation of actors in these case studies created just the right context for establishing this BI, the reliance on diverse stakeholders may pose a challenge in sustaining the BI into the future, especially if priorities and needs shift in the face of new pressures.

Many of these barriers presented throughout the book are not unique to BI, but are in fact issues that have challenged various approaches to conservation and are present in any undertaking that seeks to bring together sometimes divergent ecological, social, economic, and political goals and dynamics. Nonetheless, these barriers are not insurmountable. As many of the case studies have shown, given the right incentives, support and enabling policies, barriers can be overcome and BI can be scaled up to support conservation and production.

27.4 Viable Alternatives and Opportunities for Establishment of Biodiversity Islands

27.4.1 Community-Based Opportunities

Biodiversity islands designed in partnership with local communities or indigenous groups can show the greatest potential for long-term success (Reyes-García et al. 2019). Social factors have been identified by restoration practitioners as having a far greater influence on the longevity of restoration projects than ecological factors, with multi-stakeholder engagement being the greatest challenge (Nerfa et al. 2021). For this reason, improving communication between policy makers, practitioners, and local communities is critical for improving BI implementation. Esbach et al. show that multi-stakeholder participation can be facilitated by intentionally integrating local partnerships and participatory research into conservation and development strategies. Participatory research can be fine-tuned to meet local needs while empowering communities to play active roles in developing solutions, demonstrating that the goals of local actors and BI are compatible.

Community based natural resource management can incentivize local communities to sustainably manage resources for their long-term availability, serving as an alternative to degradative cycles of exploitation. While community-based forestry generally has positive environmental and income related outcomes, it can sometimes inadvertently restrict the rights of communities to access forest resources (Hajjar et al. 2021). Structured engagement with local communities can help design projects that are more biodiverse, and also meet the needs of their multiple users (Dumont et al. 2019).

Forest and Farmer Producer Organizations such as community forestry user groups or producer cooperatives can help generate local support for sustainably managed BI. González et al. suggest that producer and consumer, or "prosumer", cooperatives, working across stakeholder levels, can help localized biodiverse agri-food systems. Community actors (both producers and consumers, among others) are the key to building locally managed agroecological systems. Levin (b) notes that cooperative business structures can also improve social outcomes such as farm-worker health and empowerment, core tenets of regenerative agriculture.

Education and capacity building are needed to further the implementation of BI globally. The chapter by Vásquez et al. (2022) shows that many rural farmers in Panama do not see assisted natural regeneration (ANR) as a restoration practice and therefore training farmers on the benefits of ANR could help scale up the restoration of degraded lands. Demonstration farms such as Hacienda Pinzacuá and El Hatico in Colombia, and Paradise Lot in Massachusetts, U.S.A. serve as examples of heightened productivity and ecological functioning, which can inspire other farms to adopt similar practices. Urban BI are also educational centers which can connect people to land and local ecosystems, from tropical Panama to the temperate Northeastern United States and Ushuaia, Argentina (Soler et al. 2022).

When working with local stakeholders, it is important to understand a community's diverse motivations for engaging in restoration and conservation, as demonstrated in different chapters of this book. Levin (b) notes that community-led action can be motivated by ethical, philosophical, scientific, cultural, and economic values. Morales-Nieves reveals that air quality and recreation were the highest priorities in an urban community forest in Puerto Rico. In Ethiopia, church forests are managed for their spiritual use (Baez Shon et al. 2022) but, as Sigman points out, the political "monoculture" may present a risk to restoration efforts sponsored by the political party in power. In Monteverde, Costa Rica, the local conservation movement is made more resilient by its many different motivations driving conservation (Newcomer et al. 2022). Painter et al.'s work in the Atlantic forest of Brazil shows that outside support can help BI meet community needs for production, conservation, and socioeconomic well-being when coupled with understandings of the motivations of community members, nuances of land tenure, and appropriate enabling conditions.

27.4.2 Current Restoration/Conservation Efforts Favoring Biodiversity Islands

In spite of financial and other constraints faced by restoration and conservation projects, many examples have recently been brought to our attention showing evidence of a current and increasing trend of BI implementation. Several of these efforts are nurtured along by non-government organizations (NGOs) with limited funding and by private individuals and entities whose sole motivation relies on their own vocation and desire to preserve nature. A recent trend for the resurgence of agroecology strategies and experiences, as mentioned by Levin (a, b) and in the chapters by González et al. and by Painter et al., contributes to harmonizing production with conservation and promotes the spread of BI. In this subsection, a few examples are presented which illustrate that the implementation of new BI is already happening and gaining momentum. Further support and guidelines to assist their management and persistence are needed.

27.4.2.1 Examples of Recently Launched NGOs and Private Restoration/Conservation Projects

Several business enterprises located in critical areas in need of solid conservation efforts, such as the Amazon, place a strong emphasis on biodiversity conservation while promoting restoration and sustainable agriculture practices, including agroforestry, to improve livelihoods of local people. For example, in the Ecuadorian Amazon, "Aliados" was formed in 2018 to build resilient community businesses based on supporting biodiversity in the Andes and the Amazon and to connect them to markets across the globe. Aliados restores and conserves landscapes in the Amazon rainforest along with local communities and in partnership with NGOs, private sectors and other key partners through promoting agroforestry and strengthening value chains (https://www.losaliados.org/). Their projects are located in the upper Napo Watershed in the Andes-Amazon foothills, in two critical ecological corridors at the crossroads of four National Parks composed of 150,000 hectares of megadiverse cloud and rain forest. They have designed their own Theory of Change, aiming towards reaching impact at the landscape level by combining their experience and network of community, corporate and philanthropic partners to build a regenerative agroforestry and restoration landscape for a fundamentally new model of doing business in the Amazon. Their actions contribute to the creation and maintenance of BI financed by their enterprise profits as well as from charitable donations and international funding.

Several recent efforts and initiatives worldwide to advance conservation have surged with the support of local conservation organizations and people. For example, the NRDC (Natural Resources Defense Council, https://www.nrdc.org), founded in 1970 by a group of law students and attorneys at the forefront of the environmental movement, is actively working on the 30x30 initiative: to prevent mass extinctions and bolster resilience to climate change, we must protect at least 30 percent of our lands, rivers, lakes, and wetlands by 2030. The 30x30 targets "...will help maintain global biodiversity, preserve the integrity of ecosystems on which we all depend, provide safe havens to help wildlife adapt to climate change, and sustain natural systems that store carbon, such as forests, mangroves, seagrasses, wetlands, and grasslands." NRDC is focused on achieving these goals while protecting diverse habitats, improving access for all people, and identifying and managing these areas in collaboration with indigenous communities (https://www.nrdc.org/30x30-nrdcs-commitment-protect-nature-and-life-earth). Their multifaceted strategy involves key areas of work in the United States and abroad. The Sierra Club and other international conservation organizations are joining this effort as well (Brett Levin, personal communication, May 2021).

A number of other recent private conservation projects have some alignment with the BI concept that we are promoting through this book. For example, Homegrown National Park is a grassroots organization in the U.S.A. calling for action to restore biodiversity and ecosystem function by planting native species and creating new ecological networks. Their mission is to restore biodiversity and ecosystem function, stemming from the realization that every human being on this planet needs diverse, highly productive ecosystems to survive. They are catalyzing a collective effort of individual homeowners, land managers, farmers, and "anyone with some soil to plant in…to start a new habitat by planting native plants and removing most invasive plants," claiming this represents the largest cooperative conservation project ever conceived or attempted in the country. Their goal is to reach 20 million acres (8,093,713 hectares) of native plantings in the U.S.A., an area that represents approximately half of the green lawns of privately-owned properties in the country (https://homegrownnationalpark.org/resources).

27.4.3 Private Protected Areas (PPAs)

Private Protected Areas (PPAs) are areas of land or water that fulfill the conditions to be considered Natural Protected Areas (NPA) by the IUCN and that are managed by private governance (Mitchell et al. 2018, https://www.iucn.org/). All over the world there are families, communities and organizations that have decided to do something to change the current loss of natural areas and biodiversity and have begun to protect watershed headers and habitats of threatened species, restore degraded areas, develop education strategies, and promote positive contact with nature, among other initiatives that transform the way we relate to nature. Some of them have used tools of voluntary conservation, such as PPAs, with a view to getting greater formality and legal security to their ventures (Monteferri 2019). These areas hold BI that need management guidelines to ensure their efficacy and persistence.

In recent decades, the voluntary conservation movement on private lands has grown in different parts of the world, contributing to address the loss of biodiversity (Roldán et al. 2010). For example, a study in South Africa showed that, if PPAs were considered within the protected area system, results on estimations of species diversity would almost triple (Gallo et al. 2009). The level of consolidation and growth of voluntary conservation movements vary depending on each region. The private conservation movement in Latin America has been growing in recent years. At the 2018 Private Conservation Areas Congress for Latin America, this increase was made evident with a total of 4152 protected areas covering 4,618,042 hectares (Monteferri 2019). In Peru, there are a total of 1.5 million hectares of PPA in the whole country, including different forms of private conservation: PPAs as well as conservation and ecotourism concessions. Around 70% of these areas are located in the Peruvian Amazon, combining different legal tools for private conservation (Carolina Butrich, NGO "Conservamos por Naturaleza", personal communication, April 2021, https://spda.org.pe/wpfb-file/acp-en-peru-301-pdf/).

Owners and managers of PPAs often suffer from financial, logistical and other difficulties which pose a threat to their conservation efforts, as manifested by Víctor Zambrano, personal communication, April 2021. He owns a PPA in the Peruvian Amazon and works in the "Comité de Gestión de la Reserva Nacional Tambopata" (Management Committee of the Tambopata National Reserve), located in Madre de Dios, Peru. For Víctor, the main challenge is for landowners to find ways to generate long-term value without having to decrease land productivity and ecosystem services.

Voluntary conservation plays a key role as it creates a culture of conservation and makes it more accessible to all citizens. When managing land with conservation as a major purpose, agroforestry, agrobiodiversity and silvopasture gain space in the face of monocultures; permaculture and agricultural biodynamics become more important than chemical fertilizers; organic farming eliminates pesticide use that is generating drastic decreases in insects in the world (Monteferri 2019). Owners of PPAs explore ways of managing from a perspective of custodians, seeing nature as an ally rather than an obstacle.

Given the multitude of complex social and ecological challenges, there is an urgency to take action, and conservation at local and regional levels takes on unique importance (Morton 2013). Leadership at the local level will play a key role in the decades to come, as interconnectedness facilitates the replication of local initiatives, with communities becoming increasingly more informed and eager to see change. Voluntary conservation allows volunteers, companies, farmers, families, schools and universities to be recognized, participate and collaborate in preservation, and facilitates respect of biodiversity at all scales. To ensure their persistence and successful management, tax benefits could be provided to PPAs along with some measure of compensation from other commercial interests that benefit from the carbon sequestration potential and other ecosystem services they provide.

27.4.3.1 Biodiversity Islands in Indigenous Territories

Land use systems made up of complex assemblages embedded in a forestry matrix, as is the case in many traditional indigenous sacred sites, agroforestry systems (Baez Schon et al. 2022; Gadgil et al. 2021), and indigenous territories can be considered BI in themselves, as explained in the Introductory chapter of this book (Montagnini et al. 2022). Known also as "Islands of Nature," they can be many square kilometers in size, generally use native forest species for sustainable food production and biodiversity, and are integrated with the natural forest. Several examples located in indigenous territories worldwide were well documented in a recent report by The Intergovernmental Science-Policy Platform on Biodiversity and

Ecosystem Services (IPBES) (United Nations IPBES 2019). The protection of these Islands of Nature is ensured as long as the indigenous peoples' territories and rights to use the land are respected, which often conflicts with development goals of other sectors. For example, protected territories inhabited by indigenous peoples in the Peruvian Amazon are threatened by road development, oil extraction, and other industries (Joseph Zárate, personal communication, April 2021, Zárate 2021). As oil exploration moves from industrialized countries to other locations such as in Peru and Ecuador, indigenous territories and their biodiversity face increasing threats.

Indigenous movements and their supporters, including the legal system in each affected country/territory, however, are actively seeking justice and winning court battles. For example, the Union of People Affected by Texaco (UDAPT, www.udapt.org) in Ecuador won a legal battle against the oil company, found to be guilty of egregious pollution and irresponsibility in the Ecuadorian rainforest. Ten years later, they are still fighting for the settlement that would benefit the tens of thousands of indigenous people who have been impacted (Julio Prieto, personal communication, May 2021). The case is explained in detail in a recent Forces for Nature podcast (https://forcesfornature.com/podcast/advocating-for-environmental-justice-in-the-ecuadorian-rainforest/).

In Ecuador, the Confederation of Indigenous Nationalities of the Ecuadorian Amazon (La Confederación de las Nacionalidades Indígenas de la Amazonia Ecuatoriana), or CONFENIAE, is the regional organization of indigenous peoples in the Oriente region of the Ecuadorian Amazon. Nine indigenous peoples living in the region—Quichua, Shuar, Achuar, Huaorani, Siona, Secoya, Shiwiar, Záparo, and Cofán—are represented politically by the Confederation (http://www.confeniae.org.ec/). CONFENIAE is one of three major regional groupings that constitute the Confederation of Indigenous Nationalities of Ecuador (CONAIE). It is also part of the Amazon Basin indigenous organization, COICA (http://COICA.org.ec). While these organizations get some technical and financial assistance from several NGOs and other groups, and the indigenous people appreciate their help, they often would prefer greater autonomy in their decision making (Efren Nango, CONFENIAE, personal communication, February 2021). The indigenous peoples and their allies are challenged to not allow external forces to divide and disrespect their organization as they advance efforts to exert their rights to the land and biodiversity, including the embedded BI within their territories.

27.4.3.2 Examples of Ongoing Agroecological Initiatives Supporting Biodiversity Islands

New ways of practicing agroecology to harmonize food production with conservation often lead to the spread of BI, as described in both chapters by Levin, and by González et al. (2022). These practices and experiences carried along by different groups of people are spreading, managing to overcome financial, technical training and other constraints. For example, recent presentations on agroecology and biodiversity by local biologists and agronomists were offered to local farmers who are transitioning to agroecological production systems, in an event taking place at the agroecological farm "La Dorita" located in Basavilbaso, Entre Ríos province, Argentina (Libertario González, personal communication, May 2021). These are small BI which are delineated and protected to fulfill local needs.

Individual farmers worldwide who practice agroecology in a variety of ways, including agroforestry, contribute to the creation of BI through their individual efforts and often using their own financial resources, as described in the chapters mentioned above as well as in other chapters in this volume from Calle et al., Esbach et al., Montes-Londoño et al., Painter et al., and Toensmeier. An agricultural producer in the state of Zulia, Venezuela who manages a 1000-hectare farm including silvopastoral systems with buffalo, many saman (*Samanea saman*) trees that produce feed for cattle, secondary forests of different ages, as well as areas with bamboo and oil palm, was seeking our advice on how to design and manage BI after watching a program on CNN[1] (Wilmer Morán, personal communication, April 2021). Thus, our book hopefully will provide information to help individual efforts like this one to design, protect and manage BI.

27.4.3.3 Recent Government Policies Promoting Agroecological Practices

In some cases agroecological transitions from conventional agriculture are already being supported by government initiatives that go along with local agroecology movements, even in countries like Argentina and the U.S.A., where industrial agriculture for large scale production of grains is the norm. These initiatives are a response to the environmental issues created by monoculture agriculture as mentioned earlier in this chapter.

In Argentina, where export taxes on soybean production comprise a large portion of the Gross Domestic Product, the Argentine Society of Agroecology (SAAE) was created in 2018 and has been pivotal in the consolidation of agroecology in the country (https://es-la.facebook.com/pages/category/Interest/SAAE-Sociedad-Argentina-de-Agroecolog%C3%ADa-126879274899065/). Brazil and Argentina are the only two Latin American countries that have constituted a National Society of Agroecology. The First Argentine Congress of Agroecology was held in 2019 (https://fcagr.unr.edu.ar/?p=14040). Training events to lead the transition to agroecology aimed at producers and technical personnel have been organized by the National Institute of Agricultural Technology, INTA (INTA Procadis, https://inta.gob.ar/acerca-de-procadis). In the Buenos Aires province, by April 2021 there were 350 farmers registered as agroecological, comprising a total of about 40,000 hectares

[1] Interview, CNN en Español, from CNN studio in Atlanta, GA, U.S.A., aired March 27–28, 2021, "Pandemia, Biodiversidad y Futuro" ("Pandemic, Biodiversity and the Future") in GloboEconomía, a CNN program with José Antonio Montenegro, a Warner Media production, https://www.youtube.com/watch?v=f68tzy65zq4, or search YouTube:"Cómo afectó el ser humano a la biodiversidad"

distributed all over the province, including large and small producers (Germán Lanzer, Director of Agroecology for the Buenos Aires province, Transition to Agroecology course offered by INTA Procadis, April 2021).

In 2020, the Ministry of Agriculture, Fisheries and Livestock of Argentina created the National Direction of Agroecology, within the Secretariat of Food, Bioeconomy and Regional Development (https://www.revistainternos.com.ar/2020/08/=). Its primary objective is "to intervene in the design and implementation of policies, programs and projects that promote intensive and extensive agroecologically-based primary production at all levels." Interacting with producers, agricultural organizations and municipal and provincial governments, they are executing a Strategic Productive Transition Plan for agroecological implementation, providing technical assistance, and establishing credits or tax tools for its promotion.

Also in Argentina, the National Network of Municipalities and Communities that promote Agroecology (Renama) works with some thirty municipalities in the different productive regions of the country (www.renama.org). Renama has incorporated about 170 producers so far, with an estimated 86,000 hectares under agroecological management. "This is not an alternative practice. On the contrary, it is the agriculture of the coming years" (Eduardo Cerdá, Director of the Division of Agroecology, and also president of Renama, 2020 interview with InterNos, local media from Buenos Aires, Argentina). In the same interview he added: "There's a strong paradigm shift. The current production model was important at the time, when new fertilizers, herbicides and strong technological innovations resulted in good production increases. But the continuity of this model has brought us many problems in terms of soil losses (according to INTA, more than 50% of the country's soil organic matter has been lost) and increases in herbicide-resistant weeds. This has brought along the use of more agrochemicals to control them, which in turn has increased costs above profits, leaving a lot of producers out of the game. In addition, producers realize what it means to be in contact with these substances which were claimed not to generate acute poisoning. But it turns out that the problem was their chronic toxicity, that is, toxicity generated from long exposure to the products. This is a needed change of paradigm from the perspective of improving nutrition and increasing resilience in the face of the current pandemic" (http://www.revistainternos.com.ar/2020/03/actual-modelo-de-produccion-es-drogodependiente/).

Dissemination of agroecological practices and regenerative agriculture in all their forms that are environmentally friendly, harmonizing productivity and environmental goods and services, is driving the promotion and persistence of BI in human dominated environments. There is already enough traditional and scientific knowledge among farmers and international and local institutions as we have described in several chapters of this book (e.g., Baez Schon et al., Clavo Peralta et al., Levin (a), Montagnini et al., Montagnini and del Fierro). These practices need to be promoted using incentives, especially in the early years of implementation, until adequate production levels are reached. These incentives can take many forms such as soft loans, materials, and tools, and should include education and technical assistance at all levels.

In the United States, the Department of Agriculture (USDA) has long provided technical and financial assistance and other resources to farmers and ranchers via agencies including the Natural Resources Conservation Service and the National Agroforestry Center. These agencies and their programs help landowners implement practices that conserve and restore the natural resources on their land and in their operations. This assistance is provided through a variety of different incentive programs including the Environmental Quality Incentives Program (EQIP), which offers financial resources and one-on-one help to plan and implement improvements that address natural resource concerns. The Conservation Reserve Program provides an annual payment for removing environmentally sensitive land from agricultural production and planting species that will improve environmental health and quality (https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/; https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/).

With the United States re-entering the Paris Agreement of the United Nations Framework Convention on Climate Change in 2021, renewed attention on its international climate mitigation commitments may help bolster these working lands conservation programs in recognition of the climate mitigation opportunities they could potentially provide. Via executive order, the Biden-Harris administration recently directed the USDA to develop a strategy to encourage the voluntary adoption of climate-smart agricultural and forestry practices that result in additional, measurable, and verifiable carbon reductions and sequestration. While the contours of this strategy are still being developed, the strategy will be designed to accommodate all farmers, and will seek to integrate climate-smart practices into existing programs or create new programs that strengthen markets for agriculture and forestry products generated through climate-smart agriculture and forestry practices, including via support of private voluntary carbon markets (https://www.usda.gov/sites/default/files/documents/climate-smart-ag-forestry-strategy-90-day-progress-report.pdf). Agroforestry practices, including windbreaks, buffers, alley cropping, silvopasture and multi-story cropping, as well as other agroecological practices such as cover crops and no-till, are among the practices being considered for inclusion in a potential new climate-smart agriculture and forestry program, which may facilitate the establishment of BI on working lands in the U.S.A.

27.4.4 Valuing and Financing Biodiversity Conservation

A large disparity exists between the resources needed and the available funds for financing conservation, and this has created a dire situation for the future of biodiversity conservation, as discussed in a recent interview published by the Nature Conservancy: it has been estimated that by 2030 the world needs as much as an additional US$598 billion to $824 billion annually to close the financing gap (Solberg 2021). Financing biodiversity on its own is a difficult task, considering that the effects and payoffs of such conservation are not always tangible, and that conservation of biodiversity is a multidimensional global issue. Financing biodiversity can become increasingly easier, however, when tangible and valued resources such as carbon or water are incorporated into conservation strategies (Sheban 2022).

The first step towards building these tangible and effective conservation strategies is the proper assessment and valuation of ecosystem services. Proper valuation is essential in developing new initiatives, and programs such as Payments for Ecosystem Services (PES) may be efficient in encouraging future biodiversity conservation through compensation. PES programs have considerably increased in recent years, although biodiversity-focused PES programs have remained limited. Compensatory mitigation banking is also growing, while voluntary biodiversity offsets are a recent policy development and have yet to experience large amounts of growth (Salzman et al. 2018). Valuation systems that bundle multiple services could better encourage sustainable land uses to farmers and protect biodiversity, even if the PES is only provided for a single service such as water or carbon (Montagnini and Finney 2011). Biodiversity objectives might also be incorporated into future ecological action programs.

Another opportunity for funding conservation is through taxing certain activities that are detrimental to worldwide ecosystems, such as imposing emissions taxes on airline travel to discourage fossil fuel consumption or implementing a variety of "polluter pays" taxation programs. These funds could in turn be used to finance conservation initiatives such as the implementation and maintenance of BI. If the financial penalties were established at sufficient levels, perhaps industries would self-regulate to address environmental degradation and avoid paying such taxes. Such an approach might accelerate progress for sustainability by directing pollution tax funding toward implementing BI and carbon sequestration projects. As Newcomer et al. described in their chapter in this volume, such an approach has seen moderate success in Costa Rica with gas taxes being used to fund the national PES program.

As we have described, the effort to integrate biodiversity into the market is already growing, with investments worldwide coupled with positive environmental outcomes gaining in popularity. Agricultural and consumer markets are increasingly shifting products and supply chains to align with conservation goals. Because BI establishment generally happens on fragmented landscapes, funding and acquiring these small patches of land through government action and policy could satisfy both land development and biodiversity conservation goals in the future, and may be more effective than the approach of designating large amounts of land solely for conservation initiatives. Preserving numerous small areas of land for BI conservation rather than rendering large swaths of land economically unusable seems mutually beneficial for governments and for landowners and can contribute to conservation goals as well.

Voluntary conservation actions from companies, farmers, families, schools and universities should be financially recognized as they participate and collaborate in creating BI at all scales. Financial incentives to ensure successful management and persistence of privately established BI may take many forms such as loans, soft credits, and the provision of materials and tools. In particular, tax benefits could be provided to Private Protected Areas as well as to landowners who protect sensitive areas within their properties, for example, riparian forests that contribute to landscape connectivity and other ecosystem services as shown by Giraldo et al. (2022). This type of incentive can be calculated based on the area covered by the BI, or by valuing the ecological importance of a particular area for conservation purposes. Other compensation could be derived from other commercial interests such as companies or enterprises that benefit from the carbon sequestration potential and other ecosystem services provided by BI.

27.4.5 The Framework: Current Trends in Biodiversity Conservation Aligning with the Biodiversity Islands Concept

There have been several trends and useful perspectives on how protected area design issues could be addressed more effectively (McNeely 2021). Bengtsson et al. (2003) highlighted some of the limitations of protected areas, which covered just over 11% of the land at that time. While the landscape perspective and the integration of resilience theory and biodiversity conservation is now much more reflected in biodiversity policy (e.g., see IPBES 2019), improvements in conservation practice and landscape management have recently been quite small (Bengtsson et al. 2021). The CBD's Strategic Plan for Biodiversity 2011–2020 was highly relevant to protected areas as a major conservation tool (Pimm 2021; Sayer et al. 2021). Its target 11 called for establishing at least 17% of terrestrial and inland water biomes as protected areas, along with 10% of coastal and marine biomes. These were to be effectively and equitably managed, ecologically representative, and well connected as parts of systems of effective area-based conservation measures that are integrated into wider landscapes and seascapes.

At the time, however, protected areas were considered too static when they need to be more dynamic (Bengtsson et al. 2003, 2021; Mc Neely 2021). A dynamic landscape approach that mimics natural disturbance regimes could include, for example, successional lands that are recovering from over-exploitation. These resemble the territories managed by indigenous peoples such as the shifting cultivation practices described by Gadgil et al. (2021). Indigenous territories or parts of them where sustainable multistrata agroforestry and forest systems are practiced are considered BI as defined in this book. The importance of landscape connectivity is a current hot subject in the conservation mainstream (McNeely 2021), with detailed guidelines prepared by an IUCN international team (Hilty et al. 2020). Landscape connectivity is discussed in this book in relation to the effectiveness of BI.

The Aichi targets set in 2010 have led to the expansion of systems of national parks and other categories of protected areas, and over 90 of the signatory countries have attained the 17% target. However, some governments have established protected areas in degraded and marginal areas that have limited conservation value, often because those protected areas simply were not needed for anything else. There is still not enough evidence of the effectiveness of protected landscapes in delivering biodiversity outcomes (Sayer 2021). The value of landscape approaches to conserve biodiversity through management of the broader landscape within which conventional protected areas are located is expected to increase (Sayer et al. 2021). This concept aligns with the integrated landscape management approaches suggested in this book.

The fifteenth meeting of the Convention on Biological Diversity (CBD) Conference of the Parties (COP), Kunming, China, October 2021 has established seven thematic programs of work corresponding to some of the major biomes on the planet. Each program establishes a vision and basic principles to guide future work. They also set out key issues for consideration, identify potential outputs, and suggest a timetable and means for achieving them. Implementation of these programs depends on contributions from signatory parties, the Secretariat, and relevant intergovernmental and other organizations (https://www.cdb.int). CBD COP-15 is likely to adopt relatively simple, aspirational, and politically attractive targets for biodiversity conservation (Sayer et al. 2021). Civil society is likely to prefer enhanced conservation measures, but people are often reluctant to accept actions that restrict their material wellbeing, thus conservation strategies need to be scientifically sound and aligned with the cultures and economies of local societies such as is described for BI in this book. Research, training, and capacity building are needed to manage programs of biodiversity conservation (Sayer et al. 2021). This also pertains to BI, and this book has set the basis for implementing and successfully managing BI using an inclusive, landscape oriented and integrated approach.

It has been broadly recognized that solutions to the problems of biodiversity conservation come down to working with people, their lives, aspirations, fears, and social complexity. Although people and nature will not always peacefully coexist, rigorous science and intelligent technology can help (Berlyn 2021; Pimm 2021). Evidence from chapters of this book shows that BI may constitute such a solution when properly designed and managed within the social milieu where they are embedded.

27.4.6 The Context: Biodiversity Islands in Changing Environments

Climate change is increasingly a threat to both natural and human systems. The success of BI as effective conservation solutions is vulnerable to changing climate conditions, including via impacts on habitat requirements and species ranges, as well as the cascading effects of shifting socioeconomic demands. At the same time, however, BI have an important role to play in contributing to climate change solutions. Land use, including agriculture and forestry, accounts for an estimated 23% of total anthropogenic greenhouse gas emissions (Shukla et al. 2019).

Reducing deforestation and introducing, or reintroducing, trees and herbaceous cover into working lands not only benefit biodiversity, but can have outsized impacts on greenhouse gas emissions via conserved carbon stocks, reduced emissions, and increased carbon sequestration. These so-called natural climate solutions, which include conservation, restoration and improved agricultural practices, can contribute up to one-third of the cost-effective climate mitigation we need with the potential to remove as much as 23.8 petagrams of CO_2 equivalent (Griscom et al. 2017).

Co-benefits of conservation, including the livelihood support they provide and ecosystem services, such as watershed regulation, can also help increase the resilience of communities impacted by climate change (Griscom et al. 2017). Given the magnitude and urgency of this challenge, curbing climate change and limiting global temperature rise to below the 2 °C degree threshold set by the Paris Agreement will require ambitious and radical changes in our production systems. As an integrated, flexible conservation approach with great potential, BI can be an important piece of the nature-based solutions necessary to address the climate crisis.

27.5 Conclusions: Biodiversity Islands in Action

The lessons learned from the chapters of this book form a collection of experiences showing positive and promising results of how BI can be implemented and managed. Through a series of informative case studies and detailed explanations of the intricacies of BI creation, the contributions to this volume provide a comprehensive context for the impediments and opportunities of BI implementation amidst various societal and environmental factors. Several chapters in the book discuss the challenges that BI development face, including a lack of conceptual understanding of BI function, incompatibility with current local societal practices or government priorities, and competing economic/productive land use.

Many practical alternatives are presented that address these challenges through the creation of BI. Several of these opportunities relate to communities' motivations, which is why addressing social issues and improving communication are critical for establishing effective and lasting BI. The book presents a variety of examples of BI created in differing circumstances, from NGO action to AFS implementation, where involvement of local and indigenous community members plays a vital role.

BI present an opportunity for sustainable, dynamic, productive conservation, which is why they are becoming increasingly desirable in the global conservation movement. As societies look for alternatives to maintain economic prosperity, provide culturally-important community spaces, and conserve local ecosystem biodiversity, BI are sure to become more widely used, which underscores the importance of the information described in this book as a tool for planning and implementing BI.

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