SATOYAMA INITIATIVE

Satoyama Initiative Thematic Review

vol. 4

Sustainable Use of Biodiversity in Socio-ecological Production Landscapes and Seascapes (SEPLS) and its Contribution to Effective Area-based Conservation

2018

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Satoyama Initiative
The Satoyama Initiative is a global effort, first proposed jointly by the United Nations University and the Ministry of the Environment of Japan (MOEJ), to realize "societies in harmony with nature" and contribute to biodiversity conservation through the revitalization and sustainable management of "socio-ecological production landscapes and seascapes" (SEPLS). The United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS) serves as the Secretariat of the International Partnership for the Satoyama Initiative (IPSI). The activities of the IPSI Secretariat are made possible through the financial contribution of the Ministry of the Environment, Japan.

UNU-IAS
The United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS) is a leading research and teaching institute based in Tokyo, Japan. Its mission is to advance efforts towards a more sustainable future, through policy-relevant research and capacity development focused on sustainability and its social, economic and environmental dimensions. UNU-IAS serves the international community, making valuable and innovative contributions to high-level policymaking and debates within the UN system. The activities of the institute are in three thematic areas: sustainable societies, natural capital and biodiversity, and global change and resilience.

IGES
The Institute for Global Environmental Strategies (IGES) was established in March 1998 under an initiative of the Japanese government and with the support of Kanagawa Prefecture. The aim of the Institute is to achieve a new paradigm for civilization and conduct innovative policy development and strategic research for environmental measures, reflecting the results of research into political decisions for realising sustainable development both in the Asia-Pacific region and globally. The Institute will tackle fundamental challenges to human society, and to redefine the values and value systems of our present societies that have resulted in the global environmental crisis, in order to create new ways of conducting activities and a new paradigm for civilization.

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Foreword

In recent years, the sustainable use of biodiversity — for human livelihoods, survival, and well-being — has been increasingly recognized for its benefits to biodiversity conservation. In places where sustainable use through harmonious interaction between humans and nature has shaped complex, dynamic mosaics of habitats and land uses, the resulting landscapes and seascapes contribute significantly to effective area-based conservation of biodiversity, although often they do not conform to any legal or administrative protected-area boundaries. Research led by UNU-IAS has come to refer to these kinds of landscapes and seascapes as socio-ecological production landscapes and seascapes (SEPLS), and highlights the important roles that both social and ecological components play in shaping sustainable ecosystems and human livelihoods in areas where production activities are undertaken.

UNU-IAS has worked closely with the Ministry of the Environment of Japan in the development of the Satoyama Initiative, a global effort to realize "societies in harmony with nature," focusing on the revitalization and sustainable management of SEPLS. We have hosted the Secretariat of the International Partnership for the Satoyama Initiative (IPSI) since its establishment at the Tenth Meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD COP 10) in Aichi-Nagoya, Japan in 2010. In this role we coordinate the efforts of partners across the globe toward biodiversity conservation through integrated and holistic landscape and seascape management approaches with mutual benefits for biodiversity and livelihoods. As IPSI's membership has grown to 230 organizations, it has accumulated a wide range of knowledge and experience, and many members are now working collaboratively for better management of production landscapes and seascapes in various settings around the world.

Thus, the fourth volume of the Satoyama Initiative Thematic Review, focuses on how the sustainable use of biodiversity as practiced in well-managed SEPLS can contribute to effective area-based conservation of biodiversity. The case studies presented here highlight how the concept of SEPLS, implemented in different spatial, cultural, and administrative contexts, can contribute to global conservation goals, especially in the context of the Convention on Biological Diversity (CBD) and its Aichi Biodiversity Targets. Aichi Target 11 contains provisions for protected areas and "other effective area-based conservation measures (OECMs)", their integration into the wider landscapes and seascapes, and their effective and equitable management. I am confident that the cases presented in this volume will provide inspiration and useful knowledge for practitioners, policymakers, and scientists, and that the activities described herein will make broader contributions to the knowledge base of the Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services (IPBES), as well as to the CBD's Strategic Plan for Biodiversity 2011-2020, the Sustainable Development Goals (SDGs), and other ongoing policy processes.

Prof. Kazuhiko Takemoto

Director, United Nations University Institute for the Advanced Study of Sustainability

Preface

The Satoyama Initiative is "a global effort to realise societies in harmony with nature", started through a joint collaboration between the United Nations University (UNU) and the Ministry of the Environment of Japan. The initiative focuses on the revitalisation and sustainable management of "socio-ecological production landscapes and seascapes" (SEPLS), areas where production activities help maintain biodiversity and ecosystem services in various forms while sustainably supporting the livelihoods and well-being of local communities. In 2010, the International Partnership for the Satoyama Initiative (IPSI) was established to implement the concept of the Satoyama Initiative and promote various activities by enhancing awareness and creating synergies among those working with SEPLS. IPSI provides a unique platform for organisations to exchange views and experiences and to find partners for collaboration. At the time of writing, 230 members have joined the partnership, including governmental, intergovernmental, nongovernmental, private-sector, academic and indigenous peoples' organisations.

The Satoyama Initiative promotes the concept of SEPLS through a three-fold approach that argues for connection of land- and seascapes holistically for management of SEPLS (see Fig.1). This often means involvement of several sectors at the landscape scale, under which it seeks to: 1. consolidate wisdom in securing diverse ecosystem service and values, 2. integrate traditional ecosystem knowledge and modern science and 3. explore new forms of co-management systems. Furthermore, activities for SEPLS conservation cover multiple dimensions, such as equity, addressing poverty and deforestation, and incorporation of traditional knowledge for sustainable management practices in primary production processes such as agriculture, fisheries and forestry (UNU-IAS & IGES 2015).

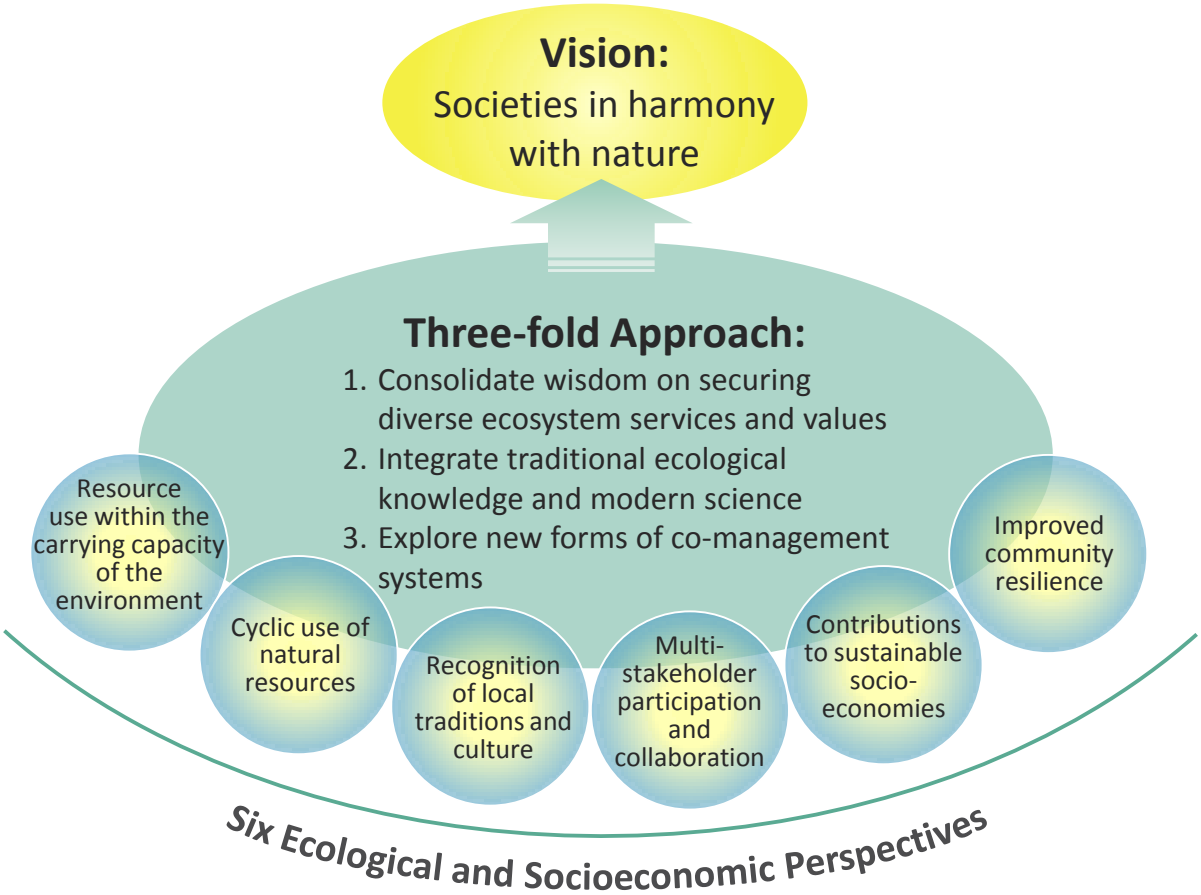

Figure 1. The conceptual framework of the Satoyama Initiative

As one of its core functions, IPSI serves as a knowledge-sharing platform through the collection and sharing of information and experiences on SEPLS, providing a place for discussion among members and beyond. More than 170 case studies have been collected and are shared on the IPSI website, providing a wide range of knowledge covering diverse issues related to SEPLS. Discussions have also been held to further strengthen IPSI's knowledge-facilitation functions, with members suggesting that efforts should be made to produce knowledge on specific issues in SEPLS in order to make more targeted contributions to decision-makers and on-the-ground practitioners.

It is in this context that a project to create a publication series titled the "Satoyama Initiative Thematic Review" was initiated in 2015 as a joint collaboration between UNU's Institute for the Advanced Study of Sustainability (UNU-IAS), which hosts the IPSI Secretariat, and the Institute for Global Environmental Strategies (IGES), an IPSI partner and research institute based in Japan. The Thematic Review was developed as a compilation of case studies providing useful knowledge and lessons focusing on a specific theme that is important for SEPLS. The overall aim of the Thematic Review is to collect experiences and relevant knowledge, especially from practitioners working on the ground, considering their usefulness in providing concrete and practical knowledge and information as well as their potential to contribute to policy recommendations. Each volume is also accompanied by a synthesis chapter which extracts lessons learned through the case studies, presenting them for policy-relevant academic discussions. This series also contributes to efforts being made by researchers to strengthen the evidence base on socio-ecological dynamics and resilience, including those under the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Convention on Biological Diversity (CBD).

The first volume of the Satoyama Initiative Thematic Review was published in 2015 with the theme "enhancing knowledge for better management of SEPLS", focusing on ways to identify, collect, document, maintain, exchange, refine, augment, and make use of information and knowledge for better management of SEPLS. The second volume's theme was "Mainstreaming concepts and approaches of SEPLS into policy and decision-making", covering topics including advocacy, multi-stakeholder engagement, facilitation and coordination of institutions, concrete tools and information useful for policymakers and stakeholders. The third volume, titled "Sustainable livelihoods in SEPLS" identified drivers linked to sustainable livelihoods in SEPLS that are crucial to meet needs for human well-being and to foster sustainable use of natural resources.

Purpose of the Satoyama Initiative Thematic Review Volume 4 (SITR-4)

In this volume, we seek to highlight how the sustainable use of biodiversity as practiced in well-managed SEPLS can contribute to effective area-based conservation of biodiversity. The concept of SEPLS includes the idea that integrated and holistic management approaches can have mutual benefits for biodiversity and livelihoods, sustainably conserving biodiversity while providing humans with adequate ecosystem services. The case studies included here give examples of how such approaches on the ground can contribute to the goals of the global conservation agenda, especially in relation to the CBD's Aichi Biodiversity Target 11, which contains the concept of "effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures" and their integration into the wider landscape and seascape.

Like previous volumes, this publication was developed through a multi-stage process including both peer review and discussion among the authors at a workshop. Authors had several opportunities to get feedback, which helped them to make their manuscripts more useful and easy to understand for readers. First, each manuscript received comments from the editorial team relating primarily to their contributions to the theme of the volume. Peer review was then conducted by the authors of other chapters, with each author receiving feedback from two other authors who were requested to comment on whether the manuscript was easy to understand and informative, provided useful lessons, and so on. The aforementioned workshop was then held to enable the exchange of feedback between authors. Here, the authors presented their case studies and received comments both from the two designated reviewers and from the other workshop participants. The workshop also served as a place for discussion to further deepen understanding on the theme and to extract findings across all the case studies. The basic ideas contained in the synthesis chapter were developed from the presentations and discussions during the workshop, and the chapter was made available for review by authors and selected experts before finalisation.

Our experience producing these volumes leads us to believe that the above process offers an opportunity for authors from both academic and non-academic organisations to contribute to knowledge-building in an accessible and interactive way, as well as to provide high-quality papers written in simple language for academics and a broader audience alike. It is our hope that this publication will be useful in providing information and insights to practitioners, researchers, and policymakers on the relevance of SEPLS to the conservation of biodiversity under different institutional frameworks, whether within protected areas, as other area-based conservation measures, or as buffer zones and connections between protected areas. This, we hope, will prompt policymaking that strengthens support for such integrated and holistic approaches to managing resources and human well-being.

We would like to thank all of the authors who contributed their case studies and the other participants in the case study workshop. We also greatly appreciate the efforts of IGES for their continued collaboration in the publication process of this volume. Our grateful thanks are also due to the Ministry of the Environment, Japan for supporting the activities of IPSI and its secretariat hosted by UNU-IAS.

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Participating authors and editorial team at the SITR-4 authors' workshop, held from 22 to 24 May 2018 at the United Nations University Headquarters in Tokyo, Japan

Chapter 1

Enhancing effective area-based conservation through the sustainable use of biodiversity in socio-ecological production landscapes and seascapes (SEPLS)

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1. Introduction

Socio-ecological production landscapes and seascapes (SEPLS) are areas characterized by mosaic ecosystems that are utilized and managed in various ways by the local communities to meet their needs. The following aspects broadly describe SEPLS:

- SEPLS are complex, dynamic and adaptive systems;
- SEPLS management practices hinge on time-tested practices that may be adapted to suit current realities of ecological functioning and social demands;
- Management of SEPLS is anchored in local innovative practices and decentralized autonomous operations;
- SEPLS place a strong focus on "essence of place" linked to a sense of identity. This implies that heritage/cultural values should also be maintained beyond ensuring sustainability of production and use;
- SEPLS demonstrate high levels of biocultural diversity (Maffi & Woodley 2010) and re-connect people to nature;
- SEPLS buffer pressures from urbanization and social changes in rural areas especially through the use of agro-biodiversity. They also often serve as sites of refuge for endangered species;
- The resilience of SEPLS is influenced by production and consumption patterns. This, in turn, is influenced by the activities of multiple stakeholders and their commitment to maintain SEPLS; and
- SEPLS provide connectivity to various types of ecosystems and ecosystem uses. This includes not just the spatial use of a landscape or seascape, but also the various actors who have an interest in the site, across various scales of decision-making and landscape governance.

These SEPLS, despite their diversity, are linked by similar characteristics. First, they are socio-ecological systems that inherently thrive when both environmental components are healthy and well-functioning and social systems are resilient. This implies an innate need to engage in sustainable production activities to conserve biodiversity and strengthen local livelihoods by conserving natural resources through sustainable use of biodiversity and ecosystem services. A recent empirical analysis of International Partnership for the Satoyama Initiative (IPSI) members' case studies in Asia found that sustainable livelihoods based on sustainable use made up the highest proportion of solutions applied or proposed in IPSI member experiences in Asia (Kozar et al. 2018).

Table 1. Overview of the case studies

Chapter number (country)	Title (author)	Type of area conserved	Socio-ecological context and problems	Focus
Chapter 2 (Uganda, Tanzania)	Perceptions of resilience, collective action and natural resources management in socio-ecological production landscapes in East Africa (Bedmar Villanueva et al.)	Not within designated areas Secondary conservation	The absence of supportive government policies, agencies, and lack of local collective action pose challenges to the resilience of the SEPLS and ecosystem services.	Creation of spaces for informed, public discussion on resilience and management of SEPLS to motivate community efforts and local initiatives.
Chapter 3 (Spain)	The contribution of chestnut orchard recovery projects for effective area-based conservation: Two cases in Asturias (Díaz-Varela et al.)	One site within and another outside designated areas Secondary conservation	Increasing abandonment of chestnut orchards within public forests puts at risk the conservation of in situ endangered native cultivars, the associated landscape, and ethnographic and cultural values.	Revival and reintroduction of traditional knowledge for tree management, combined with modern techniques, and ensuring dissemination of this knowledge to the community.
Chapter 4 (Chinese Taipei)	Transformations towards sustainability – A SEPLS restored by the Gongrong community (Chao et al.)	One site is adjacent to another site which is situated partially in a National Park Primary, secondary and ancillary conservation	Environment degradation and loss of agricultural production due to improper land development, habitat degradation, pollution, decreasing income, aging, and depopulation, etc.	Measures to stop environmental degradation and revive agriculture to reinstate biodiversity and ecosystem services.

Chapter number (country)	Title (author)	Type of area conserved	Socio-ecological context and problems	Focus
Chapter 5 (Indonesia)	Conserving local marine and terrestrial biodiversity and protecting community resources through participatory landscape governance in Semau Island, Indonesia (Dwihastarini et al.)	Not within designated areas Secondary conservation	Pressures on small, lowland island ecosystem and its biodiversity from climate change, excessive use of agricultural chemicals and deforestation	Community-led projects to support sustainable livelihood activities, establish new institutions and networks, and negotiate new agreements to protect community resources and local biodiversity.
Chapter 6 (Ecuador)	Ensuring conservation, good governance and sustainable livelihoods through landscape management of mangrove ecosystems in Manabí, Ecuador (Obando et al.)	Within protected areas Primary and secondary conservation	A mangrove, estuary and mountain range ecosystem and production landscape and seascape threatened mainly by the use of chemical residue from agricultural and shrimp farming activities.	Communal organizations for mangrove and dry forest species reforestation. Improvement of local governance resulting in government recognition of community and private reserves, also enabling local income generation and various degrees of sustainability in SEPLS activities.
Chapter 7 (Colombia)	Conservation on Private Lands Integrating Sustainable Production and Biodiversity in the Mid Dagua River Basin, Colombia (Orjuela-Salazar et al.)	Includes several protected areas Secondary to primary conservation	Intensive and expansive agriculture has been threatening the ecosystem services of the basin. Lack of financial resources inhibits conservation actions in these production landscapes.	Conservation actions, participatory management associated with the conversion of private land into natural reserves of civil society recognized by the national government as protected areas with existing land titles and private property rights.
Chapter 8 (Kenya)	Sustainable use of biodiversity in socio-ecological production landscapes and seascapes (SEPLS) and its contribution to effective area-based conservation: The case of *Kaya* forests on the Kenyan Coast (Wekesa & Ndalilo)	Indigenous sacred forests as areas of effective conservation Primary and secondary conservation	Pressure on sacred forests (Kaya forests) due to demand for sand mining, wood products and other biological resources	Integrated landscape management, revival of traditional norms and institutions to preserve knowledge and crop diversity through establishment of cultural centers and domestication of wild foods and medicinal plants
Chapter 9 (Ecuador)	Tree microrefugia and community-based conservation in Tropandean mountainscapes: A bio-cultural approach for heritage management of "El Collay" protected forest in Southeastern Ecuador (Sarmiento et al.)	Includes protected areas (i.e. UNESCO World Heritage site) Secondary to primary, and ancillary conservation	Development encroaching into protected areas causing the loss of native biodiversity, natural resources and culturally significant land as well as degraded ecosystems	Socio-ecological approaches are promoted as management strategies, including application of the Payment for Environmental Services and Complex Adaptive Systems methodologies. Approaches aim to synergize understandings of community perceptions and valuations of these species with their capacity to withstand climate change.

Chapter number (country)	Title (author)	Type of area conserved	Socio-ecological context and problems	Focus
Chapter 10 (Worldwide)	Contributions of socio-ecological production landscapes and seascapes to the achievement of Aichi Biodiversity Target 11 in the Group of Like-Minded Megadiverse Countries (LMMCs) (Leles et al.)	Protected Areas Primary to secondary, and ancillary conservation	Ensure that SEPLS are acknowledged in national policies and international landscape conservation management strategies	Illustrate, through official reports, the relevance of SEPLS in achieving the various objectives of Aichi Target 11 in the LMMC group.

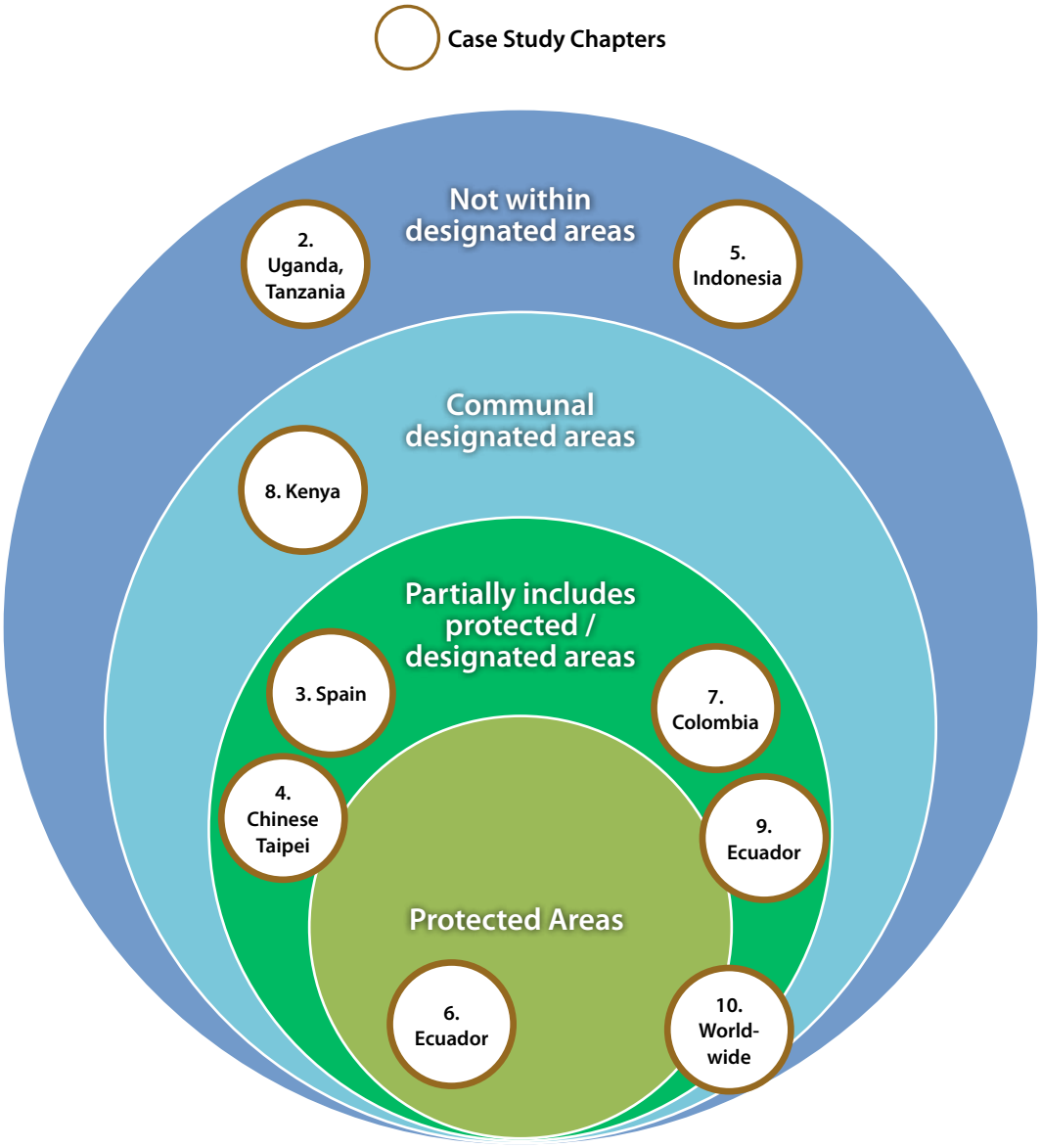

Figure 1. Types of areas conserved by the case studies

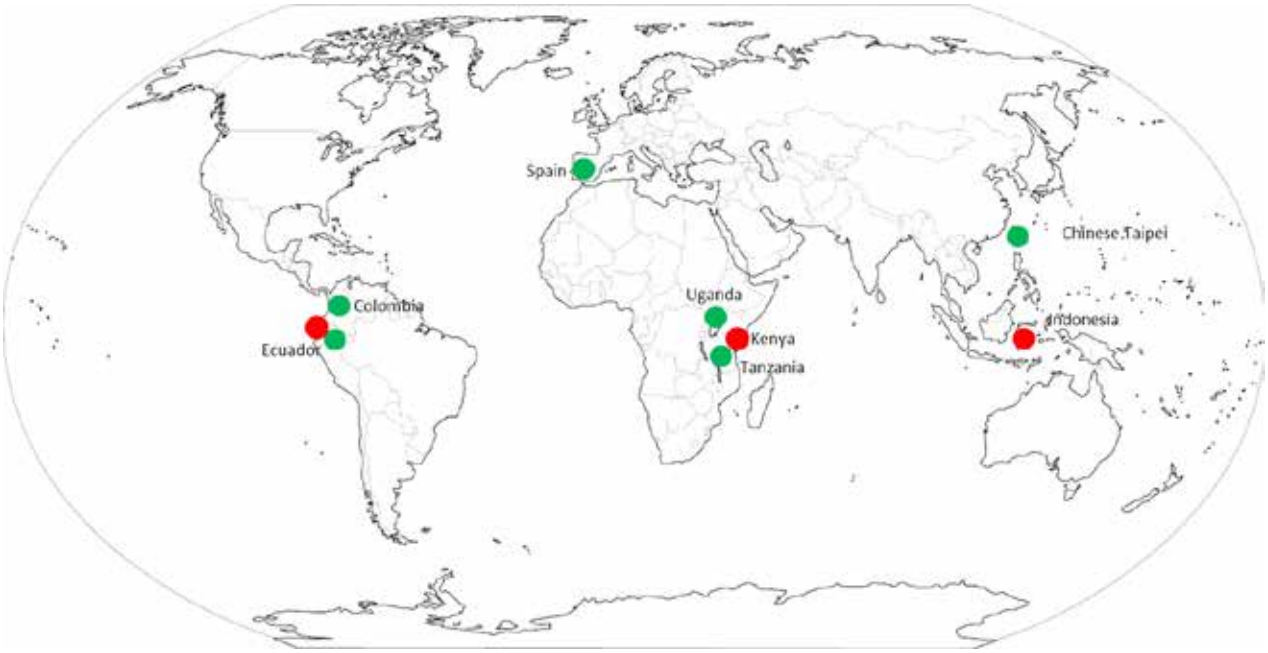

Figure 2. Locations of the case studies presented in the Satoyama Initiative Thematic Review Volume 4 (green: landscape; red: mixture of landscape and seascape)

The case studies in this volume highlight these aspects in different socio-ecological and political contexts. Table 1 gives an overview of the case studies, Figure 1 summarises the types of areas conserved, and Figure 2 illustrates the locations of the landscapes and seascapes covered.

This volume contains: 2 case studies from Asia; 3 from Africa; one from Europe; and 3 from South America. It also includes one global case study on Like-Minded Megadiverse Countries (LMMCs), a group that includes the following 20 countries: Bolivia, Brazil, China, Colombia, Costa Rica, Democratic Republic of Congo, Ecuador, Ethiopia, Guatemala, India, Indonesia, Iran (Islamic Republic of), Kenya, Madagascar, Malaysia, Mexico, Peru, Philippines, South Africa, and Venezuela (Bolivarian Republic of).

1.1 How do SEPLS connect to global policy?

The concept of SEPLS, as highlighted in the introduction, is strongly linked to the emerging dialogue among the international community on recognizing the critical role of decentralized, endogenously-led conservation activities, in other words, those led by local communities themselves (CBD 2018; Jonas et al. 2017). Areas covered by this type of activity may be within or part of existing protected areas, or spatially distinct from protected areas, but can demonstrate effective area-based conservation. In this volume, we seek to highlight how SEPLS contribute to global conservation goals and identify various challenges and trade-offs. At the same time, we aim to highlight emerging and feasible options being explored to ensure socio-ecological resilience. We focus specifically on Aichi Biodiversity Target 11 (hereafter referred to as "ABT 11"), as SEPLS are linked to several of the specific objectives of this target.

2. Methodology

We undertake our analysis of sustainable use in SEPLS and effective area-based conservation through nine case studies submitted by members of the International Partnership for the Satoyama Initiative (IPSI). This chapter aims to provide a synthesis of the case studies presented in this volume, with material taken both from the manuscripts themselves and from discussions at an authors' workshop held from 22 to 24 May 2018 at the United Nations University Headquarters in

By 2020, at least 17 per cent of **terrestrial and inland water areas** and 10 per cent of **coastal and marine areas**, especially areas of particular importance for biodiversity and ecosystem services, are conserved through **effectively and equitably managed**, **ecologically representative** and **well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape**. (COP 10 Decision X/2, Strategic Plan for Biodiversity 2011-2020). (*Bold text indicates the objectives to which SEPLS relate.*)

Tokyo, Japan. The principal authors of the case studies were invited to the workshop to present their cases and to discuss how the sustainable use of biodiversity as practiced in well-managed SEPLS can contribute to effective area-based conservation of biodiversity. In this context, the workshop discussions addressed the following two key questions:

- How and under what conditions can we ensure sustainable management and use of biodiversity in SEPLS and their contribution to effective area-based conservation?
- How can such effective area-based conservation contribute to the goals of the global conservation agenda, especially in the context of the CBD and its ABT 11?

These questions helped to contextualize the challenges and opportunities faced by SEPLS in achieving biodiversity conservation and sustainable development. These include: i) ensuring actual biodiversity conservation benefits from the sustainable management of production landscapes and seascapes, ii) establishing equitable institutional frameworks, iii) incorporating interests of various stakeholders, iv) gaining recognition of SEPLS as area-based conservation measures, and v) contributing to Aichi Biodiversity Targets and other global conservation goals. The workshop covered a wide range of linked drivers, and associated opportunities and challenges, that impact society and nature in production landscapes and seascapes.

3. SEPLS and other effective area-based conservation measures

While the process of identifying the definition and characteristics of "other effective area-based conservation measures" (OECMs) as mentioned in ABT 11 is ongoing, the conclusions of the 22nd Meeting of the Subsidiary Body on Scientific Technical and Technological Advice (SBSTTA-22) of the Convention on Biological Diversity (CBD) in July 2018 recommended defining an OECM as follows (CBD 2018):

> A geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity[1], with associated ecosystem functions and services and, where applicable, cultural, spiritual, socio-economic, and other locally relevant values.[2]

Through an examination of the descriptions of both OECMs and SEPLS, this section highlights how the two concepts are aligned. In the above definition, criteria for identifying OECMs can be broadly organized into four categories: (1) the area is not currently recognized as a protected area; (2) the area is governed and managed; (3) the area's governance and management achieve positive and sustained long-term outcomes for the in-situ conservation of biodiversity; and (4) the area contributes to conservation of associated ecosystems and services, and cultural, spiritual, socio-economic, and other locally relevant values. We discuss the relevance of each criterion to SEPLS as follows.

3.1 Criterion 1: The area is not currently recognized as a protected area

This is one of the most important criteria, as SEPLS also are *not necessarily protected areas*. SEPLS are production landscapes with strong anthropogenic characteristics, emphasizing a harmonious relationship between humans and nature. They demonstrate the concept of *humans in nature* as a "social-ecological system", defined in part as "a coherent system of biophysical and social factors that regularly interact in a resilient, sustained manner" (Redman et al., 2004). Descriptions of the characteristics and linkages of socio-ecological systems mostly attempt to emphasize the existence of local knowledge, people and technology, and property rights institutions, besides ecosystems as such (Berkes et al., 2000). OECMs that are relevant to SEPLS, following the IUCN WCPA (2018), achieve at least one of the following:

(1) primary conservation, referring to areas that may meet all elements of the IUCN definition of a protected area, but are not officially recognized as such because the governance authority does not want the area to be designated as a protected area by the relevant national government;
(2) secondary conservation, achieved through the active conservation of an area where conservation outcomes are a secondary management objective; and
(3) ancillary conservation, referring to areas that deliver conservation outcomes as a by-product of management activities, even though biodiversity conservation is not a management objective.

3.2 Criterion 2: The area is governed and managed

Spatial characteristics of SEPLS, meaning their structure and position as governed and managed areas within the wider landscape, can contribute to their role in area-based conservation. In this sense, there are at least two ways in which they function to conserve biodiversity: (1) They can increase connectivity as corridors for animal and plant species, allowing for movement of species that require

large home ranges and migrating species; and (2) They can provide a buffering function between strictly protected areas and human settlements, such as when an agricultural landscape adjacent to a protected area makes the protected area itself more effective for conservation of biodiversity and ecosystem services.

Case studies in this volume prove that the SEPLS they cover are mostly governed and managed to serve these two purposes: as corridors and as buffer zones. From the spatial point of view, the restored chestnut orchards in North-West Spain (Chapter 3) function as corridors as well as buffer zones between protected areas and the immediate rural environment. Likewise, the Gongrong and Ankang communities in Chinese Taipei (Chapter 4) are physically and biologically connected to the Yangmingshan National Park (YNP). The agricultural landscape expands the effective conservation area of the YNP and buffers it from anthropogenic pressures such as habitat degradation, without any additional cost for the establishment and maintenance of a corridor. In the Páramo grasslands of the tropical Andes (Chapter 9), ledges on steep mountainsides have been protected from fire and grazing, and they also support a greater plant diversity than adjacent grazed lands. The ledges could effectively be construed as microrefugia OECMs, and the integration of such OECMs with protected areas such as the Sangay National Park, Rio Negro-Sopladora National Park, and Cajas Massif Biosphere Reserve, is consistent with community-based conservation, local cultures, and management that fosters biocultural diversity.

3.3 Criterion 3: The area's governance and management achieve positive and sustained long-term outcomes for the *in-situ* conservation of biodiversity

The efficiency of a protected area can be improved when surrounding SEPLS are governed and managed sustainably, because the effective conserved area is increased. Community engagement, in turn, raises awareness in the protected area and the efficiency of production through sustainable practices. SEPLS are also cost-effective, because production activities can generate revenue for communities, incentivizing them to sustainably manage the SEPLS.

Notwithstanding the fact that there are fewer public areas to declare as new protected areas, it is essential to think about other strategies for conservation on private lands. One successful case is the NRCS (Natural Reserves of Civil Society) in Colombia (Chapter 7), which registered 13 natural reserves of civil society and signed 20 conservation agreements with private owners, creating a corridor of about 640 ha that connects the territory in all aspects, linking private owners with protected areas.

3.4 Criterion 4: The area contributes to conservation of associated ecosystems and services, and cultural, spiritual, socio-economic, and other locally relevant values

Biodiversity and ecosystem services, including those related to cultural, spiritual, socio-economic and other locally relevant values, are vital to SEPLS. SEPLS can include production activities in various economic sectors particularly those directly related to natural resource use and management as described in various chapters in this volume – agriculture, forestry, fisheries, wildlife utilization, and tourism. When integrated into the wider landscape or seascape, SEPLS can facilitate interactions between stakeholders in these and other sectors, as well as cultural identity. SEPLS are heritage territories where landscape memory for local communities is recorded, where people rely on emotional ties, and where domesticated and heirloom varieties are obtained by applying traditional ecological knowledge and practices, further emphasizing their cultural and social relevance.

3.5 How are SEPLS linked to ABT 11?

While ABT 11 refers to protected areas and other effective area-based conservation measures, protected areas can include areas that allow sustainable use consistent with the protection of species, habitats and ecosystem processes. In addition to protected areas, areas conserved by indigenous and local communities, as well as privately protected areas, may also be included, provided that the following conditions are met. The area conserved should:

- include areas of particular importance for biodiversity and ecosystem services
- be ecologically representative, containing adequate samples of the full range of existing ecosystems and ecological processes
- be effectively and equitably managed with planning measures in place to ensure ecological integrity and the protection of species, habitats and ecosystem processes, with the full participation of indigenous and local communities, and in a manner that costs and benefits emerging from the management of the areas are fairly shared between the different actors.
- be well-connected to the wider landscape or seascape using corridors and ecological networks to allow connectivity, adaptation to climate change, and the application of the ecosystem approach (which implies having conservation interventions applied ecosystem-wide rather than having fragmented measures) (CBD 2013).

Table 2 summarizes how the OECM criteria above relate to the cases in this volume.

Table 2

OECM criteria	Examples from this volume
Criterion 1: Not currently recognized as a protected area	
	Serves as primary, secondary and ancillary conservation (Chapters 2 and 5).
Criterion 2: Governed and Managed	
2.1. Geographically defined space	Obscured definition for large-scale landscape particularly in defining indirect beneficiaries and ecosystem services impacts. Mostly clear boundary of interventions induced by the management systems (Chapter 9).
2.2 Legitimate governance authorities	Autonomous, decentralized government structures that have formally agreed to collaborate in the maintenance of rural livelihood (Chapter 10).
2.3 Managed	Self-managed by communities as ancillary conservation (Chapters 4 and 5), private natural reserves (Chapter 7).
Criterion 3: Achieves positive and sustained long-term outcomes for the *in-situ* conservation of biodiversity	
3.1. Effective	Cost-effective in conservation of biodiversity and ecosystem services (Chapters 4 and 5).
3.2. Sustained over long-term	Time-tested, biocultural territorial planning (Chapters 9 and 10) and reflecting future community visioning.
3.3. Information and monitoring	For the most part, there is a lack of robust monitoring due to OECMs being considered non-primary targets for conservation and not the main habitats for charismatic species.
Criterion 4: Contributes to conservation of associated ecosystem functions and services and cultural, spiritual, socio-economic and other locally relevant values	
4.1. Ecosystem services	Wildlife corridor, particularly for mega species, providing connectivity (Chapter 8), and functioning as microrefugia and better watershed services, (Chapter 9), buffer zones (Chapters 3 and 4).
4.2. Cultural, spiritual, socio-economic and other locally relevant values	Passing on indigenous, traditional knowledge and reinforcing cultural identities through preserving traditional culture and arts (Chapter 8).

Source: (for OECM criteria) Convention on Biological Diversity (CBD) 2018, Recommendation adopted by 22nd Meeting of Subsidiary Body on Scientific Technical and Technological Advice 22/5: Protected Areas and Other Effective Area-Based Conservation Measures (CBD 2018).

All of the above conditions can apply to SEPLS, which contribute to ABT 11's fundamental elements of connectivity, equitable management and representation. Examining how well-managed SEPLS can contribute to ABT 11 also helps us to identify various contexts in which SEPLS exist, how they are managed, what kind of institutional arrangements are involved in their governance, what kind of challenges and emerging issues they face, and what combinations of solutions and approaches can be used to tackle the trade-offs arising from these challenges.

4. Challenges and Opportunities

4.1 Challenges in sustaining SEPLS in a changing world

Some of the significant challenges identified by the authors relate to drivers of change, perceptions of risk and institutional redundancies. Below, we also highlight how these challenges are being addressed within the different SEPLS contexts.

4.1.1 Drivers of change

Changes to resource use patterns and SEPLS, whether positive or negative, are driven by social, economic and environmental factors, such as migration and dynamic changes caused by both humans and nature. These can include changes in demographics, perceptions of values, policy, climate, and natural disasters, among others. From the case study experiences, changes in SEPLS use and management have been affected by recent developments in migration, demographic change, changes in people's values related to nature, pollution, and production/conservation policies. The challenge lies therefore in anticipating and adapting to the impacts of the various drivers (see Table 3).

4.1.2 Perceptions of future risk

The sustainable management of SEPLS relies on perceptions, both local communities' local perceptions and those of external stakeholders, of the threat of degradation on the one hand, and common benefits from sustainable

management on the other. Often though, the perception of future risk is lower relative to planning for present needs, meaning that actions are generally planned and executed based on near-term priorities, and may not help achieve longer term sustainability in the SEPLS. Therefore, any intervention needs to demonstrate intermediate benefits to cover short-term needs, as these serve to motivate communities towards desired long-term planning. This is well illustrated in some of the cases. For example, after restoring abandoned farmlands and cleaning up the degraded environment, farmers in the Gongrong community in Chinese Taipei (Chapter 4) were able to expand activities to "new" agricultural production practices such as crop diversification, growing of traditional crops, and eco-friendly farming practices, which have helped to increase their average annual income. These successes have motivated more residents to practice sustainable farming, which was significant as most of them are young farmers who are beginning to see a future in farming in that area. This is the fruit of the comprehensive Rural Regeneration Plan, which was able to translate environmental conservation efforts into economic benefits for the local community. In some of the autonomous, decentralized governments of the El Collay Commonwealth in Ecuador (Chapter 9), environmental restoration measures and adaptation to climate change supported the establishment of the community-conserved area of El Collay, mainly to provide localized conservation of some Andean tree species and orchids, as well as to secure the continuing contributions of nature to people captured with mechanisms of payments for ecosystem services (PES) related to hydroelectricity production. It is also observed that communities can plan for future risks when given appropriate tools and information, for example participatory discourse and assessment on resilience, risk, and likely benefits in the short, medium, and long-term. An example of such a tool is the "Toolkit for the Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes", as demonstrated in the case studies of Uganda and Tanzania (Chapter 2), that provided space for communities to deliberate on and discuss the challenges affecting their

Table 3. Drivers and impacts of change

Driver	Changes and impacts	Examples from this volume
Migration	Immigration could bring about changes in resource and land use, resulting in conflict due to differing perceived value of the site. On the other hand, out-migration of people from a site often results in insufficient population available to maintain the SEPLS.	In the case of the El Collay Commonwealth site in Ecuador (Chapter 9), immigration of people for purposes of "amenity tourism" had increased the perceived value of the site, but on the other hand triggered a conflict between the production and real estate values of the site. Immigration also results in bringing in people who do not have the same degree of connectedness with the site and resources, with consequent issues arising in the use and management of resources. In the Gongrong community of Chinese Taipei (Chapter 4), young people began to move to cities seeking better job opportunities due to reduced livelihood options as a result of environmental degradation, thus leaving the community with an aged population and decreasing productivity.
Demographic change influencing changes to value perceptions of nature	The motivations of older and younger populations, and of different actors in the maintenance of SEPLS, varies, and could have positive or negative consequences.	In Rakai village, Uganda (Chapter 2), residents lament that the progressive decrease of resources brought about by population increase has in turn also diluted "community identity", with a resultant neglect of natural resources. It was observed that in some cases (Chapter 9), the youth who returned home to the SEPLS after working elsewhere, whether on holiday or to relocate, were interested in investing in maintaining the sites and improving their sustainability.
Policy changes	Policy decisions and support from national and multi-lateral levels could bring about change in the management of SEPLS.	In the Mid Dagua River Basin (MDRB) region of Colombia (Chapter 7), the conversion of private land into Natural Reserves of Civil Society (or NRCS) recognized within management categories of the National System of Protected Areas (SINAP), is introduced as a voluntary process whereby the owner of a private farm linked to conservation processes can turn the property into a government-recognised protected area, but keeps the land titles and private property rights.
Under-utilization	Under-utilization of natural resources due to abandonment of agricultural land caused by environmental degradation and/or demographic change could further degrade biodiversity and ecosystem services.	In the Gongrong and Ankang communities in Taiwan (Chapter 4), agricultural land had been abandoned due to environmental degradation caused by pollution. Also in the villages of Caranga Baxu and Villamorei of North-West Spain (Chapter 3), abandonment of the primary sector and a demographic shift to an aged population had brought about the abandonment of chestnut orchards.

Driver	Changes and impacts	Examples from this volume
Pollution	Chemical pollution or sedimentation, due to excessive chemical use from expansion of agricultural and aquaculture activities, could bring about environmental degradation and loss of biodiversity and traditional livelihood options.	In the Balian Stream of Chinese Taipei (Chapter 4), degradation of the upstream environment, together with problems within the midstream settlement, including mismanagement of domestic wastewater, overuse of chemical fertilizer and pesticides, increasing abandonment of agricultural land, overfishing and improper stream construction, and clearing of riparian vegetation, had resulted in a dying stream and degradation of production landscapes. On Semau Island in Indonesia (Chapter 5), biodiversity on the island and the surrounding sea is threatened by the excessive use of chemicals in agriculture, which decreases soil fertility and results in chemicals in the soil being carried to the ocean through rainwater. The use of chemicals in agriculture rose in the last two decades and has increased ever since the community was introduced to vegetable seedlings and hybrid corn. At the mouth of the Chone and Portoviejo rivers in Ecuador (Chapter 6), fisheries harvests had significantly reduced due to sedimentation and pollution mainly caused by the chemical effluent from agricultural and shrimp-farming activities.
Economic development	Economic development, such as expansion of a particular industry competing for natural resources and land at the expense of traditional ones, could bring about biodiversity loss.	The communities of Rakai in Uganda and Lushoto in Tanzania and the Kaya forests of Kenya (Chapters 2 and 8) are under extreme pressure from sand harvesting and the extraction of building poles, as well as encroachment on forest areas in search of more fertile land for crop farming and livestock grazing. The communities switched to domestication of plants naturally growing in Kaya forests to relieve pressure on the forests, hence contributing to the conservation of the existing biodiversity. The loss of natural cover and ecosystem services associated with the Dagua River in Colombia (Chapter 7) due to agricultural expansion, had led to the cutting of natural forest to establish crops or pastures to feed livestock and for timber. More than 80% of the mangroves in the Chone River Estuary and Portoviejo River Estuary in Manabí Province, Ecuador (Chapter 6) had been destroyed to make way for pools for the shrimp industry.
Revival of traditional knowledge and cultural values	Local communities are starting to recognize and revalue traditional knowledge in managing their SEPLS and natural resources, not only for biodiversity and environmental conservation, but also to effectively utilise resources for economic gains, foster social cohesion and preserve cultural identity.	The Mijikenda community in the Kilifi and Kwale counties on the Kenyan Coast (Chapter 8), through collective action, established cultural villages adjacent to each of the Kaya forests as an alternative source of income and to ensure Mijikenda cultural practices are not lost. The cultural villages provide centralized venues for showcasing Mijikenda cultural ceremonies, rituals and biodiversity-conservation related practices.
Integrating science with traditional knowledge	Traditional knowledge coupled with modern technology and science could bring about more efficient ways of management suited to the human-resources capacity of a site.	In the villages of Caranga Baxu and Villamorei in North-West Spain (Chapter 3), restoration of abandoned chestnut forests used traditional knowledge combined with modern techniques for operations like reclamation of trees, conservation and maintenance of the orchard.
Climate change	Pressures from climate change compel local communities to switch to different production methods and patterns, but in some cases communities count on experience-based wisdom and traditional resources to diversify their risks.	The low-lying Kenyan coastal region (Chapter 8) has been experiencing frequent droughts, floods and increased incidences of pests and diseases as a result of climate change. These impacts of climate change, coupled with rapid population growth and overdependence on natural resources by local communities, are causing extensive degradation of natural resources leading to loss of biodiversity and low food productivity. The responding strategies to conserve biodiversity in light of changing climatic conditions include diversification of traditional crop varieties by planting different crop varieties in the same season on the same piece of land, as well as domestication of wild plants for income, medicine, and food security, and planting large areas of resilient traditional crop varieties.

landscape resilience and possible local solutions in the wake of ongoing socio-economic, ecological and climatic changes. In the case of Manabi province, Ecuador (Chapter 6), the resilience evaluation provided the local communities and organizations the opportunity for debate and analysis on the strengths and weaknesses of the SEPLS, which helped them develop priority action plans to address key threats and weaknesses, thereby reinforcing the resilience of the SEPLS against future risks.

4.1.3 Limited or even nonexistent positive value internalization of negative externalities

SEPLS, as multifunctional landscapes, produce provisioning (food, fodder, fiber, and others), regulating, supporting, and cultural ecosystem services, along with spiritual elements that provide benefits to local communities and external beneficiaries (Wiggering et al. 2006; Lambin & Meyfroidt 2010). While the intangible benefits contribute greatly to human welfare, as they are rarely traded in markets or financially priced, their values are barely noticed in many socio-economic systems. Consequently this lack of value awareness contributes to the degradation of ecosystem services and results in overconsumption of common-pool resources (Lant, Ruhl & Kraft 2008). Thus, enabling policies and instruments that facilitate capturing the tangible and intangible values of SEPLS, while also taking into consideration local perceptions and cultures, is critical (Leimona, Chakraborty & Dunbar 2018).

4.1.4 Institutional and governance inefficiency

The case studies in this volume show that common governance problems exist in the way SEPLS are managed and utilized. Problems that result in institutional and governance inefficiency range from corruption to changing administrations that substantially shift priorities for management. In this case, multi-stakeholder involvement with quantifiable indicators of good governance is still considered to be one of the best institutional elements in managing SEPLS (Daily et al. 2009; Howe et al. 2014).

4.2 Opportunities

In spite of changes, SEPLS still continue to be well managed in harmony with nature. The distinct social and ecological characteristics of a landscape or seascape point to locally-relevant solutions for their management and use. A wealth of related knowledge and approaches for their deployment is already available (UNU-IAS & IGES 2015). It is also noteworthy that rather than individual interventions, a cohesive set of coherent solutions is required to address concerns in SEPLS. In relation to the Andean landscapes (Chapter 9), the case study's author has suggested that the world "managed" is made up of two parts: "man" and "aged", implying that human priorities over time determine appropriate approaches, referring to what geographers call spatiality and historicity (Sarmiento 2000). Several opportunities for SEPLS management can be identified from the case studies in this volume:

- Greater diversity makes SEPLS more resilient to socio-economic, environmental, and political shocks. Diversity of resources and the mosaic character of SEPLS enable various livelihood activities and enhance socio-economic and environmental resilience.
- Authors observe that the young generation can be classified into two types of people: native youth residing in the community or who return from working elsewhere; and migrants from other places. Both types require support from the resident community to connect with the landscape or seascape and local culture.
- Communities should be recognized as agents of change and as having the capacity for strategic management of SEPLS.
- The linkages between science and practice, if fostered by co-production of knowledge and co-learning, ensure that communities have better capacities for managing SEPLS and integrating traditional knowledge and modern technologies.
- It is important to foster social connections and social capital for SEPLS management; likewise, participatory toolkits foster greater connections, peer-to-peer learning, and south-to-south cooperation.
- Nested policy approaches should be pursued that allow decision-making at multiple levels and on multiple scales, from individual plots to national and regional scales.

SEPLS, as the foregoing shows, are important sites for conservation of natural resources and exemplify human-nature interactions with broadly positive outcomes for conservation goals and human well-being. It is in this way that SEPLS contribute to ABT 11, which seeks to ensure area-based conservation in a manner that is effective and equitably managed, and integrated into the wider landscape and seascape. In line with the criteria for identification of OECMs described in section 3 above, stakeholders in SEPLS adapt their management practices to take into account different land use mixes and demonstrate effective solutions for the sustainable use of biodiversity by varying the scale, ecosystem or policy response type (economic, social, technical, etc.) of solutions and their combinations of use (Kozar et al. 2018). The case studies here demonstrate that it is possible through diverse approaches to ensure ecosystem integrity and sustainable use of biological resources.

4.2.1 Practical opportunities to overcome identified challenges

In addition to the challenges identified in section 4.1, authors experienced difficulties including visualising the spatial extent of conservation effects and motivating stakeholders towards desirable action. Some opportunities to face these suggested by the case studies are identified below.

- Setting up appropriate analytical scales spatially and socially to provide pertinent solutions:

  Considering that SEPLS operate within multiple time and space scales, distinctions between potential uses of spatial and socio-ecological data and information and their scales are essential to efficiently and effectively provide solutions at the right scales. In the case of valuation of ecosystem services, Costanza et al. (2014) list some of the potential uses of such solutions differentiated by types of values, spatial scales, and precision needed. The potential uses can range from raising awareness, national income and well-being accounting, specific policy analyses, land use planning, PES, and detailed analysis of other policy choices and scenarios. Further, stakeholders at different scales attach different values to ecosystem services, and consequently their interests in ecosystem services also differ (Hein et al., 2006). In this case, roadmaps and indicators developed inclusively through community discourse activities allow for the community's ownership of SEPLS management.

- Raising awareness with tailored messages and lessons from the ground:

  Tailoring messages for decision makers, users of commodities and services, and producers requires a good understanding of their respective priorities, perceptions, and motivations to action. It is useful to link communication messages to good practices and efforts towards their replication by others in similar circumstances. This helps faster uptake and mainstreaming, both across communities and across levels of governance.

- Monitoring and evaluation for diversification and certification of products based on minimum standards:

  The management of SEPLS can add value to agricultural and nature-based products by certification and labelling, but only if the benefits and socio-ecological services provided by SEPLS can be proven and made visible to both producers and consumers through regular monitoring and evaluation. Monitoring and evaluation are meaningful only with the setting of baselines, indicators, targets, and carefully selected methodologies to systematically collect data and interpret the results. The monitoring and evaluation process should involve multiple stakeholders, and the economic returns from these products should benefit the community and the management of SEPLS.

- Building partnerships, sharing experiences, and learning lessons from each other:

  Partnerships between various stakeholders not only bring in differing expertise, but also promote effort sharing and ensure diverse interests and equity issues are addressed, which in turn ensures commitment. Thus, in building partnerships, it is important that the process first promotes an inclusive dialogue among stakeholders on equity and shared values, including traditional values and human rights values. Partnerships should also aim to empower different segments of the communities, in particular encouraging youth engagement, through capacity building and training, environmental sensitization, and enhancement of cooperation. Authors also suggested that youth-related organizations working with the CBD should be encouraged to engage with the Satoyama Initiative. There should be platforms in place to disseminate knowledge on co-production to build understanding of common language and common interests amongst stakeholders involved in the management of SEPLS.

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[1] As defined by Article 2 of the Convention on Biological Diversity (CBD) and in line with the provisions of the Convention.

[2] SBSTTA-22 was held in Montreal, Canada from 2-7 July 2018. This definition was based on the work of the Technical Expert Workshop on OECMs for Achieving ABT 11, held in Montreal, Canada from 6-9 February 2018.

Chapter 2

Perceptions of resilience, collective action and natural resources management in socio-ecological production landscapes in East Africa

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Abstract

If properly managed, socio-ecological production landscapes and the ecosystem services they provide can contribute to the well-being of local communities, as well as to the achievement of the global conservation agenda and of other relevant development policies at the national level. However, many of these landscapes worldwide are often highly insecure due to unsupportive government policies, agencies, and lack of local collective action. By conducting a network analysis and participatory exercises with district officials and farmers in two communities from Rakai (Uganda) and Lushoto (Tanzania) districts, we studied local perceptions regarding (a) the contribution of natural resources to local farmers' livelihoods, and how these farmers, in turn, contribute to the conservation and sustainable use of these natural resources, (b) landscape threats and resilience, and (c) major causes of the identified and possible local solutions for mitigating them. The study shows that in the four communities there was very little communication among farmers and that the cooperation between farmers and local and district stakeholders was rather limited. Farmers did not seek much information concerning conservation and use of natural resources and very few of them were aware of the existence of government programs regulating natural resources management. In addition, the study sites were found to be experiencing a progressive degradation of their natural resources. We, therefore, conclude that the creation of spaces for informed, public discussion aimed at making the institutional context more favourable for the creation and coordination of community groups and at enhancing their interaction, would contribute to a wider movement of knowledge and social exchange. This, in turn, could ultimately result in the creation of local initiatives aimed at the conservation of natural resources.

Keywords: Climate change, natural resources management, socio-ecological production landscapes, biodiversity, perceptions of resilience

Country	Uganda
Province	Central Region of Uganda
District	Rakai
Size of geographical area	3,351.5 Km^2
Number of indirect beneficiaries	492,441 persons
Dominant ethnicity	Baganda

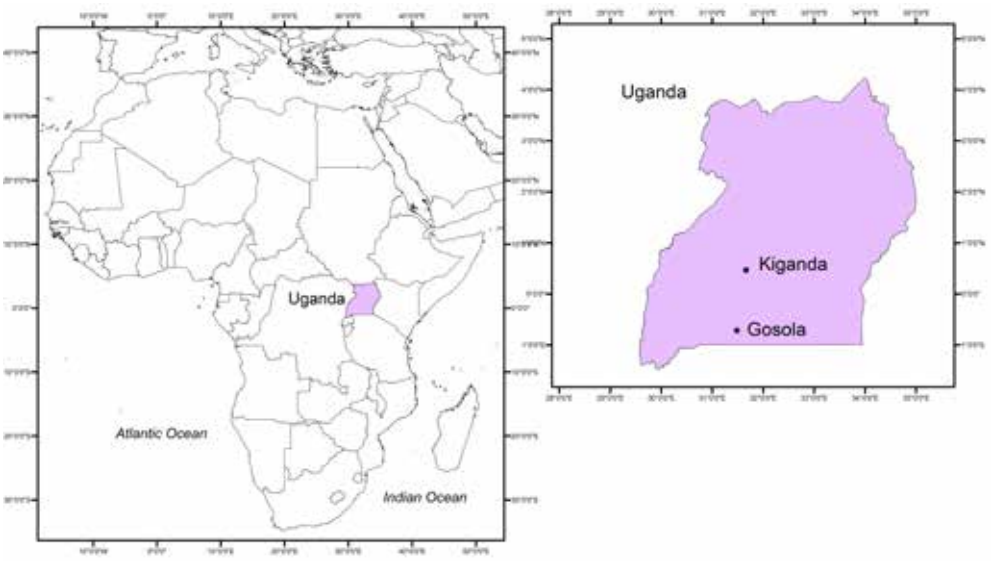

Figure 1. Map of the country and case study region - Uganda

Country	Tanzania
Province	Tanga Region
District	Lushoto
Size of geographical area	4,091.62 Km^2
Number of indirect beneficiaries	518,008 persons
Dominant ethnicity	Sambaa

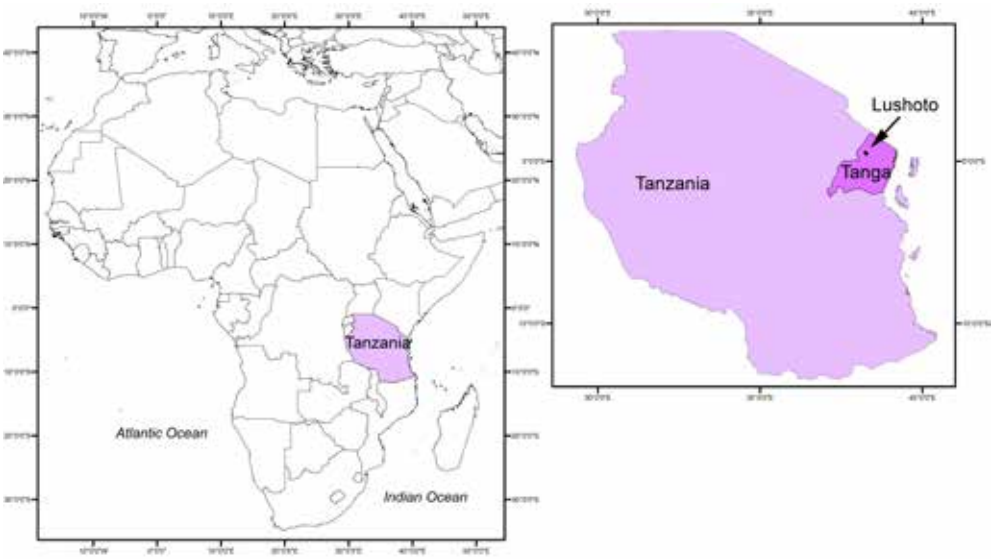

Figure 2. Map of the country and case study region - Tanzania

Uganda:

Size of case study/project area	…… hectares
Number of direct beneficiaries	31 persons
Geographic coordinate (longitude and latitude)	0° 43′ 0″ S, 31° 24′ 0″ E
Dominant ethnicity	Baganda

Figure 3. Land use and land cover map of case study site - Uganda

Tanzania:

Size of case study/project area	…… hectares
Number of direct beneficiaries	45 persons
Geographic coordinate (longitude and latitude)	4° 47′ 55″ S, 38° 17′ 25″ E
Dominant ethnicity	Sambaa

Figure 4. Land use and land cover map of case study site - Tanzania

1. Introduction

One of the outcomes of the 10th Conference of the Parties to the Convention on Biological Diversity (CBD COP 10) was the adoption of the "Strategic Plan for Biodiversity 2011-2020" (CBD 2010). Among the key features of this Strategic Plan was the establishment of 20 Aichi Targets to achieve global biodiversity conservation. In particular, Target 11 addresses the need to establish and manage protected areas as effective tools for meeting environmental challenges. However, conservationists agree that protected areas are not the only tools for maintaining ecosystems (Woodley et al. 2012) and that in a concerning number of cases, the protected areas are not as effectively protected as they should be (Jones et al. 2018). As a result, the importance of integrating protected areas into the broader landscape is increasingly recognized (e.g. Ervin et al. 2010), and doing so is aimed at guaranteeing the conservation of ecosystems and the services that they provide.

The term socio-ecological production landscapes and seascapes (SEPLS) defines "a mosaic of production landscapes (or seascapes) that have been shaped through long-term harmonious interactions between humans and nature in a manner that fosters well-being while maintaining biodiversity and ecosystem services" (Gu & Subramanian 2012). In some cases, SEPLS are formally recognized as protected areas under different frameworks. Many others are not recognized as such, yet they contribute to the conservation of both biological and cultural diversity. Resilient SEPLS are crucial for securing ecosystem services, benefiting local communities' well-being and, at the same time, contributing to the global conservation agenda. In this context, "resilience" of a SEPLS is understood here as the ability of a SEPLS to absorb or recover, in terms of both ecosystem processes and socio-economic activities, from various pressures and disturbances without lasting damage. The importance of functioning ecosystems for the poorest and most vulnerable societies in the light of climate change it is widely recognized (e.g. WRI 2005). In fact, as climatic events become more severe, well-managed ecosystems such as forests or wetlands can buffer many flood and tidal events, landslides and storms. However, many of the SEPLS that integrate these ecosystems are comprised by so-called "common-pool natural resources". Common-pool natural resources, including forests, pastures, water systems, fisheries and biodiversity, are typically defined as rivalrous (i.e., one person's use of a resource detracts from others' use of the same resource), and non-excludable (i.e., it is difficult or impossible to prevent others from accessing the resource). Consequently, natural resources are commonly threatened by a number of factors such as population pressure, expansion of agriculture and unsustainable agricultural and rangeland practices, land fragmentation, poor implementation or enforcement of natural resource management policies, and the loss of traditional knowledge and weakening of customary institutions. Managing natural resources amidst the added stresses associated with climate change constitutes a challenge (Tompkins & Adger 2004). In the case of agricultural production systems, in particular, climate-related stresses may potentially lead to a progressive increase in smallholder farmers' reliance on natural resources and hence contribute to their further erosion and eventual loss in the absence of supportive policies, agencies, and local collective action initiatives designed to counteract these effects. In this context, collective action, understood as the coordination of efforts among groups of individuals to achieve a common goal when individual self-interest would be inadequate to achieve the desired outcome (Ostrom 1990), might be essential to enhancing the sustainability of natural resources management (e.g. Abramovitz et al. 2001; Tompkins & Adger 2004).

This study draws on original research conducted as part of the Policy Action for Climate Change Adaptation (PACCA) project, implemented under the CGIAR Research Program on Climate Change Agriculture and Food Security (CCAFS). We focus on identifying local perceptions regarding (a) the contribution of natural resources to local farmers' livelihoods, and how farmers, in turn, contribute to the conservation and sustainable use of these natural resources, (b) landscape threats and resilience, and (c) major causes of the identified threats and possible local solutions for mitigating them, in four study sites located in Uganda and Tanzania.

This chapter is organized as follows: Section 2 describes the study sites, the methodology is presented in Section 3, Section 4 deals with the results, Section 5 with the discussion of the findings, and finally, Section 6 concludes with some policy implications.

2. Study sites

The study was carried out in Yamba and Kwang'wenda, two representative villages of the Lushoto district of the Tanga region in Tanzania and in Kiganda and Gosola, two villages of the Rakai district in the Kyovu Parish, in Lwanda Sub-county of Uganda (see Fig. 5). Rakai and Lushoto are ecologically similar in many aspects. The Sambaa, the dominant tribe in Lushoto, and the Baganda tribe of Rakai are predominantly farmers, with livestock keeping in both cases as a minor occupation. The four selected sites were chosen because they were among the benchmark sites of CCAFS.

The two villages in the Lushoto district are separated by a straight distance of about eight kilometers and are located in the West Usambaras, a mountainous region ranging in

Figure 5. Location of Rakai (Uganda) and Lushoto (Tanzania)

altitude from 500 to over 2,300m. Yamba is representative of forest-edge villages with high resource diversity. Although the main parts of Yamba are at 1540m above sea level, the village extends both to higher (1600m –Yamba mountain) and lower altitudes (1400m). Around the center of Yamba village, the population density is high, and the land is highly cultivated. Kwang'wenda is representative of villages with relatively fewer resources and with little or no influence on forests. It is located on a hilly area above Soni town at an altitude of approximately 1175m. The environment has been altered drastically by human activity over the years.

Kiganda and Gosola, in Rakai, are located on the inland part of the western shores of Lake Victoria, Southern Uganda, and share a similar nearly flat landscape interspersed by small hills, forming two highly cultivated landscapes, separated by a straight distance of about five kilometers. The area is nearly devoid of rivers. Though highly populated, the area suffered considerably in the late 1980s and early 1990s due to the HIV/AIDS scourge that wiped out many families. This attracted several development agencies, which progressively left the area as the pandemic diminished.

3. Methods

3.1 Participatory exercises

A series of participatory exercises aiming at elucidating the range of perceptions of landscape resilience in the four communities were held in May and October 2014. The participants of each community were identified by a local coordinator and gathered at a central location in the village for focus group discussions. In total, 31 and 45 community members of mixed gender and age respectively, took part in the study. At the beginning of each exercise, simple demographic information of the participants such as name, age and gender were recorded. During the exercises, all the information was written down on sheets of paper and pinned on the walls to be used by the participants as reference information during the subsequent exercises.

3.1.1 Introduction/brainstorming sessions

Mapping the village landscape, its diversity and natural resources maintenance over time

The participatory exercises started with the development of a map by the community members of their landscape, indicating the natural resources and the physical and infrastructural features (see Fig. 6). Participants also listed the major components of their landscape, including crop land, fallow land, wild land, forests and the agricultural and wild edible biodiversity. Thereafter, participants were asked to indicate on the maps the changes that the landscape had experienced over the previous 30 years.

Trends in main food sources: past, present and expected future

To identify the main food sources for the communities and the communities' perceptions about how these sources had changed and were likely to evolve over time, cards with pictures of the main sources of food were placed on the ground. Then, ten pebbles were given to each of the participants, who were thereafter called one at a time to allocate the ten pebbles to the different food sources according to how important each of them was at the present time. The same exercise was repeated for past and future situations (see Fig. 7).

3.1.2 Community perceptions of resilience

In the context of analyzing factors affecting the perceptions of resilience of the communities, the "Indicators of Resilience in SEPLS" were used. These indicators were first

Figure 6. Participatory landscape mapping exercise in Rakai, Uganda.

Figure 7. Participants identifying food sources on map

developed by Bioversity International and the United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS) in 2012 as a tool for engaging local communities in adaptive management of the landscapes and seascapes in which they live. The tool consists of a set of 20 indicators designed to capture community perceptions of different aspects of their production systems: ecological, agricultural, cultural and socio-economic. Likewise, the tool includes both qualitative and quantitative indicators from answers provided by the participants. These questions fall within six sections: (i) Landscape and ecosystem diversity and its conservation status; (ii) Diversity, management and sustainable use of local resources; (iii) Documentation of local knowledge and agrobiodiversity; (iv) Landscape resource governance and institutional cooperation; (v) Gender-based knowledge and social equity; and (vi) Socio-economic infrastructure and income opportunities. Each participant gave his or her own perception of landscape resilience and people's wellbeing with respect to each of the 20 indicators using a 5-point scale. A detailed description and assessment of the SEPLS toolkit can be found in UNU-IAS et al. (2014).

Before starting, the facilitator explained each indicator's question using different techniques. The facilitator also explained the meaning of the 5-point scale. A "one" meant a "very poor" status while a "five" meant a "very good" status. Participants also ranked their perception of the future trend for each question using a similar 5-point scale. A "one" meant that the participant expected the situation to deteriorate very significantly (pessimistic) in the future, while a "five" meant that he/she considered that it would improve very significantly (optimistic). Thereafter, based on the analysis of the proportion of respondents that had given scores of 1 to 5 for each indicator, areas of risk and resilience perception were identified. Overall resilience was determined by comparing perception scores from both the current status and future trends. After scoring each indicator, participants were given the opportunity to discuss their answers. The exercise concluded with a review of the main problems and threats identified during the exercise, their causes and possible solutions.

Statistical analyses

Perception scores of questions within each of the six sections of the Indicators of Resilience toolkit were pulled together and averaged. The distribution of scores in the majority of indicators was found not to be normal according to the D'Agostino-Pearson omnibus normality test. Due to the lack of normality, scores were also compared using the Kruskal-Wallis test, followed by a Dunn's test with correction for multiple comparisons. P-values below 0.05 were assumed to be significant. Mean scores were compared between the present and future scores within sections to test whether resilience was perceived to change over time for each of the study sites. Present and future scores of the six sections were also compared between communities to test whether there were significant differences between the perceptions of resilience of the four studied communities.

3.2 Network analyses

Social network data was collected through personal interviews to identify social ties. Two surveys were conducted: a household survey, and a meso-level expert survey. The household survey adopted an egocentric approach designed to explore farmers' communication with experts and other farmers. Through the use of network questions, farmers reported the names of experts and other farmers that they went to for information on climate-smart farming practices and technologies as well as the frequency and mode of communication with their named ties. The surveys also explored the size and composition of farmers' networks related to natural resources use and management, and recorded data on farmers' access to and participation in sustainable natural resources management and their perceptions about related policies. In total, 298 farmers from Rakai and 302 from Lushoto responded to the household survey. The meso-level organizations included local, district, national and international organizations relevant for climate-smart technologies and practices in the study sites.

The meso-level survey used the snowball sampling method to identify all relevant experts. It used a few of the names of experts generated from the household surveys to seed the snowball approach.

One year later, the same farmers and district officials from Rakai and Lushoto were visited again to get their feedback about the results obtained from the data analyses.

4. Results

4.1 Insights from the participatory exercises

4.1.1 Landscape characteristics

The mapping exercise made it possible to acquire a general idea about major differences between the landscapes surrounding the four communities. The landscape around Lushoto, and particularly that of Yamba, was found to be more diverse than that of Rakai. Communities living in Yamba had access to two forest reserves, and there were three forested mountains in close proximity, several permanent rivers, streams, springs, big rocks and an escarpment with caves. In total, considering the two communities together, participants listed 31 local terms to describe physical features, land use, types of farms and crop fields. Participants from Kwang'wenda mentioned 13 (42%) of the terms, whereas those from Yamba referred to 27 (87%). Some of the components mentioned only by participants from Yamba included caves, big rocks, forests and highlands. Examples of terms that appeared in Kwang'wenda and not in Yamba were terms used to define eroded and abandoned crop fields. Participants from Rakai, on the other hand, highlighted the existence of a few swamps, ponds and one lake, as well as about six hills covered with bushes and grass, which had traditionally constituted important grazing areas and sources of firewood and medicinal plants for the community, and a few private forests.

Regarding the diversity of food available in their surroundings, the participants from Lushoto listed 149 food types: the group from Kwang'wenda listed 110, and those from Yamba, 138. Participants from Gosola and Kiganda, Rakai, listed 80 food types in total. Crop fields, livestock, markets, forests and the wild environment were identified as the five most important sources of food in Lushoto. Participants from both Yamba and Kwang'wenda considered that the roles of crop production and the market had gained importance over time and were expected to continue to do so towards the future. The role of forests and wetlands was perceived differently in the different villages. The participants from Yamba felt that their role would decline significantly in the future. In contrast, participants from Kwang'wenda expected them to gain importance as a result of the growing efforts undertaken by the community to plant trees to restore the lands that had been degraded during the previous years. In Rakai, six food sources (crop fields, livestock, forests/wild environment, lakes/rivers, friends/relatives and the market) were identified as the most relevant. Overall, participants from Rakai perceived their own crops to be the main sources of food in the area. They perceived that it was so in the past as well as in the present, and expected them to continue to be important in the future. There was a general sense that the importance of the market had increased substantially over time, and it was expected to become one of the main sources of food in the future. The role of forests/wild environment was considered to have kept constant over time, while the importance of gifts coming from friends or relatives was expected to decrease progressively due to the increasing scarcity of resources.

4.1.2 Collective action

Participants from Lushoto recognized the existence of some organized forms of collective action to improve the welfare of the community. These included the construction of schools and other buildings, the cleaning of wells, and the planting of trees on hilltops. In addition, communities were encouraged to keep springs under some local management and to conserve indigenous water-conserving trees around the springs.

Twenty-one (21) organizations were involved in local development within Yamba. These included community-based organizations (CBOs), non-governmental organizations (NGOs), religious groups, government ministries, schools, national research institutions, the private sector, international research organizations and international development agencies.

Participants from Rakai explained that forms of collective action had almost disappeared in their area. Therefore, NGOs and CBOs constituted key players in encouraging the formation of new farmers' organizations to improve farmers' ability to bargain collectively on issues that affected them, such as better prices for their agricultural produce. Some forms of collective action, however, still existed in the area for taking care of the common wells. There were no bylaws regulating natural resources management and participants recognized that the few regulations established by the government were not being enforced. This was attributed to the absence of natural resources within public lands.

Eight stakeholder institutions were identified in Rakai: two CBOs, one local NGO, one international NGO, the project being implemented by the CGIAR consortium, and religious and educational groups.

Table 1. Mean ± Standard Deviation (SD) of values for present status (P) and future trend (FT) scores for the four villages visited

Section of the SEPLS toolkit	Lushoto (Tanzania)				Rakai (Uganda)			
	Kwang'wenda		Yamba		Gosola		Kiganda	
	P	FT	P	FT	P	FT	P	FT
Landscape/ecosystem diversity and its health	2.6±0.8	2.7±1.0	4.0±0.7	4.2±0.6	2.1±1.2	2.1±1.3	2.1±0.9	1.7±0.9
Diversity, management and sustainable use of local resources	3.2±0.9	4.1±0.4	3.6±0.9	4.1±1.0	2.2±1.5	2.4±1.4	2.0±1.1	1.5±0.9
Documentation of biodiversity and related local knowledge	2.6±1.5	3.1±1.2	2.3±1.2	2.1±1.2	3.1±1.8	3.6±1.4	2.3±1.2	1.8±0.9
Landscape resource governance and cooperation	1.9±1.1	4.0±1.0	1.7±1.1	3.8±0.7	3.6±1.5	2.8±1.7	2.3±1.2	2.1±0.9
Gender knowledge recognition and social equity	4.1±1.2	4.6±0.5	4.1±0.9	4.2±0.8	2.2±1.2	2.4±1.5	3.6±1.3	3.3±1.4
Socio-economic infrastructure, health and opportunities for income generation	2.8±1.4	3.8±0.7	3.6±0.8	4.1±0.5	3.5±1.2	3.5±1.1	3.1±0.9	2.9±1.0
Overall mean	3.0	3.7	3.5	3.9	2.6	2.7	2.6	2.3

4.1.3 Natural resources status and use

Loss and deterioration of water bodies, pasturelands, forests, wildlife, and crop diversity were some of the examples given by participants from both Lushoto and Rakai when they were asked to reflect on changes in the natural resources in their surroundings experienced over the previous 30 years. The reasons given by participants from the four communities to explain this situation were similar. These included mismanagement of natural resources, increased competition for natural resources due to population increase, changing food preferences, poor agricultural practices, poor access to seeds, climate-related factors, emergence of new pests and diseases and lack of consideration of some of the members of the community towards the others. Ineffective, or the absence of, cooperation among stakeholder groups, progressive disappearance of traditional resource management systems and lack of leadership at the local level were also pointed out as some of the main reasons behind the lack of enforcement and implementation of laws regulating natural resources conservation and use.

Overall, participants perceived that there was nothing they could possibly do about the depletion of natural resources. This was particularly true among the participants from Rakai, who indicated that as the population increased, the resources progressively decreased, weakening, in turn, the "community identity".

4.1.4 Communities' perceptions of landscape threats and resilience

Table 1 gives a summary of the mean values given by participants from the four communities with regard to the current status and future trends (based on predictions for 30 years' time in the future) for each of the sections covered by the SEPLS toolkit. In line with the responses given during the previously conducted participatory exercises, responses to the SEPLS exercises revealed that participants from Lushoto had the highest levels of optimism with regard to both present and future trends, with an average of 3.4 and 3.8 points, respectively, compared to Rakai, that scored "average" for both current status (2.6 points) and future trends (2.5 points). Perceptions of resilience were found to be the highest in Yamba, followed by Kwang'wenda, Gosola and Kiganda. The level of optimism regarding future trends followed a similar order.

Statistical analyses

The scores given by the participants from Yamba to the questions contained in the section "landscape/ecosystem

diversity and its health" were particularly high. In fact, statistical analyses revealed that they were significantly higher than the scores given by participants from the other three villages for both present and future trends ($P<0.001$). The scores given to the questions about "diversity, management and sustainable use of local resources" for both present and expected future trends by the participants from both Yamba and Kwang'wenda were also significantly higher than the scores given by participants from the two villages in Rakai ($P<0.05$). We, however, did not find significant differences between the mean scores given by the participants of Kwang'wenda and Gosola for the present. In contrast, the values given by participants from Lushoto to the questions related to "landscape resource governance and cooperation" for the present time, were fairly low. In fact, they were significantly lower than those obtained in Gosola ($P<0.001$). However, participants from both Yamba and Kwang'wenda were optimistic with regard to expected future trends, giving significantly higher scores to the questions contained in that section for the future ($P<0.001$). The mean scores given by participants from Gosola with regard to expected future trends for questions related to "documentation of biodiversity and related local knowledge" were also particularly high, being significantly higher than those given by the participants from Yamba and Kiganda ($P<0.05$).

4.2 Insights from the surveys

4.2.1 Natural resources use and farmers' awareness about norms and regulations

Despite the widespread concern expressed by the farmers during the participatory exercises regarding the steady erosion of natural resources in their surroundings, results from the survey revealed that only a few of the interviewed farmers from both countries considered themselves to be contributing to the maintenance of natural resources. In Rakai, 69% of respondents indicated that they were contributing to the maintenance of wells, pastures on hills (2%), and natural forests and wetlands (1%), whereas in Lushoto the highest level of contribution was found for natural forests, with 33% of the respondents confirming this.

Responses given by the surveyed farmers concerning the use of vacant or public land, and regarding their awareness about the existence of rules or regulations governing natural resources management, differed between the two countries. More than half (69%) of the interviewed farmers from Rakai reported use of vacant or public lands to obtain water (58%), to collect firewood (52%) and medicinal plants (51%), or for animal grazing (16%). In contrast, relatively few reported being aware of the existence of rules or regulations governing natural resources management on private or public lands. The opposite results were found for Lushoto, where very few of the interviewed farmers reported use of vacant, public or common lands (18%), and a fair amount of them reported being aware of the existence of rules or regulations. This was particularly true in the case of natural forests, for which 61% of respondents reported knowledge of rules or regulations.

4.2.2 Social Networks

Farmer to farmer

Although the results from Lushoto were slightly more positive, analyses revealed that the connections among farmers and between farmers and local experts were rather weak in the four study sites (see Table 2). The network analysis also provided an opportunity to explore whether certain actors had structural or relational disadvantages, based on social and gender variables, that could limit their access to information or other types of resources. The results from both Rakai and Lushoto revealed that women had smaller networks compared to men. Twenty-nine per cent (29%) of the respondents from Lushoto and 27% from Rakai answered that they did not seek information about farming practices or technologies from any other farmer. Moreover, 49% of respondents from Lushoto and 59% from Rakai reported that they had no direct connections with any experts at all inside or outside their villages.

Table 2. Percentage of respondents with no contacts in Lushoto and Rakai, differentiated by gender

	Respondents with no contacts		Proportion of women among respondents with no contacts	
	Lushoto	Rakai	Lushoto	Rakai
Farmers in and out of village	29%	27%	66%	67%
Experts in and out of village	49%	59%	58%	56%
In village contacts (farmers and experts)	25%	27%	69%	69%
External contacts (farmers and experts)	68%	56%	57%	62%

Figure 7 and 8. Participatory exercises in Rakai, Uganda

Farmer to expert and expert networks

The meso-level expert network was designed as part of the PACCA project to assess the extent to which organizations with expertise in climate-smart technologies and practices were connected among themselves and with farmers, which goes beyond the focus of this paper. However, the results presented here are still useful to understand how information and communication structures varied across sites. The results of the newtwork analyses are fully described in Jha et al. (2016).

The level of connectivity between expert organizations and farmers was found to be weak in the four study sites. Out of the 70 experts working in Rakai, only 18 (26%) were named by farmers. Similarly, out of the 85 experts from Lushoto, only 14 (16%) were named by farmers. The proportion of local experts not connected to farmers was greater in Rakai than in Lushoto. Along the same lines, analyses of existing connections among experts in Lushoto revealed that the experts that were connected to farmers were more embedded and prominent in the expert network (they had more connections with other experts) than the experts not connected to farmers in Lushoto. In contrast, in Rakai, experts who were connected to farmers were less embedded and less prominent in the expert network compared to Lushoto.

Follow-up workshops: views of local experts and farmers

In both countries, farmers' lack of confidence in the local experts and their perception of the insufficient presence of extension agents on the ground was corroborated by the farmers during follow-up meetings. District officials agreed with these feelings and recognized the lack of means of the current extension system, in particular the lack of qualified personnel and necessary resources, to meet farmers' needs sufficiently. District officials also recognized a great need to increase the use of participatory approaches and to encourage the formation of farmers' groups to strengthen communication networks. In addition, they recognized that the extension officers' lack of knowledge on how to address gender-related issues was constraining the effective inclusion of women in the training sessions.

4.3 Local solutions and interventions to increase resilience

The participatory exercises and follow-up workshops provided space for participants to deliberate on and discuss the challenges affecting their landscape resilience and possible local solutions in the wake of ongoing socio-economic, ecological and climatic changes. Some of these included (a) initiating and strengthening tree planting programmes, (b) discouraging encroachment on forests, springs and wetlands through the enforcement of relevant government regulations and policies, (c) initiating soil conservation programmes, (d) increasing communities' awareness of the importance of crop and landscape diversity for maintaining local ecosystem services, improving people's nutrition and resilience, and for climate change adaptation, and (e) strengthening and building the capacity of existing institutions, leaders and community groups, including youth and women groups, in resource use and management (see Fig. 7 and 8).

5. Discussion

It is widely recognized that resilient ecosystems are key for human well-being and for supporting communities' efforts to adapt to climate change. However, we found that the study sites presented here were characterized by a progressive degradation of natural resources in their surroundings. Participants from the four communities shared similar concerns about the decrease in accessibility to the natural resources and, as a result, to sources of wild food and

firewood, among other products, and about their consequent increasing dependence on the market. The information gathered during the participatory exercises suggests that at the time of conducting this study, only one of the four studied communities presented a relatively high level of confidence in their landscape and considered that its status would improve in the future. The perceptions of resilience held by the farmers from Lushoto, especially from Yamba, were considerably more positive than those of the farmers from Rakai. Several factors could explain the obtained results. The landscape of Yamba was characterized as having more components, habitats and food species. In addition, there was a larger number of agencies and stakeholders working at the community level in Lushoto, and more particularly in Yamba, than in the two studied communities of Rakai. Furthermore, the results from the analyses of expert networks indicate that farmers in Lushoto had better access to the most prominent/important expert organizations compared to the experts in contact with farmers from Rakai. The connections among local experts were also poor in Rakai compared to Lushoto, indicating that information exchange and communication among local experts were low in Rakai compared to Lushoto.

While the role of social networks in enabling communities to adapt to environmental changes and to successfully initiate and sustain natural resources management is well recognized in the literature (e.g. Tompkins & Adger 2004), we found that, in general, there was very little communication among farmers in the four study sites. Wosen et al. (2013) found that external sources of information, such as extension provisions, play a key role in enhancing adoption of natural resources management. In contrast, we found that not only were the connections between farmers poor, but also that cooperation and communication between farmers and local experts were almost non-existent. None of the communities studied here reported having a strong tradition of collective action oriented towards natural resources management. This could be a consequence of the lack of a sense of control expressed by the communities over the existing natural resources in their surroundings. However, we also believe that, in line with these results, and in agreement with other studies (e.g. Crona & Bodin 2006), the reported absence of collective action for natural resources management in the study sites might be also explained by the rather weak social networks existing among the community members. At the same time, the lack of enforcement of laws and rules regulating the use of natural resources makes these resources *de facto* "open access". This might explain why only a small percentage of the respondents to the survey in the four communities reported to be contributing to the maintenance of natural resources in their surroundings, despite their evident awareness and concern about its loss raised during the participatory exercises.

In contrast, farmers showed optimism when they were asked to suggest potential local solutions and interventions to increase their landscapes' resilience. That proves that there is potential in the studied communities for creating social capital for landscape governance. Going back to the study sites would allow assessment of the extent to which the conducted participatory exercises effectively contributed to raise awareness among the participants with respect to natural resources management and to changes in the communities' behaviour. The discussions held during the participatory exercises, and more specifically for each indicator of resilience of the SEPLS toolkit, certainly contributed to improvement of communities' awareness of the values of biodiversity and the different components of their landscape and allowed communities to evaluate current conditions across the landscape and to identify and reach agreement on priority actions with the potential to improve the status of biodiversity conservation in their surroundings. In addition, by encouraging community members to reflect on their landscape's resilience and how it could be improved, the indicators exercise might have given them a greater sense of ownership over management processes. The above findings suggest that the study sites would benefit from the creation or the reform of policies and institutions aimed at supporting control by the communities over natural resources and at making the institutional context more favourable for the creation and coordination of community groups. Presumably, it would likely lead to better conservation, management and use of the natural resources and ecosystems in their surroundings and of the services that they provide.

6. Conclusions

By conducting network analysis and participatory exercises with district officials and farmers in two communities from the Rakai (Uganda) and Lushoto (Tanzania) districts, we assessed the extent to which farmers relied on and were concerned about the status of natural resources available in their surroundings, their contribution to their maintenance, and the different uses they were making of them. In the literature, collective action appears to be a promising approach to guarantee sustainable natural resources management. Similarly, social networks are known to have a role in the diffusion of innovations through social learning, joint evaluation, social influence and collective action processes. However, in this study we found the existence of only weak local collective action initiatives related to natural resources management. Presumably, the widespread feeling of lack of control over the natural resources of the studied communities, together with the particular institutional settings and the absence of local initiatives,

have contributed to a situation in which natural resources are under threat, subject to overharvesting, land conversion and underinvestment. In addition, the weak interconnections found between the surveyed farmers and the consequent limited exchange of knowledge between them, might have also contributed to the absence of collective initiatives aiming to improve natural resources management. As a consequence, we conclude that the creation or reform of policies in the communities studied here, aimed at making the institutional context more favourable for the creation and coordination of community groups and for promoting interaction among community members and social exchange, has the potential to improve the conservation of natural resources in the surroundings of the study sites. This, in turn, would contribute to the achievement of the global conservation agenda.

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Chapter 3

The contribution of chestnut orchard recovery projects for effective area-based conservation: Two cases in Asturias (North-West Spain)

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Abstract

Socio-Ecological Production Landscapes and Seascapes (SEPLS) frequently illustrate potential synergies between socio-economic development, multifunctional use of land, preservation of traditional knowledge, enhancement of ecosystem services and the conservation of biodiversity. As such, efforts for the conservation and enhancement of SEPLS can be considered aligned with "Other Effective Area-Based Conservation Measures" (OECM), as defined by Aichi Biodiversity Target 11, established by the Convention on Biological Diversity (CBD) to be attained by 2020. The utility of such areas and practices underlines the importance of acknowledging diversity in approaches to conservation and sustainable use of biodiversity, as well as the integration of communities through local initiatives. Despite this fact, many SEPLS lack specific protection frameworks or measures, as they are sometimes difficult to define clearly as nature conservation entities. However, other measures related to the enhancement of socio-ecological systems themselves can be useful for the maintenance of their nature conservation capacity.

In this study we present a project for the recovery of sweet chestnut (*Castanea sativa* Mill.) orchards in two public forests, Caranga Baxu and Villamorei, in the region of Asturias (North-West Spain). The project was promoted by the regional administration (Principado de Asturias), and its aim was to preserve in situ endangered native cultivars selected by local growers, and to protect the associated landscape, ethnographic and cultural values. In many cases, the chestnut orchards show a noticeable abandonment process, so the conservation efforts involved actions directed to recover the functionality of the systems. To do so, traditional knowledge was combined with modern techniques for operations like reclamation of trees (selection, pruning, grafting, shaping); conservation and maintenance of the orchard (shrub clearing, removal of ill trees); and the reconstruction of traditional stone structures (*corros*) used for chestnut fruit storage. In addition, efforts were made in the dissemination of knowledge regarding the project among the communities.

Chestnut orchards are interesting examples of SEPLS, as they are normally forests cultivated and managed by local owners, who benefit from a range of goods and services, including chestnut fruits, wood, and agro-forestry grazing areas. Their strategic position in the landscape often allows for local climate regulation, erosion protection and water purification. Their structural and functional characteristics host high levels of biodiversity, and are important for the conservation of endangered species like the brown bear (*Ursus arctos* Linn.). Consequently, recovery actions for maintaining the structure and function of chestnut orchards play an important role in the scope of OECMs.

Keywords: Area-based conservation; chestnut orchards; Social-Ecological Production Landscapes and Seascapes (SEPLS); rural development.

Country	Spain
Province	Asturias
District	Caranga Baxu (Proaza)/ Villamorei (Sobrescobio)
Size of geographical area	146,22 Square km
Number of indirect beneficiaries	1588 persons
Dominant ethnicity	Spaniard

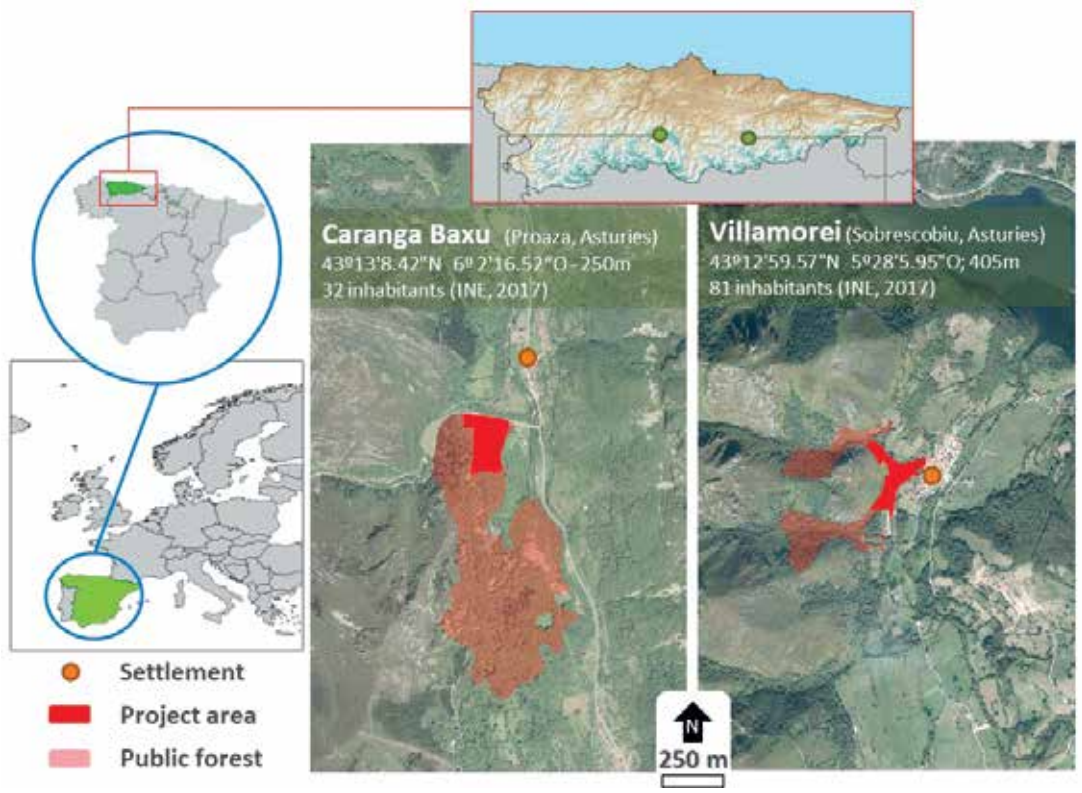

Figure 1. Map of the country and case study region

Size of case study/project area	48 hectares
Number of direct beneficiaries	113 persons
Geographic coordinate (longitude and latitude)	43º13'8.42"N 6º 2'16.52"O 43°12'59.57"N 5°28'5.95"O
Dominant ethnicity	Spaniard

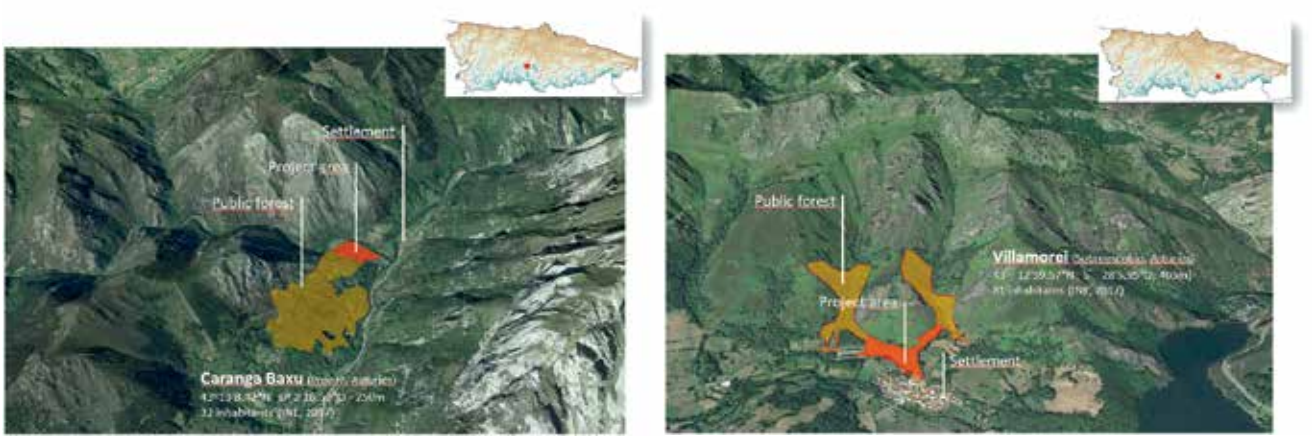

Figure 2 and 3. Land use and land cover map of case study site. Caranda Baxu village(left) and Villamorei village(right), North-West Spain.

1. Introduction

1.1 The role of SEPLS in area-based conservation measures

Socio-Ecological Production Landscapes and Seascapes (SEPLS) frequently illustrate the capacity to establish synergies among the enhancement of ecosystem services, conservation of biodiversity, multi-stakeholder socio-economic development, multifunctional use of land within the carrying capacity and resilience of the environment, as well as the preservation of traditional knowledge, local traditions and culture (eds. Bélair et al. 2010; Okayasu & Matsumoto 2013). This capacity reveals the potential of SEPLS to be an integrated part of efforts oriented towards biodiversity conservation. In this sense, Aichi Biodiversity Target 11**,** established by the Convention on Biological Diversity (CBD) to be attained by 2020, states: "By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape". While the role of protected areas formally defined by different levels of administration is clear, discussions regarding the role of "other effective area-based conservation measures" (OECMs) are still taking place. The inclusion of the latter was an effort to acknowledge the contribution of areas not legally designated as protected areas to effective conservation (Laffoley et al. 2017). Further developments of the concept were recognized to help to avoid overlooking "the diversity of ways of conserving and sustainable use of biodiversity, including by Indigenous peoples and local communities" (McKinnon et al. 2015). This underlines the importance of acknowledging diversity in approaches for conservation and sustainable use of biodiversity, and the integration of communities through local initiatives. Finally, the ongoing development of "guidelines for recognising and reporting Other Effective Area-Based Conservation Measures" (IUCN-WCPA 2018, p.16) provides a provisional definition of an OECM as "a geographically defined space, not recognised as a protected area, which is governed and managed over the long-term in ways that deliver the effective in-situ conservation of biodiversity, with associated ecosystem services and cultural and spiritual values". SEPLS in many instances fit within this definition without being subjected to specific protection frameworks or measures, as they are sometimes difficult to clearly define as nature conservation entities. However, other measures related to enhancement of the socio-ecological system itself and the improvement of the rural environment, might provide the maintenance of practices that lead to conservation of biodiversity.

As an example of actions to be taken in SEPLS, which, not being directly related to conservation of biodiversity, can contribute to the management of OECMs, we present here a project for the recovery of abandoned sweet chestnut orchards in two public forests in the region of Asturias, North-West Spain. The project was promoted by the regional administration (Principado de Asturias). Project management was developed by a joint team led by the two authors from the Universities of Oviedo and Santiago de Compostela. Activities were carried out by a local environmental services company (Canastur). The stated aim of the project was to preserve in situ endangered genetic material (i.e., native cultivars selected by local growers), and to protect the high value landscape, as well as the ethnographic and cultural value of chestnut orchards. The project took place from 8 March 2011 to 15 March 2012. We explored how actions like those implemented by this project, even when not biodiversity-conservation oriented, could support the objectives of area-based, in-situ conservation of biodiversity by the maintenance of the rural systems supporting SEPLS - a representative criterion for OECM (IUCN-WCPA 2018).

This chapter will first introduce the main features and importance of sweet chestnut orchards and the geographical settings of the project. Then, we describe the activities oriented to the recovery of chestnut orchards and associated heritage. Finally, we discuss how and why this type of action can help to define OECM approaches for conservation of biodiversity.

1.2 Sweet chestnut forests and associated SEPLS in NW Spain

Sweet chestnut (*Castanea sativa* Mill.) forests cover an extension of more than 2.5 million hectares in Europe. Their distribution includes the Mediterranean, Atlantic, Central and Eastern areas (Conedera et al. 2004b, Conedera et al. 2016). Although the species is sensitive to severe cold, and its fructification dependent on summer warmth, in North-West Spain chestnuts are found in Mediterranean and Atlantic climates, rarely above 1200 m of altitude (Diaz Varela et al. 2009; Roces-Díaz et al. 2015). Since the18th century, chestnuts have decreased dramatically, particularly in low lands, due to the spread of ink disease (caused by *Phytophtora cambivora* and *P. cinnamomi*) and more recently chestnut blight (*Cryphonectria parasitica*). Together with changes in land use systems, these are the main causes of the species' decline (Díaz-Varela et al. 2011). While the species is considered to be native to the Iberian Peninsula (Conedera et al. 2004a; Roces-Díaz et al. 2018b), its relevance as a cultivated species took form in the Medieval Ages (Conedera et al. 2004a). The traditional management of sweet chestnut adopted two different regimes (Conedera et al. 2001): a) Coppice, pure forests regenerated from adventitious or dormant buds; and b) Orchard, grafted trees organized in open stands, known as *soutos*, *castañeros* or *castañeos* in NW Spain. The main use of the former regime was for timber; the latter had a multifunctional use, constituting interesting examples of SEPLS. Normally cultivated and managed by neighbouring communities and/or individual private owners, they provide a number of goods and services. A major one is the provision of food: barely without silviculture, chestnut orchards produce yearly around 3,000 kg of high quality chestnut fruits per hectare, and up to 200 kg of *Boletus edulis* when mycorrhized (Sinde-Stompel 2015). But other services are also relevant, such as the production of high quality timber for construction (5 m^2 per hectare), wood for heating and traditional tools, agro-forestry grazing areas, litter for manure or mulching and honey production (Conedera et al. 2001; Aumeeruddy-Thomas et al. 2012; Roces-Díaz et al. 2018a). In addition, they have been described as outstanding microtopes that contribute to local biodiversity, with a great variety of mushroom species, including some of high market value (Fernández de Ana Magán et al. 1998; Baptista et al. 2010; Sinde-Stompel 2015). Their strategic position in the landscape often allows for climatic regulation, erosion protection and water purification. Their structural and functional characteristics, together with their mosaic arrangement with other ecosystems, provide them with high levels of biodiversity (Gondard et al. 2006; Guitián et al. 2012; Zlatanov et al. 2013). The configuration of mature trees, with abundant hollows and cavities, is inhabited by many species of little mammals and forest birds (Rubio 2009; Zlatanov et al. 2013). In addition, chestnuts are important in the diet of animal species including roe deer (*Capreolus capreolus* Linn.), red deer (*Cervus elaphus* Linn), wild boar (*Sus scrofa* Linn.), and the brown bear (*Ursus arctos* Linn.) (Naves et al. 2006; Rodríguez et al. 2007), the latter threatened in Spain and an umbrella species for conservation in the area (Fernandez-Gil, 2013).

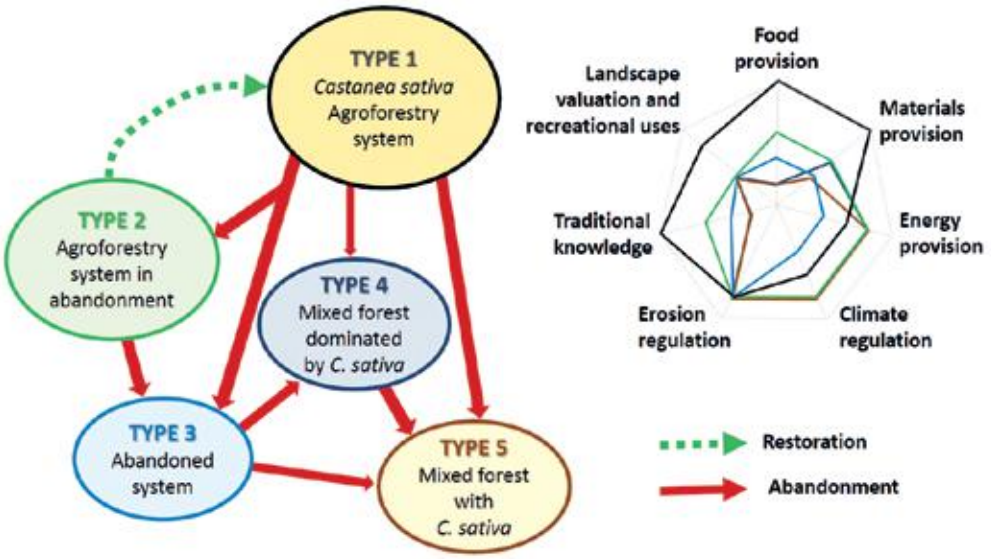

Figure 4. Abandonment and restoration pathways between the different types of *Castanea sativa* forests (left) and consequences for the supply of ecosystem services (right). Adapted from Roces-Diaz et al. 2018a.

Chestnut orchards have suffered a process of abandonment and degradation since the middle of the 20th century, due to changes in socio-economic activities in rural areas. The process of abandonment (Roces-Diaz et al. 2018a; see Fig. 4) of a fully functional chestnut agroforestry system (Type 1 in Fig. 1) can follow different pathways: passing through a transitional system of abandonment, becoming partially functional (Type 2) and eventually reaching an abandoned state (Type 3). From any of the former types, successional stages can lead, depending on site characteristics and the process itself, to a mixed forest dominated by *C. sativa* (Type 4) or by any other species (Type 5). The process of abandonment may affect the ecosystem with a decline in biodiversity, as well as with changes in the ecosystem services supply. From the balanced supply of the fully functional system, the abandonment process triggers a trend towards a slightly higher supply of regulation services, as well as some provision ones (e.g. energy).

1.3 Geographical settings

This study was centred in two sweet chestnut orchards located in public forests and associated with the villages of Caranga Baxu and Villamorei. Caranga Baxu (43°13'8.42"N 6° 2'16.52"; 250m) has 32 inhabitants (Instituto Nacional de Estadística, 2017), and is one of the settlements of the Municipality of Proaza, in the Autonomous Community of Asturias (North-West Spain). Villamorei (43°12'59.57"N 5°28'5.95"O; 405m), with 81 inhabitants, (Instituto Nacional de Estadística, 2017) is located in the Municipality of Sobrescobiu, Asturias (see Fig. 1). Both settlements are in rural areas, and despite their relatively low altitudes, they can be considered as mountainous areas due to the complicated relief and their position within the Cantabrian Mountain range. Their marginal position, while characterised by the abandonment of the primary sector and an aged population, contributed to the conservation of some traditional agricultural practices. The landscape in these areas was shaped through centuries of interaction between societies and nature, eventually defining a multifunctional agricultural and forest mosaic of which chestnut orchards were a fundamental part (López-Merino et al. 2009; Pérez-Díaz et al. 2016)(see Fig. 2 and 3).

2. Description of activities

2.1 General approach

While the chestnut orchards have suffered from the abandonment processes described in previous sections, there is still a valuable diversity of varietal genetic materials of the species, the preservation of which was one of the main objectives of the activities undertaken in the study areas. Such activities also aimed to contribute to the maintenance of the landscape, as well as the ethnographic and cultural values of the orchards. Techniques were applied to return the functionality of the systems (i.e., stability and fruit production) that had existed in the past, through a restoration process for orchards suffering the detrimental impacts of abandonment (See Fig. 4). Traditional knowledge was combined with modern techniques for operations like reclamation of trees (selection, pruning, grafting, shaping) and conservation and maintenance of the orchard (shrub clearing, removal of ill trees). Other actions were directed towards the cultural aspects of the orchard, like reconstruction of traditional stone structures (known as *corros*) used for chestnut fruit storage and conservation. In addition, specific efforts (e.g. placing informative boards in the area) were made for the dissemination of knowledge regarding the project among the community.

2.2 Recovery techniques applied on trees and orchards

The recovery of orchards involved four stages.

Felling of trees. One of the main principles for maintaining the functionality of an orchard is to recover the vitality and production capacity of both the whole orchard and the individual trees. To do so, it is important to select and maintain the grafted trees. In this stage, those trees not previously grafted were selected for a) being grafted; b) being kept for pollination; or c) being removed. The removal process used mechanical means—chainsaws for cutting and crane-implemented trucks to remove the spare materials (See Fig. 5). Due to the susceptibility of the species to fungal diseases, special care was taken to avoid infection with *Cryphonectria parasitica* and other species (e.g. disinfection of cutting tools and elimination of damaged materials), and damage to neighbouring trees.

Figure 5. Use of mechanical means to remove felled trees (Source: GIS-Forest 2012).

Figure 6. Chestnut tree before (left) and after (right) pruning, in Caranga Baxu (Source: GIS-Forest 2012).

Figure 7. Fire used in sanitation of a tree's trunk (Source: GIS-Forest 2012).

Pruning and removal of low sprouts. Pruning was executed in order to remove deadwood in the tree crowns, as well as to lower branch density and increase tree stability. This contributes to the improvement of fruit production and sanitary state of the tree. In addition, sprouts in the lower part of the trees were removed in order not to diminish the vitality of the tree (lower sprouts have the potential of exhausting the grafted tree). These operations were made using mechanical means, keeping the same disinfection protocols as those applied on the cutting tools (see Fig. 6).

Sanitation of trunks using fire. This is a technique reclaimed from traditional knowledge in certain areas of the northwest Iberian Peninsula with chestnut orchards. Old cultivated chestnut trees tend to rot in the centre of their trunk, thus increasing their exposure to diseases. Fire was used to burn the rotten part for a few minutes, creating at the same time a protective layer of charcoal. Temperature is regulated by spraying water in order not to affect the living part of the tree (see Fig. 7).

Grafting. Those trees selected for grafting in the first stage were cut at 1.5-1.8 meters to prepare them as rootstocks. Local cultivars were used for grafting: six in Caranga Baxu (with the local names of Seronda, Verdeta, Tixera, Picona, Moriña and Fanuca) and four in Villamorei (Valduna, Ramiega, Montesa and Sevillana). To preserve their genetic characteristics, stems were directly selected in each respective area to function as scions (i.e, the part of the graft that is inserted in the stem to produce fruit). Traditional techniques such as crown and cleft grafting were used in this stage (see Fig. 8).

2.3 Reconstruction of traditional structures

In the traditional management of chestnut orchards, circular structures made of stone were used for temporary in situ storage of chestnut fruits. Depending on the area, such structures were named *corros*, *corripies*, *curripas*, *corripas*, *corras*, *cuerrias* or *xoxas*. New approaches towards management, as well as new types of transport and storage means, have left these structures abandoned. Nevertheless, they have been restored in order to preserve the constructed heritage linked to traditional activities (see Fig. 9).

Figure 8. Schemes for cleft (left) and crown (center) grafting (Source: Alvarez-Alvarez et al. 2000), and results of crown grafting in the field (right; source: GIS-Forest 2012).

Figure 9. Reconstructed corro (Source: GIS-Forest 2012).

Figure 10. Content of one of the informative boards (Source: GIS-Forest 2012).

2.4 Dissemination

Another cultural aspect considered important in the area was the dissemination of knowledge regarding the project among both the local inhabitants and potential visitors. Informative boards showing the main activities, as well as the importance of chestnut orchards for the local ecology and economy, were placed in strategic locations(see Fig. 10).

3. Results and discussion

3.1 Recovery of chestnut orchards

A total of 3.3 ha of chestnut orchards (1.3 ha in Caranga Baxu and 2 ha in Villamorei) were recovered using the techniques outlined in the previous sections. The total number of trees treated was 200 in Caranga Baxu and 130 in Villamorei (see Fig. 11).

While the main objectives of the project were recovery of the orchards, the preservation of genetic material, and the improvement of landscape quality and heritage features, an early ex-post assessment of the effect of the activities on productivity was made. The assessment consisted of a comparison of the total weight of chestnut fruit harvested in two 10x10m plots, one in the restored orchard of Caranga Baxu, and other in a nearby abandoned forest, at the same hour during two days of the harvest period (20 October and 7 November) in the same year as the execution of the project. The recovered plot showed 20% more production than the abandoned one. Despite the lack of inference validity of the assessment, the results are indicative of improvements made by project actions, and are consistent with studies in similar geographical sites (e.g. Martins et al. 2012).

3.2 Potential role of recovered chestnut orchards in biodiversity protection

As explained in the introduction, the objective of the project was the conservation, in two specific sites, of native cultivars of *C. sativa*, carried out through recovery of the structure of the orchards, under the assumption that the structure may involve functions that support landscape ethnographic and

Figure 11. View of the orchard in Villamorei before (left) and after (right) the reclamation procedures (Source: GIS-Forest 2012).

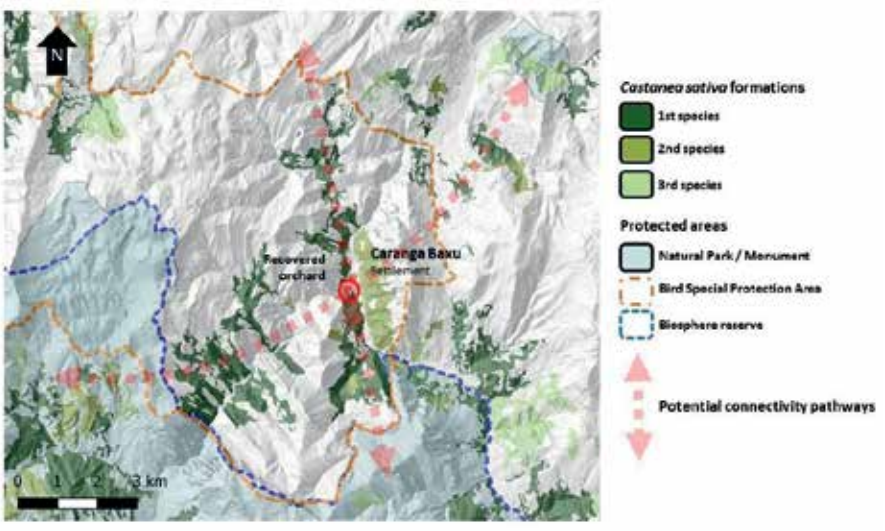

Figure 12. Relative position of the recovered orchard in Caranga Baxu (red circle) with respect to protected areas (Natural Parks and Monuments, Bird Special Protection Areas, or Biosphere Reserves). Chestnut forest typologies show where the species is dominant (first), or is the second or third species in abundance. Potential connectivity pathways show the possible function of recovered orchards as ecological linkages.

cultural values. As described for other examples of SEPLS (Okayasu & Matsumoto 2013), adequate management of chestnut orchards and plantations may potentially increase species richness (Gondard et al. 2001; Gondard et al. 2006; Martins et al. 2012), being consequently higher than in abandoned orchards. Consequently, the recovery of chestnut orchards may be interpreted as a multi-purpose measure, which contributes to the enhancement of biodiversity levels in the rural landscape, as well as the increase of different ecosystem services, including those that may be of high socio-economic relevance. As "traditional management systems that maintain high levels of associated biodiversity" (IUCN-WCPA 2018), these areas can be the subjects of strategies of "secondary conservation" in the perspective of OECMs, which is achieved through the active conservation of an area where biodiversity outcomes are a secondary management objective (IUCN-WCPA 2018).

In this context, it is important not to neglect that, in Aichi Biodiversity Target 11, both protected areas and OECMs are explicitly considered as parts of "well connected systems". In this sense, an important contribution of SEPLS in general, and particularly of the one analysed in this study case, is their function as elements that increase connectivity, due

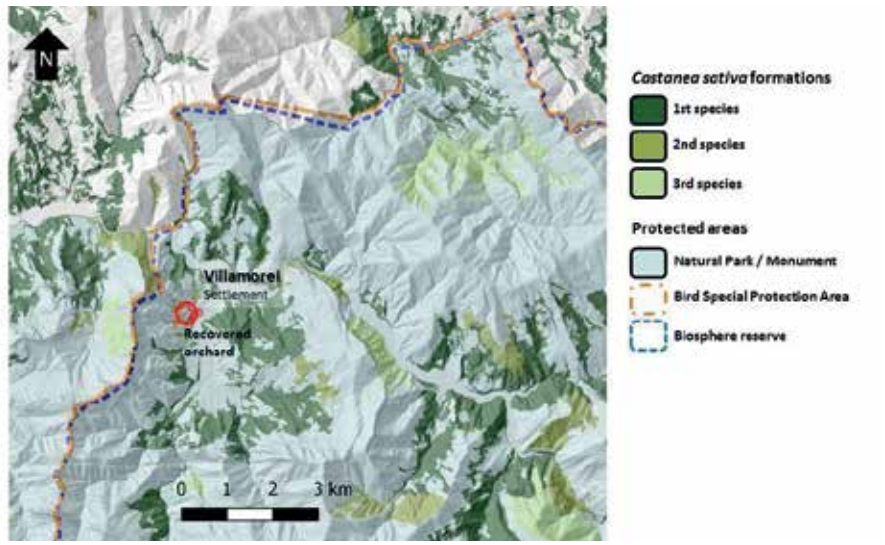

Figure 13. Relative position of the recovered orchard in Villamorei (red circle) with respect to protected areas (Natural Parks and Monuments, Bird Special Protection Areas, or Biosphere Reserves). Chestnut forest typologies show where the species is dominant (first), or is the second or third species in abundance.

to their spatial arrangement and strategic position to act as stepping stones or corridors for diverse animal and plant species. Thus, from a spatial point of view, the reclaimed chestnut orchards function as linkages as well as transition zones between protected areas and the immediate rural environment. For the case of Caranga Baxu, Figure 12 shows the potential connectivity function of the recovered orchard in the area, which can be complemented in other areas of the chestnut forest if similar actions are implemented. The recovered area can thus also be a linkage between a Natural Park, a Natural Monument and a Biosphere Reserve. Also, the area is important for brown bear populations, so recovered orchards could be beneficial to this species, taking into account the low risk of human-bear interactions (Penteriani et al. 2016), if potential damage to different productive activities of the community like livestock, fruit and honey production (Pollo 2006) is appropriately addressed.

In Villamorei the situation and potential approach is slightly different. Figure 13 shows how the area is located well inside a Natural Park, coincident with a Biosphere Reserve and a Bird Special Protection Area. In this case, the recovery of the area could complement the efforts developed inside the conservation areas, which can be especially relevant in transition or buffer zones that support nearby core areas with biodiversity spots while low-intensity human activities are taking place.

3.3 Involvement of local communities and integration in the governance system

The initial idea for the development of the project arose out of the interest shown by the local population to put to use the abandoned chestnut orchards. Motivations included both the recovery of the productive capacity of the orchards for chestnut fruits, as well as heritage preservation. For instance, many among the older inhabitants still named the individual trees by the households owning the access rights to them, which is still customary following the common law. Nevertheless, as explained previously, the orchards are classified as public utility forests, meaning that they are municipal properties, managed by the regional government. In times prior to the development of the project, the local communities tried to restore activity in the chestnut orchards, but were unsuccessful. At their request, the municipalities made a petition to the regional administration for their intervention in the recovery of the chestnut orchards. This, together with the political influence of a political party that supports the initiative, and the positive involvement of the forestry technicians, helped to stir up the interest of the administration in the project. As a result, and as explained in sections 1.1 and 2.1, the project was promoted by the local administration, which assumed the supervision and financing roles. It was managed by university experts in the field who designed the combination of traditional and modern techniques to undertake the project. Likewise, the project was executed by a local company, which carried out the technical implementation.

As a result of project execution, people from the local communities started to collect the chestnut fruits again, and reported improvement in the orchards' production capacity. In addition, livestock grazing, especially with sheep, goats and pigs, also started in Villamorei immediately following the recovery of the orchard. The recovery is also seen as compatible with other activities of local importance, such as wild boar hunting. Altogether, this is potential evidence of the improvement in the multifunctional aspects of the area.

Communities also responded actively to threats to recovered orchards, for instance with their involvement in firefighting on some occasions when wildfires extended from nearby scrublands and afforested areas. Local newspapers reported the feelings of loss and sadness of the local population after the fires (Arias 2015). Also, local as well as regional administrations have promoted the chestnut orchards in tourist routes and organized educative visits. The local company in charge of the execution, in collaboration with the University of Oviedo, developed a webpage entitled, "recurso castaño" (2011), where the works carried out are shown in video format, for extension and dissemination purposes.

3.4 Importance of the rural policy context

Inclusion of the recovery techniques of chestnut orchards into biodiversity conservation schemes should consider the evolution of and new trends in socio-ecological systems in an integrative manner. Productive chestnut orchards have experienced many changes during the last decades, and their resilience and permanence in time will depend on the dynamic exchange between socio-ecological legacies and innovations (Aumeeruddy-Thomas et al. 2012). This could take form of integration of traditional knowledge and modern technologies for the recovery of the forest structure, like in the cases shown in this work, as well as the acknowledgement of new functions, including the conservation of important species and processes in the landscape. In this sense, the management of chestnut orchards from a multifunctional perspective has the potential to create and perpetuate sustainable and resilient socio-ecological systems, promoting economic diversification, biodiversity, and environmental quality (Martins et al. 2011). Taking all this into account, secondary conservation strategies in the scope of OECMs could benefit from policy context not directly related to biodiversity conservation. For instance, the Rural Development Policy in the European Union is regulated for the period 2014-2020 through the

Regulation (EU) nº 1305/2013 of the European Parliament and of the Council (2013). In its Article 5, six "Union priorities for rural development" are defined, including priority 4, "restoring, preserving and enhancing ecosystems related to agriculture and forestry". Member states and their regions develop Rural Development Programs in order to target the different priorities. In the Regional Programme for Rural Development of Asturias (2017), the region where the study sites are located, the importance of chestnut cultivation for reducing climate change effects is acknowledged, and there are specific subsidies designed for the establishment and maintenance of agroforestry systems, with specific mention of chestnut trees as a potential species. In this framework, projects similar to the one presented here could be developed by local owners and communities for recovery of chestnut areas, enhancing the capacity of this particular socio-ecological production system for multiple functions, including the conservation of biodiversity.

3.5 Difficulties and future challenges in implementation

Besides the difficulties associated with the restoration process itself (e.g., compilation of previous research, technology transfer, stakeholder management and communications), one of the main challenges found in the project's implementation was, as commented in previous sections, the lack of institutional interest and involvement at some levels of public administration. Thus, the connection between bottom-up interest in the project and the top-down support needed for carrying it out should be guaranteed in future similar projects. Nevertheless, on a side note, it should be pointed out that at least six communities contacted the local company (due to the acquired knowledge of recovery techniques) to carry out similar projects without the intermediation of administrative bodies. This underlines the importance of technology transfer, and the interest of pilot studies in the informal adoption of management practices.

In addition, a series of generic, territorial problems were identified that may hinder the continuity and sustainability of the projects. These include: population aging (and the subsequent lack of generational replacement in rural areas); the occurrence of forest fires (that, originating in neighbouring scrublands or afforested areas, may spread into the orchards); and genetic contamination by clones resistant to fungal diseases. Consequently, rural development initiatives, forest prevention and management practices, as well as forest management practices that are non-dependent on clone varieties, should be integrated into the restoration projects.

4. Conclusions

Chestnut orchards provide a number of environmental functions, genetic resources, and economic and socio-cultural benefits. Framing all these contributions as ecosystem services allows for linking ecosystems with human welfare, ecological value, biodiversity, and the acknowledgement of the important role of these systems in rural development and the preservation of traditional landscapes and culture. Consequently, the recovery of chestnut orchards integrating traditional knowledge and modern technologies may be one of the possible strategies for secondary conservation of biodiversity from the perspective of OECMs, using SEPLS as a reference area, and benefitting from potential synergies with other non-conservation policies and actions like those related to rural planning and development.

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Chapter 4

Transformations towards sustainability – A SEPLS restored by the Gongrong community

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Abstract

Once a village with gloomy prospects due to improper land development, habitat degradation, pollution, decreasing income, aging, etc., the Gongrong community was determined in 2003 to transform towards sustainability. The principles undertaken in this transformation were found to be in line with those of the Satoyama Initiative. Based on literature review, observation and interviews with community members and relevant government staff, it is revealed that transformation of the Gongrong community went through three overlapping stages: (1) halting further environmental degradation (2004-2007), (2) capacity building (2005-2011), and (3) implementation of its strategic plan (2012-2016). With the help of a group of visionary and highly motivated elders, coupled with the capacity building programs provided by the Soil and Water Conservation Bureau (SWCB) and other partners, the Gongrong community was empowered with the capability to plan its vision and goals through participatory processes. Consequently, the community implemented its strategies and actions collectively to stop further land degradation, clean up the environment, initiate environmental friendly activities, revive abandoned agricultural land by cultivating diverse crops that could be harvested in different seasons, thereby bringing back biodiversity and ecosystem services that had once vanished. In addition to an increasing household income, the number of new young farmers in Gongrong has been rising. More importantly, by encouraging and collaborating with the neighbouring Ankang community to revive their Socio-Ecological Production Landscapes and Seascapes (SEPLS) according to the principle of the Satoyama Initiative, the Gongrong and Ankang communities serve as an Other Effective Area-based Conservation Measure (OECM) that have helped to expand the effectiveness of biodiversity conservation of the adjacent Yangmingshan National Park to this human-nature interactive landscape.

Keywords: Eco-friendly farming, Socio-Ecological Production Landscapes and Seascapes (SEPLS), Gongrong community, Other Effective Area-based Conservation Measures (OECM)

Country	Chinese Taipei (Taiwan)
Province	New Taipei City
District	Sanzhi
Size of geographical area	66 km^2
Number of indirect beneficiaries	23,072 persons
Dominant ethnicity	Han Chinese

Figure 1. Map of the country and case study region. Counterclockwise from top left, relative locations of Taiwan island (from Wikipedia), New Taipei city (dark grey area), Sanzhi (red area), and Gongrong community (pink area within the box area, see also Fig. 2).

Size of case study/project area	220 hectares
Number of direct beneficiaries	286 persons
Geographic coordinate (longitude and latitude)	25°14′57.5″N 121°30′27.7″E , 183m
Dominant ethnicity	Han Chinese (70% Hakka, 30% Hoklo)

Figure 2. Relative locations of Gongrong community, Ankang community, and Yangmingshan National Park

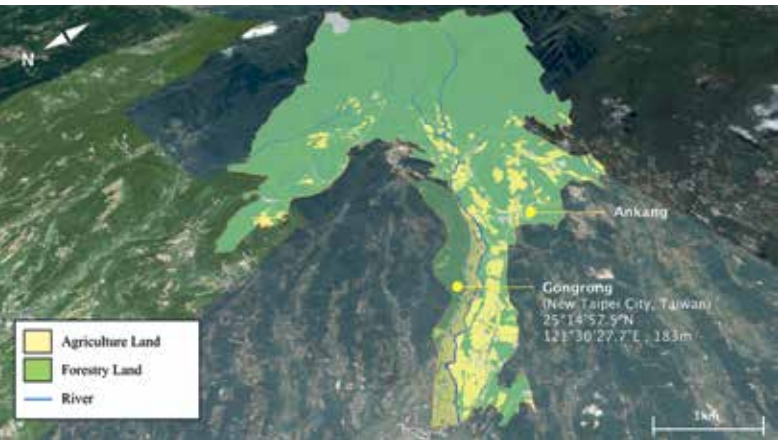

Figure 3. Land use and land cover map of case study site

Figure[1] 4. A bird's-eye view of the production landscape managed by the Gongrong community. Balian stream (blue line) flows from the Yangmingshan National Park (background) through the Gongrong community (left of the Balian stream) and the Ankang community (right of the Balian stream).

1. Introduction

The Gongrong community, which manages a 220 ha production landscape, is located in the Sanzhi District (25 15'06.45"N 121 30'32.27"E to 25 13'30.34N 121 31'16.02"E, see Fig. 1), in the northwest corner of New Taipei City in Taiwan, adjacent to the Yangmingshan National Park (YNP) (see Fig. 2). The Balian stream, with a length of 11 km and a watershed of 15 km2, flows through four communities including the Gongrong and Ankang communities (see Fig. 3). The headwaters of the Balian stream are located in the mountains of the YNP (see Fig. 4).

Over 300 years ago, immigrants from western Fujian province of China settled here and formed communities along the Balian stream, which provides quality water for the settlements and irrigation. The hilly terrain was suitable to develop terraced fields for rice growing, and rice became a staple crop of Gongrong. The small community has since depended on agricultural production for its livelihood. However, in the late 1990s, the upstream areas of the Balian watershed were devastated due to illegal landfilling, open-air trash burning, water interception and improper development of steep hillsides in the upstream forest (see Fig. 5), resulting from the neglect of duty and corruption of local officers. Heavy rains brought by Typhoon Babs in 1998 caused a serious landslide in the area, and two people were buried by the mud flow (Sanzhi District Office 2017). Degradation of the upstream environment, together with problems in the midstream settlement, including mismanagement of domestic sewage, overuse of chemical fertilizers and pesticides, increasing abandonment of agricultural land, overfishing and improper stream construction, and clearing of riparian vegetation, resulted in a dying Balian stream and the degradation of production landscapes (Hsieh, Chiu & Chu 2013). This in turn resulted in the diminished quantity and quality of agricultural products, which were much less competitive in the market, and led to a reduction in income from farming activities and the disappearance of traditional knowledge. In addition the ensuing loss of biodiversity posed a threat to the conservation effectiveness of the adjacent YNP, particularly at its northwestern border. At the same time, Taiwan was in the midst of an economic takeoff, where young people began to move to cities seeking better job opportunities, thus leaving Gongrong with an aged population and decreasing productivity.

Although some environmental degradation was apparent, local community members were not aware of the extent of environmental degradation and the disappearance of many local wildlife species. Meanwhile, the Taiwan Water Company planned to withdraw water from the Balian stream and send it somewhere else. Local politicians secretly made a deal with the water company and sold out NTD 40 million (USD 1.6 million) worth of water without the prior consent of the community. When the water company began to construct the water delivery pipeline in the Gongrong community, residents were shocked to find tons of huge pipes ready for installation. Worried about the loss of their water resource and the potential socio-economic impact, the residents of Gongrong took a strong stand against this "development" project. Following protests and negotiations, the pipeline project came to a halt but was not stopped completely. However, this incident stimulated local awareness of the importance of nature and a healthy landscape and helped ignite the extraordinary environmental transformation of Gongrong that has since occurred.

Determined to reverse the vicious circle of environmental, economic and social devastation and regain the vitality of a production landscape that was once natural and beautiful, a group of elders in the community decided to take advantage of a capacity building opportunity provided by the "Rural Manpower Training Program" of the Soil and Water Conservation Bureau (SWCB) in 2005, followed by the "Rural Regeneration Incubation Program"[2] of the SWCB between 2008 and 2011 and a series of "learning-by-doing" activities (Rural Regeneration E-Portfolio System 2018).

The collective action of the Gongrong community, which has continued for 12 years, has restored local biodiversity and the agricultural production landscape, improved local livelihoods, and inspired its neighbouring Ankang community to take similar actions to revive its production landscape and work together to reduce the threats to and enhance the conservation effectiveness of the adjacent YNP. In this paper, we report the challenges the Gongrong community has faced in reviving its socio-ecological production landscape and seascape (SEPLS), the process and key elements that facilitated the transformation of Gongrong community, the lessons learned from the project, and how such a transformation helped biodiversity conservation, thereby benefiting local livelihoods and enhancing the conservation effectiveness of the adjacent YNP.

2. Methods

Methods used in collecting information for this paper included literature review, document search, observation and interviewing of residents of the Gongrong community. Although the process of transformation of the Gongrong community and its SEPLS has spanned more than a decade, the second author Mr. Yie-Hom Lin has maintained good documentation of these processes in the Gongrong community since 2003, including the "Rural Manpower Training Program" and "Rural Regeneration Incubation Program", by keeping records on annual plans for management goals on social, ecological and economic progress and activities for achieving these goals, project reports, as well as annual reviews of results. The SWCB also have kept good records on community development, especially annual budgets and reports on projects implemented by relevant communities, including those of Gongrong.

In addition, we visited and interviewed more than 20 members of the Gongrong and Ankang communities, township and county government staff, and staff of the SWCB between May 2017 and February 2018. Interviews covered social, ecological and economic conditions prior to initiatives and during and after the transformation, as well as the key elements considered to be important for

Figure 5. Devastated upstream areas of Balian watershed: Clockwise from top left, illegal dumping of waste, illegal open-air trash burning, dead fish in polluted water, and muddy stream due to improper land development in upstream areas.

the transformation to happen. The concept of area-based conservation was investigated on site with reference to rural regeneration efforts implemented by the Gongrong community over the past 12 years. More information about the Gongrong project can be found at: http://san-chih.blogspot.com/.

3. Results

The transformation of the Gongrong community went through three overlapping stages: (1) halting further environmental degradation, (2) capacity building, and (3) implementation of a strategic plan, which are reported as follows.

(1) Halting further environmental degradation (2004-2007)

Before reviving its SEPLS, the Gongrong community had to stop further pollution and land degradation. This was done by persistently appealing to the township office, township representatives, and the county government to strengthen law enforcement and stop illegal activities in the Balian watershed. Beginning in 2007, the Balian stream was closed to all fishing as fisheries and aquatic resources had dwindled due to overexploitation and pollution. Residents of the Gongrong community voluntarily formed the Balian Stream Conservation Watch (BSCW) and began to regularly patrol along the stream to prevent illegal activities of resource exploitation and pollution.

(2) Capacity building (2005-2011)

To build up people's capacity to revive their community, residents of Gongrong participated in a series of training workshops offered by the SWCB. From 2005 to 2007, training courses were provided under the SWCB's "Rural Manpower Training Program" (Appendix 1). Under the "Rural Regeneration Incubation Program" of the SWCB from 2008-2011, additional members of Gongrong community received more than 96 hours of training together with residents of neighbouring Ankang community (see Fig. 1, 2; Appendix 2). At Stage 1 (Local Concern Stage) of the "Rural Regeneration Incubation Program", residents learnt basic concepts and policies of rural development programs and gained a better understanding of the place where they live. In 2009, they moved on to the Intermediate Stage to learn about environmental issues common to rural communities, as well as the causes and consequences of environmental problems. At the Core Competency Stage in 2010, residents of both communities were taught to conduct local resource surveys and to improve their agricultural environments. All of these "learning-by-doing" activities were decided upon and implemented by residents themselves, but the labour cost and material purchased were covered by the SWCB. At the Final Regeneration Stage in 2011, residents of both communities respectively learnt to draft and outline visions, goals, strategies and action plans to regenerate their communities based on survey results and collective discussion. As a result, several trial activities were initiated.

(3) Implementation of rural regeneration plan (2011-2016)

The final draft of the Gongrong community's regeneration plan, resulting from the processes of the "Rural Regeneration Incubation Program", was submitted to the SWCB for review. Following approval of the plan and its budget by the SWCB in 2011, the Gongrong community was able to implement this regeneration plan from 2011 to 2016. Training from the workshops enabled the residents of the Gongrong community to identify issues that needed to be addressed before the vision and goals of their strategic plan could be realized and to find the necessary assistance, e.g. experts, partners and resources, and solutions by themselves. Since 2010, residents have met at least once every month to discuss community affairs. They keep good documentation on their achievements each year and plan out actions to be taken in the following year. The draft plan of the Gongrong community was highly acclaimed, winning first place in the New Taipei City Rural Regeneration Draft Plan Contest in 2012.

After completing the training programs provided by the SWCB, residents of the Gongrong community continued to invite experts to offer trainings to enhance their knowledge, skills and capacity in identifying and solving the key issues and problems affecting their environment and production. Continuous participation in community training programs also helped to enhance collective decision-making and strengthen cohesiveness among community members in realizing the vision of their rural regeneration plan, i.e. "making a good living on your home landscape", which is in line with the vision of the Satoyama Initiative, namely, "living in harmony with nature".

The transformation of the Gongrong community through collective effort can be witnessed in many aspects. For instance, in 2005, when the first year's training courses offered by the SWCB became available, 20 residents registered but only six completed the training. To improve attendance, the elders asked residents to choose the kind of training courses they needed and wanted by themselves. The result was a well-received training program with increased participation. Nowadays the community continues to hold training workshops or courses based on its annual plan and the community needs. They are regularly attended by more than 100 residents, or 25 percent of the


Figure 6. Members of Balian Stream Conservation Watch (BSCW) regularly patrol along the stream to stop illegal fishing activities (left). Illegal fishing nets with fish found by members of BSCW (right).

Gongrong population, and aim to improve the farming and management skills of participants. Transformation with respect to the environment, economy and society is reported as follows, although improvement in these three aspects is inter-related.

3.1 Environment

As mentioned above, the self-organized BSCW has been patrolling along the stream regularly since 2007 to clean up the waterway and stop illegal fishing (see Fig. 6). The BSCW reports any illegal activities to the district office, city government, or through the media. Having cleaned up the stream, restored stream bank vegetation, and put a stop to illegal fishing, the patrol team found that the migratory Japanese mitten crab (*Eriocheir japonicas*) reappeared in upstream areas of Balian. Populations of other native fishes such as the Taiwan shovel-jaw carp (*Varicorhinus barbatulus)* and ray-finned fishes (*Zacco pachycephalus* and *Acrossocheilus paradoxus)* have also become much more abundant than before.

The Gongrong community, sponsored by the SWCB, also built several small-scale, low-cost, constructed wetlands to treat domestic wastewater by themselves (see Fig. 7). A series of five ponds were installed alongside farmhouses to change wastewater into water with a high concentration of dissolved oxygen, that is low in temperature and has a minimal bacteria content, so that wastewater can be purified before flowing back into the Balian stream. In addition to minimizing the impact of farmhouse wastewater on downstream residents and the agricultural environment of the Balian stream, these wastewater treatment ponds (constructed wetlands) also serve environmental education purposes. By now a total of five constructed wetlands for wastewater treatment have been built along the Balian stream and many more in other rural areas of Taiwan.

By controlling pollution and cleaning up the environment, farmers were able to cultivate land that had been abandoned for years. Cultivated land doubled from less than 21 ha in 2011 to 52 ha in 2017. Farmers were encouraged to apply eco-friendly or organic farming practices and farmers still practicing conventional farming were taught not to overuse


Figure 7. Constructed wetlands built by members of Gongrong community to treat domestic wastewater (left). Constructed wetlands are now used for environmental education (right), in addition to their wastewater treatment function.

Figure 8. Beautiful landscape of the Gongrong community after restoration.

pesticides and fertilizers. The area of eco-friendly or organic farms in the Gongrong community increased from 1.3 ha in 2011 to 23 ha in 2017, indicating a dramatic reduction in pesticide application.

Improvement in environmental conditions together with eco-friendly production measures helped bring back the once-vanishing biodiversity in Gongrong, evidenced by more wild plants in the fields, more snails, crabs, and fishes in the stream and more frogs in the ponds, as well as more dragonflies and less mosquitos. Residents also noticed more species of birds, including the crested serpent eagle (*Spilornis cheela)* that is a protected species, over the landscape (see Fig.8 and 9). A survey on aquatic organisms will be conducted in 2019.

3.2 Economy

In addition to the expanded cultivation of once-abandoned farmland and application of eco-friendly or organic farming practices, the number of crops planted by farmers also increased from 1 to 12 during the same period. This crop

Figure 9. Samples of species diversity in Gongrong after restoration: Clockwise from top left, Taiwan blue magpie (*Urocissa caerulea*), crested serpent eagle (*Spilornis cheela*), Japanese mitten crab (*Eriocheir japonicas*), and Swinhoe's brown frog (*Odorrana swinhoana*).

diversification has helped expand production-related activities on various crops, as well as reduced pest outbreak risk and market risk. The numbers of full-time farmers increased from 24 to 46 and part-time farmers from 17 to 52, with most of the new farmers being young people. A farmers' market was opened in Gongrong in 2012. The market sells eco-friendly and organic farming products on weekends with the intent to provide incentives to local farmers engaging in eco-friendly farming practices to sell their products and provide consumers with access to fresh and zero residue products. An increasing number of consumers are willing to drive from urban areas to Gongrong to buy fresh food and spend some leisure time there. The average annual income of farmers that were willing to disclose information (N = 19) increased from NTD 10,000 in 2011 to NTD 170,000 in 2016. This amount of income may seem low; however, it represents huge progress compared to hardly any cash income earned from agricultural production on the part of these farmers before 2005.

As farmlands were restored and water sources cleaned up, more types of crops, other than the traditional wild rice, are being cultivated, and the Gongrong community is preparing for the next stage of further production diversification. For example, they are learning to raise chickens, practice aquaculture, and to process and add value to their agriculture products to suit farmers' individual differences and increase their income. In addition, with the clean and beautiful landscape, the eco-friendly produce, and its successful story of transformation, the Gongrong community has been covered in the news media and has attracted many visitors who are willing to pay for an interpretation tour guided by residents. This source of increased income was not included in the above-mentioned income increase from primary agriculture production. Therefore, it is foreseeable that the income generated after the transformation of the community will continue to increase.

3.3 Society

During the 1990s when the Gongrong community dwindled, a majority of the male residents became addicted to drinking and gambling, reflecting a depression in the local people in general. To stop this social erosion, a dance teacher was invited to teach housewives dancing in the evenings. The housewives then encouraged their husbands to join the dancing class. This strategy turned out to be effective in replacing the gambling habits with a healthier habit without much conflict. In response to an aging society, the Gongrong community has also developed a network of eldercare. The District Public Health Center and neighbouring hospitals have been providing volunteer medical consultation and a free clinic. Likewise, elders are encouraged to participate in physical activity as a routine.

Residents have found success in initiating such community programs, e.g. dancing, eldercare and physical activity, as well as other types of social activities, and in encouraging people to take the training courses that they need and in which they have interest. Residents have found participating in community activities, discussing community affairs, learning among themselves and from invited experts, planning, finding solutions and working together to solve problems collectively to be more and more enjoyable, thus enhancing the cohesiveness of the community.

During implementation of the rural regeneration plan from 2012 to 2016, Gongrong's transformation drew the attention of the news media. The increasing number of tourists provided an opportunity for environmental interpretation and education. The farming field trips and ecological camps offered by the Gongrong community have been attended by many families and school children from Taipei. These activities have helped to raise public awareness on conservation, as well as sustainable use of biodiversity.

Figure 10. Residents voluntarily maintaining trail and irrigation ditch (left) and fixing trails in the field (right) using traditional technology.

3.4 Expansion of SEPLS and OECM with Ankang community

Witnessing the transformation of Gongrong, the neighbouring Ankang community, facing similar social, environmental and economic challenges, was stimulated and encouraged to revive its SEPLS. The Ankang community collaborated with Gongrong to maintain their Balian irrigation ditch, which has a history of nearly 200 years (first built during the reign of Emperor Daoguang of the Qing Dynasty from 1820 to 1850). The tradition of regular maintenance activity has dual functions: economically, to safeguard the water source for irrigation, and culturally, to provide a heritage that connects generations amongst themselves and with the land (Lin 2014). Recognition and protection of the associated cultural value have also led to positive biodiversity outcomes (see Fig. 10).

The Ankang community, with an area of 1,520 ha, shares the Balian stream with the Gongrong community. Therefore, a clean Balian stream associated with community health, productivity and regeneration has been of long-standing interest to both communities. Gongrong and Ankang have maintained close ties, and residents of the two communities meet regularly to discuss and coordinate efforts to deal with common issues of concern. They also continue to take training courses provided by the SWCB and other partners together, though each community drafted and implemented its own rural regeneration plan separately.

A large part of the Ankang community is located within the boundary of the YNP. Geographically, the Gongrong community, Ankang community and the YNP form a continuous landscape (see Fig. 1). Restoration of the SEPLS by the Gongrong and Ankang communities ensured the sustainable use of biodiversity that is complementary to the aims of the adjacent YNP as a protected area, i.e. conservation of biodiversity. The area of the YNP, Ankang community, and Gongrong community is 11,340 ha, 1,520 ha, and 220 ha., respectively. In other words, the combination of eco-friendly management of the SEPLS of the Gongrong and Ankang communities (1,740 ha) significantly increases the effective conservation area of the YNP.

4. Discussion and conclusion

An "other effective area-based conservation measure" (OECM), as referenced in Aichi Biodiversity Target 11, is defined as "a geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained outcomes for the *in-situ* conservation of biodiversity, with associated ecosystem functions and services and, where applicable, cultural, spiritual, socio-economic, and other locally relevant values" (CBD/SBSTTA/22/5). The core difference is that while protected areas (PAs) should have a *primary conservation objective*, an OECM should *deliver* the effective and enduring *in-situ* conservation of biodiversity, *regardless* of its objectives (IUCN WCPA, 2017). Laffoley et al. (2017) suggested that for a given measure to count as an OECM under Aichi Target 11, the measure needs to simultaneously meet ALL of the following principles: (1) achieves the *in situ* conservation of biodiversity; (2) is additional to existing protected area designations; (3) is long-term in implementation; (4) provides demonstrable evidence of conservation outcomes; (5) applies to a definable and describable area; and (6) has active governance that delivers measures to achieve conservation. Criteria for identifying an OECM include: (a) area is not currently recognized as a protected area, (b) area is governed and managed, (c) achieves sustained and effective contribution to *in-situ* conservation of biodiversity, and (d) associated ecosystem services are supported and cultural and spiritual values are identified, respected and upheld (CBD/SBSTTA/22/6, Annex III).

The SEPLS managed by the Gongrong and Ankang communities is largely privately owned and has a well-defined area that has persisted for centuries. The primary objective of management of this SEPLS is agricultural production rather than conservation. This SEPLS, which is not recognized as a protected area, has been restored by the collective action of the residents living in these two communities. Pollution was eliminated, pesticide residue in the soil disappeared, the stream became clean and the environment much more natural than before. The SEPLS began to deliver effective and enduring *in situ* conservation of biodiversity through eco-friendly or organic farming and sustainable use of biodiversity. Migratory crabs, fishes, dragonflies, frogs, lizards, snakes, birds, and mammals have come back and diverse crops have been planted. The cohesiveness of the both communities, the regular meetings and discussion among them, and the continuing education and training courses to improve their knowledge and skills, have helped to ensure commitment to actions to fulfil their vison of "making a good living on your home landscape" and to attaining the goal of maintaining healthy ecosystems. These area-based, long-term measures have achieved and can continue to achieve the *in-situ* conservation of nature as a whole. In other words, the SEPLS managed by the Gongrong and Ankang communities simultaneously meets all six principles of Laffoley et al. (2017) and the four criteria identified in CBD/SBSTTA/22/6. It can thus be considered as an OECM, particularly in the category of "ancillary conservation", which refers to areas that deliver conservation outcomes as a by-product of management activities even though biodiversity conservation is not a management objective (IUCN WCPA 2017).

The lack of connectivity between PAs has been considered a major issue that needs to be resolved in enhancing their conservation effectiveness. Therefore, there are a large number of global initiatives aiming to develop corridors between PAs to enhance exchange and gene flow of wildlife populations (Leadley et al. 2014). However, the establishment, management or maintenance of corridors between PAs can be expensive and may be ineffective in achieving conservation goals (Simberloff and Cox 1987). If, however, restored SEPLS are adjacent to PAs, they can enhance and expand the conservation effectiveness of PAs to a wider landscape without the additional cost of developing corridors. The Gongrong and Ankang communities are physically and biologically connected to the YNP and their restored SEPLS expands the effective conservation area of the YNP and buffers the YNP from anthropogenic pressures such as habitat degradation (Aichi Target 11[3]) without any additional cost for biodiversity conservation or establishing and maintenance of a corridor. The restored SEPLS also helps enhance the resilience of the two communities and of the YNP, store more carbon in this area (Aichi Target 15[4]), and prevent extinction and aid recovery of threatened species, e.g. the crested serpent eagle (Aichi Target 12[5]). In other words, a SEPLS serving as an OECM adjacent to a PA can be much more cost-effective in conservation of biodiversity and ecosystem services than establishing a corridor for conservation purposes only. Such cost-effective measures ought to be evaluated to help provide incentives for promoting ancillary conservation leading to OECMs near PAs in the future.

The collective actions of the two communities in cleaning up their environment, implementing a wastewater purification process and applying eco-friendly farming techniques also help meet Aichi Targets 4[6], 7[7], and 8[8]. The restored SEPLS provides many important ecosystem services, including: provisioning services such as crops and clean water; regulating services such as regulation of floods, drought, pest and disease; supporting services such as nutrient recycling and pollination; and cultural services such as education, leisure and tourism. The training courses on improving agricultural production skills and knowledge to conserve the SEPLS that are open to all residents helped improve the socio-economic conditions and livelihoods of all members of the communities, including those of women, the poor and the vulnerable (Aichi Target 14[9]). Finally, the SEPLS restored by the Gongrong and Ankang communities has facilitated the maintenance and development of traditional knowledge, innovations, and practices of local communities, and this in turn has helped to achieve Aichi Target 18[10].

The reviving of the SEPLS and transformation towards sustainability by the Gongrong and Ankang communities did not come easily. It took a group of champions, in this case a group of visionary, highly motivated elders in the communities, to help local residents realize the long-term and devastating impacts of land degradation and loss of biodiversity and ecosystem services on their livelihoods, igniting their willingness to make a difference. A series of well-planned capacity building programs met the needs of the communities, empowered residents and enhanced their knowledge and skills in understanding their SEPLS. They identified the threats to their livelihoods and discussed and worked collectively to decide upon and draw up a strategy plan and actions to realize their vision and goals.

In addition, the "learning-by-doing" practices and collective implementation of their rural regeneration plan helped the Gongrong and Ankang communities increase their awareness on the value of biodiversity and their capacity in taking actions to conserve biodiversity (Aichi Target 1, 19).

Land-use change around PAs often leads to the reduction of their effective size and limits their ability to conserve biodiversity (Hamilton et al. 2013). In the case of the Gongrong and Ankang communities, however, restoration of the SEPLS helped increase the effective size and conservation effectiveness of the YNP. There are many other communities which have patches of farmland of various sizes surrounding the YNP. If these production landscapes could be well managed and deliver conservation outcomes, they could offer great opportunities for the YNP to expand its conservation area further and reduce the external threat to its core area. Now that the successful transformation of the Gongrong and Ankang communities has drawn much attention from the public, many communities, including those nearby the YNP, want to visit Gongrong and Ankang and learn from them. The New Taipei City government has recently expressed an intention to promote eco-friendly farming in the regions surrounding the YNP, using the successful case of Gongrong and Ankang as a model. There is a hope that, with the collaboration of relevant stakeholders, a continuous expansion of SEPLS that correspond to the principles of the Satoyama Initiative and of OECM can be realized in northern Taiwan.

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[1] All figures and tables are prepared by the authors except Figures 2 and 3 (by Mr. Pei-Sheng Gao).

[2] The Rural Regeneration Incubation Program is a national capacity building program sponsored and regulated by SWCB. Rural communities are required to engage in four stages (levels) of training courses and activities (see Appendix 2), involving at least 96 hours of training, before submitting their 5-year community development funding proposals (Huang 2012, Hsu et al. 2017, Rural Regeneration Incubation Program Implementation Notice 2018).

[3] **Target 11** By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

[4] **Target 15** By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

[5] **Target 12** By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

[6] **Target 4** By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

[7] **Target 7** By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

[8] Target 8 By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

[9] **Target 14** By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

[10] **Target 18** By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

[11] B&B: Bed and breakfast or minshuku (民宿)

Appendix 1. Training workshops or courses taken by the Gongrong community from 2005 to 2007.

Community planning	Introduction to wild vegetables
Management of agri-tourism	Survey of wild plants in Mufung Farm
Introduction of Government Procurement Act	Field trip to visit B&B[11] in Yilan County
Community organization and team building	Develop community vision and model making
Resource, culture and history of Sanzhi District	Introduction of Co-op
Remediation of watershed and ecological engineering	Rural development and landscaping
Development and management of B&B	Rural landscape aesthetics
Resource interpretation	Rural industry and product marketing
Introduction to native plants	Resources for community tourism

Appendix 2. Stages and focus of training for Gongrong community and Ankang community under the "Rural Regeneration Incubation Program" of the SWCB from 2008 to 2011.

Year	Stages of training	Focus of training
2008	1. Local concern	Knowing your community
2009	2. Intermediate	Environmental issues
2010	3. Core competency	Survey of local resource, industry improvement
2011	4. Regeneration	Draft local regeneration plan to be implemented in 2012-2016

Chapter 5

Conserving local marine and terrestrial biodiversity and protecting community resources through participatory landscape governance in Semau Island, Indonesia

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Abstract

While significant progress has been made in expanding the national networks of Protected Areas in the last few decades, most biodiversity remains outside of formal PA systems in production landscapes involving agriculture, forestry, and other land and water uses. The fate of this biodiversity, and of the vital ecosystem services it sustains, will depend on the sound management of these landscapes and seascapes.

In Semau Island in Indonesia, the community-based landscape approach supported by the COMDEKS Programme aims to preserve island ecosystem functions through sustainable management of forest cover, as well as coastal, marine and coral reef systems, enhance resilience of agriculture and mariculture systems through improved cultivation practices and water conservation methods, promote alternative livelihoods for local communities, and foster participatory decision-making on environmental governance at the landscape level. With Semau Island being a rich ecological habitat hosting monsoon forests, and surrounded by one of the world's richest coral reefs, such community-based initiatives are vital to creating a "society in harmony with nature" and conserving the rich local marine and terrestrial biodiversity.

Supported initiatives have contributed to improved water management and seaweed farming practices, have promoted organic agriculture, and have empowered local communities to establish new institutions and networks as well as negotiate new agreements to protect community resources and local biodiversity. Environmental forums and other community institutions have been formed by local clan leaders, village governments, and community members to

establish and enforce environmental agreements. These agreements cover activities such as watershed protection, seaweed farming and mangrove restoration. In Batuinan Village, for example, community members have declared a 3-ha water catchment area as a conservation zone to raise the local water table.

This case study showcases local community activities in Indonesia that maintain and revitalize critical production landscapes and seascapes, and documents knowledge and best practices from successful on-the-ground activities to build the resilience of socio-ecological production landscapes and seascapes (SEPLS) by developing and diversifying livelihoods while enhancing biodiversity conservation and ecosystem services.

Keywords: Coastal & fisheries management; Reforestation; Traditional knowledge; Participatory landscape governance; Agrochemical-use reduction

Country	Indonesia
Province	East Nusa Tenggara Province
District	Kupang District
Size of geographical area	265 km^2
Number of indirect beneficiaries	11,756 persons (2013 census)
Dominant ethnicity	Helong and Rote (2 ethnic groups)

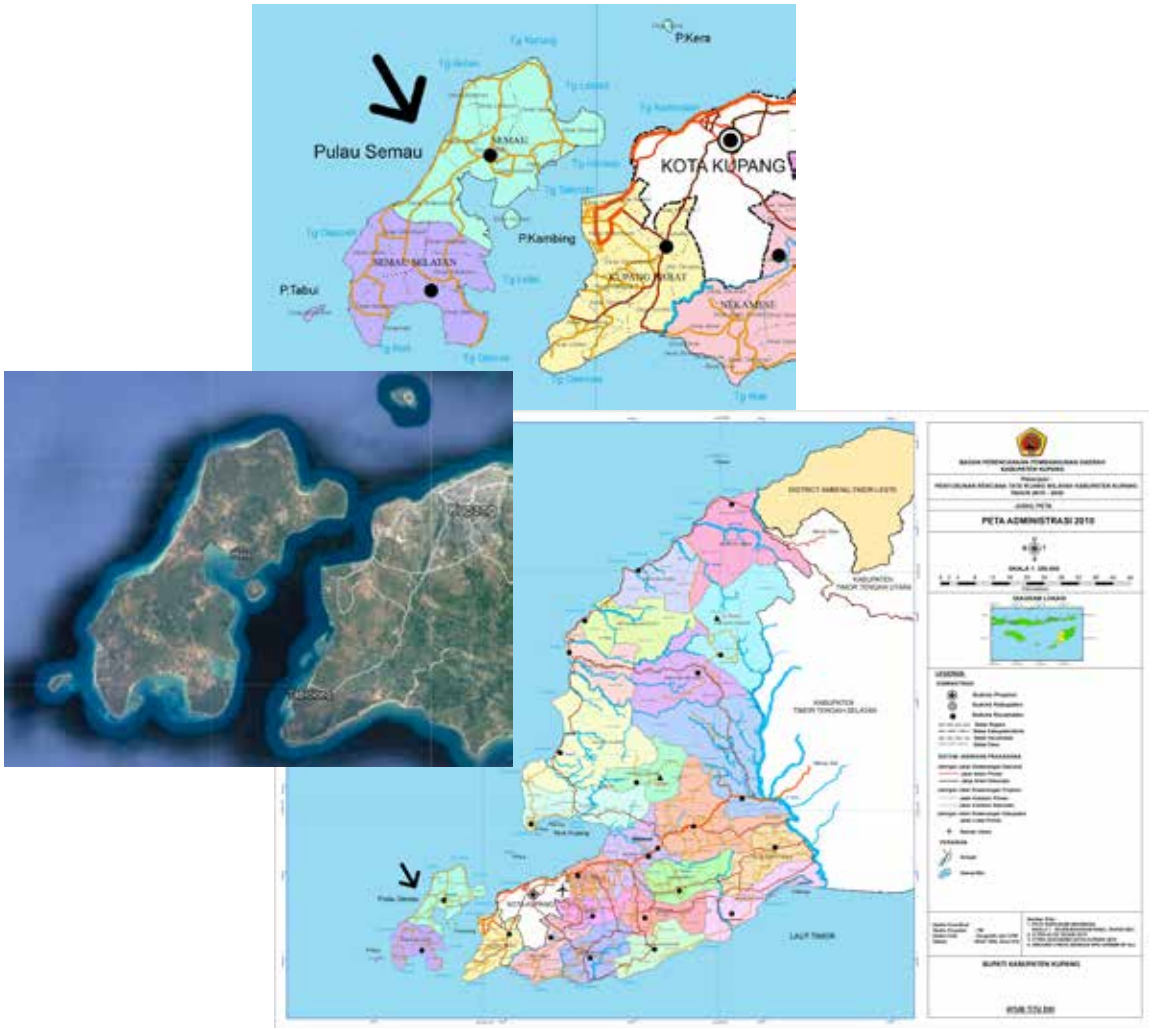

Figure 1. Map of the country and case study region. (Source: East Nusa Tenggara Province and Google Maps.)

Size of case study/project area	2,800 ha
Number of direct beneficiaries	4,084 persons
Geographic coordinate (longitude and latitude)	-10.22303, 123.38195
Dominant ethnicity	Helong and Rote (2 ethnic groups)

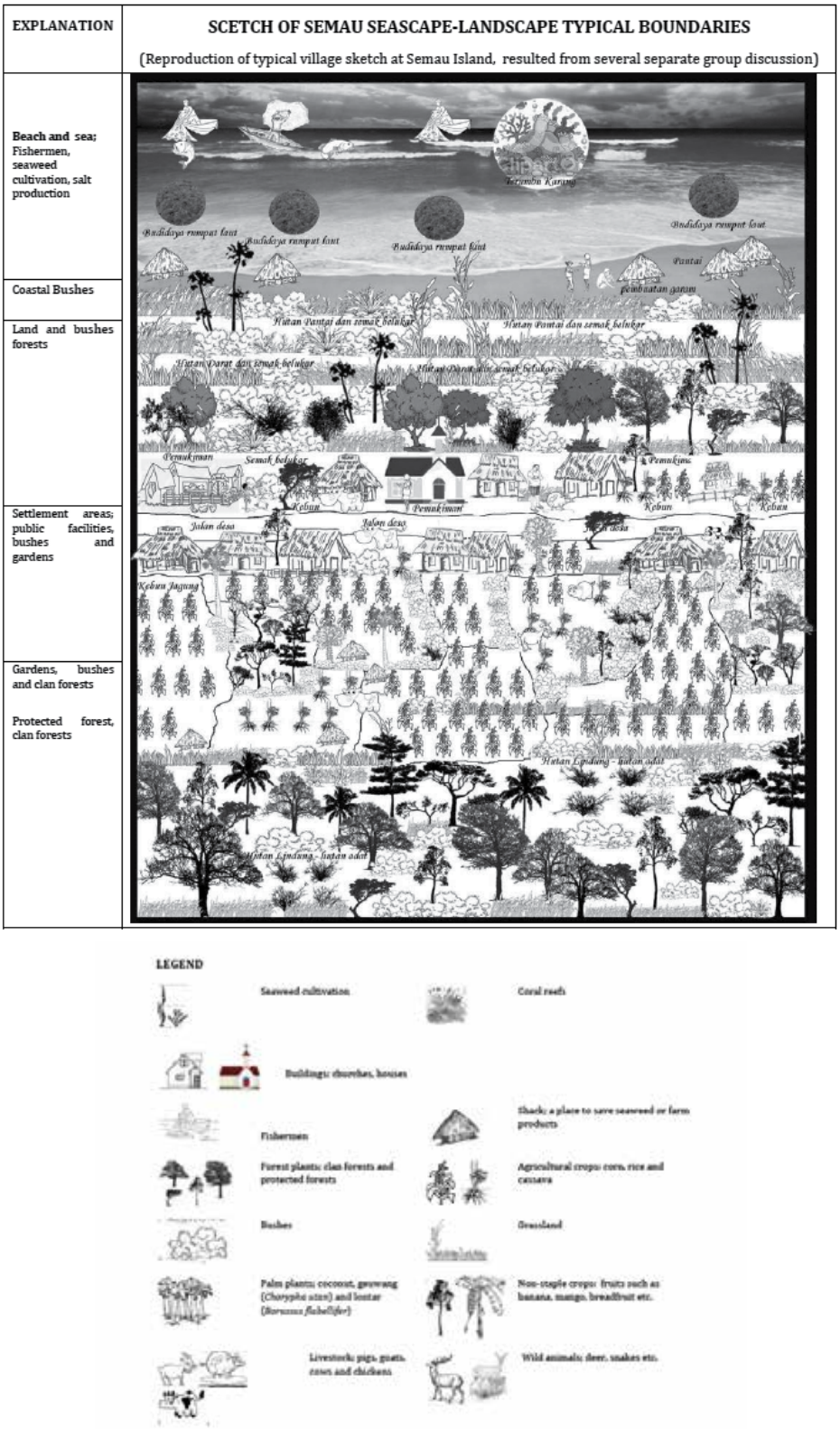

Figure 2. Land use and land cover map of case study site (Source: Bingkai Indonesia Foundation).

1. Introduction

Funded by the Japan Biodiversity Fund, the COMDEKS Programme (2011-2016) is a unique global effort implemented by UNDP in twenty countries, in partnership with the Ministry of the Environment of Japan, the CBD Secretariat, and the United Nations University - Institute for the Advanced Study of Sustainability. Working through the UNDP-implemented GEF Small Grants Programme, COMDEKS builds the capacities of community organizations to take collective action for adaptive landscape management in pursuit of social and ecological resilience.

While significant progress has been made in expanding the national networks of Protected Areas in the last few decades, most biodiversity remains outside of formal PA systems in production landscapes involving agriculture, forestry, and other land and water uses. The fate of this biodiversity, and of the vital ecosystem services it sustains, will depend on the sound management of these landscapes and seascapes.

In Semau Island in Indonesia, the COMDEKS-supported community-based landscape approach aims to preserve island ecosystem functions through sustainable management of forest cover, as well as coastal, marine and coral reef systems, enhance resilience of agriculture and mariculture systems through improved cultivation practices and water conservation methods, promote alternative livelihoods for local communities, and foster participatory decision-making on environmental governance at the landscape level. With Semau Island being a rich ecological habitat hosting monsoon forests, and surrounded by one of the world's richest coral reefs, such community-based initiatives are vital to creating a "society in harmony with nature" and conserving the rich local marine and terrestrial biodiversity.

This case study showcases local community activities in Indonesia that maintain and revitalize critical production landscapes and seascapes, and documents knowledge and best practices from successful on-the-ground activities to build the resilience of socio-ecological production landscapes and seascapes (SEPLS) by developing and diversifying livelihoods while enhancing biodiversity conservation and ecosystem services.

2. The Landscape

2.1 Geography

The target area selected as the focus of the COMDEKS project in Indonesia is Semau Island, which is a 265 km^2 island located in the western portion of Kupang District, the capital of East Nusa Tenggara Province. Semau Island borders the Sawu Sea in the south, west and north, and the Semau Strait to the east (see Fig.1). Administratively, the island is part of Kupang District and is divided into two areas: the Semau Sub-District in the north, consisting of eight villages, and the South Semau Sub-District in the south, consisting of six villages.

Semau Island is a lowland island with the average highest points at 50 m above sea level. It consists of coral and limestone, with a thin layer of soil on the surface. Most soil types found in Semau Island are Mediterranean, latosol, and alluvial with alkali saturation and limited clay content, particularly kaolinite, making it nutrient poor (Sutedjo, 2009).

For generations, the communities of these 14 villages have survived on the available agricultural and marine resources of the small island. Located in the Wallace bioregion, the island is host to rich marine, terrestrial, and coastal biodiversity. However, given the limited freshwater supply and thin soil layer, both agriculture and biodiversity are increasingly threatened, and the island faces a disproportionate risk from climate change and extreme weather (see Fig.2) (GEF SGP Indonesia 2014).

2.2 Biological resources and land use

Semau Island is a rich ecological habitat hosting monsoon forests, and the surrounding Sawu Sea is home to one of the world's richest coral reef covers. The Sawu Sea is also a critical habitat and migration corridor for 18 sea mammal species, including two endangered species: the blue whale and the sperm whale (YPPL and TNC 2011).

The local monsoon forest consists of tree species shedding their leaves during the dry season and growing new foliage during the rainy season. Some of these species are particularly significant to the lives of the Semau people, as they are used to build houses and boats, and are also sources of food and medicines. In addition to threats from climate change, biodiversity on the island and the surrounding sea is threatened by the excessive use of chemicals in agriculture, which decreases soil fertility and results in chemicals in the soil being carried to the oceans through rainwater. The use of chemicals in agriculture rose in the last two decades and has increased ever since the community was introduced to vegetable seedlings and hybrid corn. Because land cultivation with mechanical equipment is difficult on the karst terrain, farmers rely on herbicides and pesticides to assist with land clearing and weed control. After the land is utilized for farming for five to six years, farmers are forced to abandon it with the expectation that the soil fertility will gradually recover. Additionally, deforestation is a serious threat, with trees being cut faster than they can be replenished (GEF SGP Indonesia 2014).

Figure 3. Shallow waters off Semau Island, SGP/COMDEKS Indonesia

Figure 4. Seaweed farming is one of the major local sources of income, SGP/COMDEKS Indonesia

2.3 Socio-economic context

In 2013, the population in Semau Island numbered 11,756, with an average population density of 44 people per square kilometer. The majority of the island's inhabitants belong to two ethnic groups (clans) with different cultures and languages: the Helong and the Rote. Until a few years ago, clan leaders governed the distribution of land. Today, the Village Government regulates the utilization of the coast and adjacent shallow waters (extending several hundred meters from the coastline). The people of Semau Island largely depend on farming and fishing for their livelihoods. Seaweed farming, which only started in 2001, has become the main source of income for communities living along the coast (see Fig.3 and 4). When freshwater from wells is available, short-term cash crops such as fruits and vegetables provide another source of income besides fishing and seaweed farming. Rice and corn, on the other hand, are the community's primary source of food, and these locally grown staple crops are largely kept for family consumption. In addition to farming, raising livestock is important to the people of the island. Fishing occurs throughout the year, except for the rainy season when the monsoon brings high waves and strong winds. Development in Semau Island has been slow, as a number of people believe that the Semau people have magical powers, and prior to 2000, government officials were often reluctant to be sent to Semau Island, resulting in a lack of development initiatives in this region (GEF SGP Indonesia 2014).

2.4 Key environmental and social challenges

The principal environmental and social vulnerabilities in the target landscape are related to the availability of water and inappropriate agricultural practices and land use. Particular challenges include the following (GEF SGP Indonesia, 2014):

1. **Limited supply of fresh water for both agricultural and domestic uses:** Rainfall, which is the primary source of water for agriculture, is limited, with an annual precipitation of only 700-1,000 mm. Moreover, there is an insufficient number of wells, which are the primary source of water for drinking and bathing. While the government has constructed dams in several villages, a number of them are malfunctioning or experiencing siltation (BPS, 2009).

2. **Limited knowledge of agricultural practices and extension services:** The District Government has a limited number of agricultural extension staff and rarely conducts any extension services on the island, such as scientific research and dissemination of information on agricultural practices through farmer education. This has resulted in a low level of knowledge on agriculture and sustainable, innovative practices that can increase productivity and income.

3. **Soil degradation, pollution and loss of biodiversity due to the inappropriate use of chemicals:** In order to speed the cultivation of farm fields, the community relies heavily on herbicides and pesticides. Unfortunately, the soil types on the island are naturally nutrient poor, and the excessive use of chemicals further degrades soil quality. The result is that farmers are forced to abandon farmland after 5 to 6 years of use to let the soil recover. In addition, overuse of chemicals harms local biodiversity, both on land and in the surrounding sea when these chemicals are carried to the ocean in rainwater (see Fig. 5).

4. **Climate change and extreme weather:** The biodiversity and human communities of the island

Figure 5. Degraded and abandoned farm land, SGP/COMDEKS Indonesia

are threatened due to a disproportionate risk from climate change and extreme weather events, which have increased in frequency in recent years.

5. **Lack of knowledge and skills to improve livelihoods:** Community groups currently lack the skills and knowledge base to spur local innovation, improve economic activity and increase the local standard of living. Lack of capacity often limits the activity of these groups in the construction of basic village infrastructure.

6. **Deforestation:** Increasing deforestation in the area, particularly from land clearance for agricultural use due to local population growth, has further threatened biodiversity and sustainable land management.

3. COMDEKS activities, achievements, and impacts

3.1 The landscape approach and use of resilience indicators

The set of 20 Indicators of Resilience of socio-ecological production landscapes and seascapes (SEPLS), developed by Bioversity International and the United Nations University, is a centerpiece of the community consultation process. The COMDEKS methodology relies on community consultation to drive a process of participatory landscape planning. As part of this process, community members and other stakeholders come together to conduct a baseline assessment of landscape resilience, forge a Landscape Strategy on the basis of this assessment, and identify potential community actions to carry out the Strategy. The resilience indicators figure prominently in all three of these steps. As a focus of discussion, analysis, and negotiation, they are integral to the community process of generating baseline information, reaching consensus on the primary challenges to local resilience, and developing a plan of action to address these challenges. Because of their central role enabling group discussion and interaction, they are also critical to the process of generating the social capital necessary to undertake community-driven landscape projects (UNU-IAS 2013; UNU-IAS et al 2014).

Moreover, the usefulness of the resilience indicators is not restricted to the initial baseline assessment and the early stages of participatory landscape planning. They are also critical at the end of the COMDEKS grant cycle. Aside from their central role in the landscape planning process, they are also a key tool used to capture perceptions of local stakeholders of changes in landscape resilience due to supported initiatives. During the ex-post baseline assessment at the completion of COMDEKS projects, the resilience indicators are again scored, and scores compared with those from the ex-ante baseline assessment. Although comparing indicator scores from the baseline assessment to indicator scores from the ex-post assessment cannot be used as a quantitative measure of landscape resilience change, it can be used to highlight changes in local perceptions due to the completed COMDEKS projects and to determine progress toward the landscape goals enunciated in the Landscape Strategy. Thus, the resilience indicators are a prominent feature of COMDEKS implementation from beginning to end. They are also a key feature of the adaptive management cycle that COMDEKS relies on, in which project results are used as a source of learning and innovation for future community efforts (UNDP, 2016).

3.2 Community consultation and baseline assessment

In November and December 2013, the Bingkai Indonesia Foundation conducted a baseline survey to determine conditions in the target landscape. Active participation of local communities and other key stakeholders in the baseline assessment was assured through literature reviews, field observations, community interviews, and a participatory assessment of community resilience. The assessment used the resilience indicators to help measure and understand the resilience of the target landscape. Nine small group discussions and six individual interviews with village leaders were initially held. To foster women's empowerment and their effective participation in the planning process, 24 of the participants were women, and two of the small group discussions were attended exclusively by women.

A baseline assessment workshop was subsequently held with 25 participants, five of whom were women, using the resilience indicators. Following this, a second consultation was conducted (33 men, 4 women) to present the results,

Figure 6. Mapping Semau Island resources and communities during the Baseline Assessment

to discuss key problems and to identify activities that could contribute to the long-term sustainability of the target landscape. Some of the main areas of concern identified were the lack of access to freshwater, the adverse impacts of overuse of chemicals, the need for greater ecosystem and biodiversity protection, particularly of monsoon forest tree species and mangroves, as well as local crop varieties, and the need for increased agricultural/aquaculture innovation and knowledge (see Fig. 6) (UNDP 2016).

3.3 Landscape Strategy and community-led landscape projects

The baseline assessment and community consultation gave rise to the COMDEKS Indonesia Landscape and Seascape Strategy, which sets out a slate of four Landscape Outcomes and associated indicators to measure progress toward these outcomes. It is the most critical element of the landscape planning process, where landscape communities generate a vision of what a more resilient local landscape would look like and determine what actions would be required to realize this vision (UNDP 2016). In the case of Semau Island, the target area is classified as a seascape due to its small island characteristic, and the concept of a seascape consists of land and marine management based on terrestrial governance. This long-term plan strives to improve the social and ecological resilience of small island and coastal communities as well as local and surrounding ecosystems through community-based activities, incorporating the conservation of terrestrial and coastal and marine areas – as stipulated in Aichi Biodiversity Target 11 – into the core objectives of the participatory Indonesia Landscape and Seascape Strategy (UNDP 2017a).

Table 1 lists the four Landscape Outcomes around which the strategy is built, the performance indicators that are used to measure progress toward these outcomes, as well as a number of activities that would contribute to the accomplishment of each Resilience Outcome to guide the selection of local projects GEF SGP Indonesia 2014; UNDP 2016).

3.2 Achievements and impacts to date

Improving water management practices and promoting organic agriculture: Supported initiatives have brought improved agricultural practices that increase water access and decrease the use of agricultural chemicals. These include the establishment of a water conservation area that integrates tree planting with increased access to water by communities and improved irrigation systems. Village water committees have also been formed in each participating village. At the same time, 12 organic agriculture demonstration plots have been established, with crops including bananas, eggplant, capsicum, tomatoes, watermelon, sorghum, and red onions. A concerted effort to increase market access for organic crops in off-island markets is also underway. The combination of better irrigation (using both sprinklers and hand-held devices) and organic culture has led to zero chemical inputs by partner communities, a reduction in time spent irrigating crops, production of two crops per year instead of one, about 20 percent higher yields, as well as higher prices for organic produce. Adding to the success of these farm interventions has been the

Table 1. Landscape outcomes, indicators, and suggested activities from the Indonesia Landscape and Seascape Strategy

Landscape/Seascape Outcomes	Key Performance Indicators	Suggested Activities
Outcome 1: Preservation of island ecosystem functions through the maintenance of forest cover, as well as coastal, marine, and coral reef systems, and the promotion of sustainable resource use practices**.**	• Number of hectares of forest land under protection or sustainable use. • Number of hectares of seascape (coastal, marine, coral reef) under protection or sustainable use.	• Community education on the benefits of maintaining and conserving clan forests, protected state forests, and coastal and marine ecosystems; • Introduction to the benefits of coral reefs and fish aggregating devices (FAD) in fishing (to attract fish); • Training of community groups and village governments on raising and planting artificial coral reefs and using FAD in shallow coastal waters.

Outcome 2: Enhancement of the resilience of agriculture and mariculture systems through improved and sustainable cultivation practices, diversification of crops, and improved management of water sources.	• Number of community members adopting sustainable agricultural and maricultural management practices, and number of methods implemented. • Number of community organizations managing water resources efficiently and effectively. • Number and variety of new resilient crops and maricultural products promoted.	• Training on seed preparation and community education on medicinal plant species and natural plant herbicides; • Training of village governments on establishing zones for marine aquaculture, fishing, and coastal and marine protection; • Establishment of a water resources management organization for springs and lakes in and between villages; construction of new water canals or wells; • Introduction to and demonstration plots for more resilient plants, and for better seaweed cultivation methods; • Community education on the long-term impacts of chemical fertilizers and pesticides on soil fertility, harvest quality, groundwater, biodiversity and health; • Training of community groups on organic fertilizers and pesticides as well as their development and use; • Regular facilitation of experience-sharing sessions and extension services for agriculture and aquaculture in collaboration with experts from the Kupang District Agriculture and Fisheries Extension Agencies; • Introduction to the benefits of weather and climate forecast information for agriculture, aquaculture and fishing; dissemination of forecasts to the community to make agriculture, aquaculture, and fishing decisions; • Introduction to and demonstrations of chemical-free land cultivation; • Development of a study on the ideal land cover, and on water supply and water demand on the island.
Outcome 3: Community livelihood improvement through sustainable income generation.	• Number of sustainable livelihoods and income generation opportunities adopted. • Increased household income as a result of supported livelihood activities.	• Development of studies and trainings on beekeeping for community groups, as well as increasing awareness on the importance of planting hardwood trees for honey production; • Training in agriculture and aquaculture product manufacturing, packaging and seed storage methods; • Introduction of sustainable and efficient fishing gear, particularly for seasons of extreme weather, such as the west monsoon period; • Development of studies on the opportunities for marketing agriculture and aquaculture commodities from Semau Island on the Kupang and East Nusa Tenggara markets.
Outcome 4: Creation of institutional governance systems for effective participatory decision making and knowledge sharing at the landscape level.	• Number of community-based institutions created or strengthened that are engaged in integrated seascape/landscape management. • Number and type of policies influenced at the local and landscape levels. • Number of best practices and lessons learned shared among landscape stakeholders.	• Promotion of village government regulations or agreements between clan leaders for the maintenance, protection and area-based conservation of terrestrial and marine biodiversity in the target landscape/seascape; • Lobbying and support of village governments and clan leaders to make prudent and forward-thinking decisions regarding the protection of the remaining clan forests; • Support of village governments and clan leaders in the implementation of regulations that prohibit the logging of large trees, as well as in the establishment of criteria for afforestation.

Figure 7. Farmer woman in Semau Island, SGP/COMDEKS Indonesia

introduction of biogas systems in communities, which has resulted in reduced fuel wood use and related deforestation (see Fig.7).

Improving marine management and seaweed culture: Marine Protected Areas, restored mangrove forests, and protected watersheds are important elements of resilient landscapes and seascapes. Supported marine interventions on Semau Island have focused on better management of the shoreline, improvements in seaweed cultivation, and restoration of mangroves, which were heavily cut to expand seaweed farming (see Fig.8). One major advance in terms of decreasing environmental impacts has been the imposition of restrictions on the extraction of beach sand, particularly in Batuinan Village, where a guarded portal was installed to limit sand mining in the area. Meanwhile, improvements in the growth and processing of seaweed have led to higher quality and quantity of seaweed for wholesale, and the development of seaweed-related secondary products has added value to the seaweed farming enterprise. Mangrove restoration is just beginning.

Establishing new institutions and networks: A range of new institutions and networks have been established in different Semau Island communities. These, along with environmental education in schools, have acted as a key mechanism to increase local environmental awareness and planning. More importantly, these new institutions have created governance platforms for community members to act on this increased awareness. Perhaps the most important new institutions are local Environmental Forums, which have been formed in seven communities. These forums include participation of customary authorities, community leaders, community groups and government authorities. They were established at the village level to ensure restoration of damaged ecosystems and to build a system for the continuing sustainability of these ecosystems. These local forums also participate in inter-village meetings so that issues of broader concern can be discussed and planned for in a collaborative manner.

Negotiating new agreements to protect community resources and local biodiversity: Taking into account the local clan-based land tenure structure in Semau Island, the formation of Environmental Forums and other new institutions has resulted in a variety of new environmental commitments by local clan leaders, village governments, and community members. These agreements cover a wide range of activities from watershed protection, irrigation and agricultural production, to seaweed farming and mangrove restoration. For example, in Batuinan Village, community members have agreed to declare a 3-ha water catchment area as a conservation zone, with the landowners agreeing not to lease this land for other purposes and community members agreeing to limit the number of private wells in the surrounding area in order to raise the water table. In line with local clan customs, these agreements have been fostered as customary oaths – instead of written laws – demonstrating a good example of how communities manage their land in a participatory manner based on spiritual values. In addition, village members have agreed to plant some 1,650 mahogany trees in their family gardens to regenerate local forest cover. Village churches in Batuinan have even agreed that couples getting married should each plant two trees in their home gardens. In Uitiuhana Village, villagers established a nursery to raise endemic tree seedlings to be planted on an 11-ha area donated by the clan leader. A draft agreement accompanying this tree-planting effort specifies nursery and forest management rules (trees cannot be cut for 20 years) and a monitoring system. Overall, about 67 hectares of monsoon forests have been conserved through community initiatives and agreements.

Mapping local environmental governance leaders: Little time has passed since the implementation of COMDEKS projects, so changes in the quality of local environmental governance cannot be assessed yet, although it can be said that the inclusion of women and youth has improved. To help in assessing governance changes, PIKUL (a local NGO) has produced a comprehensive baseline that, among other things, mapped 93 local leaders and social innovators (69 men and 24 women), including landowners, clan leaders, community leaders, community groups, and government. The map provides an important overview of the ecosystem of actors with decision-making power regarding the utilization of resources in villages, gardens, forests, water, coasts and marine areas. It aims to support future assessments of changes in governance quality as well as efforts to carry out area-based conservation of terrestrial and marine biodiversity and community resources at the local and landscape level (UNDP 2016).

Figure 8. Sustainable seaweed farming practices, SGP/COMDEKS Indonesia

Figure 9. Community discussion on local environmental issues and governance

4. Conclusions: progress at the landscape level

The establishment of so many local environment-focused community groups and the forging of a considerable number of formal, written environmental commitments at the village level is evidence of a strong participatory trend among Semau Island communities in environmental governance. As yet, this interest is mostly confined to local village matters, and is also mostly segregated into clan and ethnic groups. To date there has been little mixing among the two different ethnic groups, who tend to live in different areas and work in different enterprises (UNDP 2016).

On the other hand, project partners are continuing to meet to share lessons among themselves, and there has been robust support from government and clan leaders of all supported projects promoting landscape resilience. The seven different Environmental Forums have established a mechanism for inter-village meetings to discuss issues that reach beyond the village level, which could be considered the beginning of an island-wide landscape community to protect local biodiversity and community resources. Moreover, the multi-stakeholder nature of these forums brings together community and clan leaders with government officials from the Ministry of Forestry and the Ministry of Marine Affairs and Fisheries, which manage the Marine National Recreation Park covering almost the entire coastal areas, and the Sawu Marine National Park located in the south and south-east waters, respectively. These forums create a fertile environment for future collaboration and exchange between the customary conservation areas governed by community leaders and the surrounding government-protected areas. They can also serve as a good example with replication and upscaling potential in other regions with similar governance structures.

5. Key messages and lessons learned

A number of valuable lessons learned were derived from supported projects' activities. In the early stages of project conception, mapping of actors, governance structures and social innovators to understand responsibilities and roles of stakeholders in the target landscape significantly contributes to successful project design and implementation. It helps the project partners to develop a clear understanding of the current arrangements, identify areas for improvement, implement innovations and monitor progress.

The baseline assessment highlighted that addressing current problems seemed more important to the local community than anticipating future risk. As resilience measures are often perceived as generating only long-term benefits without immediate improvements to daily challenges for rural livelihoods, community consultations and discussions with individuals and groups about current challenges are a vital part of the participatory landscape approach supported by COMDEKS. Assigning facilitators from grantee NGOs and CSOs to small groups, and arranging individual and group discussions throughout project implementation, significantly helps with the collection of data, which can be used as supporting elements to facilitate the SEPLS resilience assessment, in addition to applying the Indicators of Resilience. Moreover, using demonstration sites is instrumental in raising the interest of stakeholders in new approaches, concepts and technologies and helps generate buy-in from local leaders and landlords who are critical to governance reforms on the local and landscape level (see Fig. 9) (UNDP 2017b).

Addressing governance issues is a critical pillar of improving landscape resilience. Revitalizing traditional values blended with human rights values is an important process

to promote an inclusive dialogue among stakeholders. Dialogue on equity together with landscape and seascape control needs to be stimulated, including discussion of details on how shared values will be implemented in landscape management. Approaching such issues in an integrated manner is critical to conserving biodiversity and promoting sustainable livelihoods through landscape approaches. In the case of Semau Island, water supply had to be increased to boost agricultural yield, and in order to achieve this, certain agreements had to be formed with landlords who control the watersheds. In this context, agricultural productivity is a governance issue as much as it is a technical one relating to farming methods. Establishing environmental forums and water committees supported transparency and accountability around the projects in Semau Island, and has been instrumental in developing new rules and brokering agreements. These agreements have not only helped to retain customary arrangements, but also to make them more robust and less open to the vagaries of individual landlords. In addition, they promote intra- and inter-community dialogue. In this context, however, it is key to facilitate a common understanding towards long-term goals among customary leaders, clan members, community members and village governments towards sustainable landscape management. At the same time, promoting goals of individual stakeholders is the key towards collaboration (UNDP 2017b).

The NGO conducting the ex-post baseline assessment at the end of the COMDEKS project cycle used a technique called the *Most Significant Change* to collect stories from stakeholders throughout the target landscape. This technique was instrumental in identifying and documenting what stakeholders at the local and landscape level saw as the most significant change—in terms of resilience improvements—due to supported project activities. Field observations, interviews, focus group discussions, photographs, and video recordings were used to capture and record these stories, which were then used as part of the overall participatory evaluation procedure to assess project accomplishments, alongside resilience indicator scoring (UNDP 2018).

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Chapter 6

Ensuring conservation, good governance and sustainable livelihoods through landscape management of mangrove ecosystems in Manabí, Ecuador

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Abstract

In the area at the mouth of the rivers Chone and Portoviejo, which consists of mangrove forest, islands, beaches, wetlands and saltwater areas, and incorporates the dry tropical forest of the Bálsamo Mountain Range, local communities have been living on fish, crustaceans, shellfish harvesting and agriculture. However, harvesting has been significantly reduced due to sedimentation and pollution, mainly caused by the chemical residue of agricultural and shrimp farming activities. The dry tropical forest faces a reduction of its area due to urbanization and the expansion of agricultural areas. Communal organizations promote sustainable activities devoted to restoration and conservation of the ecosystems through mangrove and dry forest species reforestation. Improvement of local governance has resulted in their territories becoming protected areas and recognized by the National System of Protected Areas (SNAP). Because the economic livelihoods of the communities depend on healthy ecosystems, sustainable activities such as ecotourism, artisanal salt extraction, and artisanal fishery and harvesting have been developed. The communities have applied the Indicators of Resilience tool to assess their Socio-ecological Production Landscapes and Seascapes (SEPLS) to determine whether these socio-economic activities can occur while maintaining the integrity of the ecosystems in the SEPLS. Besides establishing a baseline to quantify the progress of the resilience conditions, the resilience evaluation allowed participating local communities and organizations to develop a work plan that incorporated these actions. As a result, it was concluded that the resilience evaluation helped the local communities and organizations to 1) share knowledge on strengths and weaknesses of the SEPLS; 2) provide opportunities for the debate and analysis of SEPLS between members of the communities; 3) develop priority action plans to strengthen the resilience of the SEPLS; and 4) rethink and recognize how the project would help to address key threats and weaknesses.

Keywords: Landscape approach, mangrove ecosystem, livelihoods improvement, strengthening governance, resilience.

Country	Ecuador
Province	Manabí
District	Sucre and Portoviejo
Size of geographical area	11.886 hectares
Number of indirect beneficiaries	10.076 persons
Dominant ethnicity	Mestizos

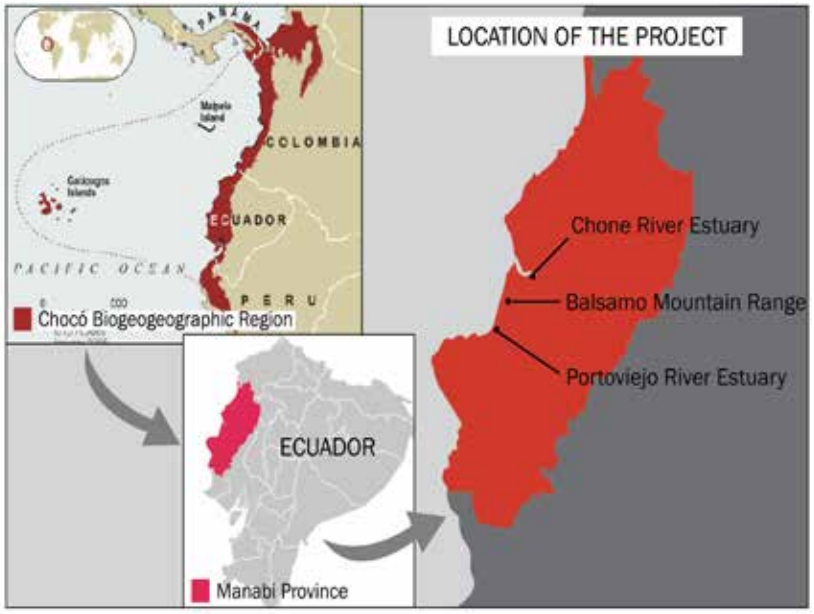

Figure 1. Map of the country and case study of FIDES's project site Note: Data for Map of the country and region from CI/CABS (2005).

Size of case study/project area	3.970 hectares
Number of direct beneficiaries	1.015 persons
Geographic coordinate (longitude and latitude)	0°43'18.96"S 80°29'29.14"O
Dominant ethnicity	Montubios

Figure 2. Land use and land cover map of case study site Note: Data for Micro Map of study area elaborated for the present article.

1. Introduction

1.1 Study site

Mangroves are considered one of the world's most productive ecosystems, providing important economic, cultural, and social services for the various communities settled around them (Ong 1982; Berger, Smetacek & Wefer 1989; Bunt 1992, Kathiresan & Bingham 2001). The study area is a mangrove ecosystem, production landscape and seascape, located within two estuaries, the Chone River Estuary and Portoviejo River Estuary of Manabí Province, Ecuador, and the dry forest of the Bálsamo Mountain Range between these estuaries (see Fig. 1, 2 and Table 1).

The Chone River Estuary drains the area of San Vicente surrounding the islands of Corazón and Fragatas, which are wildlife sanctuaries of estuarine islands full of mangroves and a state-owned protected area. The Chone river converges with the Carrizal river creating the La Segúa swamp, a designated RAMSAR site. This fresh water wetland possesses an exceptional richness of avifauna, with a bird count of over 190,000, making it a true coastal bird sanctuary (López & Gastezzi 2000).

The Portoviejo River Estuary is shaped by a mangrove forest, salt evaporation ponds (salt pans), beaches, and is the product of the confluence of the sub-basins of the Portoviejo River and Estero Bachillero. Total coverage of the mangrove forest is 57.72 ha, where 19.23 ha is in the San Jacinto community (from Charapotó village) and 38.49 ha in the Las Gilces community (from Crucita village). Regarding flora and fauna, according to Vaca and Piguave (2012), there are 75 species of phytoplankton and 17 species of higher plants in the mangrove forest at the Portoviejo River Estuary. Among these, there are four reported mangrove species: white mangrove (*Laguncularia racemosa*), buttonwood or button mangrove (*Conocarpus erectus*), black mangrove (*Avicennia germinans*) and red mangrove (*Rhizophora mangle*). This location was declared a communitarian protected area in 2011.

The Bálsamo Mountain Range is made up of approximately 9,500 ha of dry tropical forest, very-dry tropical forest, and spiny tropical shrubland, located in the central part of Manabí Province, north of the communities of San Clemente, San Jacinto and Charapoto. The Bálsamo Mountain Range presents a wide number of endemic species of deciduous forest remnants including two primates, namely the capuchin monkey (*Cebus albifrons*) and the sub-specie *Cebus aequatorialis,* endemic to the central coast of Ecuador (Tirira 2011). This location encompasses eight private natural reserves whose buffer zones overlap with the territory of three local communities.

Table 1. Size of the project area (FIDES 2017a)

Place		Areas (ha)				Source of information
		Mangrove	Estuary	Saline areas	Dry forest	
Chone River Estuary		1,189	1,623			Planimetric survey conducted in 2010 by C-CONDEM, and Ministerial Agreement of expanding protected area (Ministry of Environment, Ecuador, 2007).
Portoviejo River Estuary		58	700	52		Planimetric survey conducted in 2010 by C-CONDEM, and projected area of estuary.
Bálsamo Mountain Range	**Private Reserve Capuchino**				70	Owner/representative of reserve (Mr. Lucas Oshum)
	Private Reserve Mesita – Punta Colorada				226	Owner/representative of reserve (Association Cerro Seco)
	Private Reserve Punta Gorda				52	Owner/representative of reserve (Mr. Ramón Cedeño)
Total		1,247	2,323	52	348	

1.2 Socio-economic activities in the area

The local communities engage in fishing (sardines, mackerel, sawfish, pampanos, cara, snapper, seabass and grunt); harvesting of mollusks and crustaceans including black shell (*Anadara tuberculosa* and *Anadara similis*), red crab (*Ucides occidentalis*) and blue crab (*Cardisoma crassum*); tourism due to the beautiful landscape and beaches; agricultural activities including rice, onions and coconut production; salt extraction; and sand extraction, among others. These activities are realized based on the various ecosystems found in each location, which are outlined for Chone River Estuary, Portoviejo River Estuary and the Bálsamo Mountain Range in Tables 2, 3 and 4, respectively. The ecological impacts of these activities are also briefly addressed in this section, as impacts are inherent to these activities.

Table 2. Resource use of different ecosystems in the Chone River Estuary (FIDES 2017a)

Resources	Uses of ecosystem
Mangrove	**Capturing red crabs and shells:** The gathering of crustaceans and molluscs has been an ancestral activity in the estuary of the Chone river; however, these products are becoming increasingly scarce, due to either loss of habitat (more than 80% of the mangroves has been felled by the shrimp industry), pollution generated throughout the basin, or the shrimp farms. **Tourism:** One of the important activities in this territory is ecotourism, which is especially developed on the Corazón and Fragatas Islands. Kayaking, birdwatching and gastronomy are some of the services managed by communities.
Estuary	**Artisan fishing:** The estuary is made up of different fish species that are part of the food staples of the population. **Gathering of molluscs:** Likewise, molluscs and crustaceans are collected, the main ones being guariche, concha prieta (black ark) and scallops. Due to the loss of these species' habitat, as with the impact of pollution, they are no longer commercialized in great volume, but now are used mostly for local consumption. **Shrimp:** One of the important activities in the area is the production of shrimp for export. The shrimp industry is responsible for having felled more than 80% of mangrove forests in the area, displacing families. The industry is now one of the main causes of pollution in the estuary, especially when pools with pollutants are emptied, modifying the pH of the water.
Agriculture	Agricultural activities are performed on a small scale in the area. In winter, the main crops are: corn, cotton and crops of short durations.
Wetland La Segúa	**Chameras:** These are pools of chame (native fish species) production. Chameras involve recovering the area's emblematic chame species, since exotic species, like tilapia, a predator of chame, have been introduced in the wetland. **Tourism:** La Segua wetland has a particular scenic beauty and is also a resting place for migrant birds. Tourism is potentially a very profitable activity in the area and will permit educating visitors about the importance of the wetland.
Township of Portovelo	In the town of Portovelo, employment-generating activities have been developed, such as: the cabin restaurant, run by a group of young people with the objective of rescuing gastronomy with mangrove products. In the community workshop La Casita, the association has a venture to manufacture products with mangrove motifs.

Table 3. Resource use of different ecosystems in the Portoviejo River Estuary (FIDES 2017a)

Resources	Uses of ecosystem
Mangrove	**Tourism:** Exists within the mangroves' (San Jacinto) trails, which is a touristic service, sensitizing tourists to the importance of this ecosystem. **Crustacean harvesting:** Mangroves are a place where certain species evolve, such as guariche, blue crab and shells that have been the base alimentation of the communities. It is noted that due to the pollution levels in the estuary, the scarcity of these species is increasing.
Estuary	**Artisanal fishery:** The estuary provides many fish for food. Income generated by boat trips. **Tourism:** Fluvial itineraries. **Shrimp farming industry:** Many shrimp farms have been installed, drastically reducing the mangrove forest in the estuary and affecting the environment and the species living there.
Beach	**Tourism:** The area is one of the most important destinations for local tourism. Tourists arrive mainly from Portoviejo, Rocafuerte, Chone, and Tosagua. Peak seasons provide an important income for the communities' population, especially San Jacinto and Las Gilces, both mainly for gastronomy. **Sand extraction:** There are areas where significant volumes of sand are extracted for construction use. This is becoming a problem, as the physiognomy of the beaches changes and the landscape's beauty is being lost.
Agricultural valleys	**Rice-growing areas:** Another activity that is being developed in the area is agriculture. One of the major crops is rice, especially for the communities of Las Gilces, San Roque, and, to a lesser extent, San Jacinto. **Onion-production areas:** The industrial agriculture in certain areas around the communities have developed monoculture, especially of onion, with a high use of agricultural chemicals and labor force from the area (Santa Teresa, San Roque). **Coconut-production areas:** Las Gilces is an important producer of coconut. Coconut water is one of the most commercialized beverages in the sector.
Salt ponds	**Production of natural salt:** In the estuarine communities, there are salt ponds. In some of them, such as Las Gilces, San Jacinto and San Clemente, the production of natural salt is an important aspect for families, although the price is very low. Salt production has basically three uses and markets: for the processing of fresh cheese, cattle food and fertilizer, mainly for coconut. **Use of plastic (salt):** In the salt evaporation ponds (salt pans), sheets of plastic are still used to collect water, which after being dried by the sun, produce the salt. These plastic sheets become a contaminating element once the useful life of the plastic is over, due to improper disposal. **Native plants and birds:** The beaches, salt pans and the mangrove forest form part of the ecosystem and have important interactions generated between them. There are places of bird nesting, resting and feeding; tourist attractions are therefore a source of employment for the families of the communities. **Spirulina:** In some salt-producing ponds, spirulina has been found, which is a type of seaweed used for therapeutic purposes (especially for weight loss). However, even though it is beneficial for other activities, it represents a danger because it affects the saltwater, which is the basis for the salt production.

Table 4. Resource use of different ecosystems in the Bálsamo Mountain Range (FIDES 2017a)

Resources	Uses of ecosystem
Dry-dry Forest	**Tourism:** Although the tourist activity is relatively new, the Bálsamo Mountain Range is becoming a tourist spot of national interest. There are several dry forest trails along the sea and camping sites in the dry forest. **Research and conservation:** In some of the private reserves of the dry forest, wildlife monitoring with camera traps takes place. This information is used to create awareness through educational campaigns among the communities, and to promote scientific tourism. **Agriculture:** Extension of agricultural frontier, through seasonal crops. Urban development planning in forest areas. Indiscriminate hunting.
Marine area	**Tourism:** The combination of dry forest ecosystem with the beach area is a great attraction for tourists. **Fishing:** Fishermen from nearby communities often fish around the area. **Irresponsible mining:** In some areas, significant volumes of sand are extracted for construction use. This is becoming a problem, as the physiognomy of the beaches changes and the landscape's beauty is being lost.

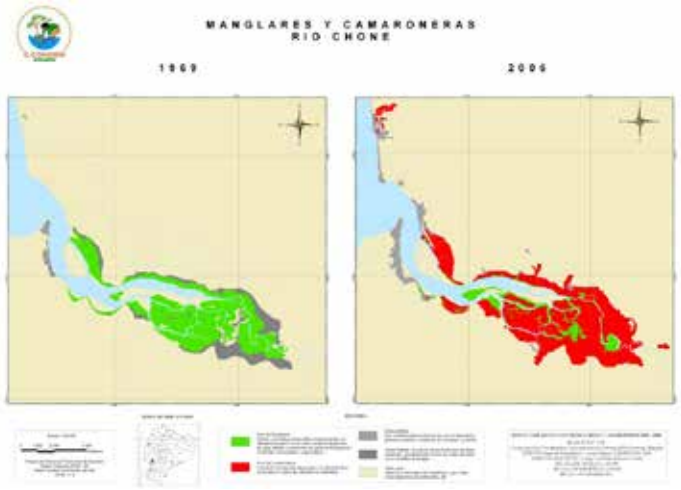

Figure 3. Destruction of mangrove forests in the Chone River Estuary (C-CONDEM 2007).

1.3 Challenges

Despite the environmental, social, economic and cultural importance of the mangroves, as well as the existence of a legal framework for protection, more than 80% of the mangroves in the Chone River Estuary and Portoviejo River Estuary in Manabí Province have been destroyed by the shrimp industry. This destruction has deteriorated living conditions for families that have lived off such ecosystem services for generations, mainly due to the decline and loss of species that have been part of the local community's food security. According to the data of the Center for Integrated Survey of Natural Resources by Remote Sensing (CLIRSEN), there were once 4,171.2 hectares of mangrove forest in the Chone River Estuary in 1969. In 1999, only 704.9 hectares remained, representing a loss of more than 80% of the mangrove forest, which was replaced by the construction of shrimp farms. By 2006, there was a slight mangrove recovery, achieved through efforts by the mangrove communities, as shown in Figure 3. The Chone River Estuary also suffers from pollution caused by the chemical residues of agricultural activities, chemicals from the shrimp industry (Barreto et al. 2011), and the discharge of wastewater.

The mangrove ecosystem of the Portoviejo River Estuary is also heavily affected by pollution, which is generated by wastewater discharges, poorly treated water coming from oxidation ponds and lagoons and domestic water discharges, as well as waste from agrochemicals that are washed away by rainwater and/or irrigation systems, in addition to organic wastes from livestock activities and by shrimp farming in captivity. Deforestation of mangroves is another existing problem due to the installation and expansion of shrimp farming industries, agricultural plots, and urbanization in the Portoviejo River Estuary.

As a result of an information survey in the area, it was determined that the territory of the Bálsamo Mountain Range is threatened by deforestation; extension of the agricultural frontier; urban development (especially of touristic centers); extraction of fine woods; loss of habitat for the fauna species of the zone; and illegal hunting.

2. Activities

Apart from the mangrove ecosystem and its socio-ecological benefits, emphasis is placed on preserving the connectivity between these two mangrove forests and the dry forest ecosystems. With this objective, work is being done to seek recognition at some level of official protection for the area, either through the state or communal protection. The aim is to strengthen community production activities that alleviate the pressure on natural resources and contribute to the conservation of biodiversity and the ecosystems, as well as the food sovereignty of the communities, the utilization of traditional knowledge and practices, and the incorporation of innovative and sustainable production technologies.

To improve the landscape resilience and management of the Socio-ecological Production Landscapes and Seascapes (SEPLS) in a collective manner, the communities applied the Indicators of Resilience in SEPLS (UNU-IAS, Biodiversity International, IGES & UNDP 2014) to assess the resilience of their landscapes and seascapes. Members of four communities, three private area owners and five public servants of the Ministry of Environment were involved(see Fig. 4). The Foundation for Social Research and Development (FIDES), a local NGO, facilitated this participatory application of the Resilience Indicators. The following areas were evaluated:

- Environmental resilience: Protect, restore and improve the ecosystems and river basins;
- Economic resilience: Diversify local economic activities and implement measures to reduce poverty and

Figure 4. Group discussion in the Resilience Indicators Workshop. Participants in the Portoviejo River Estuary. ©FIDES

guarantee food sovereignty;

- Social resilience: Improve the capacities of local organizations, their empowerment, as well as the participation of social actors;
- Political-institutional resilience: Contribute to the functioning of various institutional and governance mechanisms.

Local communities have been implementing restoration processes in certain areas through red mangrove (*Rhizophora mangle*) reforestation, and recovery of mangrove species such as shells (*Anadara similis* and *Anadara tuberculosa*) and mouthless crab (*Cardisoma crassum*) with 4,000 seedlings planted in an area of two hectares. In the state-owned protected area, 8,000 seedlings of mangrove species were planted with the support of park rangers and members of the communities.

The reforestation of dry forest in the Bálsamo Mountain Range is linked to the protection of the white-headed capuchin monkey (*Cebus aequatorialis*) (see Fig. 5), which is listed as Critically Endangered A2cd (CR) under IUCN guidelines (Cornejo & de la Torre 2015).

Community tourism plays a societal and environmental role, since it supports income generation for families and, in this way, relieves pressure on the mangrove ecosystem and dry forest. The tourism infrastructure is improving, including restaurants, cabins and pathways within the mangroves. Youth organizations such as the Group of Youth United for the Development of the Las Gilces Community and the Young Entrepreneurs of the Mangrove of San Jacinto (Portoviejo River Estuary) play an important role in these activities (see Fig. 6). In the Bálsamo Mountains, an initiative was proposed to create a touristic route based on the ancestral route of the culture "Los Caras", with the aim of generating associativity between the private reserves along the landscape.

A pilot project for the production of chame (*Dormitator latifrons*) in rice fields started towards the end of 2017 and is being tested as a sustainable productive activity. The production of crab as an alternative to chame in the rice fields will also be explored (see Fig. 7).

Artisanal salt extraction from salt ponds, which are part of the landscape, is an ancestral activity that generates income for more than 30 families in the area. A new initiative is

Figure 5. Sightings of the capuchin monkey by the camera traps in the La Gorda and Punta Verde private reserves (November 16/2016). ©Ramón Cedeño

Figure 6. Youth from UDC building the ecological path. ©UDC Las Gilces

Figure 7. Captivity breeding of chame fish. ©UDC Las Gilces

being pursued in the Commune Las Gilces in collaboration with the Salt Producers Association to produce and trade gourmet salt and salt for use in cosmetics (see Fig. 8).

Training on leadership for youths in the communities, as well as environmental education for school children, collectively prepare the younger generation to sustain the conservation efforts being embarked upon at present.

3. Results

As a result of the resilience assessment workshops, the local communities and organizations outlined the important events in recent history to their livelihoods and ecosystems (Appendices 1, 2 and 3). Likewise, they shared their knowledge on the strengths and weaknesses in the SEPLS, adjusted their existing plans, and developed priority action plans to strengthen the resilience of the SEPLS following the communities' interests and needs (see Table 6).

For example, through the resilience assessment, local community members found that there is great diversity surrounding the canal, rivers, wetlands, mountains, beaches and mangroves in their SEPLS. Uses of these ecosystems include artisanal fishing, capturing of conch, red and blue crabs, tourism and agriculture, among others. The communities found that resource management needs to be improved, including training and strengthening of collaboration among existing committees.

Prior to the resilience indicator assessment, community members took some time to revisit the history, social and political situations, and natural resources in the area. This allowed for intergenerational exchanges as well.

Different approaches were taken to protect the ecosystem and people's livelihoods for each of the three distinct landscapes. The Chone River Estuary is located within a government-protected area and managed according to its official status. The four communities along the Portoviejo River Estuary self-declared their territory as a protected area with communal management and are looking for official recognition. The Bálsamo Mountain Range belongs to a private conservation initiative, and currently there is a debate on the possibility of including the area in the National System of Protected Areas (SNAP).

To secure the remnant mangroves and recover the lost functions, mangrove areas in the Chone River Estuary were gazetted as a protected area in 2004, and those in Portoviejo became a community protected area in 2011. Since then, a series of restoration efforts have been undertaken, including mangrove replanting and integrated river basin management.

As part of the strengthening process for the protection of the communitarian reserve, an intercommunity committee, composed of the four communes of the Portoviejo River, is leading a process to obtain recognition of their protected area by the Ministry of Environment within SNAP.

Table 6. Identified priority actions during the resilience indicators assessment (FIDES 2017b)

Areas	Resilience Indicators	Actions identified in the work plan
Landscape diversity and protection of ecosystems	Nº 4 Recovery and regeneration of the landscape/seascape	Awareness on the protection of ecosystems (mangrove, wetland, rivers).
		Requests for the concession of areas (mangrove, rivers, wetlands) to community organizations in accordance with the existing legal framework.
Biodiversity (including agricultural biodiversity)	Nº 7 Sustainable management of common resources	Repopulation of species in concession areas to organizations (shell, blue crab, chame).
Governance and social equity	Nº 13 Community-based landscape/seascape governance	Strengthening of the Community Protected Area process.
	Nº 14 Social capital in the form of cooperation across the landscape/seascape	Training in the framework of human rights and nature.
		Partnerships with public and private institutions.
Livelihoods and well-being	Nº 19 Biodiversity-based livelihoods	Strengthen community tourism.

Currently, the communities of the Portoviejo River Estuary are additionally self-recognized as Territories Preserved by Indigenous Peoples and Local Communities (TICCA), which further strengthens their social and political identity, and opens the way for more participative governance.

Several tourism infrastructures were completed in San Jacinto, including the construction of 42 dining cabins on the coastal edge that had been destroyed by an earthquake. Tourism ventures managed by youth groups of San Jacinto and Las Gilces have made significant progress.

In the Portoviejo River Estuary, the Group of Youth United for the Development of the Las Gilces Community (UDC of Las Gilces) is completing an ecological path, which it is calling the "José Alberto Ecological Trail". This route into the interior of the mangrove forest allows bird watching and includes information provision from native guides. Through this ecological path, environmental education on the importance of the ecosystem will be carried out. The Young Entrepreneurs of the Mangrove of San Jacinto acquired a vessel for sightseeing tours through the estuary, bird watching and informative talks for tourists.

There has been a thorough assessment of potential actions to improve and implement the production and commercialization of gourmet salt with the Salt Producers' Association (ASPROSAL). To this end, the Environmental Plan for the "Las Pampas" salt mines was revised. This involved an initial assessment regarding compliance with the activities and action plans established in the Management Plan of the "Las Pampas" salt mines, for which the implementation period was from July 2014 to June 2017. The construction of machinery for salt processing, including a dryer and mixer, is also taking place. With the aim of establishing a production chain for this machinery, a consultancy to develop a business plan was hired.

Within the private reserves, the implementation of the tourist route "Los Caras" has had some setbacks, as private reserve owners still focus priority on their individual reserves' touristic plan and still need to bring attention to collaborative initiatives.

Despite the fact that the Corazón and Fragatas Islands Wildlife Refuge (REVISICOF) has its governmental management plan, park rangers are open to collaborate with reforestation activities and a few of them are communitarian tourist guides from the communities that surround the governmental area, which results in community guides being more supportive of these initiatives.

4. Discussion

The resilience indicator assessment helped the communities to better understand the strengths and weaknesses of their SEPLS and identify priority actions for their communities. Besides establishing a baseline to quantify the progress of the resilience conditions, the resilience evaluation with local communities and organizations provided an opportunity to recognize historical, social and political situations in the area; share strengths and weaknesses of their SEPLS among community members and other stakeholders; and develop a priority work plan so that participant organizations can incorporate these actions into their management regimes

and implement the associated projects. At the same time, the indicators assessment provided an opportunity for community members and other stakeholders to learn more about SEPLS and the communities' perceptions of the SEPLS. The indicators assessment also helped to recognize the needs of local communities, encourage them to develop co-management plans together and to strengthen the relationship between project organizers and community members, building trust.

The comprehensive landscape approach undertaken at the mouth of the Chone and Portoviejo rivers, including the dry tropical forest of the Bálsamo Mountain Range, makes conservation of the critical mangrove ecosystem possible. At the same time, it allows for the sustainable use of the mangrove ecosystem as an important source for the livelihoods of local communities. This is possible due to collaboration among a wide range of stakeholders, including community-based organizations (CBOs) such as youth associations, community members, governmental entities, private reserve owners and FIDES. Cooperation between different CBOs in the Portoviejo River Estuary is facilitated through the Intercommunal Committee, which provides support to the execution of the different productive activities. In the case of the Chone River Estuary, the link to the landscape between different CBOs is mainly made through tourism. While tourism associations work together to provide tourism services, other productive activities are coordinated by FIDES through the participation of local community promoters. Private reserve owners coordinate their activities through the Balsamo Network of Private Forest Reserves.

Communal organizations promote sustainable activities devoted to restoration and conservation of the mangrove ecosystems through the reforestation of mangroves and dry forest species, reintroduction of species such as blue crab and black ark, organic agriculture, development of alternative livelihoods including community tourism, and artisanal production of higher value salt products. They also plant fruit trees in order to provide food for the capuchin monkey, a critically endangered species in the area.

Different area-based conservation approaches were taken to protect the ecosystem and people's livelihoods for each of the three distinct sites. As the Chone River Estuary is located within a government-protected area, it is managed according to its official status; however, public servants were sensitized to collaborate with the activities of mangrove restoration and native species reintroduction promoted by the communities settled around the estuary. For the Portoviejo River Estuary, declared as a communitarian protected area with communal management, the figure of the inter-communitarian committee is of great importance in the process of its official recognition, as it reflects the compromise and organization of the four communities in the management of the area before the Ministry of Environment. As the Bálsamo Mountain Range belongs to a private conservation initiative, it becomes more complex to influence the management plan of the owners.

Strengthening local governance is one of the key factors for the success of conservation in the area, considering the significant roles that youth groups are playing in the creation of ecological paths and the management of protected areas. Their work is focused on the improvement of local management capacities, which are paving the way for their territories to become protected areas that are recognized by SNAP. Also, the recognition of the territory as a TICCA contributes to the improvement of local governance.

The activities in Manabí contribute to the conservation of biodiversity because ecotourism, as a business that brings about livelihood improvement, must be based on an intact ecosystem. The local community realized the potential of ecotourism having understood the value that biodiversity brings to them. The area is primarily used for fisheries, but, through the realization of the potential of ecotourism, contributes to the conservation of biodiversity. This fits the definition of Other Effective Area-based Conservation Measures, or OECM, which was defined after the SBSTTA 22 of the CBD as: "a geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the *in situ* conservation of biodiversity, with associated ecosystem functions and services and, where applicable, cultural, spiritual, socioeconomic, and other locally relevant values."

From the findings of this case, the indicators of identifying OECMs in SEPLS include the presence of sustained business activities that are based on the elements of biodiversity and the presence of shared understanding among community members about the value of biodiversity.

5. Conclusions

With the understanding that their economic livelihoods depend on healthy ecosystems, communal organizations were able to collectively promote sustainable activities devoted to restoration and conservation of the ecosystems, namely mangrove and dry forest species reforestation. The reintroduction of species such as blue crab and black ark, and the planting of fruit trees in order to provide food for the capuchin monkey, as well as innovative sustainable practices, such as the breeding of chame fish along rice fields, were implemented.

Local governance is improving as a consequence of community organization, focused on achieving recognition of their protected areas into SNAP. Development of local capacity, including the younger generation, is key to strengthen local governance.

The comprehensive landscape approach encompassing the mouth of the rivers Chone and Portoviejo and including the dry tropical forest of the Bálsamo Mountain Range makes conservation of the critical mangrove ecosystem possible. This is due to the fact that the area can be adequately managed by available resources, including human capital, and is large enough for revitalizing the affected species in the area.

The resilience evaluation helped the local communities and organizations to 1) share knowledge on strengths and weaknesses of the SEPLS; 2) provide opportunities for the debate and analysis of SEPLS between members of the communities; 3) develop priority action plans to strengthen the resilience of the SEPLS; and 4) rethink and recognize how the project would help to address key threats and weaknesses so it can better address the needs of local communities.

Stakeholders of the three distinct protected areas had different ways of addressing action plans derived from the resilience evaluation. Members of communities were able to incorporate these actions into their management plans in a comprehensive manner. Although the government-protected area has its own management plan, it has been possible to promote specific conservation actions among community members in order to strengthen landscape management and resilience. On the other hand, private reserve owners would be able to incorporate their way of managing SEPLS into their management plans.

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Appendices

Appendix 1: Recent history in the Chone River Estuary (Source: FIDES 2017b)

Year/Events	Effect	Community actions
1980: Invasion of shrimp farmers	Reduction of resources.	
1982: El Niño phenomenon	Expropriation of land by the Central Bank of the Estate. Abandonment of agriculture. Weakening of the communities due to migration.	Relocation of plots and homes.
1998: El Niño phenomenon		
2000 Tourism at Corazón Island		Conservation and work alternatives. Protection of the ecosystem, training. Reforestation of the dry forest and of the mangrove through *mingas*.
2004: Management Plan C-CONDEM and OFIS (now FIDES)		
2006: Young Mangrove Entrepreneurs Group		
2008: Declaration of Wildlife Refuge REVISICOF by the Ministry of the Environment Ecuador MAE.	Restrictions for the communities to carry out their activities such as: fishing, gathering and tourism.	Resistance of certain areas.
2009: The Association of Ecological Tourism Guides created		Protection of wetlands.
2014: They are recognized as the Centre of Community Tourism (CTC in Spanish)		Employment alternatives for young people. The recovery of species. The blue crab and the prieta are reintroduced.
2015 La Segua Wetland is declared a protected provincial area by GAD Manabí, however the shrimp industry is expanded to the wetland	Production of shrimp farms.	Reports to Ministry of the Environment of Ecuador (MAE) and Provincial Advice Authorities, but they go unanswered and the shrimp farms continue extending their areas in spite of the declaration and the recognition of La Segua as a RAMSAR Site.
2016. Earthquake in Manabí and Esmeraldas of 7.9 on the Richter Scale	Destruction of local economy. Loss of work. Community and family-developed infrastructure damaged.	Damage evaluation, arrangements for restoration and advancing reconstruction.

Appendix 2: Recent history in the Portoviejo River Estuary (Source: FIDES 2017b)

Year/Events	Effect	Community actions
1938: Creation of the Commune	Organizational Structure.	Eviction of invaders.
1956: Invasion of Chonera to las Gilces	Mangrove cutting.	Organizations.
1959–1975: Governmental administration of the salt	Labor shortage.	Contraband of salt.
1960: Construction of shrimp farms Construction of the port of Manta	Loss of mangroves and environmental damage Loss of the beach area.	Resistance of the inhabitants. Adaptation.
1980: Tsunami	Loss of houses and salt-production areas.	Adaptation and reconstruction.
1981–1982: El Niño phenomenon	Destruction of roads, houses and agricultural areas, floodgates.	Adaptation and reconstruction.
1995–1998: Commencement of work with OFIS Creation of C-CONDEM	Commencement of community work. Mangrove defense.	Reforestation, shells recovery, commencement of community-based tourism. Mangrove Diagnostic Ecosystem.
2010: Creation of community-based Committee	Creation of Commonwealth (5 communes).	Community-based Organizational Structure.
2011: Declaration of community-protected areas	Major union of communities.	Self-declaration of community-protected areas of the estuary of the Portoviejo River.
2012–2015: Commencement of Operational Phase 5 of PPD/PNUD	Creation of bio corridor.	Reforestation, community-based tourism, touristic structure, blue crab recovery.
2016: Earthquake in Manabí	Destruction of roads, houses, livelihood, floodwater.	Organizational reconstruction, recruitment of humanitarian aid, reconstruction process and revival of livelihoods.

Appendix 3: Recent history in the Bálsamo Mountain Range (Source: FIDES 2017b)

Year/Events	Effect	Community actions
1982–1983: The phenomenon of El Niño	Destruction of infrastructure in private reserves, Rise of seas. Rain, floods. Proliferation of shrimp nets.	Reforestation Educative program.
1998–1999: The phenomenon of El Niño	Destruction of the trail system. Public, landslide, White patch.	Eco-city/ sustainable. Reforestation programs. NGOs. Recycle/mitigation programs. Eco-city Bay. Forest network of the private reserves.
2010–2012: Poorly directed projects with the support of Senagua	Loss of the project.	Global Student Embassy (GSE) appears. The beginning of the El Balsamo junction Conservation of private reserves, Programs for regeneration and forests, and recreation. FIDES.
2016: Earthquake		Reconstruction

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Chapter 7

Conservation on private lands integrating sustainable production and biodiversity in the Mid Dagua River Basin, Colombia

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Abstract

The main problem in the Mid Dagua River Basin (MDRB) is the loss of natural cover and ecosystem services associated with the Dagua River, due to agricultural expansion, planting of clean crops such as pineapple, and ranching. Data collected since 2013 indicate the relevance of the ecosystem services offered by the MDRB to economic development in the region and human well-being; however, lack of financial resources has inhibited conservation actions in these agricultural landscapes. In response to this problem, Corporación Ambiental y Forestal del Pacifico (CORFOPAL) have worked with the community of the MDRB, with the objective of linking nature conservation to the enhancement of human well-being, by developing a participatory process of intervention favouring the improvement of the environment, sustainable production and the promotion of private conservation. Thus, this case study presents a summary of the conservation actions implemented in the MDRB, as well as the participatory management associated with the conversion of private land into natural reserves of civil society (NRCS) as a strategy to guarantee the sustainable conservation of natural resources. The NRCS is a voluntary process whereby the owner of a private farm linked to conservation processes turns his or her property into a Protected Area (recognized by the Colombian government), but keeps the land titles and private property rights. The registration process is accompanied by training workshops and incentives to maintain natural areas, giving us the opportunity to work directly with producers (farmers, ranchers, and others) and landowners to integrate conservation and production on the same piece of land. As a result, we have registered 13 NRCS and signed 20 conservation agreements with private landowners, hence establishing a corridor that connects the territory in several aspects, links private landowners with protected areas, and contributes to the conservation of the biodiversity reported for the region (261 species of flora, 102 species of resident birds, 26 species of amphibians and reptiles and 27 species of mammals). In addition, there has been an improvement in community participation in conservation and environmentally-friendly activities. Overall, inhabitants have become more aware of the importance of conservation and more committed to sustainable production practices, which ought to help them be more independent and have better opportunities in a growing green market.

Keywords: Protected areas, conservation strategies, natural reserves of civil society, community participation and private landowners

Country	Colombia
Province	Valle del Cauca
District	Middle Dagua river basin
Size of geographical area	57.220 hectares
Number of indirect beneficiaries	15000 persons

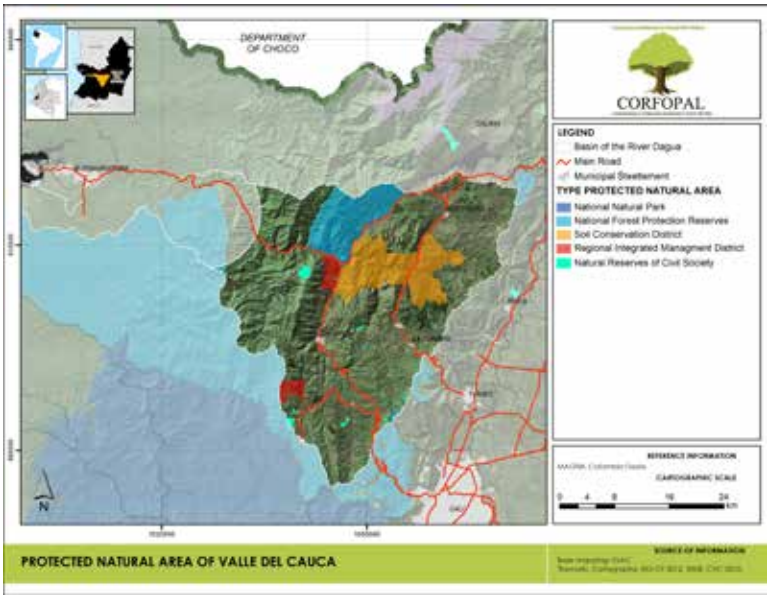

Figure 1. Map of the country and case study region. General location of Dagua River Basin and its protected areas.

Size of case study/project area	4500 hectares
Number of direct beneficiaries	280 persons
Geographic coordinate (longitude and latitude)	3º 20' a 3º 53' N y 76º 22' a 77º 05'W
Dominant population	Farmers

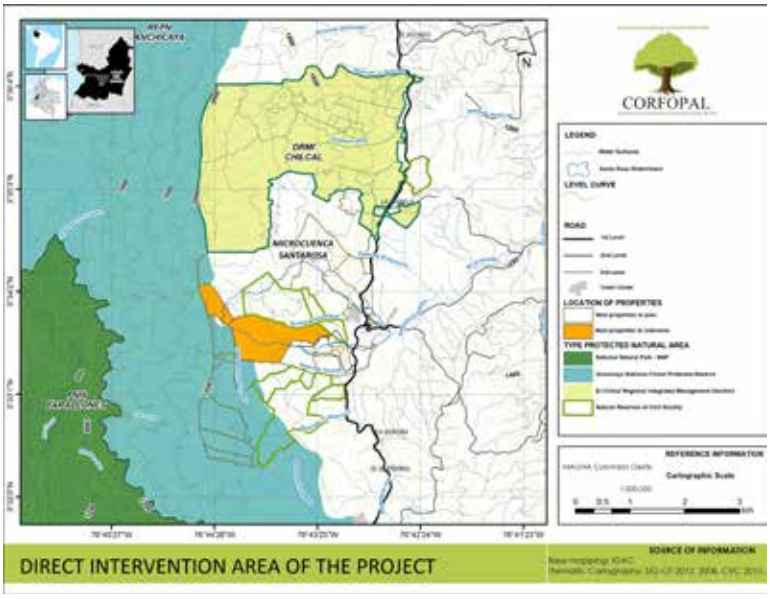

Figure 2. Land use and land cover map of case study site.

1. Introduction

The processes of appropriation and transformation of natural resources through human development to satisfy development needs and desires (Toledo 2008) has generated the gradual depletion of ecosystem services, reaching the upper limits of the load capacity of the planet (Vásquez & Serrano 2009). The forms of intrusion into ecosystems and subsequent environmental degradation have varied over time and have been influenced by cultural systems, social organization and economic bases, as well as by variables of the environment, such as biotic and abiotic factors and their complex relationships.

The conversion of forest areas into pastures, farming areas or urban centers is a worldwide problem that is intensifying due to the exponential growth of the human population and the consumerism in which today's society lives (Ehrlich & Ehrlich 2002), resulting in the simplification of ecosystems (Kareiva & Marvier 2011). This alteration of ecosystems and loss of vegetation cover has implications on the landscape and the natural dynamic equilibrium (Roda et al. 2003; ed. Rangel 2004), ecosystem services (Kareiva & Marvier 2011), local and global extinction of flora and fauna species (Turner 1996; Kattan 2002; Kattan & Murcia 2003) and total or partial loss of lifestyles and functional ecology of communities (Angelsen et al. 2011).

Concern over these problems seems to be a recurrent phenomenon in societies throughout history, as suggested by the emergence of independent control practices and responses to this problem on different continents (Meffe et al. 1997). These practices have, in most cases, translated into public and/or private spaces created for the maintenance of biodiversity for in situ conservation of ecosystems and natural habitats (Kareiva & Marvier 2011) that are set aside as protected areas.

According to the IUCN's World Commission on Protected Areas, a protected area is "a clearly defined, recognized, dedicated and administered geographical space, through legal or other similarly effective means, to achieve the conservation of nature with its associated ecosystem services and cultural values". In these areas, different actors and their respective plans and priorities that respond to particular objectives and goals (Elbers 2011) converge, generally in a disjointed way. This had led to division among policies and actions, which in many cases has resulted in habitat loss, invasion of territories or abandonment. This is worrying considering that Protected Areas form the central axis in practically all conservation strategies nationally and internationally (Elbers 2011).

In addition, protected areas face a series of external threats, such as climate change, irresponsible tourism, development of infrastructure within and outside them, increasing use and exploitation of natural resources (e.g. mining, logging) and many other threats that challenge conservation (Kareiva & Marvier 2011). In view of the above, it is essential to find a balance between the participation of various actors and those affected by protection actions in protected areas, maintain clear conservation objectives and articulate the issues surrounding the protected areas and the intrinsic needs of the territories where they are located (Maza, Cadena-González & Piguerón 2003; Elbers 2011; Kareiva & Marvier 2011).

The total surface area of terrestrial and oceanic protected areas on the planet has increased. According to the release of the World Database on Protected Areas (WDPA 2018), the total number of protected areas as of June 2018 was 234,793. This increase was made possible thanks to Target 11 of the Aichi Biodiversity Targets, which aims by 2020 for at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas to be conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas. Despite this fact, many areas of critical importance to the conservation of biological diversity and ecosystem services are outside this system of protected areas (Elbers 2011). In addition, there are fewer public areas to declare new protected areas; therefore, it is essential to consider other strategies for conservation on private lands.

According to González and Martin (2007), there are various tools for conservation on private lands. The most commonly employed are the creation of private reserves, conservation easements, lease contracts, loan agreements, conservation and usufructs, conservation trusts and purchase of land for conservation. The selection of tools depends on various factors: i) existence of necessary regulations; ii) recognition or lack thereof by the state; iii) economic compensation; and iv) use and times of restriction on the land, among others. Whatever the tool used, there must be a monitoring of compliance with the agreed restrictions on the property (González & Martin 2007).

There are three types of private reserves: i) private natural reserves, which are in fact private farms on which the owners willingly conserve some or all of the natural resources present on the property. This type does not require any procedures or regulations, which is an advantage, and does not have any kind of recognition by the government. Their main disadvantage is that they are not appropriate for long-term conservation because they are totally dependent on the owner's will. Next, there are ii) private nature reserves recognized by the government, which are private farms with voluntary conservation purposes similar to the private nature reserves, but officially recognized by the government. The advantage of this type of reserve is that

it is appropriate for medium and long-term conservation planning; however, the disadvantage is the cost and time required for establishment. Lastly, there are iii) private natural reserves recognized by NGOs, which have advantages and disadvantages similar to the reserves recognized by the government. In some countries, NGOs have programs or networks through which interested owners or farmers obtain recognition of their farms as private natural reserves (González & Martin 2007).

Colombia was the first country in Latin America to achieve recognition of the Natural Reserves of Civil Society within its management categories, recognized in the National System of Protected Areas (SINAP). Furthermore, to accomplish the objective of conservation of biodiversity and ecosystem services, these private initiatives act as connectors between other protected areas, buffer areas for anthropogenic impacts, and contribute to increasing knowledge on the territories and building the social fabric to strengthen community self-management processes for conservation (Ocampo-Peñuela 2010).

The main objective of the case study described herein is to present a summary of the conservation actions implemented in the MDRB, where nature conservation was linked to the improvement of human well-being by developing a participatory process of intervention in favour of improvement of the environment, sustainable production and the promotion of private conservation. Likewise, the participatory management associated with the conversion of private farms or land into natural reserves of civil society (NRCS) is shown as a strategy to guarantee the sustainability of natural resources.

2. Description of the Dagua River basin region

The Dagua River Basin (DRB) is located to the west of the department of Valle del Cauca in south-western Colombia (3°32′0″ N, 76°45′27″ W; 3°36′4″ N, 76°45′27″ W; 3°32′0″ N 76°41′23″ W; and 3°36′4″ N, 76°41′23″ W) (see Fig. 1), with approximately 140,121 hectares, of which 57,220 hectares corresponds to the municipality of Dagua (40.83% of the total area of the basin) (CVC 2003). The Dagua, the main tributary of the area, drains into the Pacific Ocean and presents an equilateral triangle shape.

The basin is divided physio-graphically into the Upper and Lower Part, regions well differentiated by their biophysical and socio-economic characteristics. The upper part has an area of 86,351 hectares, equivalent to 62% of the total area, distributed in eight sub-basins and five micro-basins. It corresponds to the lower part with an area of 53,771 hectares, equivalent to 38% of the total area, distributed in twelve sub-basins and one micro-basin. The middle zone of the Dagua River Basin comprises the confluence of the Bitaco, Grande and Sabaletas rivers to the east and the foothills of the Western Cordillera to the west (Vargas 1998).

There is currently a network of protected areas in the region: Farallones de Cali National Natural Park (NNP, the highest category of conservation in Colombia), three National Forest Protection Reserves (Anchicayá, San Cipriano and Dagua), two Integrated Regional Management Districts (IRMD—Chilcal and Atuncela) and the District of Soil Conservation of the Rio Grande (see Fig. 3 and 4). Currently, these conservation units work as isolated islands under different (and ineffective) management schemes, besides being highly populated and transformed. The strengthening of

Figure 3. Conservation Area La Española Watershed in IRMD Chilcal (Photo: Sebastian Orjuela)

Figure 4. Productive Landscape of Chilcal Village (Photo: Sebastian Orjuela)

biodiversity conservation is needed in the region, especially for the three different ecosystems of great importance: the tropical rainforest (henceforth TRF), tropical dry forest (henceforth TDF), and sub-xerophytic forest located in the Dagua river canyon. The TDF and sub-xerophytic forests are among the most threatened ecosystems in Colombia, designated with a critical status (WWF 2013; eds. Pizano & García 2014).

1.1 Socio-economic characteristics of the area

The main human settlements in the area are the Dagua municipality and its surrounding villages. Dagua is located at 828 m above sea level and has an average temperature of 25°C. It is characterized by abundant summits, where the three ecosystems named above merge and give place to the many basins and micro-basins of the region. The Dagua municipality has 923 km^2 of surface area and more than 36,000 inhabitants. According to the Territorial Order Basic Plan and the Municipal Educational Plan of 2008-2011, about 35.3% of the population is in a poverty situation, and the unemployment rate is 20%.

The main productive activities in the region are agriculture, cattle raising, poultry farming, pisciculture, mining, and tourism. These activities are benefited by the diversity of climates present in the wider region. In the case of Dagua, the main economic activity is agriculture, especially pineapple farming that presents a high production and quality. Other crops are tomato, cacao, banana, coffee, papaya and citrus fruit. Due to the various historical processes of settlement and land use, today this area has landscapes with a dynamic mosaic of habitats and land uses that includes villages, farmlands, forests, grasslands and private recreational farms. The landscape has been shaped over the years as a result of the interactions between people and nature in ways such that the high biodiversity present in natural relicts provides the inhabitants of the region with the ecosystem services necessary for their well-being. Therefore, we consider the MDRB to be representative of socio-ecological production landscapes and seascapes (SEPLS) (UNU-IAS, Bioversity International, IGES & UNDP 2014), which have been demonstrated as sustainable landscapes with cultural and natural heritage, that can be managed for conservation.

The threats

The main threats and pressures that ecosystems and biodiversity in general face in the MDRB region are landscape transformation and fragmentation and loss of natural cover and ecological structure. These pressures have led to habitat deterioration for the local biodiversity, as well as to the isolation of populations, the demotion of soils (leading to erosive processes), and hence the alteration of hydric regulation processes. All of this is related directly to the changes in land use that have led to permanent deforestation.

The main driver of these changes in land use is the expansion of the agricultural frontier that has led to the cutting of natural forest to establish crops or pastures to feed livestock. There is also the selective logging of timber species, due to the high demand of timber. The transformation of forest into pastures has increased soil erosion, especially in areas close to the MDRB. There are reports of deep canyons with reddish and compact soil, which are partially a result of extensive livestock keeping.

The hydric systems also suffer from these pressures, facing a decline in water quality, decrease of water flow, and loss of protective plant cover. This decline has led to habitat deterioration and alteration of hydric regulation processes. Likewise, water quality has been affected by the use of chemical pesticides and agrochemicals, inadequate disposal of solid residues, and livestock keeping. There is also mining for artisanal clay in the areas of wet forest, an activity that contaminates hydric sources with the leachate.

3. Description of activities

Data collected since 2013 indicate the relevance of the ecosystem services offered by the MDRB to the agricultural processes in the region and human well-being (CORFOPAL 2013); however, a lack of financial resources inhibits conservation actions in this agricultural landscape. In response to this problem, we have worked with the MDRB community, with the objective of linking nature conservation with the improvement of human well-being, by developing a participatory process of intervention in favour of the improvement of environmental, sustainable agricultural production and the promotion of private conservation with the establishment of Natural Reserves of Civil Society (see Fig. 2).

1.1 Natural Reserves of Civil Society (NRCS)

The Natural Reserves of Civil Society is an initiative for the conservation of biodiversity and natural resources on private property. The NRCS is the only legal privately protected area in Colombia and is part of the National System of Protected Areas (SINAP). In order to have a property registered as an NRCS, it must comply with legal and other technical requirements. In the legal framework, the property must guarantee the real and effective possession of the real property by public deed and certificate of tradition. For the technical component, the property must conserve a representative sample of the natural ecosystem and

manage the use of natural resources under the principles of sustainability, excluding industrial exploitation of timber and allowing only sustainable exploitation of wood for domestic use.

Once technical and legal feasibility have been verified, a series of steps must be completed to carry out the registration, ranging from filling in the registration form, reviewing the legal documentation of the property, and development of the zoning map of the farm, to the filing of the documentation before the national natural park unit of Colombia. Depending on the volume of requests, this process can take between four to six months.

For those cases in which the property does not meet the legal and/or technical requirements, a conservation agreement is signed. This agreement is a voluntary understanding between the owners and an NGO, where the owners commit to conserve the forests on their farm and to maintain sustainable production practices in exchange for the technical accompaniment and the implementation on their farms of conservation actions (e.g. fences for conservation, forest enrichment, silvopastoral systems and irrigation for pastures) by the NGO.

Among the benefits of registering as an NRCS are: rights of participation in the planning processes of development programs; prior consent for the execution of public investments that affect them; the right to conservation incentives that are managed through programs and projects; and other participation rights established by the law.

3.2 Property planning and agreement with owners

Once the NRCS has been established or the conservation agreement signed, a basic biophysical and socio-economic descriptive diagnosis is made, with emphasis on economic activities, family needs, and the technical requirements of land use and sustainability for the current state of biodiversity. Subsequently, a zoning of the property, agreed upon with the owners, is made using the base cartography of the area. The areas to be conserved and restored are defined, along with the landscape management tools and productive systems to be implemented, according to the potential land use and planning instruments that contribute to habitat improvement and conservation. With this information, the management plan and the monitoring system are established.

3.3 Training workshops and awareness campaigns

The local community in the MDRB has inhabited the region for several generations, which has led to a body of traditional knowledge linked to the cultural heritage of the people. We must recognize that these communities keep a repertoire of ecological knowledge that usually is local, collective, diachronic and holistic. This is the result of the close relationship these farmers have with nature and the way they have used and profited from it, which has allowed the development of cognitive systems on their own resources that are passed down from generation to generation orally. This knowledge has been lost due to the invasion of new technologies, the use of chemicals and the little interest that young people have in traditional farm work.

In this sense, as part of the participatory process of intervention through workshops and awareness campaigns, we sought to recover this knowledge and start employing it again, because these traditions are usually associated with the diversified and rational use of natural resources in agricultural production, which gives it resilience to future environmental changes. Because activities on the farms are heavily linked to and sometimes determined by gender, the seminars targeted each gender and their associated tasks in the process of counterclaim, restoration and conservation, as well as in the search of more environmentally-friendly economic activities. Consequently, capacities were built in the community and among other local actors in the areas of responsible consumption and production and the importance of sustainable of ecosystem services, as well as in the conservation of biodiversity and actions that minimize and avoid its loss.

4. Results

CORFOPAL have registered 13 NRCS and signed 20 conservation agreements with private owners (Table 1), achieving a corridor of 638.9 ha that links private owners with protected areas and contributes to the conservation of the high biodiversity reported in the region (261 species of flora, 102 species of resident birds, 26 species of amphibians and reptiles and 27 species of mammals). Moreover, participation by the community in conservation activities and respect for the environment have improved. People living in the area (reserve owners or not) are more aware and committed to sustainable production practices, enabling them to be more independent and have better opportunities in the ever-growing green market. The actions carried out on these farms correspond to the implementation of landscape management tools for conservation purposes and the reconversion of productive systems through sustainable technologies seeking environmental sustainability without diminishing the economic income of the landowners.

Table 1. List of the Natural Reserves of Civil Society (NRCS) established and conservation actions.

NRCS	Total Area (ha)	In Conservation (ha)	In Sustainable use (ha)	In Intensive use (ha)	Activities Performed				
					Fences for conservation (km)	Nurseries for Natural Forest	Forest enrichment (ha)	Silvo-pastoral systems (ha)	Agroforestry systems (ha)
El Carare I	8.8	3.89	4.94	0	1.9	1	2	4	
El Carare II	12.74	2.94	9.75	0	1.2		2	3	2
Esparta	23	5.2	16.99	1.16	1.5		2	5	2
Jurasico	24.96	22.06	2.32	1.26	2	1	2		2
La Magdalena	135	55.23	72.42	4.49			2	15	
Los Volcanes	14	9.73	4.59	0.22			2		
Masada	7.5	1.6	4.47	1		1	2	2	1
La Esperanza	20.85	4.89	13.98	1.98			2	1.4	
Mapul	6.6	2.9	2.6	1.03			1		
Canaan	66.6	46.9	19.25	0	1.5		3	6	
San Antonio	48.98	32	15.98	1	2	1	2		2
Dinaboy	213	171	31	2			2		
Tierra blanca	34.4	12	30	2.4		1	1		
Conservation agreements	22.5	12.5	10	0					
Total	**638.9**	**382.84**	**238.29**	**16.54**	**10.1**	**5**	**25**	**36.4**	**9**

1.1 Activities for sustainable production and conservation of biodiversity and ecosystem services

4.1.1 Fences for conservation

Protective isolation is a very effective landscape management tool to carry out natural regeneration processes, the recovery or maintenance of the natural riparian cover on the properties and to prevent the entry, mainly of livestock, and to allow the natural succession. To date, we have implemented 10.1 km of protective isolation on the margin of streams, protected forest strips and other areas of interest for conservation, resulting in the protection of more than 100 hectares of natural areas. Each kilometer of insulation was made with posts buried at 40 cm located every 2.5 meters, also taking advantage of trees as live poles, and with three wires of 12.5-gauge barbed wire, leaving an average minimum height above the ground of 1.60 m, to ensure the durability and effectiveness of the fence.

4.1.2 Nurseries for natural forest material production

Five trees nurseries have been constructed in order to produce plant materials required in the implementation of landscape management tools, as defined in the framework of the process. The planting materials are used for enrichment actions in areas with natural coverage in the MDRB. Among the actions carried out in the nursery were the necessary adaptations to function as a nursery, including adapting a structure for high tables upon which the available material could be easily and comfortably handled. In the nurseries, bio-fertilizers, humus and compost are also produced. For the humus, beds were built with an approximate area of 64 m^2, in which there is California red worm cultivation in constant production. For composting, three spaces were determined for cutting material, cow dung and nutritious broths. So far, 900 m^3 of earthworm humus and 1,000 m^3 of compost manure have been harvested. Organic matter is contributed both to the nursery production and in planting of plant material, both in the areas of enrichment and in the sowing carried out around the mixed fences.

4.1.3 Forest enrichment

With this landscape management tool, a total of 25 ha was planted with more than 3,000 trees. It is important to note that for this enrichment, planting was undertaken using native and timber species mostly produced in the nurseries implemented in the farms. The goal of this activity was to enrich the natural coverage that protects the streams in the reserves and accelerate the process of natural recovery of degraded areas, in order to restore the riverbank forest with the presence of TDF species, contributing to the preservation of the soil, retention of sediments, creation of food to the fauna present in the area and provision of ecosystem services.

4.1.4 Silvopastoral systems and irrigation for pastures

The main economic activity in the area has always been extensive livestock keeping. It was decided with the owners not to change this productive activity, but to improve upon it to make it more efficient and profitable. This, in turn, would allow us to carry out conservation processes to maintain not only the natural resources of the area, but also the quality of livestock kept. Therefore, the process of livestock reconversion with a silvopastoral system was carried out**,** divided with mixed fences and improvement of pastures, to allow degraded areas to recover and to preserve the existing forest relicts.

In an area of 36.4 ha, seven silvopastoral systems have been established. Additionally, three km of new mixed fences were implemented as divisions for the adaptation and improvement of 1.43 km with the same technical characteristics of the protective isolations, using native species such as Chagualo (*Clusia multiflora*) and Cucharo (*Myrsine guianensis*), associated with forage species, including mainly Nacedero (*Trichanthera gigantea*), and also mulberry (*Morus alba*) and Matarratón (*Gliricidia sepium*), to contribute to conservation and connectivity. With the implementation of an irrigation system, more efficient water management was achieved, avoiding waste and maintaining quality throughout the supply process in silvopastoral and other improvements and interventions made.

4.1.5 Agroforestry systems

Agroforestry systems consist of associating trees with established crops, which improves the development of plantings especially in dry or hillside areas, hence generating benefits such as the reduction of damage caused by wind and water (erosion) and maintenance of humidity in the soil that supports the growth of crops during drought. Furthermore, agroforestry improves the soil's physical conditions, especially the structure, among many other benefits. In this process, nine hectares of agroforestry systems were implemented on five farms, whereby 375 forest trees and 125 fruit trees associated with medicinal species, such as Citronella (*Citronella silvatica*) and Calendula (*Calendula officinalis*), were planted. The planting was undertaken using humus produced in earthworm nurseries as input of organic matter.

5. Lessons learned and conclusion

The presence of public protected areas and private conservation initiatives are an adequate strategy, but not enough to support landscapes and conservation initiatives. For greater effectiveness of interventions under a territorial approach, it is essential to consider the different forms of land ownership in the target areas, and to find a balance between the needs of people and of the protected areas. Hence, the success and sustainability of conservation actions are closely related to the potential for establishing consistent and lasting points of contact with the various actors involved, based on a better understanding of their perceptions, knowledge and the rationality that guides their practices and decisions. Likewise, it is important to establish participatory strategies with the community in order to build management initiatives.

The support to private conservation initiatives in critical places within the basin has strategically served to strengthen the protection of the entire territory and improve the quality of life of its inhabitants. For example, the Santa Rosa micro-watershed, which supplies water to two aqueducts and more than 800 families, has improved water quantity and quality after the establishment and subsequent management of the Carare I and Carare II NRCS (see Fig.5 and 6). Consequently, private conservation initiatives, recognized or not by the government, can be very useful to consolidate or generate strategic corridors within the landscapes of the DRB and can serve as connectors of protected area networks.

The landscape management actions should be monitored periodically, involving stronger social processes that allow the implemented actions to have continuity, especially when committed community members are involved. In this way, the community and their leaders would be aware of the achievements obtained and could therefore replicate the results.

The implementation of landscape management tools in the area of direct influence of the MDRB will in the short and medium term generate a dynamic of connectivity and increase the necessary conditions for biodiversity conservation in the dry forest and provision of ecosystem services. In addition, the implemented silvopastoral systems in pasture land areas will allow better management of the livestock, while the consolidation of liberated areas of forest will contribute significantly to the main ecological structure of the territory.

The restoration processes require the establishment of a monitoring scheme for the actions involved at every successional stage to cut the costs of interventions. The restoration should be considered a research process that allows knowledge to be applied to tropical dry forest restoration processes and not be an isolated initiative.

The agreements made with the landowners were only possible insofar as a constant accompaniment is carried out, where the exchange of knowledge and feedback are

Figure 5. Santa Rosa Watershed_San Jose del Salado (Photo: Sebastian Orjuela)

Figure 6. Panoramic view of San Jose del Salado from RNSC Carare (Photo: Sebastian Orjuela)

the basis for achieving the implementation of actions that reconcile the different dynamics of the property and its natural environment in favour of the conservation of ecosystem services and biodiversity.

There is great diversity of experience in the management of the NRCS, in different social, political, cultural and economic contexts in the MDRB. This allows us to deduce that it is essential to integrate public and private actors to conserve territories with fragmented but strategic ecosystems, a high percentage of which are vulnerable and in private hands.

It is imperative to involve new generations in the territory, including the school community and new inhabitants that are usually disregarded due to their lack of in depth knowledge on the conditions of the environment or because they are traveling in the territory (tourists). This involvement is important because the new generations are not interested in the field, and they do not understand the importance of conservation of the ecosystems and the traditional knowledge associated with them.

Finally, participation is milestone in this type of process. Thus, individuals, academia and civil society in general must actively participate and contribute to the formation and development of the national system of protected areas, in the exercise of their rights and in compliance with their constitutional duties.

1.1 Natural Reserves of Civil Society (NRCS) contribution to the Aichi Target 11

The Natural Reserves of Civil Society complement state conservation efforts and provide an important alternative in community work and the formation of conservation nodes on private lands that favour participation in state decisions. They also facilitate monitoring actions in public areas and become strategic actors of conservation actions in the region, especially when the conservation needs are on private lands. They are protected areas of the national order; therefore, they add to the achievement of conservation goals of the state, contributing significantly to Aichi Target 11. The last report of the National Registry of Protected Areas for Colombia (RUNAP 2018) of July 2018, indicates that there are 654 NRCS in Colombia, totalling 116,317.76 ha in 25 of the 32 departments, which corresponds to 0.7% of the total protected areas in the country. It is a conservation figure that does not exist in other countries; therefore, NRCS tend to be presumed to be Other Effective Area-based Conservation Measures, or OECMs. However, the NRCS are classified according to the IUCN as category VI, "protected areas with managed resources". The NRCS could be the best managed protected areas in the country. Where many of Colombia's ecosystems are being radically transformed, one way to prevail is for communities or families to participate individually to restore and conserve ecosystems from their private lands.

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Chapter 8

Sustainable use of biodiversity in socio-ecological production landscapes and seascapes (SEPLS) and its contribution to effective area-based conservation: The case of *Kaya* forests on the Kenyan Coast

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Abstract

The *Kaya* forests, located in Kenya's coastal landscape, are sacred forests of the Mijikenda community. These forests are peculiar multi-functional socio-ecological production landscapes that are rich in biodiversity. More than half of Kenya's rare plants are found on the coast, many of which are found in these sacred forests. Due to the rich diversity of flora and fauna, the *Kaya* forests provide an array of ecosystem goods and services which support human well-being and livelihood systems. Consequently, a study was conducted in Kilifi and Kwale counties on the Kenyan Coast, mainly inhabited by the Mijikenda community, to determine how sustainable use of biodiversity in the *Kaya* forests contributes to effective area-based conservation of biodiversity. A mixed-methods approach was used involving both qualitative and quantitative surveys. Representatives of 375 households drawn from 31 villages were interviewed using semi-structured questionnaires. Thirty-one Focus Group Discussions (FGDs), one in each village, were also held with key informants (herbalists, rainmakers, *Kaya* elders and experienced indigenous farmers) who are the main custodians of indigenous knowledge. The results showed that the Mijikenda community ensures sustainable use of biodiversity through domestication of wild foods and medicinal plants. Additionally, the solid cultural values and traditional resource governance system (*Kaya* elders' council) that connects the community were important for sustaining traditional knowledge and biodiversity, and promoting collective activities that enhance information exchange, sharing of ideas and networking. These collective activities likewise reinforce the cultural values of solidarity, collectiveness and harmony that promote integrated landscape management, and hence lead to effective area-based conservation of biodiversity. These integrated and holistic management approaches of the *Kaya* forests, if sustained, could in the long-term ensure that these sacred forests are well-connected and integrated into the broader landscape, hence sustainably conserving biodiversity while providing ecosystem services that support local livelihoods.

Keywords: Biodiversity; Kaya forests; Landscape; Management; Mijikenda community

Country	Kenya
Province/Region	Coast
District/County	Kilifi
Size of geographical area	1,224,600 hectares
Number of indirect beneficiaries	128,459 persons
Dominant ethnicity	Mijikenda

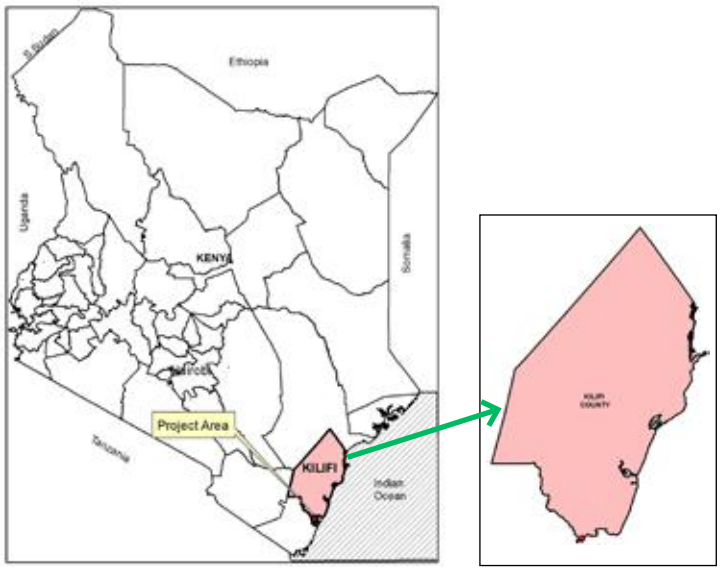

Figure 1. Map of the country and case study region. Map of Kenya showing the location of Kilifi County, Kenyan Coast (Source: GIS and Remote Sensing Department, KEFRI)

Size of case study/project area	580 hectares
Number of direct beneficiaries	10,000 persons
Geographic coordinate (longitude and latitude)	S 03° 55′ 55″ E 39° 35′ 46″
Dominant ethnicity	Mijikenda

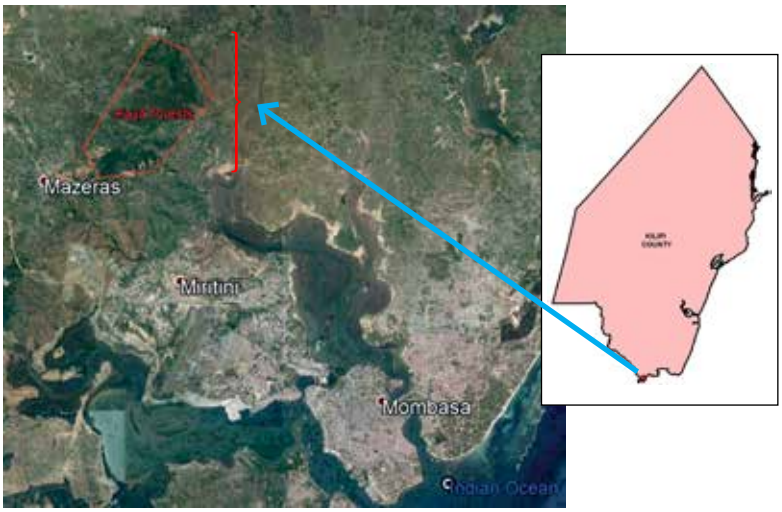

Figure 2. Land use and land cover map of case study site. Location of Kaya forests in Kilifi County, Kenyan Coast (Source: GIS and Remote Sensing Department, KEFRI)

1. Introduction

Kenya is divided into eight regions, namely, Central, Coast, Eastern, Nairobi, North Eastern, Nyanza, Rift Valley and Western. The Coast region stretches about 150 km inland from the seafront covering an area of 67,500 km^2, approximately 11.5% of the total area of Kenya (Ongoma & Onyango 2014). There are six counties in the Coast region: Kilifi, Kwale, Mombasa, Lamu, Tana River and Taita Taveta, with a combined population of 3,325,307 (Republic of Kenya 2009). The Coast region supports about 8.6% of the national population. The population increased significantly from 1.83 million in 1989 to 3.33 million in 2009, an average increase of 4.1% annually (Republic of Kenya 2007; 2009). The Kenya Coast is endowed with a variety of resources that support livelihoods and economic development in the region and Kenya as a whole, in addition to maintaining the health and function of marine and coastal ecosystems (Ongoma & Onyango 2014). The resources include coral reefs, mangroves, lowland and *Kaya* forests, Afromontane forests and historical sites which provide the foundation for the region's economy. Natural forests in the Coast region cover about 8.4% of the total land area (KEFRI 2016).

Despite being rich in natural resources, the coastal region is still characterized by high levels of poverty, where up to 70-80% of residents live below the poverty line (Republic of Kenya 2009; Wekesa et al. 2015). The rural households have limited access to clean water, basic education and healthcare. Moreover, the local population is heavily dependent on the provisions of the natural ecosystem for survival, with agriculture (crop and animal production) being the main source of food and income (Wekesa et al. 2017). Other economic activities undertaken in the region are fishing, tourism, trade, forestry and mining. Lately, the low-lying region has been experiencing frequent droughts, floods and increased incidences of pests and diseases as a result of climate change (IPCC 2001; Wekesa et al. 2017). The impacts of climate change coupled with rapid population growth and overdependence on natural resources by local communities are causing extensive degradation of natural resources leading to loss of biodiversity and low food productivity.

Kaya forests are important multifunctional socio-ecological production landscapes (Wekesa, Ndalilo & Swiderska 2016) that provide both direct and indirect benefits for human well-being. The diverse flora and fauna of the *Kaya* forests and the associated processes support local communities in sectors such as biomass energy, food, shelter, herbal medicine, eco-tourism and agriculture. Moreover, *Kaya* forests provide ecosystem services such as air and water purification, pollination, seed dispersal, climate modification, soil stabilization, drought and flood control, recycling of nutrients and maintenance of healthy habitats. Other important functions of *Kaya* forests include spiritual and aesthetic values, supporting indigenous knowledge systems and education. These forests also act as a source of genetic resources for food, forestry and agriculture. Biodiversity conservation in these sacred forests mitigates the loss of variability of plant genetic resources and hence averts economic slumps in surrounding regions. Conservation and sustainable use of the genetic resources is important to the survival of the local communities and environmental conservation. Local adaptation strategies to climate change are also directly supported by the rich biodiversity of the *Kaya* forests. (Wekesa et al. 2017)

However, *Kaya* forests are undergoing a drastic transformation in the present era of global environmental change. The forests are under extreme pressure from sand harvesting and the extraction of building poles, as well as encroachment on forest areas in search of more fertile land for crop farming and livestock grazing. The effects of climate change have further exacerbated the situation reducing the capacity of these important socio-ecological production landscapes to sustain and improve local livelihoods, conserve biodiversity and adapt and cope with the effects of climate change (see Fig. 3 and 4).

Figure 3. Aerial view of Kaya forest

Figure 4. Degraded site within Kaya forest

An integrated landscape management approach is a prerequisite to ensure the sustainable use of biodiversity in *Kaya* forests for socio-economic development in the coastal region. Integrated and holistic management approaches for *Kaya* forests could ensure that these sacred forests are well-connected and integrated into the broader landscape, hence contributing to area-based conservation of biodiversity while at the same time providing ecosystem services that support local livelihoods. This paper presents findings of a study conducted by SIFOR[1] to determine how sustainable use of biodiversity in *Kaya* forests contributes to effective area-based conservation of biodiversity. The SIFOR project, which was funded by the European Union, aimed at strengthening traditional knowledge-based innovation systems for food security in the face of climate change. The project worked with indigenous and traditional farming communities in remote areas dominated by *Kaya* forests which sustain significant biodiversity and traditional knowledge that contribute to effective area-based conservation of biodiversity in the landscape.

2. Description of the activities

2.1 Study sites and communities

The study was undertaken in Kilifi and Kwale counties mainly inhabited by sub-tribes of the Mijikenda community (see Fig. 1 and 2 for location). The study communities were Giriama, Chonyi and Rabai in Kilifi County, and Digo and Duruma in Kwale County (south of Mombasa towards the Kenya-Tanzania border). They were selected because of their diverse agro-ecosystems, rich traditional knowledge and agrobiodiversity comprising indigenous vegetables and *Kaya* forests. These communities are spread along the Kenyan coastline in wet, semi-arid and dryland agro-ecosystems. Natural resource use and management practices in the five communities are guided by customary rules, centred on the sacred *Kaya* forests culture.

About 71% of people inhabiting Kwale and Kilifi Counties live below the poverty line (Republic of Kenya 2013a; Republic of Kenya 2013b). In Kilifi County, the average annual rainfall varies from 300 mm in the hinterland to 1,300 mm at the coastal belt, while the mean annual temperature is 30-34°C and 21-30°C in these areas respectively (Republic of Kenya 2013a). Kwale County has an average annual rainfall of about 1,200 mm in the coastal belt and 400 mm in the hinterland, and an average temperature of around 24°C in the coastal belt and 26°C in the hinterland (Republic of Kenya 2013b).

2.2 Research methods

A mixed-methods approach involving both qualitative and quantitative surveys was used to explore how sustainable use of biodiversity in *Kaya* forests contributes to the effective area-based conservation of biodiversity. This approach provided breadth and depth of understanding and corroboration, while offsetting the weaknesses inherent in using each approach alone (Creswell & Plano Clark 2007). Additionally, a Participatory Rural Appraisal (PRA) method was employed; key informant interviews were held in each community, using Focus Group Discussions (FGDs) as part of both the qualitative and quantitative surveys. A mixture of open-ended and multi-response questions were asked during both surveys to explore the following key indicators: livelihoods, crop diversity, social capital, climate change, biocultural innovations and innovation factors. The quantitative survey explored them in more depth and entailed both household and community level surveys.

Stratified random sampling was used to select the respondents based on diverse socio-economic activities, adherence to traditional culture, linguistic/dialect differences, development level and proximity to urban areas (villages with varying development levels were selected for comparison) and geographical positioning and distribution in the study area. The number of interviewees chosen was proportionate to the population size for each of the villages. Representatives of 375 households were interviewed. Interviewees included herbalists, rainmakers, *Kaya* elders and indigenous farmers. Likewise, 31 FGDs, one in each village, were held with key informants (herbalists, rainmakers, *Kaya* elders and experienced indigenous farmers) who are the main custodians of indigenous knowledge.

3. Results

3.1 Age and gender profile of the respondents

Many of the respondents were elderly, with roughly half aged 55 and over (see Fig. 5). Overall, 44% of the people interviewed during the survey were women (see Fig. 6). However, women's participation was much lower by about 50% in the Digo community compared to other sub-tribes because the community is largely Muslim, and women's participation in decision-making is often low. Women were only allowed to participate in interviews in the Digo community with the consent of their menfolk, or if no men were present.

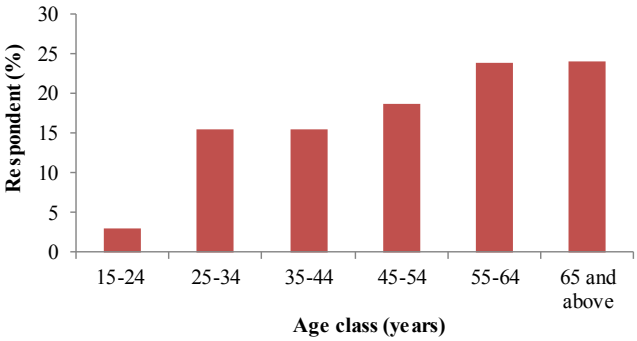

Figure 5. Age class distribution of the respondents (Source: Field survey data, SIFOR Project)

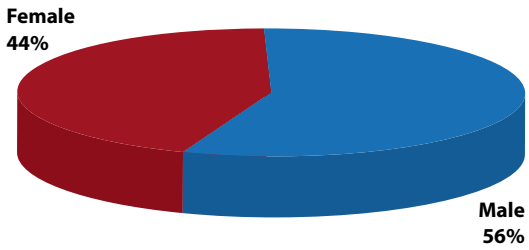

Figure 6. Gender of the interviewees for the survey (Source: Field survey data, SIFOR Project)

3.2 Strategies for sustainable use and conservation of biodiversity

Since 1982 or in the last 30 years, communities have developed and adopted several community-driven strategies based on traditional knowledge to conserve biodiversity and address their economic needs (particularly poverty and the high cost of living). These strategies are mainly technological and social/institutional in nature (see Table 1). Over and above, the most widely adopted conservation strategy to preserve biodiversity in light of changing climatic conditions is diversifying traditional crop varieties by planting different crop varieties in the same season on the same piece of land as an insurance against risks posed by climate change (reported by 42.5% of households), followed by domestication of wild plants for income, medicine and food security (35.3%), reviving of customary laws and practices to preserve traditional values and crop diversity (25.0%), re-introduction of traditional farming methods (23.6%) and planting large areas of resilient traditional crop varieties (21.7%). Thus, diversifying traditional crop varieties as an insurance against risks posed by climate change was the most practiced technological strategy to conserve biodiversity, as well as to enhance the adaptive capacity of the community with regards to the impacts of climate change.

The reviving of customary laws and practices to preserve traditional values and crop diversity was the most embraced social/institutional strategy involving 25.0% of surveyed households. This strategy helps the community to preserve traditional values and conserve diverse crop varieties and wild food and medicinal plants that are important for coping with the impacts of climate change. The diversity in crop varieties, which are mostly drought-tolerant and pest- and disease-resistant, ensures communities' food security despite variability in weather conditions. Wild medicinal plants are used to make herbal remedies to manage crop pests and treat livestock pests whose incidences are increasing due to climate change (10.0%).

Free exchange of seeds among community members through seed and farmers' innovation fairs was another social/institutional strategy applied by the Mijikenda community to conserve biodiversity (17.2%). Community seed banks have been established through the support of the SIFOR project for seed saving and storage to promote seed exchange among community members and improve their access to affordable seeds with desired characteristics like tolerance to drought and resistance to pests and diseases (10.0%). The free seed exchange contributes to the conservation of landraces and enhances community cohesion, contributing to the conservation of biodiversity. The establishment of cultural villages to conserve cultural practices and enhance cohesion was an institutional strategy adopted by 8.5% of the households.

4. Discussion

4.1. Domestication of various wild food and medicinal plants for increased income

Domestication of plants naturally growing in *Kaya* forests is largely driven by the need to diversify community incomes due to massive crop failure, as well as by the increased incidences of crop pests and diseases that necessitate development of bio-pesticides by local communities as local remedies to prevent and manage the pests and diseases. This strategy has also been employed to relieve pressure from *Kaya* forests, hence contributing to the conservation of existing biodiversity. Wild plants such as *Lilium orientale, Tamarindus indica, Ancylobotrys petersiana, Landolphia kirkii* and *Ziziphus mauritiana* have been domesticated for their fruits, which are usually sold for income. These plants can tolerate prolonged dry periods, ensuring farmers have a source of income in case of crop failure. Other wild plants like *Adansonia digitata* are not usually domesticated, but the fruits are sold either raw or after value addition through sweetening. Plants like *Monanthotaxis fornicate*, *Oldfieldia somalensis*, *Fernandoa magnifica*, *Acacia mellifera* and

Table 1. Strategies for enhancing effective area-based conservation of biodiversity developed by the Mijikenda community (Source: Field survey data, SIFOR Project)

Type of strategy	Strategy	Reasons for developing the strategy	Level of adoption (%)
Technological	Planting diversified varieties of the same crop on the same piece of land in a single season	Insurance against risks posed by climate change	42.8
	Domestication of wild food and medicinal plants	Economic benefit, medicinal and food security	35.3
	Re-introduction of traditional farming methods	Conservation farming	23.6
	Planting large areas of resilient traditional crop varieties	Increase production	21.7
	Combination of herbal plants to treat livestock diseases and manage crop pests	Improve livestock and crop productivity	10.0
	Preservation of landraces in communal seed banks	Conserve landraces	10.0
Social/institutional	Revival/preservation of customary laws and practices	Preservation of traditional values, conservation of biodiversity	25.0
	Free seed exchange	Conserve landraces, enhance cohesion	17.2
	Establishment of cultural centers	Conservation of cultural practices, enhance cohesion	8.5

Salvadora persica have been domesticated by herbalists because of their medicinal value.

The East African doum palm (*Hyphaene compressa*), which often grows in riverine areas and has recently become rare in the area following massive deforestation, is also being domesticated for use in weaving and basketry. Local community members undertaking commercial weaving and basketry at the cottage level have domesticated it on-farm as a source of raw materials. The species is also important for construction of traditional Mijikenda houses. This domestication has been taking place for the past 20 years and has provided economic, social and conservation benefits to the community through income generation, provision of cheap roofing materials and by sustaining biodiversity.

The farmers obtain propagation materials from *Kaya* forests and raise the seedlings in their nurseries before planting them on their farms. Initially, the plants lacked propagation protocols due to lack of scientific research on the propagation of such plants. However, the farmers (in groups and individually) have come up with propagation protocols using cuttings, seeds and wildings, after trying several methods following trainings supported by SIFOR project (see Fig. 7). By domesticating the plants, the pressure on the *Kaya* forests and biodiversity was reduced, and these species were conserved. Hence, these efforts contributed to effective area-based conservation of biodiversity in the *Kaya* forests and the associated landscapes.

4.2. Establishment of cultural villages/centres in Kaya forests

Kaya forests face major threats due to rapid socio-economic and cultural changes, coupled with growing human demand for forest products and land for farming due to declining agricultural productivity and farm incomes. As a result, there

Figure 7. Training of Rabai Cultural group on propagation of wild medicinal and food plants

Figure 8. Sacred hut within Kaya forest used by Kaya elders for traditional prayers, rites and rituals

Figure 9. Mijikenda community performing a traditional dance during a cultural festival

has been encroachment into the forests. Thus, the Mijikenda community, through collective action, has established cultural villages adjacent to each of the *Kaya* forests as an alternative source of income and to ensure Mijikenda cultural practices are not lost. The cultural villages provide centralized venues for showcasing Mijikenda cultural ceremonies, rituals and biodiversity conservation-related practices. Traditional huts have been built in the layout of a traditional Mijikenda village, including a traditional spiritual healer's hut, a shrine where evil spells are expelled, a traditional granary, a typical Mijikenda kitchen, as well as an area where traditional crops like cowpeas and sweet potatoes, as well as wild food and medicinal plants, are cultivated (see Fig. 8).

The cultural villages have brought together different community groups involved in traditional dancing and exhibition of cultural practices. They have enabled the community to diversify and increase its income sources through cultural tourism. Several traditional dances of Mijikenda sub-tribes are performed in the villages. This has made the cultural villages attractive places to visit for both local and international tourists (see Fig. 9 and 10). The villages have also allowed the community to network by exchanging planting materials of traditional food crops and wild crop relatives. The cultural villages have largely been promoted through cultural festivals coordinated by the *Kaya* council of elders as part of the preservation of Mijikenda culture.

The cultural villages are part of the social/institutional strategy developed to enhance community cohesion, generate income and conserve the rich biodiversity in the *Kaya* forests. Pregnant women, men and women who have engaged in sexual intercourse the previous night, menstruating women and young babies of less than six months are usually not allowed to enter *Kaya* forests. The establishment of cultural villages has made it possible for the local people, particularly pregnant women, and men and women who have engaged in sexual intercourse the previous night, menstruating women and babies less than six months old, to access services like healing, fore-telling and removal of spells, all of which would, otherwise, be done inside the *Kaya* forests. This has ensured that the *Kaya* forests are protected from illegal human activities which could have been associated with cultural practices and traditional ceremonies performed in the forests in the absence of the village.

4.3. Role of culture in biodiversity conservation

The study revealed that the cultural values of solidarity, reciprocity, equilibrium and collectiveness play an important role in binding the Mijikenda community and hence promoting socio-economic development, biodiversity conservation and adaptation to climate change through exchange of ideas. Solidarity was defined as togetherness or unity among people with a common interest, and reciprocity as equal exchange or mutual cooperation between people and nature. Equilibrium was defined as a state of balance between people and nature, while collectiveness was defined as the state of togetherness amongst members of the community.

Biodiversity conservation is deeply entrenched in the cultural values of the Mijikenda community, and the *Kaya* forests play an important role in supporting cultural values and conserving wild species for biocultural innovation (e.g. domestication of medicinal and food plants). Most traditional ceremonies are associated with natural resources, and they play an important role in conserving biodiversity. Traditional prayers and sacrifices are aimed at appeasing the spiritual world, for example, use of grains of landrace varieties such as mustard, millet, sorghum and maize and indigenous animal breeds such as cattle, sheep and chicken. The significance of these varieties in traditional ceremonies has led to their conservation. Most traditional healing ceremonies

Figure 10. Traditional dance by Rabai community during New Year celebrations

Figure 11. Kaya elders in Kaya forest after conducting prayers

use various plant parts from *Kaya* forests. Furthermore, traditional resource governance systems such as the *Kaya* elders' council are used to conserve important plant species and the sacred *Kaya* forests, where the ceremonies usually take place.

Various farming activities in the agricultural calendar are associated with traditional ceremonies. For instance, before planting seeds, *Kaya* elders offer prayers and sacrifices, requesting the spiritual world to bless the seeds and grant the community a bountiful harvest. After harvesting, thanksgiving prayers are also offered. Seeds stored after harvests are often used to perform traditional rituals aimed at averting disasters such as crop failure and animal and human diseases. Traditional knowledge regarding physical coping strategies, agriculture, seed management, weather prediction, oral legends and biodiversity conservation is equally and openly shared amongst members of the community, and is passed from older to younger generations through various methods. These include traditional ceremonies that bring members of the community together, whereby girls are mentored by elderly aunts and grandmothers, and boys by uncles and grandfathers on traditional knowledge and cultural practices that promote conservation of natural resources and associated biodiversity.

4.4. Role of the *Kaya* council of elders in biodiversity conservation

Traditional institutions such as the *Kaya* elders' council are important for sustaining traditional knowledge and biodiversity. The *Kaya* elders' council is fully engaged in governing and managing the *Kaya* forests according to the community's rights, knowledge, capacities and institutions, and the benefits arising from the forests are equitably shared. The traditional governance system by the *Kaya* council of elders has rules and regulations that restrict activities that impact negatively on the *Kaya* forests and associated landscapes (see Fig. 11).

Enforcement of rules is performed mainly through a system of taboos, curses, and other spiritual sanctions that have a powerful effect in the rural communities associated with the *Kaya* forests. Infringement of the usage laws of the council of elders attracts a fine that the miscreant must pay to avoid spiritual retribution (Githitho 2005). Rules to protect the sacred forests include a ban on cutting of live trees, although deadwood may be collected in limited amounts in some sites within the forests for domestic use. The firewood (deadwood) is collected by women who take only as much as they can carry in their arms without using a rope. Grazing of livestock is not allowed, owing to the risk of disturbing ritual symbols hidden in the forest. Livestock straying into the *Kaya* forest risk being seized and slaughtered. Wildlife, including large snakes, is not to be molested, as these animals are believed to represent spirits.

Besides the rules governing the physical and natural environment, there are other rules that protect the spiritual and ritual sanctity of the forests. Sorcery or witchcraft is strictly prohibited in the *Kaya* forests, as it is seen to be a destructive and anti-social activity. Similarly, violence and shedding of blood within the *Kaya* forests is proscribed. Suicides and murder victims cannot be buried in the *Kaya* forests. Some *Kaya* forests have rules on what should be worn when entering the forest during a visit. In certain areas within the forest, only traditional *Kaya* clothing can be worn, including a sarong and a shawl. Although visitors are shown through the *Kaya* forests, cleansing of the site afterwards is performed if the visitors are not members of the Mijikenda group associated with the *Kaya* forests.

These local rules and regulations help to preserve the communities' cultural practices, traditional knowledge and safeguard these sacred forests, hence protecting many

species, most of which are endemic to these particular forests. This promotes conservation of biodiversity in the *Kaya* forests and the associated landscapes, contributing to the effective area-based conservation of biodiversity and Aichi Biodiversity Target 11.

5. Conclusion

Clearly, traditional knowledge and cultural values and practices play an important role in enhancing effective conservation of biodiversity by the Mijikenda community. The five communities have developed a number of strategies to conserve biodiversity—mainly technological and institutional strategies. The most widespread technological strategies to conserve biodiversity were found to be: planting several varieties of the same crop on the same piece of land; domestication of wild foods and medicinal plants; re-introduction of traditional farming methods; and planting large areas of resilient traditional crops that are drought tolerant. The formation of cultural villages has strengthened cultural identity, conserved resilient landraces of crop varieties and native plant species and enhanced income and information exchange among community members. The Mijikenda community has been highly innovative in developing conservation strategies because it has solid cultural values and a traditional resource governance system (*Kaya* elders' council) that connects the community. Traditional institutions such as the *Kaya* elders' councils are important for sustaining traditional knowledge and biodiversity and promoting collective natural resources management. Community groups and cultural ceremonies bring people together, promote information exchange, sharing of ideas and networking, and reinforce cultural values of solidarity, collectiveness and harmony that are critical in promoting effective area-based conservation of biodiversity in the *Kaya* forests at the landscape level.

The ecosystem approach applied by the Mijikenda community in managing the *Kaya* forests and associated landscapes to enhance ecological connectivity and conserve biodiversity should be strengthened to stem the loss of traditional knowledge and biodiversity resources. This could be done by establishing Biocultural Heritage Territories (BCHTs)[2] that can also serve to generate income from tourism. The established cultural villages could provide the basis for establishing a biocultural territory for integrated landscape management. Moreover, capacity building on value addition of nature-based traditional products from *Kaya* forests and connected landscapes should be supported to increase incomes of local communities and create incentives for sustaining biodiversity and traditional knowledge. This would also help to revitalize traditional cultural identity, and engage youth, since it offers a vision of development which embraces both modern and traditional knowledge for maximizing livelihoods.

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[1] Smallholder Innovations for Resilience Project being implemented in Kenya, Peru, China and India.

[2] Land use mosaics encompassing indigenous and traditional land tenure, production and exchange systems, cultural identity, community organization and simultaneous goals of endogenous development and biodiversity conservation.

Chapter 9

Tree microrefugia and community-based conservation in Tropandean mountainscapes: A bio-cultural approach for heritage management of "El Collay" protected forest in Southeastern Ecuador

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Abstract

Geoecological researchers have viewed mountain biodiversity as a response to interactive climate variables (i.e., elevation, temperature, precipitation), while conservation planners have built on this view to develop schemes to satisfy positivist, reductionist frameworks based on indicator species. More recently, montological researchers have incorporated the human dimension to understand how mountain biotas are also determined by ancestral practices of land stewardship. The resulting manufactured landscapes emphasize utility, sacred values, and productivity and are more holistically viewed as socio-ecological systems (SES). We provide examples of this synergy of nature-culture hybridity in the highlands of southeastern Ecuador, in a local assembly of autonomous, decentralized municipalities, comprising the 'El Collay' Commonwealth and its protected forest.

The political process of empowerment mimicking traditional reciprocal work (*ayni*), has operated to benefit commonwealth members who joined for the common purpose (*minga*) of protecting the 'páramo' vegetation and mountain forests in the headwaters of the eastern Andean flank. This area has long been seen as the Amazon gateway, ever since the first Europeans explored the *Marañón* (sea-river) of the South American lowlands. The area, flanked by the *Sangay* National Park, a UNESCO World Natural Heritage Site, the 'Rio Negro-Sopladora' National Park and the *Podocarpus* National Park, in

southeastern Ecuador, is a ripe exemplar of community-based conservation oriented to a sustainable future through respect for agrobiodiversity traditions. An interdisciplinary group of scientists and conservation practitioners are experimenting with new approaches of political ecology and critical biogeography, to add the SES component to the development of management strategies for 'El Collay'. Key strategies include using Payment for Environmental Services and Complex Adaptive Systems methodologies to ensure protection of the existing reserve. Part of the long-term strategy is to extend protection to an adjacent area, thereby creating an ecological corridor for regional conservation of charismatic species, including the Andean bear (*Tremarctus ornatus*), the mountain tapir (*Tapirus pinchaque*), the sparkling violetear (*Colibri coruscans*) and many other bird species unique to the montane cloud forest ecosystem. By looking at paleoecological data on "romerillos" (*Podocarpus oleifolius*) and its correlation with the present distribution of "guabisay" (*Podocarpus sprucei*), we are seeking to synergize understandings of community perceptions and valuations of these species with their capacity to withstand climate change. Areas where both traditional ecological modeling and assessments of future human land-use indicate long-term survival of these flagship species are identified as potential microrefugia in extreme scenarios.

The 'El Collay' biocultural territorial planning initiative aims to provide a secure cultural and financial basis for future biodiversity conservation. Ensuring the cultural revival of indigenous practices and a comprehensive modeling scenario whereby ethnotourism, ecotourism and agrotourism could secure consistent, communitarian revenue flow to help maintain the larger 'El Collay' Protected Forest's long-term refuge condition in an exemplary Socio-Ecological System of the production mountainscape.

Keywords: Microrefugia, Community-based Conservation, *Ayni*, *Minga*, Tropical Andes, El Collay

Country	Ecuador
Province	Azuay and Morona Santiago
District	Chordeleg, el Pan, Gualaceo, Paute, Santiago de Méndez and Sevilla de Oro
Size of geographical area	29.000 hectares
Number of indirect beneficiaries	90.000 persons
Dominant ethnicity	Mestizos

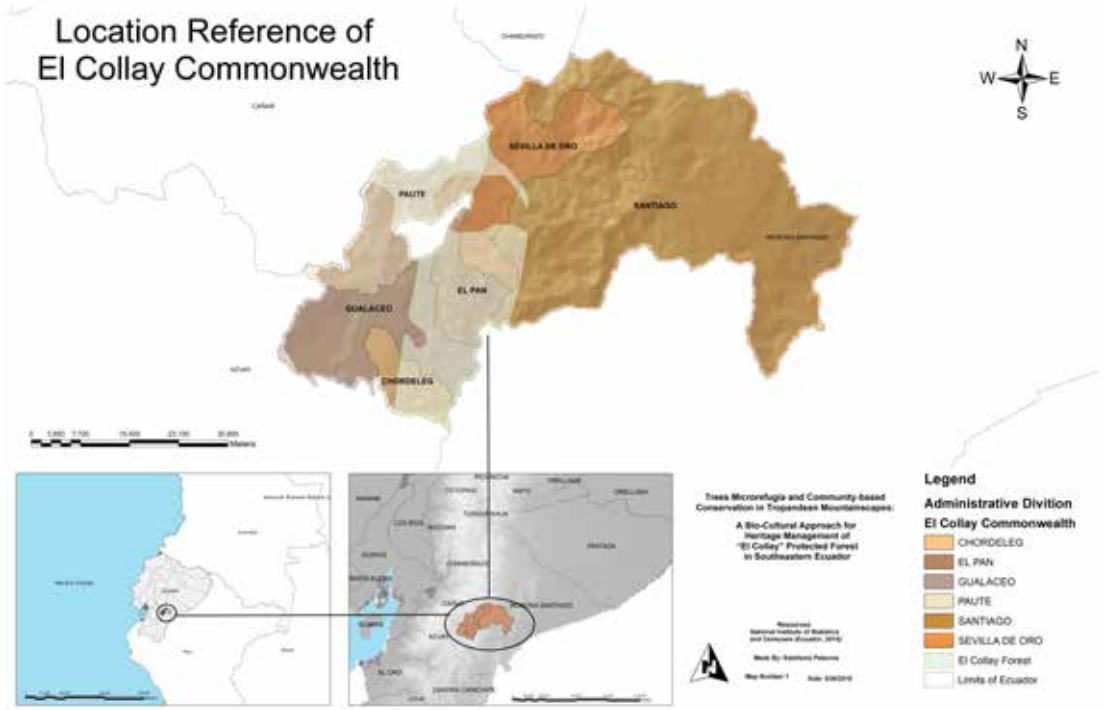

Figure 1. Map of the country and case study region

Size of case study/project area	7.995 hectares
Number of direct beneficiaries	23.000 persons
Geographic coordinate (longitude and latitude)	2°47'32.96"S 78°29'29.14"O
Dominant ethnicity	Mestizos

Figure 2. Land use and land cover map of case study site

1. Introduction

Mountainscapes are excellent laboratories to understand the coupled human-environment dynamics. Habitat heterogeneity and the variety of microclimates along the elevational gradient of the Andean flank showcase plasticity of adaptation to mountain environments (Terborgh 1977; Gentry 1988; Bunkse 1981). Disjunct distributions provide evidence of migrational responses to past and ongoing climate change (Pennington & Dick 2010). Animals and plants adjust their ranges locally or by physiological and genetic variations to respond to new conditions (Cheddadi et al. 2017). Fossil pollen records (Bush, Silman & Urrego 2004; Groot et al. 2011) and modern vegetation surveys (Feeley et al. 2011) provide evidence of the pace of response to climate change on the Andean Amazon flank. Superimposed on this evidence are vegetation responses to anthropogenic change, with modified species composition through grazing and fire (Mosblech, Bush & van Woesik 2011; Borsdorf & Stadel 2015). While we recognize the need to maintain extensive mountain protected areas for the reasons highlighted in the old "single large or several small" (SLOSS) debate of species distribution and heterogeneity (Diamond 1975; Burkey 1989), we argue that the conservation of biodiversity is assured not only by the establishment of single large conservation areas, often connected with ecological or biological corridors, but also by small and very localized Community-Based Conservation (CBC) areas that are kept because of the production of unique ecosystem services or the protection of flagship species as Other Effective Area-based Conservation Measures (OECMs). These small locales are valued by the people who live and work in these tropical Andean Amazonian flanks. The long-term protection of these areas, possibly for reasons only remotely connected to biodiversity conservation *per se*, is key in maintaining microrefugia for endemism, rare habitat types, and genetic polymorphism. As we see with the study of 'El Collay' in Ecuador, these areas often rely on the community buying-in to the ideals of, and sharing from, a well-managed conservation enterprise (Sarmiento et al. 2015) (see Fig. 1 and 2).

1.1 Biocultural heritage as a paradigmatic framework

The Andean crescent supports a conservation hotspot (Myers et al. 2000), and can be subdivided into a number

of biodiversity hotspots (Killeen et al. 2007). Few places comparably capture the rich complementarity of a coupled nature-human system as clearly as the Tropical Andes (Wulf 2015). Increasingly it is evident that many Andean systems once thought to be pristine, natural systems, are indeed manufactured landscapes. Through the use of fire and grazing, the original montane tropical cloud forests (White 2013, Moore 2014) have been modified into the socio-ecological production landscapes (SEPLs) of today. In so doing, the bioengineers of antiquity created what Hobbs, Higgs and Harris (2009) termed "hybrid" systems. But with the importation of post-colonial exotic species, many systems have been transformed into "novel" ecosystems (Hobbs, Higgs & Hall 2013), i.e. if abandoned, they would not revert to a natural state through ecological succession.

Forest clearance and vastly increased fire activity induced by human actions throughout the Holocene probably caused large areas to transform from Andean forest to the grassland páramo of the northern Andean highlands (Sarmiento 2012). Nevertheless, the ancient history of the area is still uncertain (Bush 2002), and its future remains a mystery (Malhi et al. 2010). The origin of these grasslands continues to provide fertile scholarship, particularly when realizing that we deal with Socio-Ecological Systems (SES) and their many facets (Berkes, Folke & Colding 2000; Valencia et al. 2018) (see Fig 3). Thus, we follow the Christensen Fund's (2016) beliefs that it is only by incorporating the successive human fabric (or ecological palimpsest) of biocultural landscapes that we could understand how conservation and development should co-exist for a sustainable future (Pungetti 2013). We, hence, ascertain that the core of those uncertainties lies in our inability to discern the natural and cultural divide, the extent to which human disturbance can be correlated with how climate has changed in Tropandean landscapes (see Fig. 4). This understanding is needed not only to understand the history of settlement, social development and biogeography of Andean regions, but also in making informed prognostications regarding the coupled, complex SEPLs under ongoing climate change.

Tropical Andean landscapes are renowned for their impressive diversity in culture (Moore 2014), luxuriant biota (Young 2009; Swenson et al. 2012), and extreme vulnerability to climate change (Malcolm et al. 2006; Ortega-Andrade et al. 2015). Within the paradox of development and the need for conservation of natural resources, managing cultural uses becomes paramount to a successful bridging of

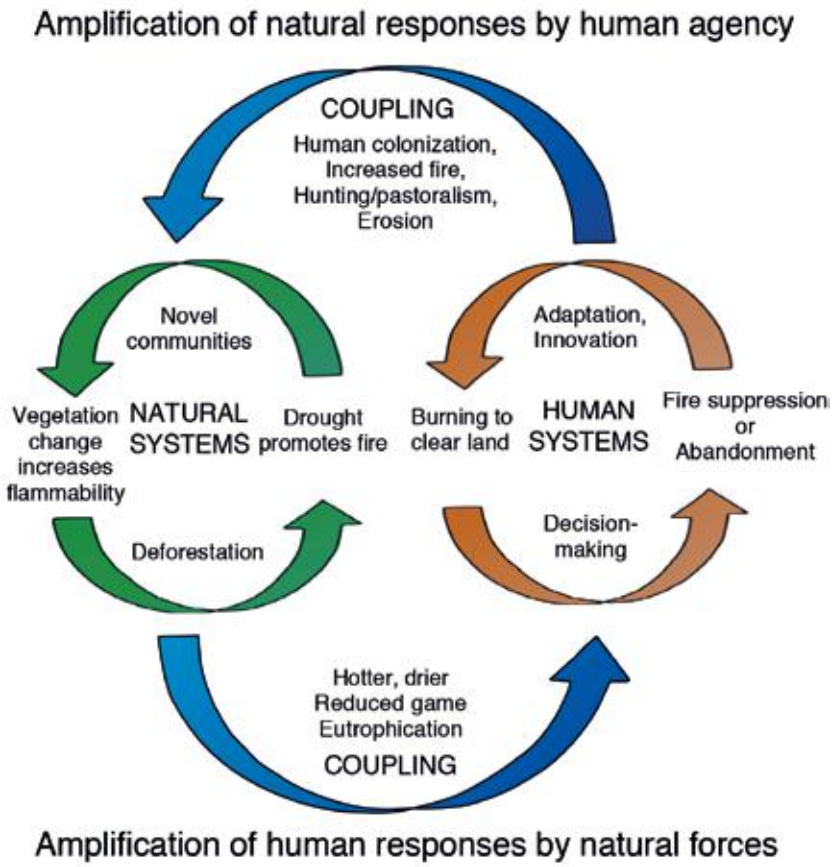

Figure 3. Coupled Human-Environment Model of the Andean Amazon flank showing the flows of energy, matter and processes to function as a Socio-Ecological System. Modified from Prof. Mark B. Bush's ideogram of the complex, adaptive system operating in Tropanden landscapes.

Figure 4. The flower of the Andinist (*Chuquiraga excelsa*) is depicted here as an iconic element of the páramos, exemplifying the bias towards the pristine. A closer look to the specimen -and its surroundings- points to the pyrophytic habit of this Asteraceae plant that makes it an indicator species of past controlled fires and thus, a testament of past human interference in the high Andean forests, becoming a proxy for biocultural heritage. Photo: Fausto Sarmiento.

conservation and societal aspirations (Odum & Sarmiento 1998; Bradshaw & Bekoff 2001). These goals are consistent with the sustainability and development goals of the United Nations, i.e., to identify how people will respond to climate change, while also conserving biodiversity in Andean forests (Mathez-Stiefel et al. 2017). Critical to this agenda is maintaining intact cultural heritage values and increasing countries' fulfillment of the Aichi Targets for biodiversity conservation. One way to aid in the goal "living in harmony with nature" of the UN Convention of Biological Diversity, is to debunk the pristine myth and to accept the new biocultural diversity paradigm with its tenets of complexity, adaptability, resilience, self-organization, memory and transcendence, to develop vernacular strategies to conserve both culture and nature (Castree 2014; Sarmiento & Viteri 2015) in the management of protected areas (Sarmiento et al 2015). By recognizing the intricate relationship of culture and nature in creating the current landscape configurations of the Andes, we will embrace the new paradigm of biocultural landscape and heritage conservation as a guiding principle of our work towards sustaining productive landscapes and seascapes (Cocks 2006; eds. Convery & Davis 2016). "Critical geography" has emerged as a discipline that attempts to hybridize the concept of nature-pristine with that of human-agency within cultural ecology and agrobiodiversity parameters (Zimmerer 2004; Sarmiento et al. 2015).

1.2 Andean Satoyama landscapes

The International Partnership for the Satoyama Initiative (IPSI) promotes SEPLs to highlight traditional knowledge of land use practices with harmonious interactions within the complex mosaics where human well-being is coupled with high biodiversity (Dublin & Tanaka 2014). Spatially, biodiversity conservation occurs not only in protected areas, but also in production landscapes, whether located in the periphery of core areas or interspersed throughout the biocultural territory (Brown, Mitchel & Beresford 2005). One of the authors has already claimed the need to revalue the contribution of agrobiodiversity conservation in the toolbox of territorial planning of complex adaptive systems (Sarmiento 2008; eds. Messier, Puettmann & Coates 2013). There are many examples that can be found in the Andes region, while including the sacred dimension that is pivotal in Andean cultural landscape research on SEPLs (Sarmiento 2003; Sarmiento, Cotacachi & Carter 2008).

Several Andean sites are already active in the International Partnership for the Satoyama Initiative (IPSI), including the 'Alto Huayabamba' Conservation Concession in Bolívar, Peru; the mangrove estuaries of Chone and Portoviejo, the dry forest of Cordillera del Bálsamo in Manabi, Ecuador; and the agroforestry system of the San Vicente de Chucurí, Santander, Colombia (Tsunekawa 2003). We are including here an example from highland Ecuador, where the principles of IPSI have been implemented in a very effective and efficient way. The 'El Collay' Commonwealth of southeastern Ecuador comprises six autonomous, decentralized governments (GADs for the Spanish acronym) that have formally agreed to collaborate in the maintenance of rural livelihoods for food sovereignty and security. Spanning both highland and lowland communities, the strategy includes the conservation of the community protected forest of 'El Collay' (see Fig. 5 and 6) in addition to OECMs. Since Food and Agriculture Organization of the United Nations (FAO) recently recognized two Satoyama areas in Japan as Globally Important Agricultural Heritage Systems (GIAHS) sites, we envision that 'El Collay', with its wealth of agrobiodiversity, heirloom species and cultural heritage, will soon become the first such GIAHS site in Ecuador.

1.2.1 Ecuadorian conservation scenarios in the Aichi flexible framework

The first Ecuadorian Congress of Geography, held at the Pontifical Catholic University of Ecuador on 14-16 February 2018, showed that conservation follows conventional tenets of species-based or habitat-based priority settings for protected areas. However, several presentations dealt with the need to incorporate biocultural territorial planning (Kong 2018; Palacios 2018; Sarmiento 2018) if the best management practices for biodiversity conservation and

Figure 5 and 6. A view of the park rangers arriving to the tourism project "La Tranca" in the mountain landscape of El Collay, where the imprint of Fuzhio and Chordeleg communities have managed the landscape with ancestral practices, aiming for maintenaining both rich cultural heritage and impressive natural capital in the cloud forests and páramos of southeastern Ecuador. Photo: Fausto Sarmiento. (Photos by Fausto Sarmiento and Estefanía Palacios)

the fulfillment of the different Aichi Biodiversity Targets are to be achieved. Changing conservation strategies have been clearly addressed as a national priority, not only in the Ecuadorian case, but also throughout the Andean world (Sarmiento et al. 2017). However, primacy of "almost untouched" páramos and cloud forests in the 'Río Negro–Sopladora' has justified the creation of a brand-new National Park in Ecuador, effectively incorporating 30,616 hectares of the area into the state-owned Heritage Natural Areas Subsystem (PANE) of the National System of Protected Areas in Ecuador. 'El Collay' is immediately adjacent to this "pristine" area, flanked by the duality of male and female *Apu*, the telluric watershed guardians: *Kari* Collay and *Warmi* Collay hills. 'El Collay' represents the best case to promote SEPLs as it demonstrates the likelihood of biodiversity conservation and situated development of OECMs, aiding in obtaining the Aichi Targets for 2020.

1.2.2 Transdisciplinary approach as a guiding principle for Satoyama landscapes in the Andes

The new tendency of integrative conservation is evident in the application of IPSI principles in the Andes. As long as legal recognition of community-based conservation (CBC) is granted, the objectives of sustainability based in biodiversity indicators will remain biased towards the totemic species, supporting ideas of "fortress conservation." The emphasis on "pristine" samples of mountain ecosystems without human interference (Sarmiento forthcoming) may identify areas of high-quality habitat for conservation, but, in doing so for the wrong reasons, may initiate future management problems. First, if the area has actually been modified by human activity, some level of such management will be needed to maintain it. Second, the desirable "near pristine" state may actually be reliant on adjoining areas that are more overtly managed. If those areas are not also maintained, the conservation strategy may fail. The IPSI contribution to debunking the pristine myth helps in understanding the imperatives of cultural agency in designing current landscape configurations, and provides a more realistic foundation for biocultural diversity conservation. We present a case study in southeastern Ecuador, where many assumptions of physical geography have been challenged in favor of the new transdisciplinary trend of bridging western science with local, traditional ecological knowledge to understand the *mosaicism* of ecological niches and the self-organized *cellularity* of emergent new ecosystem pathways within the lived-in biocultural landscape fabric (Naveh et al. 2002), providing for situated nuances of refugial ecotopes as target conservation loci for microrefugia as OECMs. As a truly participatory outcome of CBC, we present the case study of the 'El Collay' Commonwealth in southeastern Ecuador.

2. Methodology

2.1 Study area

'El Collay' Commonwealth is located in Azuay Province and spans different bioclimatic zones from the continental divide at ca. 4,000 meters above sea level (MASL) to the Amazonian piedmont of colline areas of the Morona River in the lowlands at ca. 1,000 MASL (**Aichi strategic goal C**). 'El Collay' ridge follows a south-north trajectory, from the 'El Pan' hill towards the limits of *Sangay* National Park, a UNESCO World Heritage Site (Eyre 1990), traversing six different municipalities (see Fig. 7). With the contribution of major tributaries to the *Pauti* basin, the main river of the Azuay Province, waters collected in these mountains from the 'San Francisco', 'Santa Bárbara', 'Collay' and 'Negro' rivers drain fertile volcanic and andosol terrains towards the mouth of the *Pauti* River and towards the lowland Amazon flatlands. Several dams built in this watershed provide the majority of hydroelectricity for the entire country (Cuellar & López 2000). In the species-

Figure 7. Map of the distribution of the ECPFV (or in Spanish 'Area de Bosque y Vegetación Protectora' —ABVP— El Collay) located amidst the Andean highland (Azuay province) and the Amazonian lowlands (Morona-Santiago province). Source: Alexandra Vázques 2014.

rich Andean forest, epiphytic gardens form a hydrological reservoir, as do the waterlogged areas of shrub 'páramo' that give way to depressional lakes and bogs, including the male and female *Kari Maylas* and *Warmi Maylas* (Páramo 2010, Torres & Tacuri 2008). Along with the provision of water and energy, the potential for many ecosystem services associated with the *Pauti* basin cannot be underestimated, including not only biophysical environmental services, but also cultural landscape services (Kong 2018) (**Aichi strategic goal D**). The 'Paute' mountain pass, or 'abra', has been the traditional route to connect the southern 'Sierra' of Ecuador with the 'Amazonía' region; it constituted the gateway towards the *Marañón* river (Sarmiento 1952, Ulloa 1999), the mythic sea-river of chroniclers, geodesic naturalists and colonial explorers. These lands were physically and societally hostile to European explorers. Issues ranging from highland hypoxia to lowland disease and fungus-prone settings were compounded by the fierce resistance of the original *Shwar, Achwar*, 'Motilones' and 'Bracamoros' people of southeastern Ecuador and northeastern Peru, some of them known as the mythical head-hunters (*c.f.:* shrunken heads or *Tzantza*) of yesteryear's 'jívaros' (Sarmiento 1956).

There is no agreement on the place naming of 'El Collay'. Potential origins include: (1) unconfirmed accounts at the Spanish settlement onset chronicled a brave leader, or *kuraka,* named 'Collay', whose domain extended into the region; (2) a possible reference to a northern place (*Collas*) of different but neighboring indigenous mountain villages; also, (3) the term could derive from archaic Spanish, 'collado,' that describes a low-rounded hill or low mountain pass (from Latin: *collis*), indicating the lowest level of the ridge-line between two adjacent heights, therefore, the preferred path to cross a mountain pass. This archaic Spanish definition fits well with the historical character of the 'gateway' to the Amazon via the 'Paute' river canyon (Donoso 2002). Likewise, (4) Another variant comes from the *Kañari,* that might have been a group of immigrants or *mitimakuna* of the *Inka* Empire advancing northward. A group of *Aymara* indigenous from the *puna* of southern *Inka* land or *Tawantinsuyu,* in what is now Bolivia and northern Chile, were transplanted to what is now southern Ecuador, coming from the region of *Kullasuyu.* Its local inhabitants now are called *Collas* or *Q'oyas* and live in the highlands of Argentina, Chile and Bolivia. This fact could also explain the linguistic oddity of *Kañari* toponymy, very different to prevalent *Kichwa* or Spanish/*Kichwa* combinations (Encalada 2000), as well as their similar mythology, theogony, diet and garb (Pichisaca 2001).

The 'El Collay' Protected Forest (ECPF) is a legally created CBC area with the engaged agreement of the six municipalities that make up the 'El Collay' Commonwealth. This protected forest initially occupied 7,955 ha, which was later modified to include 29,000 ha, making it one of the most representative provincial public conservation areas (**Aichi strategic goal A**). 'El Collay' also occupies an important place in the hearts and minds of the residents of these municipalities including parochial organizations, women's groups and other community groups belonging to the commonwealth, as it was conceived with a participatory communal effort via *minga*, the ancestral reciprocity practice of Andean cultures or *ayni* (Palacios 2017). The commonwealth protects the abundant wildlife of the cloud-shrouded high Andean ecosystems, as it seeks to sustain and revive ancient practices of mountain travelers (Guallpa, Ivan & Ulloa 1999), and the ethno-tourism or agro-tourism of traditional lifescape practices (Gutiérrez, Maldonado & del Pilar 2014; Borja, Lasso & Paola 2015) (**Aichi strategic goal B**).

The area supports many rare species of fauna and flora (Table 1), among which are *Chuquiraga jussieui*, which has the common name the Flower of the Andes, and the Azuay knot emblem, the *gañal (Oreocallis grandiflora*). There are remnants of old growth native coniferous woodlands with isolated 'romerillo' (*Podocarpus oleifolius*) and abundant 'guabisay' (*Podocarpus sprucei* c.f. *glomeratus)*. Also, isolated trees of 'mogollón' *(Retrophyllum rospigliosii)* are observed in faraway reaches of the range. Some nurse trees have been left amidst the clearings for pastures made decades ago, when agrarian reform favored takeover of unclaimed forests as a means to provide eminent domain and, therefore, titling and land ownership for settlers (Sarmiento 2002). Curiously, in the high ravines towards lakes and bogs, some of them considered "enchanted" by the locals, robust populations of native trees of *Buddleia incana, Gynoxis baccharoides* and *Eugenia myristica* can be observed; there are also tree ferns (*Cyathea brucei*) and even high elevation palms (i.e., *Geonoma monospatha*, *Ceroxylon andicola*). In the upper reaches, the effect of grazing is

obvious by the erosion type known as 'pie-de-vache', from French, describing the zigzagging lines of trampling on the slopes (Jampel 2016). Moreover, the presence of reeds and bulrushes (*Schoenoplectus californicus*, *Phragmites spp*.) is noticeable in the lacustrine environment, obviously planted long ago. Unmanaged reeds contribute to lakes becoming eutrophic and unsuitable for native aquatic fauna and prone for introduced species. The native fish, for instance, have long been gone, making the ubiquitous rainbow trout (*Salmo mykiss*) one of the precious trophies for local fishermen in the white-water brooks often surrounded by 'pajonal' of straw grass, such as *Calamagrostis*, *Festuca* and *Stipa*. Amidst the grass tillers or in its waterlogged roots, frogs (*Atelopus* spp) and big lizards or *guagsa* (*Stenocercus guentheri*) exist.

Notwithstanding the rich biodiversity, the matrix of anthropogenic landscapes has retained some secondary growth after ancient burnings in the region, so the pyrophytic 'surales' of *Chusquea* spp. and 'pampales' of bracken fern (*Pteridium aquilinum*) remain as clear indicators of fire disturbance. Species associated with either the burning practice intermediate-disturbance (serotiny) or with the slope failure catastrophic-disturbance (geotiny) appear later, including woodlands of Andean alder (*Alnus jorulensis*, *A. acuminata*), cherry trees (*Prunus serotina capuli*), climbers such as *gullay (Passiflora spp)* or ground bromeliads or *aguarongo* (*Puya* spp). Here, the signature of human drivers of the Andean treeline continues to be unmistakable (Sarmiento & Frolich 2002) in determining the fate of Tropandean biocultural landscapes.

Table 1. Examples of the emblematic assemblages of flora and fauna in 'El Collay' Protected Forest and Páramo pointed in the text. Names come from the Herbarium of the University of Azuay in Cuenca and from the Ecuadorian Museum of Natural History in Quito. Modified from Dr. Danilo Minga Ochoa's plant list and from Sarmiento's Ecuadorian Ecological Anthology (1987).

Scientific Name	Local Name	Heritage marker
Plants		
Podocarpus oleofolius	Romerillo	Home of the wild 'duende' or *sinsin*
Podocarpus sprucei	Guabisay	The home of the toucanets
Podocarpus rospiglossy	Mogollón	Strength of tallest timber softwood
Chuquiraga jussieui	Flor del Andinista	Untouchable but tempting
Oreocallis grandiflora	Gañal	Flagship of Azuay knot
Buddleia incana	Arbol del Inca	Sacred tree for sculptures and effigy
Gynoxis baccharoides	Yagual	Andean flower with yellow overtones
Eugenia myristica	Arrayán	Fruit ethnomedicinal
Cyathea brucei	Helecho arbóreo	Incorruptible wood
Geonoma monospatha	Palma de altura	Decumbent and sinuous stem growth
Ceroxylon andicola	Palma de cera	Tall and elegant nursing tree
Calamagrostis spp,	Paja de páramo	Multipurpose uses
Festuca spp.	Paja azulada	Insulation
Stipa ichu	Paja ichu	Fire starter
Chusquea spp	Suru	Restorative of landslide scars
Pteridium aquilinum arachnoideum	Helecho araña	Restorative of fire scars in the slopes
Prunus serotine capuli	Capuli	Restorative of fire scares in the valley
Alnus jorulensis,	Aliso blanco	Restorative of rockslides
Alnus acuminata	Aliso rojo	Restorative of alluvial mudslides
Puya spp	Aguarongo	Emblematic highland plant

Animals		
Tremarctos ornatus	Oso de anteojos	Emblematic wild beast (ukumary)
Tapirus pinchaque	Danta de monte	Seven meats and disease vector
Colibri coruscans	Quinde picaflor	Iridescent reflections
Salmo mykiss	Trucha arcoiris	Protein source
Atelopus spp	Sapa Jambato	Flagship of highland wetlands
Stenocercus guentheri	Guagsa	Sacred reptile (tale breaker)
Sarcoramphus papa	Zopilote real	Restorative cleaning
Harpya harpija	Aguila harpía	Emblematic jungle master
Odocoileus virginianus ustus	Venado	Adaptability and vigor
Pseudalopex culpaeus	Lobo de páramo	Nuanced analyst
Penelope purpurascens	Pava de monte	Good tidings greeter

2.1 Participatory environmental governance process

The "environmentality" of 'El Collay' Commonwealth is indicative of profound changes in conservation policy and decision-making in Ecuador. In the last ten years, the National System of Protected Areas has generated processes to motivate social participation (c.f., inclusion) in protected areas. The National Environmental Authority (NEA) has introduced gradual changes in the narrative of conservation, such as incorporating sustainable use of biodiversity, protecting culturally significant areas and especially valuable natural resources, and restoring degraded ecosystems. In consequence, those actions have opened the possibility to integrate other actors into protected areas management, including educational institutions, community leaders and civil society. In this sense, but under the context of cultural heritage, the Ecuadorian law on Territorial Planning, Autonomy and Decentralization of 2011 is much more specific when defining the competences that municipalities must assume in matters of culture and heritage. In article 55, it indicates exclusive competences of the municipal decentralized autonomous government in cultural matters: to preserve, maintain and disseminate the architectural, cultural and natural heritage of the canton, and to build public spaces for these purposes. On the other hand, article 144 states that the competence to preserve, maintain and value cultural heritage, corresponds to the decentralized Ecuadorian municipalities. Therefore, the biocultural heritage management increasingly involves the local community's participation, not as an option but rather as an obligation.

The participatory research methods of planning for environmental governance were built on the painstaking groundwork provided by the 'Fundación Futuro Latinoamericano' (FFLA 2014), with major breakthroughs in the establishment of the first legally recognized Ecuadorian commonwealth to protect the natural vegetation and the forest cover of the 'El Collay' region in Azuay Province. With several meetings and communal gatherings (or *minga*), the enterprise was informed and affirmed with a horizontal, rhizomic approach of previous informed consent. No preconceived hierarchical decisions were proposed, but a real exchange of dreams and wants of local community leaders of civil society and elected officials of the area's organizations took place. These included: El Pan, Sevilla de Oro, Guachapala, Chordeleg, Gualaceo, Paute and Santiago de Méndez. One of the authors served as the 'promotora' (Vázques) from FFLA that validated the participatory research and sharing of information prior to the establishment of the legal document. A "commonwealth" category was preferred over a simple "consortium" of municipalities, to enable equal participation of elected officials (who hold the office of Chair every year on a rotating basis, bringing an added factor when elected officials are placed in the ballot). The ECPF also comprises a technical unit staff to manage it, local park rangers hired with funds from the Electric Corporation of Ecuador (CELEC), residents and several interested community groups, including farmers, fruit growers, floriculturists, tour operators, women assemblages and even educational institutions.

2.2 Community-based findings for Aichi Targets

Some premises for reciprocity of communal labor were shared in the initial phases, when focus workshops and mountain hikes took place to motivate social actors' engagement (**Aichi strategic goal E**). Of note was a three-day excursion following the centuries-old mountain pathways that brought the Salesian missionaries into

Table 2. Integration of the Aichi targets considered in the study area of the El Collay Commonwealth's protected forest and vegetation.

PRINCIPLE	STRATEGIC GOAL	AICHI TARGET	OBTAINED
Adaptive approach	E	17,18,19	√
Commonality of setting the stage	E	4,17,18	
Multiscalar	A	2,1,11	√
Multifunctional	D	4,14,15,16,19	√
Multi-stakeholders	E	4,14,17,18	
Transparently negotiated	A	1,4	√
Clear rights and responsibilities	D	4,14,16,18	√
Participatory monitoring	A,B,D	9,12,13,14,15	√
Resilience	C	9,12,13,14,15	√
Capacity building	E	1,17,19,20	√

these regions, bringing the Roman sanctorum and their pastoral work towards the unknown Amazonian lowlands (Guallpa, Iván & Ulloa 2015). Indeed, one of the pillars of the commonwealth was to rescue their historic heritage. The route of Father 'Albino del Curto', from Sevilla de Oro towards Santiago de Méndez, is targeted as a touristic attraction for visitors to know the once rich gold-producing mining of El Pan, Sevilla de Oro and placer mining sites on downriver shoals.

3. Results on target evaluation

The successful establishment of the 'El Collay' Commonwealth provides effective protection to almost 29,000 ha of Andean forests and páramos. Currently, efforts to increase the acreage have received enthusiastic support. This endogenous synergy prompted international organizations (i.e., Nature/Culture International, Latin American Future Foundation and their donors) to look even closer at the wealth of biodiversity in the area. Just recently (10 February 2018), a new Ecuadorian protected area was declared for the 34,388 ha area adjacent to 'El Collay' in the 'Río Negro-Sopladora' National Park, located between two large conservation areas: *Sangay* National Park to the north and *Podocarpus* National Park to the south. The new designation effectively protects the longest conservation corridor along the Andean flanks and serves to integrate management efforts across this vast landscape. The renewed focus on biodiversity has also added many new species records for the region, including newly discovered endemic amphibians. One of the authors (Aguilar) produced a list of the orchids of the *Uchucay* Community Reserve in Gualaceo, where new *Andinia* spp. were found (Doucette, Portilla & Cameron 2017). Several emblematic species were targeted for protection along the Andean Amazon flank, including the Andean spectacled bear (*Tremarctos ornatus*), the mountain tapir (*Tapirus pinchaque*), the royal buzzard (*Sarcoramphus papa*) and the Harpy eagle (*Harpya harpija*). Many rare local endemics, including parrots, toucans and waterfowl, are indeed commonly seen in 'El Collay'.

With the creation of 'El Collay' Protected Forest we have achieved the integration of the majority of the Aichi Targets (see Table 2). The participatory process contributed to Targets 1 to 4. Contributions to Target 5 are as yet unsure, but this achievement made advances in securing Targets 6, 8 and 9, with the establishment of an alliance between Ecuagenera Cía. Ltda. and the 'GAD municipal del Cantón Gualaceo' to establish the community reserve of *Uchucay* (Bustos 2017). Target 7 remains a work in progress, but we obtained consensus among stakeholders that the ECPF will not be subjected to deforestation pressures and will continue to be monitored by park rangers. Funding for that critically important monitoring was derived from revenues for ecosystem services provided by the national utility, CELEC, funneled to the 'El Collay' Technical Office for watershed conservation operations. Target 10 did not apply to our mountainous region. With the biocultural territorial planning to be executed in the 'El Collay' next year, contributions to Targets 11, 12 and 13 were ensured for the inclusion of natural and heritage management to protect genetic diversity and heirlooms. Targets 14 and 15 were secured with restoration areas and the implementation of payment for ecosystem services (Zilberman, Lipper & McCarthy 2008), but Target 16 is not yet defined. Targets 17, 18 and 19 are fully integrated in the operation of ECPF. Likewise, Target 20 is secured at the local level with the financial commitment of the municipalities and GADs that are members of the 'El Collay' Commonwealth.



Figure 8, 9 and 10. A group of coauthors and members of the local communities of Chordeleg and Fuzhio, including the major and the technical staff of the 'El Collay' Commonwealth, after a visit to the 'cerro de la alegría' after mountain trekking through cloud forests and páramos in the heartland of Kañary ancestral lands. (Photos by Guido Román and Estefanía Palacios)

4. Discussion

The rich ethnobotanical content of traditional medicine observed in the region (Neira & Luzuriaga 2000) highlights the indigenous *Shwar* ancestral knowledge of the Amazonian flanks of montane jungles or 'ceja de selva.' The area now harbors mostly mestizo, campesino people of *Kañari* ascendance from Cañar and Azuay provinces, and *Shwar* ascendance from Morona-Santiago and Pastaza provinces (**Aichi strategic goal D**) (Fig. 8, 9 and 10). There is a strong birthplace attachment, making family gatherings an observance for major holidays, whereby heirloom dishes are prepared and ancient myths are transmitted around the elders' storytelling to the youth.

A group of coauthors and members of the local communities of Chordeleg and Fuzhio, including the major and the technical staff of the 'El Collay' Commonwealth, after a visit to the 'cerro de la alegría' after mountain trekking through cloud forests and páramos in the heartland of *Kañary* ancestral lands. Photo: Guido Román.

However, in rural-to-urban migration in Azuay and Cañar provinces, people from the villages have moved to the city of Cuenca or to the capital city of Quito, but retained 'biopatry', or place attachment, in their traditional potions, diets and religious observances while living faraway (A Neira, pers. comm.). Furthermore, a major demographic change observed with international emigration to foreign destinations, mainly Spain and the United States, makes the new economic driver of remittances an important economic subsidy that is changing the *Pauti* farmscapes' fabric (Donoso & Sarmiento, forthcoming). Amenity migrants from the global North are making Cuenca and 'El Collay' one of the most popular destinations for expats (Peddicord 2017). The previous wave of foreign migrants arrived to Cuenca motivated by economic hardship in their country of origin; however, newcomers and recent retirees fleeing to the area are fleeing their country of origin as a reflection of political rather than economic drivers (A Neira, pers. comm.).

It was the trailblazing effort of circa seven years of work by the FFLA with such a strong participatory approach at all levels (i.e., community, political, sociocultural and citizenry) that made the establishment of the commonwealth possible. The implemented process provided transparency, co-responsibility, mutual performance, strategic alliances, equity, gender equity, knowledge sharing, social engagement, communication and leadership. One of the practical outcomes was the establishment of a fund provided by the Minister of Environment (MAE) for monitoring and vigilance of the zone of conservation for the concrete action to create a Park Rangers training. Also important was the establishment of Law 047 with the mechanism to fund these guard hires from the National Electricity Company's (CELEC) mandatory 5% annual budget contribution for social and environment responsibility to the GADs of 'El Collay'. We seek to reinforce the ground already gained and keep the momentum for CBC among the villagers, knowing that federal funding for conservation has been already cut, with the CELEC contribution also diminishing or ending altogether. Going forward it is essential that we minimize environmental conflict and offer practical action-reflection to resolve issues. Similarly, we must offer the possibility of learning-by-doing supported by the new narratives of biocultural heritage and critical biogeography.

While biodiversity conservation is the main goal of the 'El Collay' Protected Forest, a renewed emphasis on cultural ecosystem services is needed to connect the lifescape of 'El Collay' with the needed protection of these species amidst

climate change. Despite concern for global warming, no direct adaptation or mitigation schemes are anticipated yet in the planning of the GADs of the commonwealth. More attention has been given to the prospective lack of rain and generalized drought than to the prospects of warmer weather. Several irrigation channels have been carved into mountainsides near Gualaceo and El Pan, for instance, that require maintenance and monitoring. Hydrological management must go beyond considering amounts only and must also manage water quality. For example, three small lakes on the 'La Alegría' hill, near Puzhía, Chordeleg, have already become eutrophic and need ecological restoration to return them to fully functioning wetlands. Water continues to be at the center of sustainable development concerns. Notwithstanding this strategic resource for hydroelectric production, water will be needed for irrigation of agricultural lands and the provision of potable, piped water for household consumption. The need for forest protection is entirely consistent with the administrative imperatives to provide water and electricity to a growing population. Recognizing the ecosystem services provided by forest and soil is a critical step that must be made all the way from the farmer to the highest administrative office.

In the *Puna* grasslands of the high Andes, Sylvester, Sylvester and Kessler (2014) suggested that ledges on steep mountainsides had been protected from fire and grazing and may offer the best analog for a "natural" plant community. These ledges support more lower plant diversity than adjacent grazed lands, but one richer in shrub species. The ledges have been suggested as targets for conservation (Sylvester, Sylvester & Kessler 2014) and could be construed as an OECM. There is no doubt that small cloud forest fragments are key to the short-term conservation of tree diversity (Wilson & Rhemtulla 2018). These fragments can offer the nuclei from which afforestation can build outward or maintain genetic stock until a broader conservation effort can be undertaken. In the longer term, unless genetic connectivity is re-established, populations will ultimately fail due to inbreeding or stochastic events. Edge effects, such as fire incursion, exotic diseases, or dry microclimates, are disproportionately damaging to fragmented areas, such that microrefugia must be thought of as a temporary not permanent respite from adversity. The integration of OECM settings with larger landscapes consistent with conservation, cultures and management that foster biodiversity can provide a matrix that increases microrefugial survivability. The different communities in 'El Collay' have an elevated chance of survival through the maintenance of forest cover for either biocultural heritage or ecosystem services, and will aid in providing microrefugia to those populations of species, such as *Podocarpus, Polylepis, Cinchona and Buddleia.* While 'El Collay' management plans do not yet explicitly deal with long-term anthropogenic climate change, the decisions made so far are entirely consistent with the long-term conservation of regional biodiversity.

To secure the long-term goal, aside from the signed commitment from the local GADs, civil society and community groups need to be energized and funded. Likewise, we still need to work to mobilize international resources and secure matching grants or endowment funds that would allow the maintenance of 'El Collay' Protected Forest for perpetuity.

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Chapter 10

Contributions of socio-ecological production landscapes and seascapes to the achievement of Aichi Biodiversity Target 11 in the group of Like-Minded Megadiverse Countries

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Abstract

The maintenance of functional integrity and health of ecosystems within protected areas is dependent not only on the protection provided but also on the ecological, economic and social interactions with surrounding areas. Efforts to create pathways for achieving socio-economic development that safeguard ecosystems and biodiversity are essential for building sustainable societies. Improving the impact of societies on protected areas is a key issue in the group of Like-Minded Megadiverse Countries (LMMCs) which are home to over 50 percent of the world's population and around 70 percent of its biodiversity. In order to facilitate the achievement of Aichi Biodiversity Target 11, an analysis was performed to determine the extent to which LMMCs' commitments make use of sustainable productive strategies and whether the commitments incorporate the perspectives of the Satoyama Initiative. Commitments from the LMMCs addressing the qualitative elements of Target 11 were drawn from National Biodiversity Strategies and Action Plans, National Priority Actions, 5th National Reports and protected areas-related biodiversity projects from the fifth and sixth replenishment of the Global Environment Facility. Commitments related to Socio-Ecological Production Landscapes and Seascapes (SEPLS) were identified as those which address sustainable productive practices. The relevant text was extracted and analysed in relation to the contribution of proposed actions to enhance the elements of Target 11 and perspectives of the Satoyama Initiative.

The results indicate that a subset of LMMCs' commitments to Target 11 is aligned with the perspectives of the Satoyama Initiative. These commitments are predominantly related to integration and equitable management of protected areas, elements of Target 11 whose progress was deemed to require more action to meet the target by 2020. By embracing the network of the International Partnership for the Satoyama Initiative (IPSI) partners and making use of the SEPLS strategy, the LMMCs could gain access to valuable knowledge and funding to accelerate implementation. Considering the importance of LMMCs to biodiversity, implementation of the SEPLS-related commitments from these countries will have global impacts for biodiversity conservation, contribute to the achievement of Aichi Biodiversity Target 11and promote sustainable socio-economic development.

Keywords: protected areas, Satoyama Initiative, biodiversity conservation, CBD, sustainable development, SEPLS

1. Introduction

The functional integrity and health of ecosystems within protected areas is dependent not only on the protection provided but also on the ecological, economic and social interactions with surrounding areas (Ervin et al. 2010; Rees et al. 2017; Watson et al. 2016). Efforts to create pathways for achieving socio-economic development that safeguards ecosystems and biodiversity are essential for building a sustainable society and conserving protected areas for the long-term. This idea is embedded in the elements[1] of Aichi Biodiversity Target 11, which states that: "By 2020, at least 17 percent of terrestrial and inland water, and 10 percent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes" (CBD 2010).

However, protected areas are often viewed and managed as islands of biodiversity, separated from the surrounding landscapes and societies (Hansen & DeFries 2007). Sectors like agriculture, forestry, and fisheries often neglect the goals of protected areas, increasing the likelihood and severity of a range of threats that may compromise biodiversity conservation (Laurance, Sayer & Cassman 2014; Symes et al. 2016). Improving the impact of societies on protected areas is a key issue in the group of Like-Minded Megadiverse Countries (LMMCs[2]) which are home to over 50 percent of the world's population and about 70 percent of its biodiversity (SCBD 2016a; UN DESA 2017) (see Fig.1).

The Socio-Ecological Production Landscapes and Seascapes (SEPLS) approach of the Satoyama Initiative is a valuable model for sustainable productive practices which can support the development of a nature-harmonious society (IPSI Secretariat 2017; Takeuchi 2010). SEPLS are defined as areas with dynamic mosaics of habitats and land and sea uses where the harmonious interaction between people

Figure 1. The Like-Minded Megadiverse Countries – embracing the partnership.

and nature maintains biodiversity while providing humans with the goods and services needed for their livelihoods, survival, and well-being in a sustainable manner (Satoyama Initiative 2010). SEPLS consist of, in many cases, croplands, settlements, forests and grasslands, as well as fisheries, and embody a great deal of traditional knowledge (Bélair et al. 2010; IPSI Secretariat 2017). Hence, the SEPLS approach promotes biodiversity conservation in secondary natural environments created through interactions between human activities and nature, and contributes to improving community resilience and socio-economic development (Japan Satoyama Satoumi Assessment 2010; Takeuchi 2010).

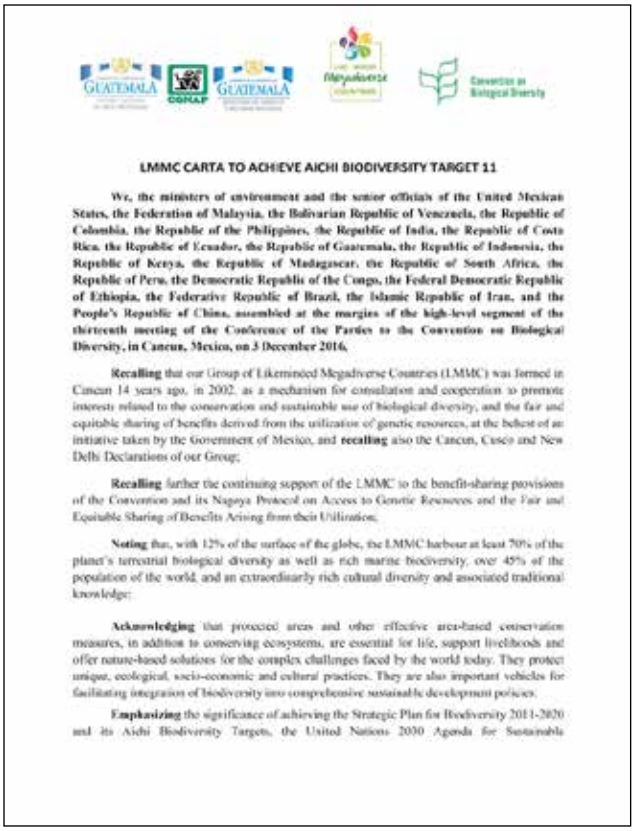
The ecological and socio-economic perspectives of the Satoyama Initiative are to: (i) achieve sustainability through the cyclical use of natural resources and use of resources within the environment's carrying capacity; (ii) promote recognition of the value of local traditions and cultures; (iii) facilitate landscape management through multi-stakeholder participation; (iv) promote socio-economic development; and (v) improve resilience of ecosystems and communities (IPSI Secretariat 2017). These perspectives can significantly contribute to facilitating the achievement of the qualitative elements of Aichi Biodiversity Target 11 and thereby improve the livelihoods and well-being of society in general and indigenous peoples and local communities in particular. Hence, synergizing the implementation of the activities of SEPLS with the national commitments for Aichi Biodiversity Target 11 in the LMMCs could facilitate both biodiversity conservation and sustainable socio-economic development within and around protected areas, contributing to achievement of Target 11.

2. Background

In the 2014 midterm assessment of progress towards the implementation of the Strategic Plan for Biodiversity 2011-2020, all of the elements of Target 11 showed progress, though only the 17% target for the conservation of terrestrial and inland waters was expected to be met by 2020 if current trends continued (Leadley et al. 2014; SCBD 2014).

Between September 2015 and July 2016, the Secretariat of the Convention on Biological Diversity (CBD) carried out six regional capacity building workshops on achieving Aichi Biodiversity Target 11, which aimed, among other goals, to provide a platform for discussing topics related to protected areas and to assist Parties to the Convention in identifying roadmaps for national priority actions to be undertaken in the following years to achieve the target by 2020.

The results from an analysis of over 1,400 priority actions, as well as other commitments identified by the Parties to the Convention that participated in the above regional workshops, suggested that if commitments are implemented as proposed, the area-based coverage of targets for terrestrial and inland waters (at least 17%) and for coastal and marine areas (at least 10%) would both be surpassed, while significant progress would be made for ecological representation, conservation of areas important for biodiversity, and effective management (Gannon et al. 2017; SCBD 2016b). However, the equitable management (governance/equity) of protected areas and their integration into the wider landscape, seascape and various sectors were found to require more efforts to speed up progress for the achievement of Target 11. These elements requiring more efforts form the backbone for a harmonious relationship between societies and protected areas. For example, diverse and good governance can help to ensure conservation is effective, resilient and widely covered. In terms of social outcomes, enhancing governance can help ensure that protected areas positively contribute to (and do not undermine) well-being and sustainable development within landscapes and seascapes (SCBD 2018a). Protected area integration can foster the development of a connected, functional ecological network among protected areas and facilitate the mainstreaming of values, impacts and dependencies of the biodiversity and ecosystem services provided by protected areas into key sectors, such as agriculture, fisheries, forestry, mining, energy, tourism and transportation (SCBD 2018b).



LMMC CARTA TO ACHIEVE AICHI BIODIVERSITY TARGET 11

We, the ministers of environment and the senior officials of the United Mexican States, the Federation of Malaysia, the Bolivarian Republic of Venezuela, the Republic of Colombia, the Republic of the Philippines, the Republic of India, the Republic of Costa Rica, the Republic of Ecuador, the Republic of Guatemala, the Republic of Indonesia, the Republic of Kenya, the Republic of Madagascar, the Republic of South Africa, the Republic of Peru, the Democratic Republic of the Congo, the Federal Democratic Republic of Ethiopia, the Federative Republic of Brazil, the Islamic Republic of Iran, and the People's Republic of China, assembled at the margins of the high-level segment of the thirteenth meeting of the Conference of the Parties to the Convention on Biological Diversity, in Cancun, Mexico, on 3 December 2016,

Recalling that our Group of Like-minded Megadiverse Countries (LMMC) was formed in Cancun 14 years ago, in 2002, as a mechanism for consultation and cooperation to promote interests related to the conservation and sustainable use of biological diversity, and the fair and equitable sharing of benefits derived from the utilization of genetic resources, at the behest of an initiative taken by the Government of Mexico, and **recalling** also the Cancun, Cusco and New Delhi Declarations of our Group;

Recalling further the continuing support of the LMMC to the benefit-sharing provisions of the Convention and its Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization;

Noting that, with 12% of the surface of the globe, the LMMC harbour at least 70% of the planet's terrestrial biological diversity as well as rich marine biodiversity, over 45% of the population of the world, and an extraordinarily rich cultural diversity and associated traditional knowledge;

Acknowledging that protected areas and other effective area-based conservation measures, in addition to conserving ecosystems, are essential for life, support livelihoods and offer nature-based solutions for the complex challenges faced by the world today. They protect unique, ecological, socio-economic and cultural practices. They are also important vehicles for facilitating integration of biodiversity into comprehensive sustainable development policies.

Emphasizing the significance of achieving the Strategic Plan for Biodiversity 2011-2020 and its Aichi Biodiversity Targets, the United Nations 2030 Agenda for Sustainable

Figure 2. The Like-Minded Megadiverse Countries Carta to Achieve Aichi Biodiversity Target 11

Improvements in the relationship between societies and protected areas and the achievement of Target 11 in its entirety are sought by the LMMCs. The meeting of the LMMCs on the margins of the high-level segment of the thirteenth meeting of the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) in 2016 resulted in the *Like-minded Megadiverse Countries Carta to Achieve Aichi Biodiversity Target 11* being welcomed by the COP (CBD 2016; SCBD 2016a). The *Carta*, *inter alia*, acknowledged that protected areas are "important vehicles for facilitating integration of biodiversity into comprehensive sustainable development policies", called upon "all Parties, and other countries, which have not yet identified and developed their national priority actions (roadmaps) to do so and to implement them to facilitate the achievement of Aichi Target 11 by 2020 at the global level", and urged "all partners and stakeholders to take concerted efforts to abet the implementation of roadmaps" (SCBD 2016a) (see Fig.2).

In order to facilitate the achievement of Aichi Biodiversity Target 11 and to enhance the progress of the qualitative elements[3] of the target, the present study aims to determine the extent to which LMMCs' commitments make use of sustainable productive strategies and incorporate the perspectives of the Satoyama Initiative, either implicitly or explicitly. The results highlight ways that the LMMCs and the International Partnership for the Satoyama Initiative can pool resources and efforts in a concerted manner to facilitate implementation and contribute to the achievement of Aichi Biodiversity Target 11, as well as to enact the ecological and socio-economic perspectives of the Satoyama Initiative.

3. Methodology

3.1 Data collection

Commitments from the LMMCs addressing the qualitative elements of Target 11 were drawn from: National Biodiversity Strategies and Action Plans (NBSAPs); Fifth National Reports of Parties to the CBD; Status, Gaps and Opportunities and National Priority Actions (NPAs) from the six regional workshops on protected areas; and protected area-related biodiversity projects from the fifth and sixth replenishment of the Global Environment Facility (GEF). The relevant text was extracted and compiled according to its contribution to one of the qualitative elements of Target 11.

3.2 Classification system

The excerpts, referring to commitments, from the above sources were compiled in a database and classified according to the level of confidence that the actions put forth will be implemented by 2020. A weak commitment, scoring 1, simply addresses the element of Target 11 in the document. The need for action is recognized; however, there is no designed framework or action(s) mentioned. A commitment scoring 2 includes a legal framework addressing the element and/or a list of actions that should be implemented in order to address the element. In this case, there is no explicit plan for how to implement these proposed actions. A strong commitment, scoring 3, has developed a specific plan(s) for the implementation of the proposed action for the element.

3.3 Identification of SEPLS-related commitments

From the database containing all LMMC national commitments related to the qualitative elements of Target 11, SEPLS-related commitments were identified as those which address at least one of the perspectives of the Satoyama Initiative conceptual framework. After identification of SEPLS-related national commitments, we developed a new framework linking the commitments to a set of perspectives[4] related to those in the original Satoyama Initiative framework. These perspectives include actions on: sustainability related to cyclical use of resources and use of resources within carrying capacity of the environment; traditional knowledge related to the recognition of the value of local traditions and culture; gender related to promoting the inclusive participation and recognition of the importance of women to sustainable production and biodiversity conservation; landscape management related to multi-stakeholder participation and spatial planning in the context of a broader landscape; socio-economic development related to production and benefit sharing, increase in revenue and capacity building; and resilience actions related to improving ecosystem health, adaptation to climate change and better landscape connectivity.

3.4 Data analysis

The national commitments of the LMMCs were classified according to (i) country, (ii) document from which the commitment was extracted, (iii) type of environment of the commitment (terrestrial/coastal-marine), (iv) contribution to the elements of Target 11, and (v) contribution to the set of perspectives of the Satoyama Initiative. Based on commitment score, mean scores were calculated for each perspective in order to test whether perspectives vary according to the level of confidence that actions will be implemented. The mean commitment scores were plotted and compared using a one-way ANOVA and a Tukey test of multiple comparisons.

Since one commitment may result in multiple benefits, a network of interactions between SEPLS-related national commitments and the framework of perspectives of

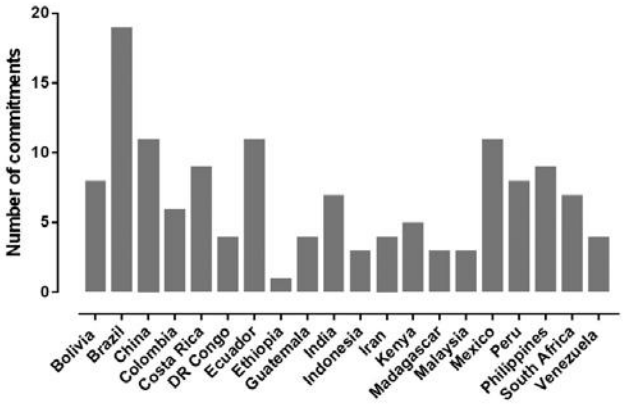


Figure 3. Number of SEPLS-related commitments by Like-Minded Megadiverse Countries.

the Satoyama Initiative was constructed to facilitate the visualization of interactions among elements of Target 11 and the modified framework of perspectives. The network was plotted in the programme R, version 3.3.0, using the package bipartite (Dormann, Gruber & Fruend 2008).

4. Results

From a database of 1,036 LMMCs' commitments addressing the qualitative elements of Aichi Biodiversity Target 11, a total of 137 commitments also address at least one of the perspectives of the Satoyama Initiative. These 137 national commitments aim to harmonize protected areas with the needs of sustainable production.

The identified SEPLS-related national commitments proposed actions to, *inter alia:* promote production landscapes and/or seascapes; promote improvements for sustainable management of biodiversity with a focus on socio-economic development; or, address improvement of production practices by local communities.

SEPLS-related commitments were identified from all LMMCs (Fig. 3). A mean of 6.85±4.15 commitments was identified per country, ranging from 1 to 19 commitments. The majority of commitments proposed actions in terrestrial ecosystems (66%) followed by commitments targeting both terrestrial and coastal and marine ecosystems (16%) (Fig. 4A). Four percent of commitments proposed actions exclusively in coastal and marine ecosystems. Fourteen percent of commitments did not specify the type of ecosystem to be targeted by the proposed actions.

Sixty percent of SEPLS-related national commitments were derived from GEF projects, 40% from GEF-5 and 20% from GEF-6 (Fig. 4B). The remaining 40% of commitments were derived from NBSAPs (32%), National Priority Actions (4%), National Reports (2%) and reports of Status, Gaps and Opportunities from the regional protected area workshops (2%). This highlights the opportunity for synergies with the GEF-5 and GEF-6 projects that are not yet completed, as well as upcoming GEF-7 projects and the various commitments of the Parties to the Convention. These synergies with the SEPLS strategies could provide for a more effective implementation of the qualitative elements of Target 11.

The identified SEPLS-related commitments spanned all qualitative elements of Target 11, namely, integration, equitable management, effective management, connectivity, conservation of areas important for biodiversity and ecosystem services, and ecological representation (Fig. 5A).

Integration and equitable management of protected areas were elements which had the highest number of SEPLS-related commitments, 50 and 37, respectively. Twenty-two SEPLS-related commitments targeted management effectiveness, and 15 targeted connectivity. Commitments to improve ecological representation and the coverage of

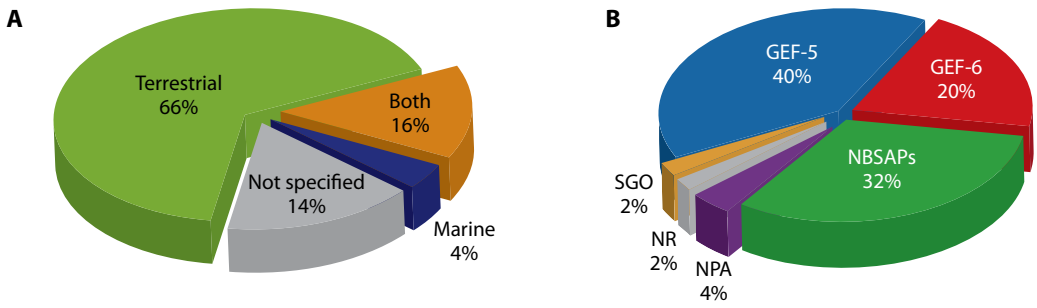


Figure 4. Distribution of SEPLS-related commitments according to the target ecosystem (terrestrial/coastal-marine) and source. (A) SEPLS-related commitments were identified as containing actions targeting exclusively terrestrial environments (green), both terrestrial and costal and marine environments (orange), exclusively costal and marine environments (blue), and commitments whose actions did not specify the type of environment targeted (grey). (B) SEPLS-related commitments were derived from GEF-5 projects (blue), GEF-6 projects (red), National Biodiversity Strategy and Action Plans (green), National Priority Actions (pink), National Reports (grey) and reports of Status, Gaps and Opportunities from regional workshops on protected areas (orange).

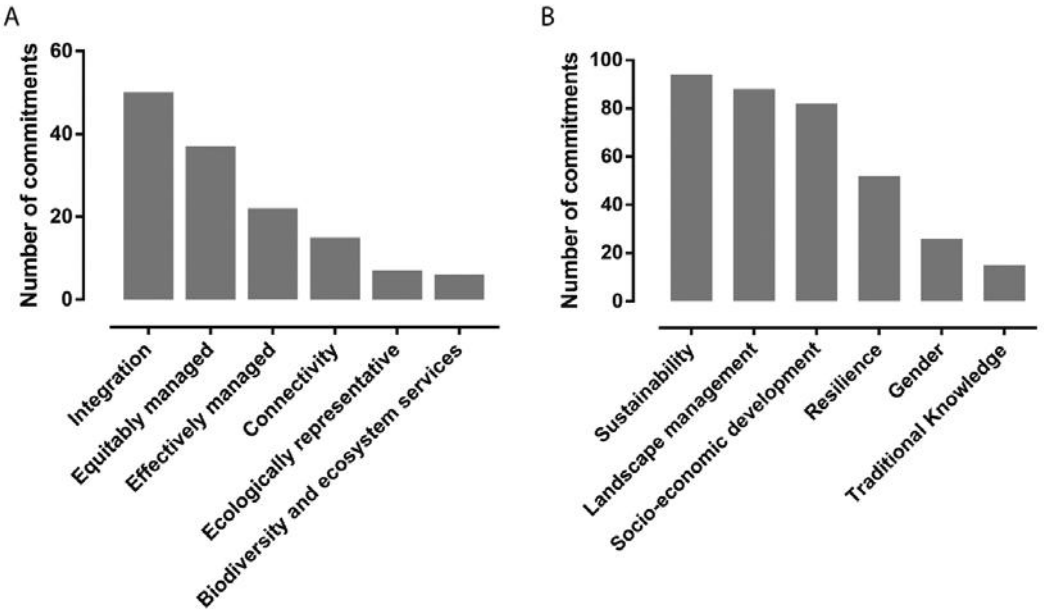


Figure 5. Distribution of SEPLS-related commitments by elements of Target 11 and by perspectives of the Satoyama Initiative. (A) Number of SEPLS-related commitments according to the elements of Target 11 to which they will contribute most if implemented. (B) Number of SEPLS-related commitments that would contribute to the perspectives of the Satoyama Initiative if implemented.

areas important for biodiversity and ecosystem services had the lowest number. Seven SEPLS-related commitments targeted under-represented ecosystems, such as montane forests, wetlands, estuaries, and mangroves. Six commitments targeted areas important for biodiversity and ecosystem services and were associated with improved conservation and wise use of wetlands and river basins to ensure maintenance of hydrological regimes.

SEPLS-related commitments were analyzed to determine whether implementation of identified actions will contribute to the achievement of the perspectives of the Satoyama Initiative (Fig. 5B). The perspectives with the highest number of identified actions were those addressing the improvement of sustainability of production practices—including both resource use within carrying capacity and cyclic use of natural resources (94 commitments), landscape management (88 commitments) and socio-economic development (82 commitments). Actions contributing to the improvement of ecosystem resilience, such as climate change adaptation and connectivity, were iterated in 52 commitments. Actions targeting gender were listed in 27 commitments, and there were 15 actions targeting the conservation of traditional knowledge.

SEPLS-related commitments were scored according to the level of confidence that the proposed actions will be implemented. Overall, mean commitment scores were moderate-high for all perspectives of the Satoyama Initiative, suggesting the majority of commitments addressing the perspectives are well-elaborated and present a framework of actions or specific plans for the implementation of the commitments (Fig. 6). Scoring differences of commitments contributing to the perspectives of the Satoyama Initiative were not statistically significant ($F_{5, 361}$=1.625, p=0.152).

SEPLS-related commitments of the LMMCs were linked to perspectives of the Satoyama Initiative in order to evaluate the structure of multiple benefits derived from the implementation of identified actions. The network resulting from the synergistic links of Target 11 national commitments of the LMMCs with the perspectives of the

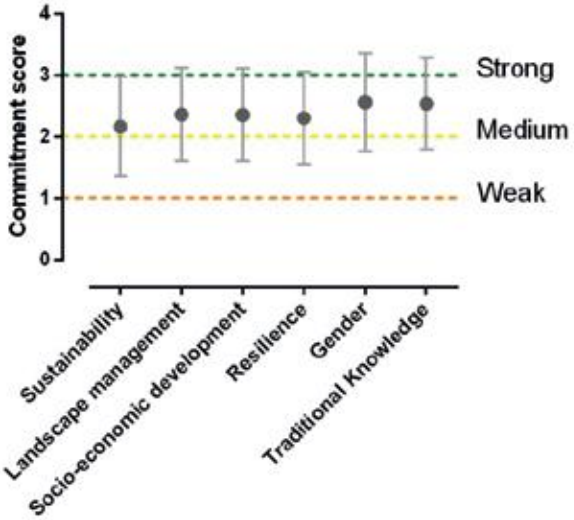


Figure 6. Score of the confidence in the implementation of SEPLS-related commitments according to the perspectives of the Satoyama Initiative to which they will contribute if implemented. Values represent mean ±SD.

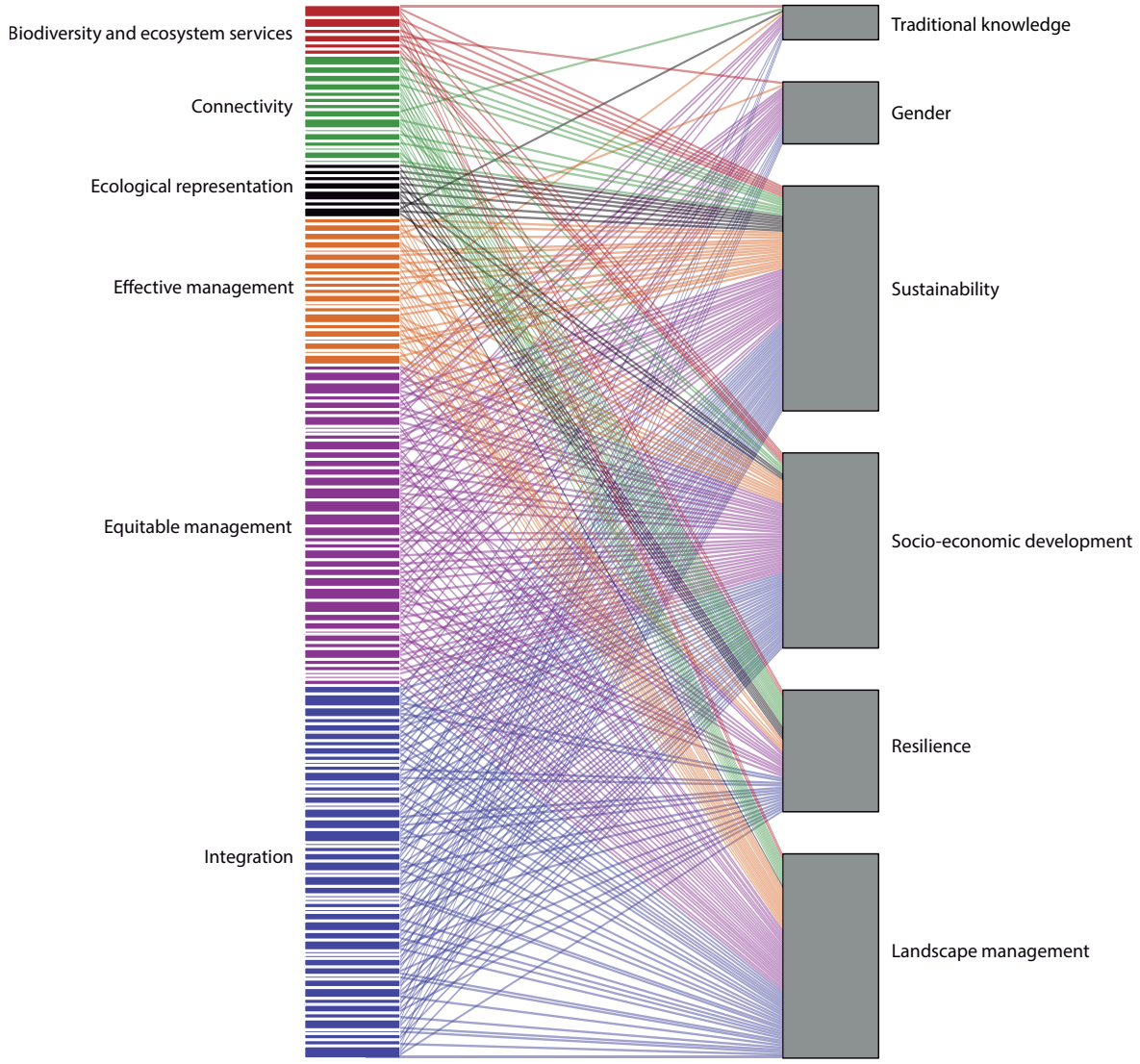


Figure 7. Bipartite network illustrating interactions between SEPLS-related commitments (left) and perspectives of the Satoyama Initiative (right). Commitments were coloured according to their contribution to the elements of Aichi Biodiversity Target 11: biodiversity and ecosystem services (red), connectivity (green), ecological representation (black), effective management (orange), equitable management (purple) and integration (blue).

Satoyama Initiative is highly interconnected (Fig. 7). This result suggests that most of the SEPLS-related national commitments incorporate multiple perspectives of the Satoyama Initiative, and that each of the perspectives are reflected in actions spanning most of the qualitative elements of Aichi Biodiversity Target 11. It further highlights the interconnectivity between the LMMCs' commitments to enhance the qualitative elements of Target 11 and the perspectives of the Satoyama Initiative. This interconnectivity corroborates that these commitments, although not always addressed in explicit language, bear actions that promote the SEPLS vision and, therefore, could be achieved by the implementation of the SEPLS strategies. Implementation of SEPLS-related commitments would result in substantial improvements to the qualitative elements of Aichi Biodiversity Target 11 and support progress towards the 2050 Vision for Biodiversity—a world in harmony with nature.

5. Discussion

To make the achievement of Aichi Biodiversity Target 11 a reality, concerted efforts will be required to facilitate the implementation of national commitments. The second phase of the CBD Secretariat's strategy on protected areas is geared towards addressing this requirement. It includes, among other facets, the identification and mobilisation of relevant regional partners, bilateral and multilateral funding agencies and experts to enable regional implementation support networks for Target 11. These networks will facilitate implementation on the ground and provide technical

support through regular communications with national implementers and relevant stakeholders, and provide capacity development, as well as monitoring and reporting on the progress towards the achievement of Target 11 (SCBD 2018c; Gannon et al. 2017; SCBD 2016b).

It is clear from their commitments that the LMMCs aim to improve the status of protected areas in their countries building upon the call made in the LMMCs' *Carta*. To accomplish this, many national commitments of the LMMCs have specified sustainable production within or adjacent to protected areas. The identified SEPLS-related commitments intrinsically incorporate the overarching vision for a society in harmony with nature, the approach and the main ecological and socio-economic perspectives of the Satoyama Initiative. The intricate network of synergies among Target 11 commitments and the ecological and socio-economic perspectives of the Satoyama Initiative suggest that the LMMCs could make use of the SEPLS strategy as a mechanism to facilitate the implementation of these commitments. This synergistic implementation would contribute to improving the overall status of Aichi Biodiversity Target 11, and especially target protected area integration and equitable management, the elements that require increased efforts to meet the target by 2020.

SEPLS, if managed effectively, can contribute to the integration of protected areas into the wider landscape, seascape, and various sectors. This could occur through the facilitation of landscape planning processes and multi-stakeholder participation, favouring more equitable management initiatives with the participation of local communities, improving management effectiveness by mainstreaming biodiversity across sectors and within communities, facilitating connectivity by reducing the resistance to wildlife movement in the landscape, and conserving areas important for ecosystem services that support sustainable production (Bélair et al. 2010; Plieninger et al. 2014).

These efforts can significantly contribute to improving the livelihoods and well-being of local communities while ensuring the long-term conservation of biodiversity within protected areas. Improving these key qualitative elements of Target 11 can strengthen relationships between conservation practitioners and other stakeholders, in particular with local communities and indigenous peoples, responsible for the management of land and marine resources across the broader landscape and seascape. These efforts could likewise help not only to increase the effectiveness of protected areas, allowing for the management of ecological processes that occur over large spatial scales, such as hydrological processes, pollination, and larval dispersal in marine systems, but also to tackle threats that occur outside protected areas such as fire, pollution and hunting, and address drivers of change that occur at large scales, such as economic, demographic and political factors. For example, Chao et al. (2018) report in this issue significant transformations towards sustainable use of natural resources and restoration of degraded ecosystems around Yangmingshan National Park in Taiwan, following the rebuilding of a SEPLS by the local community. The collective actions of the Gongrong and Ankang communities in applying eco-friendly farming, engaging government officers to strengthen law enforcement, and implementing sewage purification greatly contributed to reducing pollution in the landscape resulting in significant improvement of stream water quality. Chao et al. (2018) also shows that SEPLS mobilize people, in this case, a group of visionary, highly motivated elders in the communities, to help local residents realize the long-term and devastating impacts of land degradation and loss of biodiversity and ecosystem services on their livelihoods and ignite their willingness to make a difference. The SEPLS approach, in this case, has improved the management effectiveness of the Yangmingshan National Park and increased its effective size by integrating large privately owned areas in the surrounding landscape (Chao et al. 2018). The International Partnership of the Satoyama Initiative has a wide network of partners within the LMMCs and has implemented the SEPLS approach in many of these countries. By embracing the network of IPSI partners, LMMCs would have access to funding sources including the Satoyama Development Mechanism (SDM) and the Community Development and Knowledge Management for the Satoyama Initiative (COMDEKS), capacity building initiatives developed by IPSI and a wealth of knowledge, guidelines and case studies to accelerate implementation of actions to reach synergistic goals. IPSI may hold the key and the potential to fill in the gaps and improve progress for the qualitative elements of Target 11 through the goal of establishing, restoring and maintaining SEPLS within and around protected areas.

6. Conclusion

SEPLS are a valuable model for sustainable productive practices which can support the development of mutually beneficial relationships between societies and protected areas. A subset of LMMCs' national commitments to Aichi Biodiversity Target 11 is aligned with the perspectives of the Satoyama Initiative. These commitments are predominantly related to the elements integration and equitable management of Target 11, elements that form the backbone for a harmonious relationship between societies and protected areas and whose progress requires more action to meet the target by 2020. The network resulting from the synergistic links of Target 11 national commitments

with the perspectives of the Satoyama Initiative is highly interconnected, suggesting that implementation of these commitments has the potential to promote multiple benefits. This implies that efforts to mainstream SEPLS to the LMMCs will have the potential to facilitate effective implementation of national commitments for Target 11 and to encourage accounting for the concepts of SEPLS in the national planning process. Taking into consideration the relevance of LMMCs to biodiversity conservation and the challenges to promote sustainable socio-economic development, progress toward implementation of the national commitments through the SEPLS approach will have a global positive impact on biodiversity, contribute to safeguard protected areas in hotspots for conservation and promote societies in harmony with nature through socio-ecological production and sustainable development.

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1 The elements of Target 11 refer to the individual clauses in the language of the target, and include both quantitative elements (at least 17% terrestrial and at least 10% marine coverage) and qualitative elements: ecological representation, coverage of areas important for biodiversity and ecosystem services, connectivity, integration into the wider landscapes and seascapes, and effective, and equitable management (governance and equity).

2 The group of the Like-Minded Megadiverse Countries (LMMCs) consist of: Bolivia, Brazil, China, Colombia, Costa Rica, Democratic Republic of Congo, Ecuador, Ethiopia, Guatemala, India, Indonesia, Iran (Islamic Republic of), Kenya, Madagascar, Malaysia, Mexico, Peru, Philippines, South Africa and Venezuela (Bolivarian Republic of).

3 See footnote 1 for more information.

4 This modified set of perspectives merged "resource use within carrying capacity of the environment" and "cyclic use of natural resources" from the original conceptual framework of the Satoyama Initiative. These are described under a new perspective called sustainability due to the uncertainty in classification of identified commitments. Additionally, gender equality was included as a new perspective in this study in order to add information on how gender is being addressed in the context of SEPLS and Target 11.

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