SATOYAMA INITIATIVE

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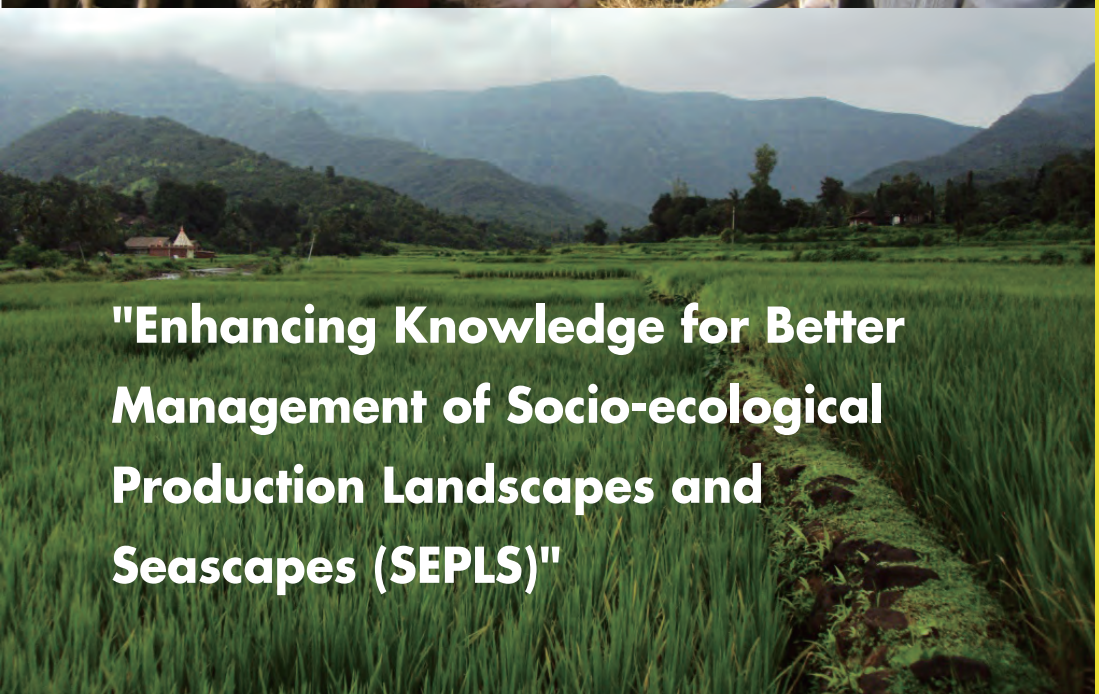

"Enhancing Knowledge for Better Management of Socio-ecological Production Landscapes and Seascapes (SEPLS)"

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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 IPSI, an international partnership of organizations working to realize the vision of the Satoyama Initiative.

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

Through my work in recent years at my own Committee in Ghana and with the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) and the International Partnership for the Satoyama Initiative (IPSI), I have seen the continuing global trends of growing population and food demand, urban development and intensive management of farmland. At the same time, loss of biodiversity is ongoing, and the ecosystem services on which human well-being depend are threatened.

With this in mind, it has become more vital to gather and analyze knowledge on the roles that all forms of ecosystem management can play in conservation, including what we call “socio-ecological production landscapes and seascapes (SEPLS)”. If creating harmonious relationships between the natural environment and human production activities in the landscape is the goal, it will require us to make full use of all kinds of knowledge held by diverse people, from scholars to practitioners working on the ground to the stewards of indigenous and local knowledge.

I am therefore very pleased to see the progress that IPSI is making in collecting and synthesizing case studies from its member organizations. Eleven of these cases have been compiled here, with an emphasis on tools and approaches to enhance knowledge for the better management of SEPLS. These case studies provide key lessons learned from on-the-ground activities, and also offer policy recommendations to develop local capacity for the management of SEPLS, their revitalization and maintenance.

This is the first volume in a publication series, and insights from this and future volumes should not only provide concrete and practical knowledge to contribute to issues such as sustainable farming, livelihood improvement, biodiversity conservation and sustainable use of natural resource, but also contribute to the achievement of the Biodiversity Strategic Goals C and D, the Aichi Biodiversity Targets 11 to 16 and the new Sustainable Development Goals. I look forward to future developments in this project, and to seeing insights contained in this series impact IPBES and other global policymaking processes.

Prof. Alfred Oteng-Yeboah

Chair, Ghana National Biodiversity Committee

Foreword

The United Nations University has long been working with the international community as we try to resolve pressing global problems of development and human well-being. Our institute works closely with the Ministry of the Environment of Japan in the development of the Satoyama Initiative, and 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 in 2010. Five years have now passed, and the partnership's development has been remarkable, with its membership having grown to 172 diverse organizations and its influence also growing steadily at an international scale.

Throughout the evolution of the IPSI partnership, knowledge sharing, including the collection and analysis of case studies, has been one of the key pillars of our activities. The Secretariat has published and shared more than 80 case studies on the IPSI website, and these provide a wide range of knowledge about the contributions of sustainably-managed socio-ecological production landscapes and seascapes (SEPLS) toward biodiversity conservation and human well-being. I am pleased to oversee this new publication series featuring thematic reviews of these case studies. The knowledge contained here, based on IPSI's partners' experiences in the field, seeks a deeper and more focused understanding of SEPLS and their benefits for linking local practices, science and policy.

In addition to the IPSI members, I welcome the contribution from the Institute for Global Environmental Strategies (IGES) in creating this publication. Thanks to their hard work, this publication represents another step forward in global recognition and understanding of SEPLS, and a positive development for international policy-making processes and our institute's mission in contributing to the field of sustainability.

Dr. Kazuhiko Takemoto

Director, United Nations University Institute for the Advanced Study of Sustainability,
Secretariat of the International Partnership for the Satoyama Initiative

Preface

The Satoyama Initiative is “a global effort to realize 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 conservation and revitalization of “socio-ecological production landscapes and seascapes” (SEPLS), where production activities help to 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. The United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS) serves as the Secretariat of IPSI. IPSI provides a unique platform for organizations to exchange views and experiences and to find partners for collaboration. At the time of writing, 172 members have joined to the partnership, including governmental, intergovernmental, nongovernmental, private-sector, academic and indigenous-peoples’ organizations.

As one of its core functions, IPSI serves as a knowledge-sharing platform through the collection and sharing of information and experiences on SEPLS, and provides a place for discussion among members and beyond. More than 80 case studies have been collected and analyzed, and are shared on the website and in the form of various publications, providing a wide range of knowledge covering diverse issues that SEPLS entail. 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 the project to produce the Satoyama Initiative Thematic Review was initiated. The overall aim of the Thematic Review is to collect experiences and relevant knowledge, especially from practitioners working on the ground, taking advantage of their potential for providing concrete and practical knowledge and information as well as contributing to policy recommendations. Each volume of the Thematic Review will compile case studies with useful knowledge and lessons related to a specific theme related to SEPLS, including a synthesis chapter produced to clarify its relevance to policy and academic discussion and to help make lessons learned practical in the field.

For this first volume of the Satoyama Initiative Thematic Review, the theme is “enhancing knowledge for better management of SEPLS”, covering topics regarding ways to identify, collect, document, maintain, exchange, refine, augment and make use of information and knowledge for better management of SEPLS. The focus in particular is on tools and approaches used by and with local communities and other stakeholders to deepen understanding of SEPLS and their management. The volume compiles eleven selected case studies provided by authors belonging to IPSI member organizations. Authors were asked to describe how tools or approaches have been applied on the ground, including both their advantages and challenges, and how such processes promote real action. They present a wide range of experiences of using tools and approaches for dealing with information and data related to SEPLS management in 13 countries (China, Japan, Taiwan, Philippines, Vietnam, Thailand, Tonga, New Zealand, Germany, Turkey,

Kenya, Uganda and Guyana) and in various socio-ecological conditions from mountainous to coastal and from suburban to rural.

The case studies were grouped into different subthemes according to the primary focus of the tools and approaches used. Theme A, “listening to and presenting community perspectives on SEPLS”, focuses on obtaining community perspectives on SEPLS, either by outsiders such as researchers interacting with local communities, or through local communities’ own initiative. These papers show how knowledge has been derived and presented through bottom-up processes. Theme B, “learning from experience”, focuses on tools and approaches that facilitate learning by doing among the participants in projects or activities. These papers demonstrate how organizations can contribute to learning processes by carrying out their respective missions. Theme C, “measuring multidimensional aspects of SEPLS”, focuses on tools and approaches to gather both qualitative and quantitative information to understand different aspects of SEPLS. Whereas papers in Theme A describe more exploratory approaches, papers in Theme C demonstrate more structured procedures for engaging local communities.

This publication was developed through the following process, including both peer review and discussion among authors. The 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 fit and contribution to the theme of the volume. Peer review by the authors of other chapters was then conducted, with each author receiving feedback from two other authors who were requested to check if the manuscript was easy to understand, informative enough, provided useful lessons, and so on. A workshop was then held to enable the exchange of feedback between authors. Here, 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 (Chapter 1) were developed through the presentations and discussions during the workshop, and the chapter was made available for public review before finalization.

We are hopeful that this process offers an opportunity for academic and non-academic practitioners to contribute to knowledge building in an accessible and interactive way as well as to provide quality-assured papers written in simple language for broader audiences. We also hope that this publication will be useful in providing information and insights on sustainable management of SEPLS for practitioners, researchers and policymakers.

We would like to thank all of the authors who contributed their case studies and the other participants in the case study workshop. We would also like to express our special appreciation to Prof. Alfred Oteng-Yeboah (Ghana National Biodiversity Committee) and Prof. Kazuaki Hoshino (Kagoshima University; UNU-IAS), who took the role of facilitators at the workshop. Our grateful thanks are also due to the Ministry of the Environment, Japan for supporting the activities of IPSI and its secretariat, which is hosted by UNU-IAS.

Editorial team (Suneetha M. Subramanian, Kaoru Ichikawa and Ayako Kawai)

Chapter 1

Enhancing knowledge for better management of socio-ecological production landscapes and seascapes: appropriate tools and approaches for effective action

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1. Introduction

"Socio-ecological production landscapes and seascapes (SEPLS)" is a term that has been used to describe spaces around the world where continuous human interaction with nature through adaptation to and modification of the local environment has resulted in sustainable natural-resource use, based on careful observation and accumulated experiences (Gu and Subramanian 2014; Ichikawa 2012; Bélair et al 2010). Sustainable use and management of natural resources in various production activities, including farming, pasturing, fishing, collecting non-timber products and many others, have created landscapes that secure diverse goods and services for people while maintaining biodiversity and ecosystem functions (Folke and Berkes 1998; Duraiappah et al 2012).

The typically mosaic pattern of land and water uses and natural habitats in SEPLS ensures the maintenance of biodiversity, self-contained circulation of resources and thus a sustainable provision of ecosystem services for human welfare. Such socio-ecological systems enhance resilience in the face of various natural and economic risks (Benton et al 2003; Schippers et al 2015; Abson et al 2013) and provide various socio-economic and ecological benefits at multiple scales. As many of the case studies shared on the website of the International Partnership for the Satoyama Initiative (IPSI)[1] show, SEPLS directly support livelihoods in local communities by providing food, fuels and building materials, as well as means of income generation through ecotourism, crafting and value-added products among others. In addition, they provide a variety of cultural and spiritual services. They also support ecosystem functions operating at larger scales, such as water regulation, water and air purification and climate regulation, which in turn contribute to people's health and human security. Proper SEPLS management helps to conserve biodiversity by providing habitat quality and refuge for wild species as well as greater diversity in domesticated species and the livelihoods they support. At the national scale, resilient and sustainable production in SEPLS contributes to national economies while nurturing cultural identities and various other ecosystem services and benefits, thus promoting sustainable development and biocultural diversity.

Significant numbers of these landscapes and seascapes are found all over the world, and although many of them may be in developing countries, they maintain a sustained presence in all types of economies given their links to national income and culture. Continuing and building upon traditional production activities has been shown to improve the diversity, stability and productive capacities of natural systems and at the same time, to ensure livelihoods, access to food and health resources and other social benefits. Even so, despite the high biocultural values associated with SEPLS, many of them are threatened due to changes in use patterns arising chiefly from economic compulsions and mainstream institutions that advocate the use of land and resources for other activities.

Rising demands on land for various alternate uses (infrastructure development, etc.), increasingly lucrative large-scale cultivation practices for huge volumes of homogeneous farm products (monocropping), policy directions shifting away from traditional practices, and changes in local peoples' perceptions regarding the importance of SEPLS are some of the significant drivers that encourage their conversion to other uses (Gu and Subramanian 2014). This affects the functioning of socio-ecological systems, resulting in a decrease in the quality of human well-being and ecological integrity. Such potential adverse consequences indicate that there is a need for

innovative ways of understanding, assessing, planning, monitoring and constantly reviewing the management and revitalization of SEPLS. Given the diversity of issues they face and the biocultural contexts in which they are found, appropriate tools and approaches for each specific situation should be used in such processes. This publication aims to address this need by highlighting results from eleven case studies contributed by IPSI partners.

In this chapter, we summarize findings from a selection of case studies on tools and approaches for enhancing knowledge for better management of SEPLS. In the following section, principles of mechanisms to identify, collect, document, maintain, exchange, refine, augment and make use of information and knowledge are presented, as observed from the different case study examples. This covers quantitative tools such as field data measurement and collection (Chapters 2, 9 and 11), questionnaires (Chapters 9 and 10), literature surveys (Chapters 3 and 10), indicator assessment (Chapters 5 and 12) and participatory mapping (Chapters 2 and 5). It also covers ways to involve local communities in enhancing knowledge, such as community dialogues (Chapter 4), "Farmers Field Schools" (Chapter 7), anthropological research (Chapters 3 and 4) and community-based monitoring (Chapter 2), as well as approaches taken by particular organizations or projects that entail various knowledge-enhancing opportunities involving local communities and citizens (Chapters 5 and 6), for example through daily and continuous interaction and networking (Chapter 8). In many cases, external players such as researchers, NGOs and development agencies are the ones who introduce the tools and approaches to local communities and work with them. But there are several cases where tools and approaches are co-produced or co-developed by communities together with external players or their use is initiated by the communities themselves.

2. What are appropriate tools and approaches?

With the wide variety of tools and approaches available, in order to identify those that are effective for assessing, monitoring and ensuring good management of SEPLS—with "good" meaning that SEPLS continue to provide various ecological and social benefits—it is useful to consider what kinds of outcomes their use would produce. This chapter provides a list of six positive outcomes with examples from the case studies in this volume. It should be noted, however, that although many of the case study examples have contributed to identifying each of the different outcomes, here we only highlight a few per outcome for illustrative purposes.

(1) Value articulation: Tools and approaches can serve as value-articulating instruments, where certain messages are conveyed depending on the kinds of tools used. For instance, an inherent bias towards natural over social systems could emerge if the approach involves only an inventory of biological resources. Furthermore, the use of certain approaches such as participatory and inclusive discussions can lead to building social capital and empowerment, including addressing aspects of income generation, gender equity, building a sense of ownership and enhancing communities' bargaining power.

For instance, consider the work by SPREP (Chapter 9), who combined results gained from quantitative assessment—the Rapid Biodiversity Assessment Program (BIORAP)—and qualitative assessment (socio-economic assessment) to identify socio-ecological solutions. If the focus had only been on the results of the BIORAP, social priorities could have been ignored. The underlying assumption for applying qualitative assessment was that sustainable and equal decision-making in natural-resource management cannot be achieved without understanding the linkage between ecosystem services and human well-being, and that therefore it is important to understand how people value ecosystem services. As a result of this approach, a number of important socio-ecological relationships were identified, which can be reflected in future policy planning. A similar relationship is seen in other cases such as the one from Taiwan (Chapter 11).

On the other hand, SPERI's approach of running a "Farmers Field School (FFS)" (Chapter 7) acts to empower farmers, build their capacity and educate them about eco-friendly farming. The FFS assumes that knowledge needs to be received by, identified with and practiced by the students, so they focus on hands-on practice, learning by doing and face-to-face learning. In the example from Turkey (Chapter 5), the approach used in the Community Development and Knowledge Management for the Satoyama Initiative (COMDEKS) Programme involves promotion of community-based landscape management, aiming to support local communities in adaptively managing their landscape for the long term through various measures for well-being that include both human-nature and human-human interactions. For this purpose, the "Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes" tool was selected since it is designed to engage local communities in adaptive management of natural resources, focusing on various social and development goals, and inherently predisposes the participants towards these concepts.

(2) Knowledge creation: Tools and approaches can lead to better and more comprehensive understanding of SEPLS and even result in knowledge creation. Periodic use of tools in a region can help monitor project performance and establish feedback loops between production actions and results.

Three of the case studies provide good examples: Nature and Livelihoods' case from Uganda (Chapter 10); Bioversity International's case from Kenya (Chapter 12); and SWAN International's case from Taiwan (Chapter 11). The case

from Uganda used literature review, questionnaires and focus groups in local communities in order to identify socio-ecologically integrated landscapes and challenges that communities face in such landscapes. Using participatory tools allowed community members to consider their landscape from a SEPLS-related point of view, and raised awareness and concerns about the landscape. Similarly, the example from Kenya used the "Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes" to understand farmers' perception of resilience. The study concluded that this tool is effective in enhancing knowledge on SEPLS, raising awareness and pointing to future directions. In the case of the study from Taiwan, the researchers compared conventional tea farming and eco-friendly farming in terms of their biodiversity and economic value by combining quantitative assessment and qualitative assessment. This showed that eco-friendly farming was more beneficial for both biodiversity and income generation.

(3) Policy advocacy: Use of tools and approaches can help to keep decision-makers better informed with comprehensive, concrete data and information collected through established and transparent methods. Case studies show that the involvement of the state in such processes can be effective in ensuring better understanding of on-the-ground realities by policymakers.

The case study from Turkey (Chapter 5), for example, showcases a project that has contributed to changes in policy at various scales, such as the setting of "no-fishing" zones and certification of sustainable fish, input into government conservation plans by local community members and scientists, and influence on the regional development plan. In a similar vein, the use of community-based monitoring and information systems (CBMIS) may be considered an effective approach to protect and empower local communities and inform decision-makers. For instance, some traditional occupations in the case from the Philippines (Chapter 2) were officially acknowledged through CBMIS-related action.

(4) Awareness-raising: Increased understanding—of the current state of SEPLS as well as the challenges and drivers of change they face—among different stakeholders, including citizens, can lead to the development of effective strategies for management, and further, to specific actions. This then can also serve as a catalyst to develop the capacities of local communities and different stakeholders to address management and governance of SEPLS.

The case studies from Aichi Prefecture in Japan (Chapter 6), China (Chapter 3) and the Urato Islands in Japan (Chapter 4) illustrate this point. Aichi Prefecture is implementing a three-year project that involves local citizens and the private sector to select native trees, collect their seeds and raise seedlings for further distribution in the region. Through the project, participants learn about the local nature, gain a better awareness of environmental conservation and improve their sense of attachment to the place. The anthropological approach (participant observation, interviews etc.) used in the case study from China brought unexpected positive changes to the local community. Repeated visits by the researchers to the village and their interest in the village's history, ecology and culture began to nurture community confidence and create an enabling environment for relevant activities. The villagers started preparations for eco-tourism, such as re-evaluating and collecting their assets and seeking support from authorities. In the case of the Urato Islands, the initial aim of the research was to understand how SEPLS and cultural assets contributed to the resilience of the local community in the face of disasters, so the researchers applied a qualitative ethnographic approach and conducted community dialogue sessions. These community dialogue sessions, which offered a space for local community members and stakeholders to discuss the future they wanted, turned out to play a positive role in motivating local communities to initiate actions.

(5) Better networking: A well-designed tool or approach should consider the perspectives of multiple stakeholders that can eventually lead to better networking and cooperative action and strategic planning. This can lead to various desired outcomes, such as livelihood improvement, income generation and development of high-value market products, building on the available resources, skills and capabilities of the local population and external players.

The examples from Germany (Chapter 8) and Turkey (Chapter 5) highlight this point well. The Landcare Association Central Black Forest (LACBF) in Germany sees its role as bringing stakeholders together and supporting stakeholders in building win-win relationships. For example, it brings farmers and consumers together and supports building market chains to develop added-value produce. The COMDEKS project in Turkey facilitated various types of communication among and beyond local community members. This allowed fisherwomen to create networks, increase their solidarity and begin to organize themselves to expand their network.

(6) Better understanding of trade-offs and synergies: Tools and approaches can unravel the various trade-offs and synergies that arise in the interaction of activities by different stakeholders, both for ecological and social systems.

The case from Taiwan (Chapter 11), where the biodiversity value and economic value of conventional and eco-friendly farming practices were assessed, demonstrated the longer-term benefits of the latter for both types of value. This was also evident from other approaches, such as CBMIS used by FPP and local partners (Chapter 2), the Farmers Field Schools in Vietnam (Chapter 7), Landcare management that addresses both economic and biodiversity benefits in Germany (Chapter 8), biodiversity and socio-economic surveys used in Tonga (Chapter 9) and others. Each of

these case studies vividly captures the conflicts pertaining to social and environmental parameters that arise while trying to realize different goals in a geographical region. They also highlight how the appropriate choice of tools and approaches can ensure that risks are minimized during the process of achieving these goals.

3. Tools and approaches: selection, design, preparation and implementation

With the understanding that selection and use of tools and approaches affect the ways people understand landscapes, and thus do not have neutral outcomes but rather influence decision-making and advocacy as seen above, we argue that there is a need for carefully thought-out, well-designed and appropriate choice of tools, their preparation and implementation. The following principles were extracted from the experiences of the authors in this publication for consideration when using the tools and approaches to ensure desirable outcomes relating to management of SEPLS.

Selection and design of tools and approaches:

(1) Select and design tools and approaches to fit into the local context.

One way to ensure a good fit with the local context is to choose flexible tools and approaches that can be adjusted and customized for local needs. Sometimes, collaborative production of new tools can be helped based on experiences with existing tools. This also allows further development beyond existing tools, even prompting collaborative exercises between disparate actors. *For example, while the same set of "Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes" was used in Turkey (Chapter 5) and Kenya (Chapter 12), the indicators were modified for each context. For one thing, they were translated into local languages. Furthermore, as some of the terms used in the indicators were considered too technical for local communities, they were simplified and explained in a manner tailored to local contexts and supplemented with relevant examples.*

Another option is to provide a wide range of different tools and approaches from which to choose. *For instance, CBMIS as described in the FPP case (Chapter 2) includes diverse tools and approaches, some of which are technically simple and basic while others are more advanced and sophisticated. Different tools can be selected depending on the particular circumstances in which target sites are found. Several technical global workshops have been held to exchange information on these tools and approaches among practitioners.*

Tools that can capture diverse aspects in the target area can be used for narrowing down issues to further focus on at later stages. This enables scoping of the extent of challenges and opportunities in SEPLS and strategizing on mechanisms for later interventions.

Preparation:

(2) Understand local contexts first.

Listening to local communities to learn their perspectives, issues they face, community structures including traditional leadership, relevant stakeholders and socio-cultural situations is a fundamental starting point. Introducing oneself to the community and building trust is an essential process for obtaining meaningful information, although this often takes time. *For example, in China (Chapter 3) the authors took an anthropological approach, with the lead author spending 75 days in the field, eating and working with villagers and trying to learn the local language. By conducting "respectful fieldwork", they succeeded in building good relationships with the local communities and collected high-quality data and information while assisting the local people in finding solutions to their local challenges themselves.*

Learning from existing literature can also provide extensive knowledge and complement other tools and approaches. *In the case of Uganda (Chapter 10), extensive knowledge was obtained through literature review together with a questionnaire survey, and researchers were able to identify common and differing issues among SEPLS in different sites. The development of the "Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes" also built on previous literature and experience, as seen in the case from Kenya (Chapter 12).*

(3) Find entry points to local communities and ensure wider engagement.

To ensure effective engagement of local communities, it is often useful to find an appropriate person who can serve as a bridge. *In Kenya (Chapter 12), local communities where the "Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes" would be applied were chosen because of the long relationships between the communities and the authors' organization. Recognising traditional leaders and seeking their cooperation was also found to be effective.* For wider engagement, local events such as ceremonial events and regular community meetings can be utilized to help the local community feel more comfortable cooperating with researchers.

At the same time, outsiders may able to help bring together people who do not normally have much opportunity to consult with each other. *For example, in the Urato Islands in Japan (Chapter 4), community dialogue sessions functioned as a space for people from four islands and various stakeholders to gather and discuss various issues related to rebuilding their communities after the natural disasters, most of which had been left largely unspoken.*

This served as an important opportunity for making concrete actions.

To ensure the widest possible participation, and that diverse voices including those of women and marginalised groups are heard, the norms and cultural aspects of the area should be considered. For example, when conducting focus-group discussions it may be better to form separate groups for women and men, according to social conventions.

(4) Familiarize the community with tools and approaches, and make objectives clear.

Any tools and approaches will have strengths and weaknesses. Although their use can provide useful outcomes as shown in the previous section, there are also limitations in merely using tools and approaches without sufficient comprehension of their purpose. Thus, making objectives clear to target communities is necessary to avoid false expectations. *In Germany (Chapter 8), LACBF members clarified options for sustainable land management practices for the local farmers together with their long-lasting benefits, and also investigated possibilities for subsidies and other monetary compensation mechanisms. As the farmers come to understand that the LACBF considers benefits for man and nature, they asked for advice and were willing to put more efforts into sustainable management. In Aichi, Japan (Chapter 6), a technical manual was developed on the native tree seedling project that described details from collection of seeds to raising and planting, with the aim that it would be replicated in other areas in the future and enable the intended users to have clarity on the purpose and outcomes of their actions.*

(5) Sufficiently consider pros and cons of using different tools and approaches.

The implementer or researcher needs to be aware that the use of specific tools and approaches can have different outcomes and consequences. In order to ensure the best potential outcome, it is important to reflect on assumptions relating to the SEPLS as well as impacts. For example, simple and basic tools can be used by large numbers of people, while technical and sophisticated tools might be used to collect more detailed and focused data. Also, if a tool can capture multidimensional aspects relating to SEPLS, it might be difficult to collect detailed information, as it may be time-consuming or impossible to capture specifics. *For example, the "Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes" used in Turkey (Chapter 5) and Kenya (Chapter 12) are multidimensional and useful for holistic understanding, though they do not collect detailed data for any specific dimension. In Taiwan (Chapter 11), quantitative field measurement was employed that made it possible to statistically analyze data on biodiversity, but interview surveys were also conducted to obtain socio-economic information. Both of these approaches have their merits and limitations, showing once again that the choice of tools depends on the purpose or objective.*

Implementation:

(6) Ensure capacity building.

Use of tools and approaches involving local communities in collecting information and deepening understanding of the local socio-ecological environment can serve as a great opportunity for capacity building. It can lead to the empowerment of communities and local facilitators, as well as upscaling of effects beyond the target community. *In Tonga (Chapter 9), a Rapid Biodiversity Assessment Program (BIORAP) was conducted with joint participation by 17 international experts and 18 local Tongan staff members. One of the aims of the BIORAP was to train local scientists and environment officers in biodiversity-survey techniques.*

It is especially important to involve younger generations, as shown in the example from Vietnam *(Chapter 7). Seeing that many minority youths lack access to proper education, SPERI's main focus in its approach is to provide training using Farmers Field Schools (FFS) for ethnic minority youths who have strong ambition and interest but lack financial resources.*

(7) Provide feedback.

Feedback can raise awareness, provide communities with confidence in their activities and traditional knowledge, and facilitate further action. *In the Taiwan case (Chapter 11), the authors presented the farmers with their research results, which showed that their eco-friendly farming practices contributed to biodiversity. The farmers appreciated this, as there had been no report on the local biodiversity in the region for the previous 40 years. They also discussed the need for consensus on a vision for future development and more collective effort, communication and collaboration among farmers.*

Summarizing data and information and making it understandable to local stakeholders and policy- and decision-makers may be necessary as was done in the case of Tonga (Chapter 9), where SPREP created synthesis and documentary materials for presenting key findings and recommendations.

In all cases, there is a need to clarify the ownership and further protection of data coming from application of tools. For example, documenting knowledge and practices of communities on use and management of various resources is an important activity to ensure that such knowledge is not lost, but issues on how to ensure that culturally sensitive information is respected and community claims of ownership over such knowledge is secured need to be addressed.

(8) Feedback cycles: adjust tools and approaches after implementation.

Tools and approaches are part of continuing processes in SEPLS management. As described in the seven principles above, depending on the purpose and context, appropriate tools and approaches should be chosen and designed. Preparation is necessary for effective application, with careful consideration during implementing stages. Lessons learned through this process should then be reflected in any subsequent applications and upscaling activities in the future through adjustment of the tools and approaches.

This kind of feedback cycle also enables users to clarify and resolve challenges that may arise in the course of implementation of tools and approaches. Such challenges might include issues of how to define a community or how to identify the important challenges a community faces. Landscape management can expected to be improved by being informed by enhanced knowledge gained from the use of tools and approaches. In turn, the results of actions should be well analysed so that tools and approaches can be selected and used appropriately. In addition, going through this cycle with collaboration between external agents and local communities can lead to better solutions related, for example, to aligning communities' interests with government policies, or to changing community behaviour and practices in line with the expectations of external actors involved as parts of value chains or as funders of activities within the SEPLS.

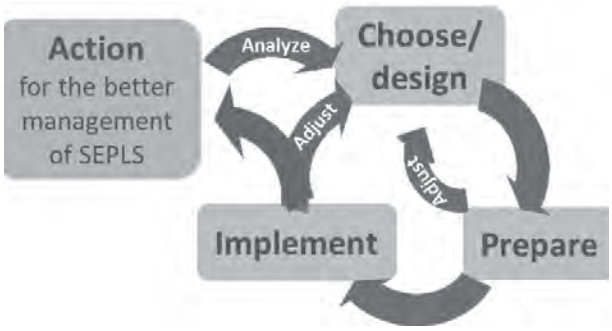

Figure 1. Feedback cycle for better use of tools and approaches. Note that adjustment of tools and approaches can occur at any time from preparation to after implementation, while in order to choose and design appropriate tools and approaches, current local conditions including results of actions already undertaken should be properly analyzed.

4. Conclusions

SEPLS are highly contextualized production areas that are rich in resources and cultural values. While several broad principles bind the kinds of activities that occur in SEPLS around the world, they are individually characterized by customs, norms, political factors and ecological conditions. While there is a growing awareness that such systems are vital to achieving biodiversity and development goals concurrently, a lot of thought needs to be given to the mechanisms to be deployed to promote and strengthen them. For this reason, enhancing knowledge on SEPLS, including their ecosystem functions, production systems, local culture and governance is a critical process in order to effectively manage SEPLS. Visualizing, assessing and monitoring the impacts of strategies and actions requires sensitively approaching and working with communities in these landscapes and seascapes and the use of appropriate tools and approaches to achieve desired outcomes. Community priorities related to their welfare are multi-dimensional, and the deployment of any tool or approach to understand or improve livelihoods and natural-resource management needs to be comprehensive and inclusive.

The eleven case studies in this volume demonstrate some among the diversity of tools and approaches available for enhancing knowledge, their usefulness, and their potential for replication in similar contexts. They are by no means exhaustive, but rather give an overview of directions that various measures (both objective and subjective) by engaging local communities may take to enable assessment SEPLS management and also foster actions to promote and sustain these landscapes and seascapes. There is a wide variety of potential positive outcomes that can be provided by using different tools and approaches, in terms of value articulation, knowledge creation, policy advocacy, awareness-raising, networking and understanding of trade-offs and synergies. One tool or approach cannot provide all of these; rather they should be selected to suit the specific situation and purposes. In any case, the eight elements described in this chapter should be considered during the process of selection and design, preparation and implementation, as they can help lead to effective processes and provide better outcomes in enhancing knowledge for better management of SEPLS. We are hopeful that this volume will engage all interested parties in working towards more focused design and effective implementation of tools and approaches.

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Listening to and presenting community perspectives on SEPLS

Chapter 2

Community-based monitoring and information systems as an emerging toolkit to improve management of SEPLS

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Abstract

This paper focuses on community-based initiatives in socio-ecological production landscapes and seascapes (SEPLS) that relate to the monitoring of the status of, and changes in, ecosystems and related community health and well-being.

In different regions of the world, indigenous peoples and local communities have developed or are developing their own monitoring approaches, based on a mix of traditional knowledge and new or innovative technologies and tools. These approaches are referred to as "community-based monitoring and information systems (CBMIS)".

While generally the first aim of data collection and monitoring is to strengthen the local knowledge base for territorial resource management and community development, CBMIS also increasingly contributes to global assessments related to biodiversity, climate change and development. CBMIS initiatives are quickly gaining the acknowledgement, recognition and support of international policy-makers, conservation and development agencies, and the academe. Key processes that already use and acknowledge CBMIS contributions are the Convention on Biological Diversity (CBD) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).

CBMIS is particularly relevant to SEPLS because of the interaction between humans (indigenous peoples and local communities) and their environment and natural resources, and focuses on SEPLS key issues such as species used as food and medicine, documenting and monitoring the effects of land and resource-use practices, and monitoring of customary rules and norms.

Keywords
Community-based monitoring, customary sustainable use, indigenous peoples, Convention on Biological Diversity

1. Introduction

This paper focuses on community-based initiatives in socio-ecological production landscapes and seascapes (SEPLS) that relate to the monitoring of the status of, and changes in, ecosystems and related community health and well-being.

In different parts of the world, indigenous peoples and local communities are developing their own monitoring approaches, based on traditional knowledge and holistic views of people and environment, often using and adapting new technologies and innovative approaches (see section on methodology). As a result of efforts to get together and share these experiences, a network on community-based monitoring and information systems (CBMIS) has formed over the past two years. CBMIS is understood as "the bundle of monitoring approaches related to biodiversity, ecosystems, land and waters, and other resources, as well as human well-being, used by indigenous and local communities as tools for their management and documentation of their resources [1]."

One key process that has already acknowledged CBMIS contributions is the Convention on Biological Diversity (CBD). The fourth edition of its flagship publication, the Global Biodiversity Outlook (GBO-4)[2], released in 2014, included a number of examples based on CBMIS. Recent Decisions adopted by the Twelfth Meeting of the Conference of the Parties to the CBD (COP-12) also stressed the importance of CBMIS in monitoring the implementation of the 2011-2020 Strategic Plan for Biodiversity and the achievement of the Aichi Biodiversity Targets (see results section).

CBMIS is particularly relevant to SEPLS because of the interaction between humans (indigenous peoples and local communities) and their environment and natural resources. CBMIS is applied for a wide range of research topics, based on the priorities of communities, including issues key to SEPLS such as:

- species used as food and medicine, food security and livelihood issues;
- status and trends in traditional languages and occupations;
- status and trends of flora and fauna;
- documenting and monitoring effects of land- and resource-use practices (e.g. use of fire, selective harvesting, rotational farming);
- monitoring of customary rules and norms that govern natural resource use and management practices;
- land use and tenure issues and external pressures on SEPLS in indigenous territories, including reporting and monitoring of degradation, illegal activities, pollution, etc.

Generally the primary aim of data collection and monitoring is to strengthen the local knowledge base for territorial resource management and community development. However, the contribution of case studies and complementary data for monitoring of progress towards international targets and agreements is an important added value of CBMIS initiatives, which is gaining increasing acknowledgement and support from international policy-makers, conservation and development agencies, and the academe.

With CBMIS's local (micro) level focus, and the profound knowledge and connection to the areas being monitored, indigenous peoples and local communities can make important contributions to national and global assessments and monitoring initiatives that are carried out at larger scale, especially in areas where other organizations do not have the capacity to collect detailed data.

2. Methodology, tools and sample cases

CBMIS is very diverse and can range from technically simple and basic to technologically advanced and sophisticated. Some of the methodologies and processes that have been presented so far in the network include community mapping, resource inventories, eco/agri-calendars, biodiversity registers and other community-based biodiversity monitoring (CBBM) approaches. The tools being used include questionnaires and forms (hardcopies), cameras, GPS, video, smartphones and tablets, community radio, measurement kits (for water and soil samples and for carbon storage calculations), and people's oral testimonies. Many communities work with selected software to link their data to maps and computer databases. There are currently many free or cheap (open-access) web-based tools available that communities can consider using (e.g. EpiCollect, Sapelli, ODK, GIS Cloud, OpenStreetMap) (Ferrari et al. 2015), depending on their priorities and needs.

Several technical global workshops on CBMIS have been organized since 2013 to exchange information on tools and methodologies. These have been much appreciated by the practitioners involved and the process is expected to continue in order to consolidate approaches, develop a toolkit that communities can use and adapt, and to develop ways to aggregate data from the ground up.

Community-based mapping has been recognized as a very important tool for documenting and monitoring trends in land use. Participatory videoing is another initiative some of the communities have taken (for instance in Cameroon) to document land use changes.

The following are a few selected examples of CBMIS.

Case study 1: Holistic land use management and monitoring systems of the Ngati Hine people, Aotearoa, New Zealand

The Ngati Hine people of Aotearoa, New Zealand, headed by the Maori community-based organization Nga Tirairaka o Ngati Hine, are facing environmental problems affecting their territory, including intensive farming with chemicals, deforestation, and change in land use from hunting and gardening to agriculture and exotic forestry. To address these problems, they decided to establish a monitoring framework to keep track of resource use and changes in their territory. The monitoring framework is not merely based on ecosystems, but on people's cultural and spiritual identity, particularly the realms of gods and goddesses that relate to biodiversity. These include: water; earth, soil, minerals; cultivated foods; forest trees, plants, birds; ocean water, marine fish; coastal tidal zone, shellfish; and berries, mushrooms and edible plants. In the monitoring framework, all species are considered to be equally important and dependent on one another – so all species are monitored. (For example, within the freshwater realm of Tangaroa, 45 attributes of the river are monitored and recorded. A monthly programme is run based on the Ngati Hine moon calendar, which provides a timeframe for recording each attribute. Local guardians monitor their assigned areas at least once a month with the aid of tablets and a specific GIS software (GIS Cloud), testing the calendar and adding to it. They record data, monitor and control invasive species and coordinate enhancement work (e.g. riparian planting or clearing obstructions for longfin eels, a significant species for the Ngati Hine who help the eels to swim past the waterfalls during their migrations)). The Ngati Hine put together databases on species of significance, focussing on those that are no longer sustainable for customary use as medicine or food. For example, in relation to the vulnerable kiwi bird, the Ngati Hine work to control pests and plants that are poisonous to kiwi and ensure it has enough food. Youth are actively involved as monitoring activities are used as a way to transfer and apply traditional knowledge on biodiversity. Information is uploaded into a database and

further actions are discussed in joint meetings.

Figure 1: traditional eel storage (Photo by Cilla Brown)

One of the key outcomes of this community monitoring initiative is that it informs collective action on environmental restoration, water allocation and pest control. This has a direct positive impact on local ecosystems and communities. The government recognizes the quality and importance of the work by this community and provides financial assistance for research on species of national importance.

Case study 2: Monitoring of carbon storage through rotational farming, Thailand

The Indigenous Knowledge and Peoples Network (IKAP), a regional network of indigenous communities throughout Mainland Montane Southeast Asia, has as its primary goal the protection, promotion and enhancement of the practice of indigenous knowledge. The IKAP carried out research in three areas in Chiang Mai province where rotational farming is practiced. The research illustrated that rotational farming (or shifting cultivation) is a highly sophisticated agro-forestry practice where a selected patch of land is cleared and its vegetation dried and then carefully burned. Then the land is cultivated, and after harvesting left fallow for a long period (generally 7-10 years) to regenerate. All this is carried out based on a deep cultural and spiritual relationship between the people and the environment and in accordance with customary rules and regulations.

Unfortunately, rotational farming is often misunderstood and blamed for forest fires, release of carbon into the atmosphere, and forest destruction. The community research addressed this issue. Community monitoring of Karen farming areas in Mae Lan Kham and Hin Lad Nai (Trakansuphakon 2015) using a stock-based approach to analyze above-ground carbon, showed that rotational farming stores much more carbon than it emits. The net carbon storage from fallow fields, covering 236 ha and left to recover for up to 10 years, accounts for 17,348 tons C, while CO2 emissions from the burning of fields amounts to only 480 tons C.[3] The research also documented a large number of edible plant species that grow (or are grown) in each successive year during the 7 to 10 year fallow period, all of which significantly contribute to food security and sustainable livelihoods, as well as diverse species of fauna that find food in and are attracted to the fallow plots.

Figure 2: Young local researchers from Mae Lan Kham collecting data to measure carbon sequestration in a year 5 rotational farming fallow site. They measure tree growth and related biomass to calculate the amount of carbon absorbed during each year of the fallow period (7-10 years) to compare with the amount of carbon emitted during the burning season. (Photo by IKAP)

This community-based research and monitoring activity illustrates the positive contribution of rotational farming to people's livelihoods, biodiversity, carbon storage and to the revitalization of traditional knowledge and cultural identity. It has also contributed to changing the perspectives of government and media and to the adoption of a Thai Government Cabinet Resolution for the Revitalization of the Karen Way of Life in 2010 and its subsequent implementation, thereby providing policy support for the maintenance and revitalization of a particularly important example of SEPLS in Northern Thailand.

Case study 3: CBMIS in Tinoc, Ifugao, Philippines

Tinoc is one of the pilot communities of the Philippine Traditional Knowledge Network (PTKN), where community-based monitoring of traditional knowledge is being conducted using multiple indicators including linguistic diversity, traditional occupations, land tenure and land use change.

Data generated includes cultural mapping of multiple land and forests uses, documentation of customary tenure systems, traditional occupations, status of traditional knowledge holders and cultural transmission. Status of flora and fauna, productivity of major crops and soil fertility have also been investigated. Some findings include: contraction

of watershed forests to 60% of their size in 1970 due to conversion to vegetable farming, and up to 30-50% decline in rice yields due to weakening of traditional knowledge on soil enhancement practices, as well as increased pest damage due to veering away from traditional pest control such as synchronized farming activities.

The information gathered through the project is being used to stimulate community action on conservation, sustainable use and customary governance over lands, forests and waters. Plans have been developed for revitalizing traditional knowledge and strengthening customary practices and law, including:

- biodiversity management plans;
- demarcation of protected watershed areas;
- strict controls over the privatization of common lands critical for community, well-being and biodiversity;
- assisting with forest regrowth; and
- shifts from chemical-input farming to ecological/ sustainable farming.

The information has been shared with local and national governments. It has led to the adoption of a covenant (by the local community and local government) to arrest environmental degradation and promote people's well-being through the revival of indigenous knowledge practices and systems of territorial management.

Drawing on pilots such as activities in Tinoc, the Philippine Traditional Knowledge Network (PTKN) and Tebtebba Foundation submitted a list of traditional occupations to the Philippine National Statistical Coordination Board (PNSCB) for consideration in the revision process of the Philippine Standard Classification of Occupations (PSOC). This resulted in the incorporation of some of the submitted traditional occupations. The PTKN also coordinated with the National Focal Point of the CBD on updating the National Biodiversity Strategy and Action Plan (NBSAP) and associated traditional knowledge indicators (TEBTEBBA 2013).

Case study 4: Wapichan people monitor their territory

The Wapichan people (composed of 17 communities) in Guyana, have successfully developed a community-based management plan (Forest Peoples Programme 2012) in 2012 for use and care of lands and natural resources in their territory (composed of a mosaic of forest and savannah habitats). They are now setting up an environmental monitoring programme to monitor environmental changes in the territory (forest cover, water quality, threatened species, land use, etc.), and to inform traditional authorities about activities that are, or may be, harmful to the environment and the communities. This information is then used in dialogue with relevant government authorities, for instance in relation to proposed or existing mining and logging concessions.

The information is also intended to support a Wapichan application for a collective land title over their customary territory, using photographic and geo-referenced evidence of traditional use. From 2013-14 a start was made with the training of two community monitoring teams, including customized design and testing of community monitoring forms (on smart phones), field monitoring trips, and trial use of an Unmanned Aerial Vehicle (UAV) to monitor extractive activities in remote areas of their territory. The Wapichan are currently developing a community-owned website which includes an interactive map with all mapping data and locations. This is expected to be made public after the pilot-testing.

Figure 3: A member of the Wapichan land and forest monitoring team piloting the use of an unmanned aerial vehicle (UAV) to monitor land use change in remote areas of the Wapichan territory. (Photo by Digital Democracy – Gregor MacLennan)

The development and implementation of the territorial management plan and the setting up of an environmental monitoring programme (including the choice of monitoring tools) have taken place through hundreds of intra- and inter-community meetings, workshops and agreements. While many challenges lay in front of them, the Wapichan are proudly looking forward to a sustainable future for their communities and landscape.

3. **CBMIS Results (to date)**

Results of CBMIS are starting to be realized at the local, national and international level. At the local level, the primary aim of data collection and monitoring is to strengthen the local knowledge base for territorial resource management and community development. In this respect, local communities are using the data for their own strategies and to address their needs and aspirations. In all the cases above, the development of community-based research and monitoring activities has contributed to strengthening the institutional capacities of local communities and to developing concrete activities to protect and sustainably use their territories and resources.

One of the most common tools used has been community mapping. Maps produced by the communities demonstrate their traditional occupations and customary

use of resources in their territories and are often used as the basis of a territorial defence strategy. They are likewise used as a tool at the local and national levels to assert more secure land and resource rights and to support the communities in dialogue and negotiation processes with outsiders who want to access forests traditionally inhabited or used by them. For example, community maps have contributed to renegotiation of protected area management plans in Cameroon and Thailand, exposure and monitoring of illegal logging in Cameroon, and negotiation with mining and logging companies in Guyana, Suriname and Cameroon (Forest Peoples Programme 2011). In more recent years, they have also been used as the basis for territorial sustainable development planning, as illustrated by the Wapichan case in Guyana.

Outcomes also include a better understanding and appreciation of indigenous practices (such as rotational farming, which is still the subject of much dialogue and debate), overcoming biases toward and incorrect assumptions about indigenous practices and land use patterns, and a better understanding of the sustainable nature of various customary practices by indigenous peoples and local communities – for instance subsistence hunting versus illegal poaching, hunting or fishing. Community-based documentation has demonstrated that indigenous areas (including SELPS) are not open-access areas, but regulated commons, based on collective ownership and use, and have their own effective ways of governance, management and monitoring, based on customary rules and laws. Some of the communities have been able to influence policy and legal reforms through the data and information produced. As illustrated in the second case study, in Thailand, for example, work on the relationship between cultural identity and customary natural resource use (particularly rotational farming) has contributed to the adoption by the Thai Cabinet of a Resolution for the Revitalization of Karen Way of Life in 2010 and for consistent implementation of the resolution. In the Philippines, as a result of monitoring work at the local level, the Philippine Traditional Knowledge Network (PTKN) and Tebtebba Foundation became involved in review and revision of the National Biodiversity Strategy and Action Plan.

Community efforts have resulted in greater appreciation and support also at the international level, to date particularly related to the CBD and IPBES. A Decision at the COP12 meeting (October 2014) welcomed the initiatives and contributions from the CBMIS network[4], and the 8th Meeting of the Working Group on Article 8(j) and Related Provisions referred to CBMIS as "a significant initiative to complement data being generated through national reports and through other means about the implementation of the CBD Strategic Plan"[5]. Parties at SBSTTA-17 also noted that "citizen and community based initiatives have an important and growing role to play in helping deliver in-situ monitoring". It was likewise noted that "local knowledge and monitoring efforts are often a critical source of information, complementing scientific approaches and frequently covering different temporal and spatial scales. Respect, trust, equity and transparency are essential for enabling monitoring that draws on combinations of indigenous, traditional and scientific knowledge systems"[6].

The 4th Global Biodiversity Outlook (GBO-4, October 2014) complete report, executive summary, and technical background papers included a number of CBMIS case studies and information based on community-based research and materials, and suggested actions in support of community-level initiatives and contributions. At COP12, the CBD also took a very important step in recognising and supporting customary sustainable practices of indigenous peoples and local communities by adopting a Plan of Action on Customary Sustainable Use[7]. Emphasis will now be on implementation of the plan and CBMIS can certainly play a role in both implementing the plan and monitoring progress up to 2020 and beyond.

The IPBES process is another example of a global assessment process that has embraced CBMIS to balance the conventional science bias. The IPBES has formed a Task Force on Indigenous and Local Knowledge to develop and test approaches and procedures for working with different knowledge systems, although the task force is still in the initial stages of work.

CBMIS approaches and methods have also begun to be acknowledged for their effectiveness and level of sophistication by independent academic institutions. Recent research (Finn Danielsen et al., 2013) to assess monitoring possibilities for the Convention on Biological Diversity 2020 indicators, and those of 11 other international environmental agreements, concluded that of the 186 indicators in these 12 environmental agreements, 69 (37%) require monitoring by professional scientists, whereas 117 (63%) can involve community members as "citizen scientists". The research further concluded that promoting "community-based and "citizen-science" approaches could significantly enrich monitoring progress within global environmental conventions"(Finn Danielsen et al. 2013). Similar analyses by the same research team, published in the journal Ecology and Society, showed that communities living alongside the world's tropical forests can estimate an area's carbon stocks as effectively as hi-tech systems, and that local communities are able to monitor forest biomass up to the highest standards of the Intergovernmental Panel on Climate Change.[8]

4. Expanding the reach of CBMIS: discussing a potential journey

Monitoring activities by communities at the local level have taken place for a long time. However, the recent focus on CBMIS has helped heighten the role that community monitoring can play at the local, national and international level. At the local level, CBMIS is likely to be used by

indigenous peoples and local communities to monitor and take action on issues identified by them as important and relevant. At the national level, CBMIS can contribute to national monitoring, assessments and reporting related to any relevant process (e.g. NBSAPs and implementation of the UN Declaration on the Rights of Indigenous Peoples). At the international level, while so far CBMIS has been acknowledged and recognized in the CBD and IPBES, there is clearly a natural potential for expansion to other SEPLS-relevant processes.

This year the UN General Assembly will agree on a global transformative agenda on sustainable development with the vision of "leaving no one behind." Equally important to the post-2015 sustainable development plan will be the monitoring and accountability mechanisms being established to benchmark progress and inform further action for implementation. To date, efforts have focused on the UN Statistical Commission and government actions to monitor progress, but the "Data Revolution" concept[9] promoted by Secretary General Ban Ki-Moon raises the potential for widespread citizen involvement in this crucial activity, with tools being available for widespread data generation, management and use. Likewise, in December 2015, the UN Framework Convention on Climate Change is expected to adopt binding commitments on climate change mitigation and adaptation. The CBMIS network already includes communities working on climate mitigation; therefore, CBMIS could be well poised to contribute to monitoring the implementation of post-2015 climate commitments. While these are possible options, they would require support for CBMIS as a complementary method to national statistics and global monitoring systems, as well as collaboration with relevant research institutions.

Expanding the application of CBMIS presents both advantages and challenges. While the advantages of CBMIS at all levels are obvious from the above sections, CBMIS is also facing a number of challenges. Working with multiple knowledge systems is not a simple task. Not all conventional scientists agree that citizen science and local knowledge should complement their data and research, pointing at methodological differences regarding peer-review and empirical testing, differences in scope and level (micro to macro) and the potential for data disaggregation and aggregation. On the other hand, working with and using traditional knowledge brings up questions related to intellectual property, free, prior and informed consent (FPIC) and benefit-sharing for local groups feeding into global assessments and contributing valuable knowledge and time. We propose that the key is building trust and mutual respect and understanding among different knowledge systems. Dialogues have begun between different knowledge holders to investigate potential ways of working together.[10]

Another challenge is the concern on the part of community organizations already engaged in community-based monitoring initiatives regarding the potential for a steep increase in the demands/requests placed on indigenous and local community networks or groups, many of which are struggling to find funding or support for their local-level work. The priority from the community's point of view is resource mobilization to continue and carry out their monitoring and data-gathering work. Many communities face daily threats and are in need of increased financial and technical assistance. In this regard, it should be noted that technical assistance for CBMIS can take various forms and shapes. In some cases, indigenous peoples or local communities develop technical capacity internally and only rely on very specific and limited advice from outside (e.g. case study 1). In other cases, support from, and collaboration with, indigenous organizations operating at the national or subnational level (e.g. case study 3) or national or international NGOs (e.g. case studies 2 and 4), is involved. However, it is most important that the indigenous people or local community retain control over decision-making and the outputs of the CBMIS process.

5. Conclusion

While monitoring activities by communities at the local level have taken place for a long time, the recent initiative of a network of indigenous peoples and local communities to focus on CBMIS is heightening the role that community monitoring can play at local, national and international levels. The case studies demonstrate how CBMIS can be used to take stock of resources on the ground and of community well-being, to protect communities and the resources on which they depend from unwanted external pressures and potentially unsustainable activities, to support communities in developing, implementing and monitoring their own territorial management plans, and to contribute data and information to national environmental and development processes, thereby participating more effectively in them. CBMIS is also emerging as a useful toolkit in monitoring implementation of international commitments and national targets. While the CBD and IPBES have already taken significant steps to acknowledge and support CBMIS, there is clearly a natural potential for expansion to other SEPLS-relevant processes, such as the post-2015 Sustainable Development Goals and the climate change commitments expected to be agreed upon in December 2015. While a number of challenges are emerging, CBMIS initiatives have the potential to become important complementary data sources for global, regional and national assessments relevant to biodiversity, climate and sustainable development and for monitoring implementation of international processes and agreements. Most important of all, however, is that CBMIS tools should remain controlled by, and useful to, indigenous peoples and local communities on the ground in their daily lives.

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[1] See UNEP/CBD/WG8J/8/9

[2] See http://www.cbd.int/gbo4/

[3] See UNEP/CBD/WG8J/8/INF/11

[4] For instance Decision XII/12, para 6: "Welcomes the work carried out under the Working Group on Indicators of the International Indigenous Forum on Biodiversity and other international organizations, in particular the Community-Based Monitoring and Information System approach, to operationalize the indicators on the status of traditional knowledge, innovations and practices and customary sustainable use of biological diversity, to assess progress towards implementing the Strategic Plan for Biodiversity 2011-2020 and achieving the Aichi Biodiversity Targets".

[5] See Document UNEP/CBD/WG8J/8/L.2 (Progress report on the implementation of the programme of work for Article 8(j) and related provisions and mechanisms to promote the effective participation of indigenous and local communities in the work of the Convention).

[6] UNEP/CBD/COP/12/2 (SBSTTA17 report), annex 1.

[7] Decision XII.12, pages 3-10

[8] See http://www.bbc.com/news/science-environment-24713215.

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Chapter 3

Historical changes of co-management and biodiversity of community forests: A case study from S village of Dong minority in China, 1950-2010

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Abstract

The CBD emphasized the important roles of "in situ conservation" and traditional knowledge, while more local participation and benefit sharing may be crucial to achieve the Aichi Targets in the next five years. Co-management of community forests as "community based nature reserves" may become the key to meet gaps in networks among protected areas. Based on seven visits comprised of 75 days of on-the-ground field research, including county-level archives collection, participatory observation, questionnaire surveys, key person interviews and group interviews, this paper compares the traditional and current situation in the status, technologies, and institutions of forestry and biodiversity in the community forest management in S village in south China from 1950 to 2010. It was found that intention toward agricultural production, decision-making rights in community forest management, degree of fragmentation of forest property and forest classification systems, may be key institutional approaches, while land regeneration methods and harvest periods may be significant technical approaches for the management of biodiversity, through which the co-management regime will impact on the biodiversity of the village. Methodological approaches of influencing the co-management, by both coercive government interventions and respectful academic advice, were also discussed to further enhance understanding of external interventions on community-based biodiversity conservation.

Keywords
biodiversity, co-management, community forests, forestry policy, Dong minority, China

1. Introduction

Although protected areas are one of the most important elements for the successful implementation of the Convention on Biological Diversity (CBD) (Adams, 2004; IUCN, 2015), they are understaffed, underfunded and beleaguered in the face of external threats (Le Saout, et al., 2013) and have made some negative impacts on local poverty (Adams et al., 2004). However, many traditional forests scattered in Chinese villages with no staff and few funds have preserved various species as "community based nature reserves" (Liu, Zhang & Zhang, 2012; Luo, Liu, Zhang, 2009; Yuan, Liu, 2009), even in the background of rapid social change, such as growing human populations (Mace, 2014), expanding agricultural land uses (Noble, Dirzo, 1997), increasing urban migration (Klooster, 2013) and the rising market value of plantations (Barlow et al., 2007) during the last 60 years. Although the unique role of indigenous and local communities in biodiversity conservation was recognized (UN, 1992; Berkes, Colding, Folke, 2000; CBD, 2010; Rands et al., 2010), the mechanisms and the effectiveness of community-based biodiversity conservation should be carefully studied on the explanation not only of ownership (Agrawal, Chhatre & Hardin, 2008) but also of governance institutions and behavioral patterns (Rands, et al., 2010). In China, with about three sequential differing trends in state-driven regime changes concerning governing forestlands during the 1950s-1970s, 1980s-1990s, and 2000s, community forests were used and managed by a combination of government and local people at different participatory degrees – referred to as different co-management regimes (Berkes, Geoge & Preston, 1991). This paper attempts to illustrate a case study on different forest co-management regimes in S village, where there are community forests and "community based nature reserves", looking at the years between 1950 and 2010 with great socioeconomic

transformations, in order to find out: Are there any approaches that impact good biodiversity conservation of community forests in co-management regimes?

Section 2 introduces an anthropological methodology for data collection; section 3 analyzes the impacts of approaches to community co-management to understand how the status of biodiversity in the village came about. Section 4 gives a brief summary to show the approaches, and section 5 discusses and concludes what kind of co-management approaches can benefit community forest management as well as biodiversity. Rethinking of the influence of field research on the villagers is also discussed by a comparison with the roles of government in the approaches, to further enhance understanding of external interventions in community-based biodiversity conservation.

2. Methodology

2.1 Site selection and field research

Based on the research project "Traditional Knowledge of Dong Ethnic Group and its Implication to Forest Policy" (71163006) funded by the National Natural Science Foundation of China, the S village was selected as one of the key sites for a grounded study because of its "community based nature reserves" – a relatively large area of Fengshui forest[1] with an ancient stone monument for protection of the natural forest. There is said to be only one complete natural forest with a conservation monument in Hunan province, which is a relatively developed province in China. We, at first, wanted to study these Fengshui forests carefully to see why they could be preserved as a whole in their original states despite interventions in the form of numerous forest-related policies that led to conversions to plantations or degradation in other forests since the year 1949, the foundation of the new China. So from June 2012 to January 2015, we conducted a total of seven visits comprised of 75 days of on-the-ground field research in S village, living, eating and working with the villagers and trying to learn their language[2]. In the field, our team emphasized the principle of helping without disturbing – with the values of respect, equality, nature-and-ecology friendliness, and an aim to understand social locations in the landscape arrangement, details of the history, and meanings in the culture of the village. The schedules, activities/methods, and outputs/effects of the field research are showed in the Appendix Table[3].

Our work in the field resulted in a good trusting relationship with the villagers and the local governments, allowing us to collect reliable field data to make a valid analysis. During these visits, county-level archives on main forestry policy reforms during 1950-2010 and the Chorography of the County were consulted. Questionnaire surveys were administered to 32 households in the village to collect basic information on household resources, livelihood, production, forest management and traditional knowledge at both household and village levels. There were group interviews of elder men to map the boundaries of various kinds of forests (including Fengshui forests). In-depth interviews were also held with key persons, such as the oldest villagers, to obtain information on the history of policy reforms, technical transitions, species and forest changes. The village head was interviewed to obtain information on the current situation and the officials of the county forestry administration were interviewed to understand government-level forestry management. A lot of informal information about the village, particularly the traditional technology, decision-making customs and species important to daily lives, were gathered through interactions with the villagers while the team stayed in the village during the study.

2.2 Description of the study village

S village is a traditional hamlet of the Dong ethnic minority. It is located 26°08'N, 109°30'E; along the boundaries of Guangxi, Hunan and Guizhou provinces of southern China at an average altitude of 1,150 meters above sea level (see Figure 1).

Figure 1 Location of S village in China

According to the Chorography of the County, temperature is 5.8 degrees average in January and 25.9 degrees average in July; the area has above 1,300 millimeters annual rain fall, 1,400.3 hours average annual sunlight, and 298 days of frost-free season. It has nearly 800 hectares of forestland and 60 hectares of farmland, supporting not only 800 people, but also hundreds of kinds of plants and birds, sometimes wild boars and wild goats (Survey data, 2012). Besides usual timber forests, consisting of oriental white oak (*Cyclobalanopsis glauca;* 青 冈 in Chinese), schima superba (*Schima superba;* 木荷 in Chinese), camphor tree (*Cinnamomum glanduliferum;* 雲 南 樟 in Chinese), maple (*Acer amplum subsp. Bodinieri;* 三角楓 in Chinese) and so on, forests also contain some endangered trees such as nanmu (*Phoebe zhennan;* 楠 木 in Chinese), and Chinese yew (*Taxus wallichiana;* 紅 豆 杉 in Chinese)[4]. Nearly all species mentioned above can be found on Houlong Mountain – a piece of the Fengshui forests in S village. It was said that in the past there were more kinds of wild species, especially 50 years ago, than there are currently.

As a traditional Dong minority village, forests have served multiple meanings since ancient times, and there are

some special customs related to forests. For over 300 years, villagers have survived by using self-subsistence paddy farming systems and living in wooden houses. They also believe the Fengshui forests can bring fortune to the community and its people (Liu, Zhang & Zhang, 2012), and thus had an ancient cutting ban for protecting the natural status of the Fengshui forests in effect since the Qing Dynasty. Chinese fir (*Cunninghamia lanceolata;* 杉木 in Chinese) plantations of 20 years can be harvested for the construction of shutters, furniture, and daily necessities. Chinese fir logs of 60 years can be used for coffins. Only in cases where money is urgently required will farmers sell out the Chinese fir plantations. This lifestyle has influenced and molded the meaning of the forests in the villagers' minds, which has gone on to form traditional knowledge for managing the resources for hundreds of years.

With economic and social development dominated by the government since 1949 (Lin, 2007; Wen, 2013), community forests passed through a deforesting and then reforesting process that saw natural forests cut down while artificial forests were expanded. Now, the natural forests form 35% of total community forests, and most of them are located very far away from the core village. The exception is Houlong Mountain, where the forest is next to the core village and functions like a community-based reserve for biodiversity. Population has grown to over two times since 1950, and migrant working has become the main source of income beside agriculture and artificial forestry (see Table 1).

Table 1 illustrates the history in S village of natural forest development and management regime changes. As the regime changed, actions to ruin natural forests rose with great biodiversity loss. The following section will determine what intermediates the relationship between the management regime and forest biodiversity in a common village, and explain the impact mechanism on biodiversity conservation by both government level and traditional community level.

Table 1 Forest, population, and livelihood changes in S Village

Time	Before 1952	1952-1982	1982-2000	After 2000
Regime	Privately owned	Government-based	Household-based	Co-management
Forest	Fengshui forests (about 2%); Unexploited natural forests (formed about 65% but decreasing); Artificial forests (formed about 33% of the forest estate but increasing)			Public Welfare Forests (21%) (including Fengshui forests); Commercial Forests (79%)
Population	About 60 households; 300 persons	(increasing)	(increasing)	191 households; 805 persons (up to 2010)
Livelihood	Agriculture (about 80%), Traditional artificial forestry (about 20%)		Agriculture (20%), Artificial forestry (10%), Migrant working (60%), Others (10%)	

Source: Survey data, and estimated according to group interviews of mapping.

3. Co-management changes and influence on approaches to biodiversity

3.1 Forestry policy interventions and co-management changes

In China before the year of 1949, forests in villages belonged to private persons or clans. During the period 1950-1980, some policies on land tenure reform and people's communes were put in place that improved the collectivization process from the natural resource tenure aspect. All forestlands except state-owned forests regulated by laws were claimed by collectives, and governments as representatives of the collectives had absolute authority to decide on the felling and planting of trees. Especially in 1958-1960 when the "Great Leap Forward" movement[5] was launched, many natural forests were cut down by the commands of governments in order to make steel as the nation pursued a dream of catching up with the US and the UK. However, during the same era, the so-called "3-year natural disaster period" occurred when food was inadequate in rural areas and nearly all villagers went to forests to look for food, many planting grains on forestlands. In 1964, the "Emulating Dazhai on Agriculture" Campaign was also launched and continued until the year of 1978, concerning farming on mountains. This farming on mountains ruined many forests including natural forests.

In 1979, with the start of the "Reform and Opening Up" policy (MacMahon, Zou, 2011), the regime of forest management was preparing to become market oriented. The "Household Responsibility System" (Mullan, et al., 2011) was launched in the winter of 1981 to allocate the right of forest management to households. Households could make decisions in forestry production by themselves. Until 1986 there were no other restrictions by governments on cutting, so a new excessive deforestation was driven by villagers along with escalation of market price. A "logging quota system" was set from 1986 to impose restrictions on households, requiring them to have certificates to cut trees and finish relevant afforestation requirements after felling trees. But natural forests were still broadly destroyed and

reforested with timber species. After grave floods in 1998, the central government began to recognize the ecological function of forests, especially natural forests. Since the year 2000, the county of the S village began to implement a new classification policy of forest management, whereby forests were divided into two kinds: commercial forests and public welfare forests – the latter were determined to include forests beside the national roads, around sources of water, and those in the regions vulnerable to water and soil loss. The area of public welfare forests that cannot be felled covers nearly all the remaining natural forests that were close to villages and roads, and have been subsidized by governments since 2001, with the level of the subsidies improving since 2010 (See Figure 2). There are two kinds of power, from governments and communities themselves, to protect natural forests now.

These above policies impacted community forest management through administration from local governments. To natural forests, the regime for managing village forests evolved from self-management to government-based management, household-based management and then to a kind of co-management. The participatory degree of villagers in making decisions concerning natural forest management ranged from concentrated at first, and then to partially empowered. The following sections of the case study will make clear how the power of government impacted, through re-interpretation by the traditional knowledge, the status of natural forests and biodiversity of the S village.

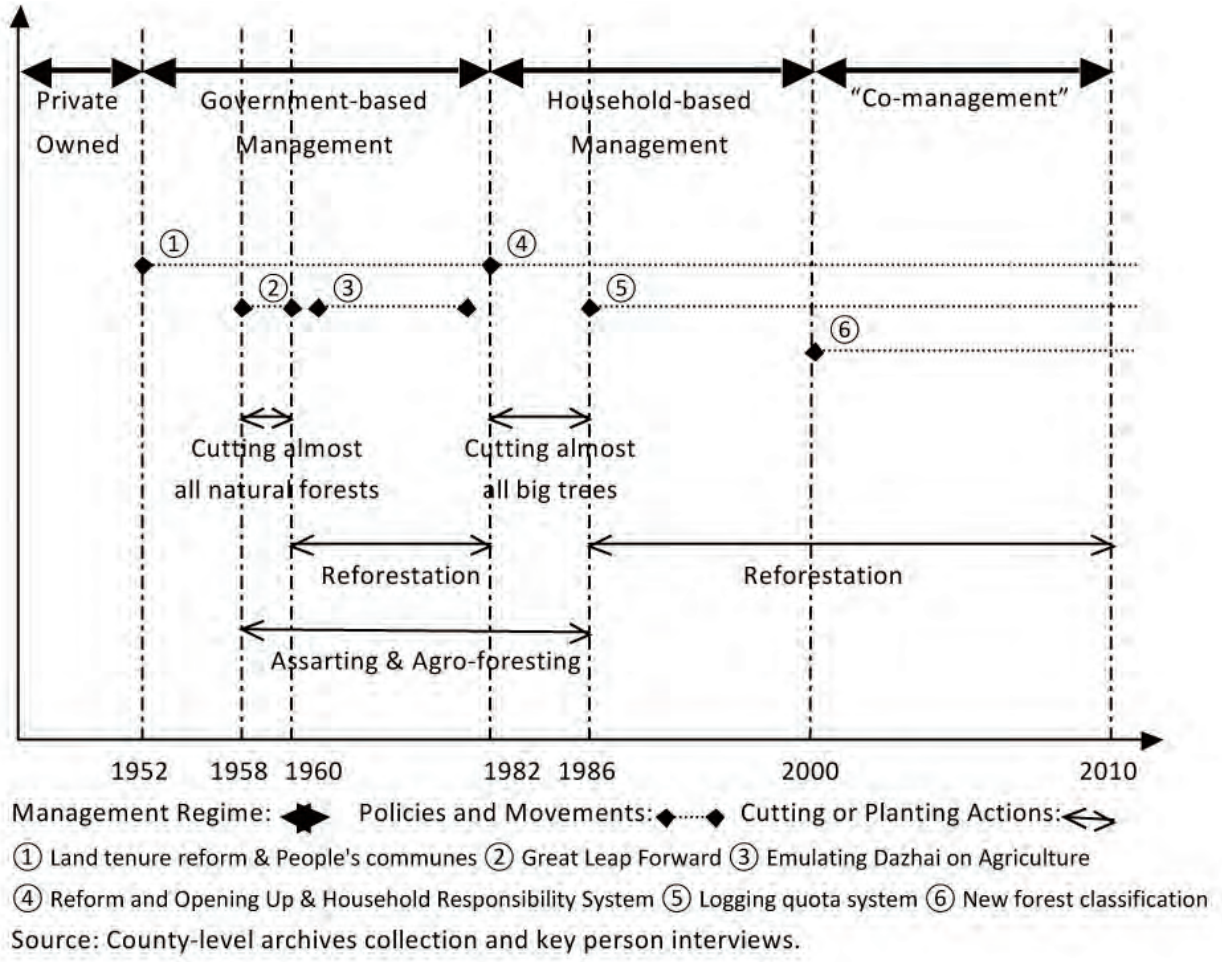

Figure 2 History of Management Regime Changes and Natural Forest Development in S Village

3.2 Approaches based on institutional influence

Community forest co-management may firstly bring institutional change to forestry. There are two types of institutional changes observed in the community forest: property and classification management.

3.2.1 The property of community forests

Before the year 1949 and the establishment of the new China, the community forest was managed by the biggest landowner, who was known as the most powerful and trustworthy elder man in his clan and the village (Luo, 2001). He was responsible for organizing production,

adjusting disputes, doing business on behalf of the village, and so on. The social structure of the traditional Dong village was based on blood relations. Including S village, traditional Dong villages regarded rivers, farmlands and forests as the public property of clans, and every villager had to do as the village regulations and customs required.

After 1949, the management agent became the leader of the village and the production team. Institutionally, forests turned into the resources of people's communes. The government regarded forests as the raw material of industrialization for state construction. In this era, especially the period of the "Great Leap Forward" movement, the intent to industrialize driven by the state caused broad and grave deforestation, to natural forests in particular. Elder villagers reported that tremendous amounts of big trees were cut in valleys, even those which could not be embraced by five people, because of imposed commands from the commune that might result in punishment if disobeyed. Many villagers felt regret that numerous big felled trees rotted because they could not be delivered out of the valleys due to lack of forest roads.

From 1981 the household-contract responsibility system in agriculture was operated, and farmlands were assigned to each household, with the result of basically solving the problem of food and clothing. Then implementation of the "Three-fixes" policy in the forestry area was implemented, and the management rights of the community forest returned to the households. According to household surveys, 15 of 32 respondents cut and planted trees in the 1982-1986 period, comprising an area one fifth of the total reforesting area of the samples. The official of the county forestry administration interpreted, "The forestlands belonged to households, and forestland area per household was relatively small (about 3.4 hectares), let alone to the area per unit (about 0.7 hectares[6]). Because of tiny areas per unit of the forestlands, households would choose to cut more broad-leaved trees to plant more fir or pine trees to make more money, so that most of them didn't care, but cut whatever trees, big or not, on their forestlands." Recently, the criterion for reforesting formulated by the provincial forestry administration was promoted with reforesting subsidies, but if households did not want to gain the subsidies, they might neglect the criterion. Since 1986, the government enforced the "logging quota system". If households wanted to harvest trees, they had to apply for the cutting quota to the local forestry administration. The official would design a cutting plan according to the approved quota regulating the boundaries and the paths of the new forestry road. For the sake of fragmentation management as a result of the "Three-fixes" policy, various forestry roads also made mountains segmented into pieces, potentially significantly affecting the movement of animals (Chen, 1999).

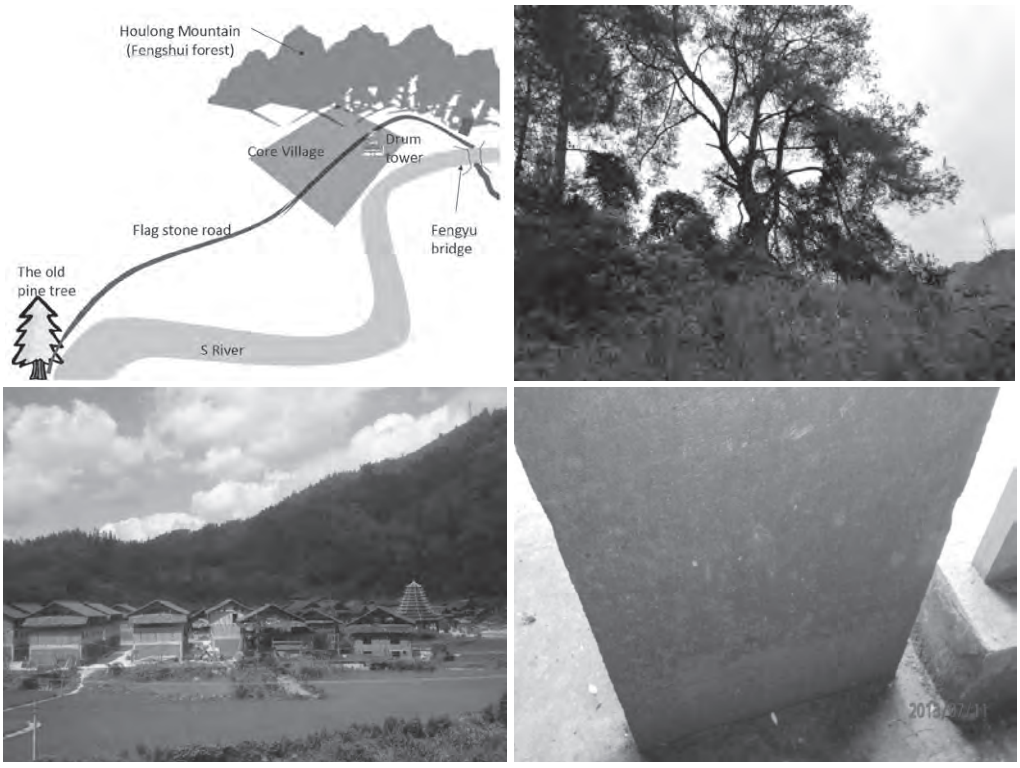

Figure 3 The Fengshui map, the big pine tree, the Houlong Mountain and the stone monument for cutting ban, in S village (Source: the map was drawn by Minghui Zhang according to the group interview of elder men; the photos were taken by Ms. Jeongja, Lee.)

After 2000, 21% of S village's area was classified as public welfare forest, to some extent protecting nearby natural forests and the wholeness of partial forests, and benefiting biodiversity. However, the subsidies seemed not enough to meet the needs of the households of the public welfare forests, even when the amount given was growing. It is said that a staff person of the county administration who was not a villager of S was arrested by the forest police, for he secretly set fire to his public welfare forest on purpose, thinking he could sell the burned trunks of trees for more money legally. Unfortunately, he could only be capricious in the prison after this.

3.2.2 Classification management

Before 1949, use and conservation decisions regarding the resources of the whole village were made by the landlords. The landscape of S Village was designed as a wood raft berthing beside the river, backing Houlong Mountain and anchored by an old pine tree (See Figure 3), so predecessors set conservation rules for preserving the Houlong Mountain and the old pine tree. According to the perspectives of these rules, forests in S village were divided into two parts of Fengshui forests and timber forests. Though the classification system was different from the policies of the state, villagers still obeyed the customs of protecting Fengshui forests during every era.

Predecessors made an oath with blood on the cutting ban of Houlong Mountain and established a stone monument with official characters[7] during the Qing dynasty (1636-1912). Nobody could be admitted to cut Fengshui trees. Villagers believed that the person who cut Fengshui trees would get sick and even die; not only that, the person would have to kill his pig to share with every villager, warning other people to obey the cutting ban[8]. Even during the "Great Leap Forward" era when the government commands were king, villagers made every endeavor to protect Fengshui trees. An elder villager told us that they beat a wok into the trunk of the old pine tree so that it could not be cut down by other workers from the commune. Regarding timber forestlands, traditional knowledge also existed to protect big trees and biodiversity (See Section 3.3).

From 1950 to 1980, external leaders and political campaigns were active, but the villagers tried their best to protect Houlong Mountain. After 2000, the area of ecological public welfare forest was divided by the government without negotiation with the villagers, and the villagers were informed of the results. Houlong Mountain was the ecological public welfare forest. All villagers so agreed, thus no one destroyed Houlong Mountain or argued to possess its subsidies: Houlong Mountain belongs to the whole village, which has been the consensus in the village generation by generation. Now, officials of the county forestry administration have said that there were thousands of kinds of trees, and more than six hundred-year-old ancient huge trees, that are the habitat of many kinds of birds, such as little egrets (*Egretta garzetta;* 小白鷺 in Chinese). The primary school of the S village stood in front of Houlong Mountain for hundreds of years. After school, whatever eras, children were keen to go to the mountain to pick wild flowers, look for honeycombs or seek wild fruits. "Houlong Mountain is a unique sign of the S village," the villagers said to us.

3.3 Approaches based on technical influence

S village, located alongside the Yangtze River Basin, provided timber for the royal house via rivers perhaps since the late Ming dynasty (1368-1644). Over hundreds of years, they formed their unique technology in managing forests. This technology has been partly changed due to the influence of modern knowledge brought by governments during eras. Co-management may also bring technical combinations.

The Dong minority's traditional artificial forests were a kind of farm-oriented forest – from the Qing dynasty, predecessors of the Dong created a set of tree-cultivation technologies, including controlled burning for artificial land regeneration, intercropping with agricultural and forestry plants, forest tending by farming, thin planting and clear cutting (Shen, 2006). Fir trees were the traditional main species of artificial forestry which needed over 20 years to be harvested as timber for building houses, or over 60 years to be used as coffin boards. It was observed that controlled burning and firewood chopping, hole depth for planting trees, and harvest time might have changed after modern interventions.

3.3.1 Controlled burning and firewood chopping

Though controlled burning as a method for artificial regeneration is controversial, the Dong minority has used it for hundreds of years. Employed in a traditional way, fire could not burn down big broad-leaved trees that that ancient villagers preserved. It was even ruled that nobody could cut these wild trees, because, for example, the Chinese bayberry (*Myrica rubra;* 楊梅 in Chinese) might provide fruit for food, the Tung oil tree (*Vernicia fordii;* 油桐 in Chinese) for house painting, and the cubeb litsea tree (*Litsea cubeba;* 山雞椒 in Chinese) for cool relaxing. Including chopping for firewood, elder villagers would not cut big trees. Most elder men believed there were gods in the wild big trees.

But nowadays, mainly due to the smaller fragments of forestland, disenchantment and modern science, as well as more tools that facilitate lower cutting costs, households have usually chosen to cut all the big trees when they prepare soil for more space to plant fir or pine trees (*Pinus massoniana;* 馬尾松 in Chinese) or bamboo (*phyllostachys pubescens;* 楠竹 in Chinese), that can be expected to sell for a good price. Hence, in the timber area as a traditional classification of the community forest, the more "valuable"

species of fir, pine and bamboo remained.

3.3.2 Depth of the hole

Traditionally, villagers thought that there was no significant difference in the depth of holes dug to plant trees in S village, so they usually dug shallow holes for convenience. During the 1980s, an afforestation project in S village supported by the World Bank required villagers to dig a 1 meter* hole for planting a fir tree. Officials of the project even made a mould to measure the holes. The official of the county forestry administration told us that the technology of the World Bank might be better, because the deeper hole was beneficial to loosen the soil, making more humus buried and helping the growth of trees. Furthermore, the trees planted according to the requirements from the World Bank needed only 12 years to reach the harvest period, while ones planted by the traditional method needed 15-16 years or longer. Nowadays, some villagers support the technology of the World Bank; other villagers still consider there to be no distinct gap between deeper or shallower holes, and also consider the costs of time and labor.

3.3.3 Harvest period

The traditional harvest time was usually 20 years for timber and 60 years for coffins. In present day, harvest time is decided by the logging quota system, which gives consideration more to the volume of forest stock, making the harvest time potentially shorter than the traditional one. Regretfully, we have limited knowledge and tools to measure the species and amounts of soil microorganisms to confirm whether or not the shorter harvest cycle influences the quality of soil. A piece of data given by an official of the forestry administration in Jinpin county, where there is also a Dong minority area, showed that this generation of fir artificial forests has revealed degeneration, but it was unclear as to whether the cause was pure forests or the shorter harvest period.

4. Conclusion and lessons learned

4.1 Conclusion: a framework of co-management impacting on biodiversity

Based on the above analysis comparing the traditional and present day in status, technologies, and institutions of forestry and biodiversity in S village, a summary can now be given to show what approaches may influence the role of co-management in biodiversity conservation (Figure 4). Intention toward agricultural production, decision-making rights in community forest management, degree of fragmentation of forest property and forest classification systems, may be key institutional approaches, while land regeneration methods and harvest periods may be significant technical approaches through which the co-management regime will impact on biodiversity. These approaches should be given attention, for management regimes may significantly impact the conservation of biodiversity.

4.2 Lessons learned: stakeholders and biodiversity conservation

Since 1949, the orientation of forestry policies has been changing over several eras, revealing a “centralization - decentralization - co-governance” process in the forestry administration of the state. This process brought different management regime changes of “self-management - government-based management - household-based management - co-management”, which resulted in various conditions of the community forest and biodiversity based on the approaches mentioned above. According to the classical definition by Prof. Berkes and his colleagues,

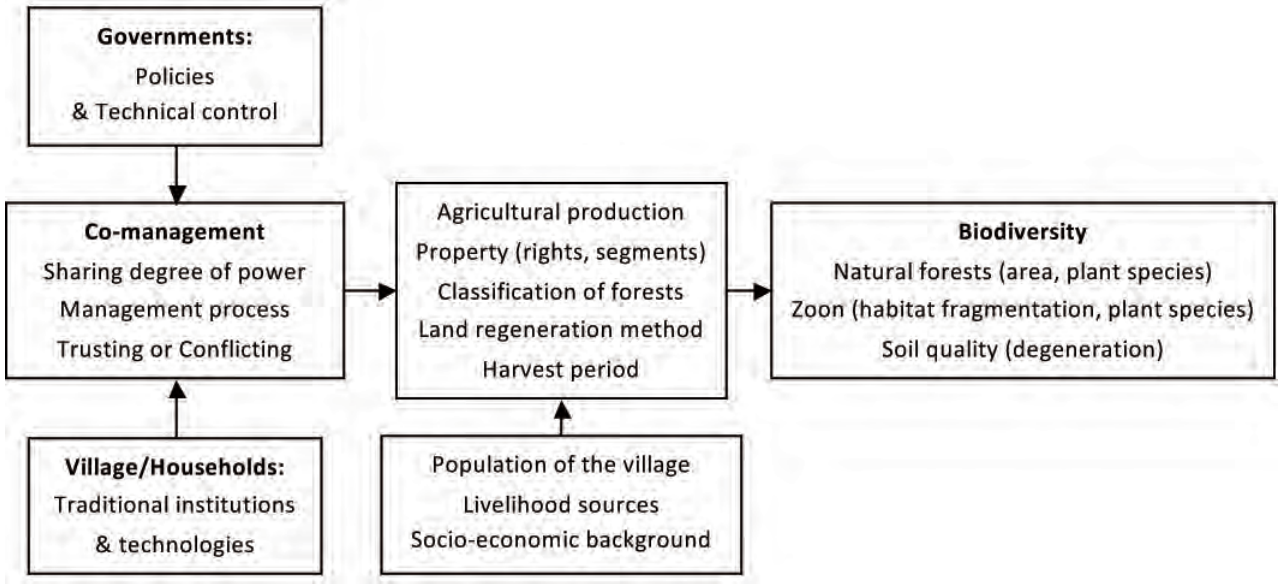

Figure 4 Framework concluded from the case study

"co-management" refers to an approach to governance of natural resources based on the sharing of power and responsibility between the government and local resource users (Berkes, George & Preston, 1991); it should be seen as a process involving extensive deliberation, negotiation and joint learning within problem-solving networks (Carlsson, Berkes, 2005). Based on this concept, there are four aspects that require discussion related to co-management practices and biodiversity in S village in China.

4.2.1 **Coercive external interventions may damage local biodiversity.**

Imposed commands of government may bring about neglect of local traditional forestry knowledge, whereby local biodiversity needs may not be met by external knowledge. The deforestation of 1958-1960 took place in the process of imposed commands by governments, as well as the "Emulating Dazhai on Agriculture" Campaign during 1964-1979, which might have led to a large scale opening up of forestlands (most formed by natural forests) for more farmlands. In these political movements, the traditional decision-making system had no power against the compulsory tasks and commands.

4.2.2 **Weak internal capacity may also result in biodiversity loss after decentralization.**

With the lack of traditional management power, in addition to the shocks of market opening, forest decentralization may fail. The deforestation of 1982-1986 was the result of decentralization with the market opening; the result was the opposite of the general theory of decentralization. The new generation of villagers might be have been familiar with the traditions after facing a lack of traditional forest knowledge for 30 years, and they seemed not to have the emotional attachment to the natural forests, rather pursued the market value. As a result, many broad-leaved trees and the rich diversity of trees were lost due to ruthlessness and ignorance.

Figure 5 Spontaneous landscape protective actions in S village recently (Source: The pictures were taken by the villagers in S village recently. The upper-left is discovery of another ancient monument; the upper-right is a new traditional building for an ecological restaurant; the lower-left is corn harvest of ecological agriculture for the next-year's duck feed; the lower-right is ducks raised by a local ecological method.)

4.2.3 Spontaneous internal capacity building for landscape protection may benefit local biodiversity conservation.

Last year, S villagers were awakened and formed a new self-confidence regarding their village, especially the Fengshui forests – the "community based nature reserves". They now want to protect their Satoyama landscape in order to recover the entire original appearance of the village to make better lives for themselves (see Figure 5). They have begun to repair their ancient objects (e.g. repairing an ancient pavilion of the Qing dynasty, planning to replant various fruit trees beside the core village). They also have gone out to visit other villages to find out about their special attributes and areas of confidence. Likewise, they have set up positive communication with local town and county governments to consult and acquire administrative resources and support, while the governments with pleasure have provided help according to the requirements of the village. Recently, seven volunteer villagers began cooperating to operate ecological agriculture, the idea to manage their landscape in an integrated manner deriving from amongst themselves. They rent a length of the S river and some waste farmlands as well as forestlands along the river, reusing lands for chemical-free farming and raising of free-range ducks, whose products both satisfy themselves and can be sold in the local market. They were also planning to create a brand for the village to absorb outsiders into ecological tourism and insiders into landscape conservation in S village.

4.2.4 Respectful external advice may enhance local concern for biodiversity.

The government and this research team are the same as outsiders, impacting the landscape management of S village. But our approach is different from the coercive interventions in the 1960s and 1970s. We visited as observers and consultants to follow and research the landscape management in the village. Respectful fieldwork can help with collecting data to figure out the reality for researcher, while assisting the local people to make findings themselves. Moreover, as Fischer and his colleagues considered (Fischer, et al., 2014), two sides of "co-management" may not work together toward the same aim. We should pay attention to those tacit, informal institutions on the traditional and community side; Likewise, co-management may be constructive on only one side – in some cases, the community side may interpret the policies and then take action toward natural resources (e.g. the forest classification system in this case); in other cases, the government side may force or form the decision-making conditions (e.g. commands in the year of 1958-1960, and fragmentation of forest property rights). So the divergence may destroy the trust between the two sides, leading to degeneration in natural resources. Hence, as academic researchers attaining trust in the field, we are supported by an independent research foundation and have relative objective and broad insights. As such, we could dedicate ourselves to balancing the divergence and enhancing the local area to gain new positive ideas for management innovations.

Article 8(j) of CBD emphasized the important roles of "in situ conservation" and traditional knowledge, while more local participation and benefit sharing may be the crucial to achieve the Aichi Targets in the next five years (Tittensor, et al., 2014). Co-management of community forests as "community based nature reserves" may become the key to meet gaps in networks among protected areas in aspects of both geographic location and financial matters. According to this paper, regarding future implications for co-management of the community forest and biodiversity, the capacity building of communities on collecting as well as using traditional knowledge to realize community confidence may be the first step.

Regarding aspects for future study, in this paper, areas and plant species of natural forests, the fragmentation degree of forestland and the degree of forest degeneration were used to demonstrate the concept of biodiversity in a community forest ecosystem, for these three variables to some extent reveal the species diversity and richness of plants, zoon and microorganisms in the ecosystem. In the future, if these variables can also be measured by better techniques such as GIS and soil monitoring, with more refined concept measures of co-management and approaches, further research may test this framework by more quantitative and persuasive methods.

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[1] Fengshui (風 水) forests are a kind of forest classified by local people in most places of southern China. Villagers usually arrange a piece of forest by the sides of their houses or core villages as protection screens for certain reasons based on fortune.

[2] The villagers speak the Dong language and Mandarin Chinese.

We can communicate by Mandarin Chinese, but the Dong language is still the native language for them to best express themselves.

[3] While this approach could be considered PRA (participatory rural appraisal) or RRA (rapid rural appraisal), it did not work like that in reality, because our approach was used to merely collect data for understanding the research question and not for some aggressive (or said positive) development or environmental intent. Indeed, we embraced the values of biodiversity, traditional wisdom and nature, but they weren't delivered on purpose. However, the polite actions and respectful communications mentioned in Table 1 brought us good and friendly relations with the villagers, and also reminded them of need to be more and more caring of their Fengshui forests which are unique and valuable in their lives. In short, our research approach unintentionally triggered the villagers to pay attention to biodiversity conservation in their village.

Because their new actions in biodiversity conservation, as mentioned at the end of the paper, were spontaneously started over the last months, it is too early for them to be assessed. Thus, this case only includes the results of our research, which illustrated the effects of biodiversity conservation by villagers themselves in the early history under the interventions of policies. Regarding why they adopted and implemented conservation activities to date, causes may be both related to historical necessity and culture values. We do not think the causes can be explained clearly before we understand the value and the effects of this conservation by community-path.

[4] They all can be checked on the IUCN "Asia Red List", produced by ABCDNet.

[5] The Great Leap Forward was the attempt of China from 1958 to 1960 to modernize by labor-intensive methods and industrialization.

[6] This is smaller than the smallest area of a forest compartment (1 hectare) in the concept of forestry science.

[7] Dong minority has no writing characters. To our understanding, they used the official characters – Han characters (漢 字) – to show formality to villagers and respect to strangers.

[8] The first time, one of landlords let his wife cut a small branch on Houlong mountain, seen by others as intentional, and then killed his pig to give to every villager as a punishment. A pig was expensive to a household and ancient villagers could eat meat only during festivals. So the cutting ban and the punishment took effect as a custom until today.

Appendix Table: Schedules, activities/methods, and outputs/effects of field research

Schedule	Reasons and purposes	Activities/Methods	Outputs/Effects
June-July 2012	To collect and understand basic information on the village	• Participatory observation (living with villagers for about two weeks) • Transect walk • Visit/questionnaire survey at both the village and households levels • Focus group discussion (mapping Fengshui of the village) • Visit/questionnaire survey and in-depth interviews with government-level forestry administration	• Data for 32 households on resources, livelihood, production, forest management and traditional knowledge • Village level data on community and forests situation • Fengshui map • Officials view of the forest management in the village
Jun. 2013	To understand how they allocated forest lands during reform policies	• Participatory observation (living with villagers for about two weeks) • Transect walk • In-depth interviews with key villagers according to the statistics data from last surveys	• Villagers knew and accepted us further • Comparisons among various approaches in allocating forests of each village group • Details of a dispute with a neighbor village
July 2013	To describe and learn the socio-ecological system (SES) of the village	• Participatory observation • Transect walk • In-depth interviews with key villagers according to the last field research	• Map and boundaries of various kinds of forests • Livelihood seasonal calendar (esp. related to forests) • Various technical and informal institutions of forest management
Jun. 2014	To confirm understanding of the SES	• Participatory observation • Transect walk • In-depth interviews with key villagers according to the last field research	• Further information in the traditional institutions of forest management
July. 2014	To learn the history of the village		
Oct.-Nov. 2014	To participate in the 60th annual Celebration of the county	• Literature review • Participatory observation	• County-level archives about main forestry policy reforms during 1950-2010 • Villagers were interested in ecological agriculture and tourism
Jun. 2015	To perform a favor concerning their ecological agriculture and tourism To make clear the social network of the village	• Visiting other villages with heads of the village • Focus group discussing with the officials of the town and heads of the village • Asking for a name list of the village	• Social network map • Proposal draft of ecological agriculture and tourism • A new action involving several young villagers
Apr. 2015	To observe the new actions on ecological agriculture	• Participatory observation	• More trust in the new ecology-friendly actions

Chapter 4

Socio-ecological linkages in Japan's Urato Islands

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Abstract

Conservation and sustainable use of natural resources constitute the foundation for human well-being. In the Urato Islands, located off the northeastern coast of Japan, communities have formed strong linkages with surrounding landscapes and seascapes, not only as a source of livelihoods and sustenance, but also in the face of regularly reoccurring natural disasters. Although the magnitude of the 11 March 2011 Great East Japan Earthquake and Tsunami exceeded any such events in recorded history, a combination of strong community bonds, intimate knowledge of terrestrial and marine systems, and cultural richness resulted in a robust and resilient response by local communities, which was further strengthened by external bonds with multiple diverse stakeholders. Field visits were conducted during 2011-2015 to better understand the nexus of social, ecological and production processes that have shaped the communities in the Urato Islands as well as their surrounding landscapes and seascapes. Community dialogue sessions were also organized to facilitate multi-stakeholder dialogue among community members and external actors. Furthermore, a critical assessment is provided of the concepts underlying ecosystem-based disaster risk reduction (eco-DRR) as reflected in the revitalization of communities in the Urato Islands following the events of 11 March 2011.

Keywords:
Urato Islands, eco-DRR, human-nature linkages

1. Introduction

Despite technological advances and industrialization processes across the world, humans remain just as dependent on the Earth's ecosystems for their well-being as ever. In the past, people lived in the proximity of their resource base, giving them a direct and personal interest in sustainable resource management (Olson 2000). Ongoing processes of globalization, however, have often caused production activities to shift into areas characterized by cheap labor costs and limited regulation (Gray 1997), in the process causing a growing spatial disconnect between people and the resources they consume. This distance, in turn, influences people's perceptions of ecosystems and the services they provide, with some research suggesting that simply being proximate to an ecosystem increases people's perceptions of its value (Muhamad et al. 2014; Sodhi et al. 2010). But unprecedented rural to urban migration has led to a world in which the majority of people live in cities, and the associated loss of human connections to productive landscapes and seascapes raises considerable concerns about the future of sustainable resource use (WHO 2015).

1.1 The landscapes and seascapes of the Urato Islands

Within this case study, focus is placed on the socio-ecological production landscapes and seascapes (SEPLS) of the Urato Islands, which are part of the municipality of Shiogama City in Miyagi Prefecture. The Urato Islands consist of four different islands, namely, Katsurashima, Nonoshima, Sabusawajima, and Hojima, with a current total population of about 400 altogether (Figure 1). Mariculture (oyster farming), *nori* production (seaweed farming) and small-scale coastal fisheries are the dominant maritime production activities, while rain-fed agriculture on the islands themselves is largely a source of supplemental foodstuffs for local consumption (Figure 2). The Urato Islands and the surrounding Matsushima Bay are also firmly embedded in the cultural fabric of Japan, and are known not only as one of the "Three Views of Japan", but also as the setting for many well-known stories and tales. When Albert Einstein visited Matsushima in 1922, it is said that he remarked how "No great artisan could reproduce its beauty". Likewise, Franz Doflein, one of the first marine biologists to visit Japan, dedicated a considerable part of his surveys to the Urato Islands and surrounding areas due to the complex mixing of ocean currents off the shores and the cultural richness of the region. On one rainy day in 1906, he sailed through Matsushima Bay noting the many fishing boats, before landing on an island where he

provided a 100+ year-old description of Japanese SEPLS (*satoyama* and *satoumi*): "I walk westwards among the rice fields. The area is richly cultivated; mulberries cover some areas, and many of the country's common vegetables are being grown: beans, cucumbers, melons, eggplants. In between there are thickets and patches of forest […]" (Doflein 1906).

Figure 1: The Urato Islands (Source: Shiogama City 2015)


Figure 2: Socio-ecological production landscapes and seascapes in the Urato Islands (Photo by Akane Minohara)

1.2 Resilience of the Urato Islands to earthquakes and tsunamis

The decision to assess SEPLS in the Urato Islands is based not only on the long history of strong human-nature linkages (Flint et al. 2013), but also due to the fact that these communities are located in a highly disaster prone region. While earthquakes and tsunamis remain largely unpredictable in many ways, the Gutenberg-Richter model identifies the logarithmic relation between earthquake frequency and intensity. Accordingly, not only have major earthquakes shaped the region, but earthquakes of 6.5 magnitude or more can be expected on an almost annual basis (Silver 2012). On 11 March 2011, the largest earthquake and tsunami ever recorded in Japan's history struck off the northeastern coast of Japan. As of 11 March 2015, official records state that 15,891 people lost their lives and 2,584 people are still missing, with more than 400,000 houses being completely or partially destroyed (National Police Agency 2015). The Urato Islands were partially submerged under a series of huge waves, which washed away houses as well as aquaculture facilities and equipment, causing severe damage to the livelihoods of residents. Although three people went missing from one of the islands, no other casualties were reported. Residential infrastructure was heavily impacted, however, with 166 houses across the Urato Islands being completely or partially destroyed. Subsequently, 48 temporary housing units were built for those who lost their homes, but some residents, mostly elderly, left the islands completely to live with their children's families now living on the mainland (Shiogama City 2014). In March 2015, the much-anticipated disaster recovery public housing units were completed, and 23 households on two of the islands started their new lives there, while the temporary-housing residents on the other two islands are still waiting in their tiny prefabricated houses (Shiogama City 2015).

In this case study, we consider how loss of life under such extreme conditions was minimized in the Urato Islands and the potential role that SEPLS and cultural linkages played in mitigating the damage. Likewise, focus is placed here on the resilience of these SEPLS in the years following the 2011 disasters. Within the context of climate change and the projected increase in frequency and intensity of extreme weather events, understanding and promoting resilience in the face of disasters is of crucial importance (IPCC 2012).

2. Methods

A number of field visits were conducted in the Urato Islands during 2011-2015 in order to observe the recovery process of the communities and the people's livelihoods. The research was primarily conducted using formal and informal interviews with local people and relevant stakeholders, and through observations of their daily lives as well as key events. Qualitative ethnographical approaches such as semi-structured interviews using snowball sampling and participant observation were employed to deal with issues that are often highly sensitive and emotional, while making continuous efforts to build trust with local people.

In addition, two community dialogue sessions were organized in August 2012 and April 2013, respectively, by Tohoku University and the United Nations University in collaboration with other members of the International Partnership for the Satoyama Initiative (IPSI) including the Ministry of the Environment of Japan, Ink Cartridge Satogaeri Project (Brother, Canon, Hewlett-Packard, Lexmark and Seiko Epson) and CEPA Japan as part of an IPSI collaborative activity[1], where people from the four islands and various stakeholders gathered together to discuss rebuilding and revitalization of the islands[2] (Figure 3). These two community dialogue sessions built on a multi-stakeholder platform and were key turning points for the rebuilding process of the Urato Islands as a whole. Not only did they allow the islanders to express and share their anxieties, concerns and future hopes, most of which had been left largely unspoken, but also provided

opportunities to materialize their hopes into more concrete actions through sharing them with external stakeholders as well as to bring together various ideas and thoughts. Key guiding questions for the community dialogue sessions are presented in Tables 1 and 2 (for more details, see IPSI 2012 and 2013).

Figure 3: Active interaction among islanders and external stakeholders during the two community dialogue sessions (Photo by IPSI Secretariat)

Table 1: Key questions from the first community dialogue session (August 2012)

Key questions
1) Things that they are proud of in their communities; 2) Things that they feel anxious about (before and after the tsunami); 3) Ideal future for their communities; 4) What each person can do for their communities.

Table 2: Key questions from the second community dialogue session (April 2013)

Key questions
What can be done by (a) 1 person, (b) 10 persons, and (c) 100 persons in order to 1) Prevent further population loss; 2) Create mechanisms to attract people from outside the islands; 3) Maintain the environment to continue living on the islands.

3. Results

3.1 Socio-ecological production linkages

There is a growing recognition that biological diversity underpins ecosystem health and thus the resilience of natural systems (Millennium Ecosystem Assessment 2005). Likewise, diversity of culture, which includes lifestyles, ways of living together, value systems, traditions and beliefs (UNESCO Universal Declaration on Cultural Diversity 2002), is considered to be an integral component of many ecosystems (CBD COP Decision V/6), and has the capacity to increase the resilience of social systems (Pretty et al. 2009). Such considerations have led, among other things, to a range of literature on socio-ecological systems (SES) examining how site-specific natural resource management has evolved into coupled systems where the ecological characteristics of a system are inextricably linked with the cultural characteristics of the people interacting with it (Binder et al. 2013). The concept of socio-ecological production landscapes and seascapes (SEPLS) further expands and strengthens this definition by placing emphasis on the potential for such coupled systems to be specifically shaped to ensure long-term productive capacity, the basis for human well-being and sustainable societies throughout history (Blasiak and Nakamura 2013). According to Gu and Subramanian (2014), SEPLS are "dynamic mosaics of habitats and land uses that have been shaped over the years […] in ways that maintain biodiversity and provide humans with goods and services needed for their well-being". The complex interactions between nature (biological diversity) and culture (cultural diversity) that form SEPLS over time are defined by the rich variety of local knowledge often referred to as Traditional Ecological Knowledge, which dynamically adapts to help "monitor, interpret, and respond to dynamic changes in ecosystems [while increasing resilience or] the capacity to recover after disturbance, absorb stress, internalize it, and transcend it" (Berkes et al. 2000: 1252). Such a "knowledge-practice-belief complex" gradually develops and improves through trial-and-error learning (Berkes et al. 2000), and has played a critical role in the survival of islanders who are especially vulnerable to rapidly changing natural environmental conditions (Hong 2013). In the Urato Islands, a variety of locally-adapted and socially-embedded knowledge and practices that help to cope with dynamic changes were observed during this study.

Over many years, people in the Urato Islands have nurtured harmonious relationships with their surrounding SEPLS, and developed an in-depth knowledge of how to maintain them in a sustainable manner. Many examples exist, for instance where the communities spontaneously set dates on which clams were to be collected, as well as upper limits for the maximum amount that can be harvested each year to avoid overexploitation of this common resource. In 2015, one person per household with fishing rights

is allowed to harvest up to 10 kg of clams at a time in a designated container at allocated beaches (in rotation) on six occasions in total between mid-April and mid-May, while simultaneously being encouraged to remove Glossaulax didyma, which has caused severe damage to the clam populations of the islands (Interview, April 2015). There is no formalized rule as such, but community members spontaneously organized themselves to set the limit, since they noticed a decline in clams due to an increase in alien species. In another example of optimal use of natural resources in the Urato Islands, although starfish are regarded as an enemy by fishermen, the local practice is to use collected starfish for productive purposes. After first drying them in the sun, the starfish are applied as a natural fertilizer to vegetable crops to boost yields in the productive landscapes near the seashore (Figures 4). Crushed oyster shells, which are categorized as industrial waste by the local government, are also optimally used as a source of soil/plant nutrition in the vegetable fields. These are examples of the cyclic use of resources based on traditional knowledge or wisdom that is unique to the SEPLS in the remote Urato Islands, where cultural practices have developed to make optimal use of available resources. While not all these practices are specifically regarded as adaptive or coping mechanisms by the islanders, many expressed their wish to continue living in harmony with nature, and to pass their experiences and skills on to the new generation (First community dialogue, August 2012).

People in the Urato Islands also exhibit a deep-seated feeling of awe and appreciation for nature, which finds expression in a range of different ways. There is a stone monument to which people used to pray for rain, and each island still holds an autumn festival every year for good harvests. Passing down such traditions and customs seems to have also strengthened the cultural and spiritual linkages of the communities with their surrounding landscapes and seascapes, forming vibrant SEPLS. Meanwhile, some community members express regret that certain traditions are disappearing, a change which they primarily attribute to the aging population of the islands, which is considered to be a serious challenge (First community dialogue, August 2012). People in the Urato Islands, like many other coastal communities in Japan, see the mountains and sea as being connected and understand that protecting the upstream environment results in better harvests in the downstream near-shore ocean areas. Based on this belief, it was once common for fishers' households to make a pilgrimage to Shinto shrines located on the hilltops of the Three Mountains of Dewa (Dewa Sanzan), which are located far inland within the Tohoku region and are considered as sacred sites for fishers among others. This tradition, however, has not been practiced for many decades.

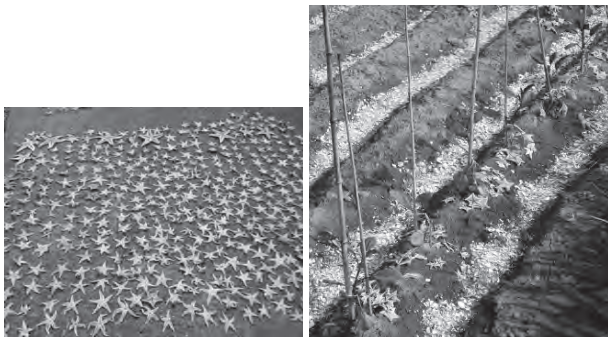

Figure 4: A unique example of making full use of local resources: starfish, which are considered a pest by fishermen, are utilized as a natural fertilizer for crops (Photo by Akane Minohara)

3.2 **Response to disaster**

Living side by side with nature means that people receive both the blessings provided by the SEPLS surrounding them, but also that they could potentially be more vulnerable to disasters caused by extreme events such as earthquakes, typhoons and tsunamis. Although the residents of the Urato Islands are implicitly exposing themselves to higher risk, they fully understand this duality of nature, and simultaneously embrace both its bounty and its dangers. One of the oyster masters on the Urato Islands, who has devoted his efforts to oyster farming over the last few decades, once remarked that every year he is a first-year student when it comes to cultivating oysters, as each year is different: there are good times and bad times. Other oyster farmers also explained how they modify their methods and techniques every year in an effort to achieve better harvests without causing negative impacts on the sea. This type of adaptive management using trial-and-error learning is commonly practiced throughout the Urato Islands and the surrounding sea. Following the same global trends previously mentioned, many people, especially those who are young, have left the islands and moved to cities to seek lives with greater stability and more convenience. Those who remain on the islands, however, are maintaining the cultural traditions of the past, while continuing to develop and adapt their production and distribution activities to meet the realities of an interconnected and interdependent world.

The fact that there was almost no loss of life in the Urato Islands as a result of the tragic events of 11 March 2011 was considered by many as miraculous, given the magnitude of damage to the islands and the aging populations of the communities. However, it is too simplistic to conclude that the communities were simply lucky. Discussions with local community members underscore that many lives could have been lost if the strong bonds that connect the community members did not exist. In fact, over the course of the community dialogue session in August 2012, it became apparent that islanders have a high level of pride in the strong community bonds that are built on deep humanity. Other points of pride that

they mentioned share this same cultural dimension, but were related to the aesthetically beautiful landscapes and seascapes as well as tasty local delicacies, among other things. In contrast to the anonymity of urbanized areas in modern Japan, the communities of the Urato Islands still maintain a culture of helping one another, which has been deeply embedded in their daily lives. While it is difficult to quantify such actions in a precise or statistical manner, it is nevertheless a common occurrence to observe someone giving a helping hand to another without a moment's hesitation. Likewise, in the Urato Islands, people never lock their front doors, because they know their neighbors are remaining watchful of the whole community even when they are away from home. Another mechanism that results in strong community bonds is the practice of local women to frequently visit each other's houses to drink tea and bring along small 'gifts' – fish caught in the morning, vegetables just harvested, or one of their specialty dishes. Gift exchange was seen as playing a key role in forging social bonds in pre-industrial societies (Lévi-Strauss 1969), but is still highly relevant and deep-rooted in Urato Island communities as a social lubricant. When the 11 March 2011 earthquake hit the Tohoku region, the bonds formed by all of these bits and pieces of communal life were tested. People reacted immediately and took sensible action even in the face of an unprecedented event, running into the houses of elderly residents without even pausing to remove their shoes, before loading them into the back of vans and taking them to an evacuation site at the top of a hill. In the weeks after the initial disaster, these bonds continued to manifest themselves in the way people supported each other in the evacuation center when there was a lack of regular provisions of food, water, gas and electricity. After the disaster, it was common for evacuation centers to distribute foodstuffs only when they had enough and an equal amount for everyone in order to avoid conflicts among the evacuees. However in the Urato Islands, such restrictions were not necessary as it was 'business-as-usual' for them to share a piece of bread with a couple of people, and instead they set their own rules for providing larger amounts of food to those who engaged in physical reconstruction work, as well as children at a rapid stage of growth (Interview, 2015).

3.2.1 First community dialogue session (August 2012)

In addition to these strong community bonds, the involvement of various external stakeholders from outside the communities has played a critical role in accelerating the rebuilding process in the Urato Islands, while bringing together the residents of the four different islands for collective action. Given the situation the islanders were facing prior to the 11 March 2011 disasters, including depopulation, an aging population and the decline of local industries due to a lack of young successors, a tacit understanding exists among the local people that simply returning to the pre-disaster situation would not solve the deep-rooted challenges and revitalize their communities. As reflected in the diverse range of participants in the two community dialogues sessions, a wide range of stakeholders, including NGOs, universities, the private sector, local and national governments, a UN organization,

Table 3: A selection of community voices from the two community dialogue sessions and some of the actions taken (as of August 2015)

Community voices	Actions taken
- **Brand value-added products** - Establish a place to sell Urato's specialties - Expand distribution channels	- Branding and promotion of local delicacies, and test marketing in Tokyo (February 2014) - Establishing a mothers' group to further promote Urato's specialties (on-going) - Establishing a community center with food-processing facilities (to be completed in March 2016)
- **Train island guides** - Provide on-the-ground experience of oyster and seaweed farming - Teach how to cook local foods using satoyama/satoumi products - Pass down traditional knowledge and skills	- Eco-tourism and study programmes (on various occasions)
- **Create vegetable fields**	- Turning abandoned land into vegetable fields (on-going IPSI activity)
- **Jointly run "community boats"**	- Community boat service operated by the islanders (since September 2014)
<Other proposed activities> - **Welcome newcomers and those who return to Urato** - Provide a trial living opportunity - Offer homestays - Provide special education for children - **Open "child-raising concierge" by grandpas and grandmas …**	

and other individuals have joined together in support of the islanders not only as they recover from the disaster, but also as they seek to move forward. The first community dialogue session, held in August 2012 primarily focused on collecting the opinions and visions of islanders about the strengths of their communities, as well as negative trends and the ideal future characteristics of the islands. An overview of the key questions raised during this session is included in Table 1.

3.2.2 Second community dialogue session (April 2013)

Building on the outcomes of the first community dialogue session, the process was continued. A second community dialogue session was therefore organized in April 2013 for discussion and presentations that took into consideration the importance of multi-stakeholder collaboration and the unique sets of ideas on how to overcome various challenges that the Urato Islands have been facing, namely to: 1) prevent further population loss, 2) create mechanisms to attract people from outside of the islands, and 3) maintain the environment to continue living on the islands. Among the topics that were discussed (see Table 2), some have since materialized or are in the process of doing so, for instance the branding and promotion of local delicacies, especially mothers' home-made cooking (Figure 5a), conducting eco-tourism or study programmes to introduce visitors to the beauty of nature, the people and their livelihoods (Figure 5b), attracting external funding to build a processing space to produce value-added products, and turning abandoned land into vegetable fields. These and other proposals were voiced by participants and subsequently shared with the group - a selection of these is included in Table 3.

Figure 5a: Urato Island "mothers" selling home-made oyster curry and oyster chowder at a farmers' market in Tokyo (February 2014)

Figure 5b: An oyster farmer giving an on-the-boat lecture for an international summer seminar in the Urato Islands (August 2014) (Photo by Akane Minohara)

4. Discussion and conclusion

The community dialogue sessions are the basis for a substantial component of this research and have been crucially important for the post-disaster recovery and revitalization efforts in the Urato Islands. As a methodology, community dialogue sessions using a similar approach could be broadly applicable within both post-disaster settings as well as communities struggling to address deep-seated challenges. Key factors that enable their broad applicability include their inclusiveness, which enables a range of stakeholders to both participate and feed their thoughts into change processes, and the ultimate usefulness of such dialogue to serve as a catalyst for action, setting long-term change processes in motion in an organic and locally-owned manner.

This research in the Urato Islands has also underscored how strong community bonds, supported by a solid knowledge base about surrounding SEPLS and a wide range of coping strategies such as self-organization of managing the commons and adaptive management through trial-and-error learning, can lay the foundations for an entire community's resilience. This effect is further strengthened through external linkages with various stakeholders. Even the community members who are considered to be the most vulnerable are supported by these community bonds, which play a key role in disaster risk reduction despite the magnitude of the disaster. Currently, there is growing attention to the possibilities of ecosystem-based disaster risk reduction (eco-DRR) rather than conventional hard engineered solutions (Renaud et al. 2013). Given that the magnitude of disasters can vary due to human-induced factors, it is sensible to incorporate local socio-ecological knowledge based on people's long-standing mutual relationship with their surrounding SEPLS in a more active manner in order to reduce underlying risk factors. Nevertheless, the massive movement of people from rural to urban areas should not be seen as precluding the possibility of community bonds, but rather underscoring the need for informal social mechanisms such as the "tea time" in the Urato Islands that strengthen connections. With the diversity of local customs that are surely represented in each urban area, there is no lack of potential mechanisms for strengthening these bonds, but perhaps the lack of a shared production landscape or seascape is one reason for weak human-nature relationships in urban areas.

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[1] Further information about IPSI collaborative activities available online at: http://satoyama-initiative.org/en/partnership/activities/

[2] The objectives of the collaborative activity were to: (1) rebuild and restore the disaster-affected SEPLS aligned with natural processes; (2) revitalize and support communities in a sustainable manner, built upon local nature, culture and industries to overcome deep-rooted problems of depopulation, aging populations and a lack of successors; (3) develop a model of post-disaster restoration and revitalization of communities in decline, and share the lessons learnt with the rest of Japan and abroad.
For details of the community dialogues, see http://satoyama-initiative.org/en/community-dialogue-seminar-in-tsunami-affected-tohoku-region/ (First community dialogue in August 2012) and http://satoyama-initiative.org/en/2nd-community-dialogue-seminar-held-in-japans-tsunami-affected-tohoku-region/ (Second community dialogue in April 2013)

Learning from experiences in SEPLS

Chapter 5

Promoting resilience of socio-ecological production landscapes and seascapes in the Datça-Bozburun Peninsula, Turkey

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Abstract

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 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.

This case study from COMDEKS activities in the Datça-Bozburun Peninsula, Turkey, showcases local community activities that maintain and revitalize critical production landscapes and seascapes. The case study documents the knowledge and experiences gained from successful on-the-ground actions by local communities to maintain and revitalize socio-ecological production landscapes and seascapes (SEPLS) and demonstrates how this work can be scaled up or adapted to other parts of the world.

Keywords
resilience, landscape, seascape, Satoyama Initiative, COMDEKS, local communities

1. Introduction

Funded by the Japan Biodiversity Fund, the Community Development and Knowledge Management for the Satoyama Initiative (COMDEKS) Programme (2011-2016) is a unique global effort implemented by UNDP 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, promoting knowledge sharing, and strengthening capacities for sustainable development toward achievement of the Aichi Biodiversity Targets.

COMDEKS is currently implemented in selected communities in twenty countries, representing a wide variety of landscapes and seascapes: watersheds in Cambodia, Ecuador, and Costa Rica; inland water systems such as lakes in Malawi, Niger, and Kyrgyzstan, and wetlands in Slovakia; agro-pastoral systems in Ethiopia, Cameroon, and Brazil; mountain ecosystems in Bhutan, Ghana, India, and Nepal; coastal seascapes in El Salvador, Fiji, Indonesia, and Turkey; and grasslands in Mongolia and Namibia.

This case study from COMDEKS activities in the Datça-Bozburun Peninsula, Turkey, showcases local community activities that maintain and revitalize critical production landscapes and seascapes. The case study documents the knowledge and experiences gained from successful on-the-ground actions by local communities to maintain and revitalize SEPLS and demonstrates how this work can be scaled and replicated in other parts of the world.

2. The landscape

2.1. Geography

The target landscape for the COMDEKS Project in Turkey is the Datça-Bozburun peninsula, located in Muğla province

in the southwest of Turkey. The Datça-Bozburun peninsula is recognized as a Key Biodiversity Area as it represents one of the most pristine remaining Mediterranean lowland forest and coastal landscapes (Figure 1). The target landscape spans 247,700 ha and includes Datça and Bozburun peninsulas and their surroundings, with a northward extension covering the rich marine habitats of Gökova Bay. It is a diverse, hilly landscape with harbors and bays along its coasts. The steep cliffs prevent the expansion of the road network to some extent and provide suitable patches of habitat for wildlife.

About 90 percent of the Datça-Bozburun peninsula is protected under several natural parks, wildlife reserves, natural and archeological sites, as well as six no-fishing zones and two Special Environmental Protection Areas (Gökova SEPA and Datca-Bozburun Peninsula SEPA). Because of these protection efforts as well as the maintenance of traditional practices, the Datça-Bozburun Peninsula has preserved a healthy human-nature relationship and landscape resilience. However, due to increasing tourism and residential development, traditional practices are increasingly being abandoned as they become economically less attractive. Human attachment to nature is progressively weakening, resulting in degradation of the landscape and loss of heterogeneity, despite protected status and management efforts by the state.

Figure 1: The Datça-Bozburun peninsula is recognized as a key biodiversity area (Photo by Gökmen Argun, COMDEKS Turkey)

2.2. **Biological resources**

The Datça-Bozburun peninsula is a rich trove of biodiversity. It triggers key biodiversity area criteria for seven different taxa, including plants, birds, mammals, amphibians, reptiles, butterflies and dragonflies, and hosts several globally endangered terrestrial species. The Mediterranean lowland forests in the area are the most pristine in the Aegean region, containing evergreen shrub-lands and coastal flora such as Turkish pine (*Pinus brutia*), oriental sweetgum or Turkish sweetgum, *(Liquidambar orientalis*), Mediterranean cypress (*Cupressus sempervirens*), and Cretan date palm (*Phoenix theoprasti*).

Additionally, the Datça-Bozburun peninsula encompasses an exceptionally valuable marine and coastal area that is an important nursing ground for several marine species and a source of rare fauna, including the Mediterranean monk seal (*Monachus monachus*), the Loggerhead sea turtle (*Caretta caretta*) and the Sandbar shark (*Carcharhinus plumbeus*). On this basis, a 2,300-ha section of Gokova Bay has been designated as a Marine Protected Area.

2.3. **Socioeconomic context**

The population of the target landscape exceeds 100,000 people, with high population growth due to significant migration into the area. Household income for residents of Datça-Bozburun is moderate and literacy is low. The majority of the population still depends on natural resources for their livelihoods. Today, local communities on the peninsula earn their living mainly through fishing, tourism and agriculture. Poverty and food security issues are minimal in the target landscape.

The heterogeneity of the area's agricultural habitat is high, due to the typological, climatic, historical and cultural characteristics of the region. The warm climate, along with varying soil quality and moderate precipitation have enabled people to produce crops such as barley, almonds and olives that can thrive in modest conditions. Almonds and olives are generally produced under rain-fed conditions, based on traditional practices, often involving steep hillside terraces. This makes traditional farming an important livelihood activity for the local community.

Fishing is a major source of income for many families in the region, with women being active in the trade. Indeed, the Datça-Bozburun peninsula has the highest population of "fisherwomen" in Turkey—approximately 200 women actively fishing (Figure 2).

Figure 2: Fishing is one of the key livelihood activities in Gokova Bay, Turkey (Photo by Zafer Kızılkaya, COMDEKS Turkey)

Ownership of almost all forested land belongs to the state and is managed by state authorities. Locals are free to benefit from the wood and non-timber forest products within

the legal limits set by the national legislation. Locals have all the ownership and tenure rights of their own agricultural or residential land except in the situations where their land falls into protected area boundaries. There, associated legislation comes into play and land owners are free to manage the land as the protection status allows.

2.4. Key environmental and social challenges

Many of the most imminent threats on the Mediterranean coast seem to appear on the Datça-Bozburun peninsula. Local traditional livelihoods are now subject to strong pressures from tourism, seasonal migration and residential development, despite the desire and potential for nature-friendly development by the local residents. Seasonal population fluctuation is high (the population increases about fivefold in the summer) due to summer homes and tourism. This puts additional pressure on the scarce water resources and infrastructure, which in turn increases pollution and causes destruction of sensitive habitats.

Attachment to the landscape by area inhabitants weakens day by day as traditional practices, which ensured the heterogeneity of the landscape for centuries, are abandoned and lands are sold to tourism developers for a handsome price. An important factor contributing to the local loss of attachment to place is the feeling by local stakeholders that they are not part of the decision-making process or management of the local protected areas, which cover a considerable portion of the peninsula.

As a result of these increasing development pressures and accompanying habitat destruction in local land and marine ecosystems, the rate of degradation of the landscape is increasing. The most troubling manifestations of this degradation are loss of local agricultural products such as fig and mastic, abandonment of traditional fishing/diving practices for more profitable activities, destruction of valuable forests, and decreasing wildlife populations. Studies also show that, despite their protected status, the population of vulnerable Mediterranean species continues to decline.

In addition, recent changes in national laws regarding protected area management, as well as reorganization of administrative structures in charge of protection, have some troubling implications for the area's parks and protected areas. Datça-Bozburun is among several protected areas that face the loss of their valuable protected status, which to date has limited threats to the landscape.

3. COMDEKS activities, achievements, and impacts

3.1. Community consultation and baseline assessment

The cornerstone of the COMDEKS community-based landscape management approach is supporting community organizations to revitalize their landscapes and seascapes through participatory land use planning that builds their awareness and capacities for governance and innovation. COMDEKS communities practice an adaptive management cycle in which they first assess socio-ecological conditions, trends, problems, and potential opportunities in their landscape; identify desirable ecological, social, and economic outcomes as dynamic building blocks of resilience; plan activities in pursuit of these outcomes by boosting ecosystem productivity and sustainability and improving organizational capacities of communities to execute projects and measure results; and finally adapt their planning and management practices to reflect lessons learned and new conditions and opportunities.

Resilience Indicators – In the COMDEKS participatory planning phase, community members apply resilience indicators - developed by Bioversity International and UNU-IAS - to guide the assessment of socio-ecological production landscapes. Through interactive mapping exercises, communities identify ecosystem features and land uses, and pinpoint resource access and management challenges. The use of resilience indicators is integral to conducting the participatory baseline assessment for each target landscape. For local communities to strengthen resilience of their SEPLS, it is important for them to understand the current conditions of the landscapes or seascapes in which they live and work. To accomplish this, the baseline assessment uses a set of 20 resilience indicators designed to capture community perceptions of different aspects of key systems – ecological, agricultural, cultural and socio-economic. The indicator set includes both qualitative and quantitative indicators, but measurement is based on the observations, perceptions, and experiences of the local communities themselves.

The indicators aim to provide communities with a framework for discussion and analysis of socio-ecological processes essential for SEPLS resilience. This relates to critical management objectives such as food security, agricultural sustainability, livelihood development, provision of ecosystem services and conservation of biodiversity, strengthening of community- and landscape-level organizations, and landscape governance for equity and sustainability. Discussion of the indicators within communities stimulates knowledge-sharing and analysis, which are key factors in creating social capital for landscape governance, planning and management, and which confirm community ownership of this process.

COMDEKS is one of the first programs of its kind to deploy resilience indicators as an integral part of its methodology and as an organizing principle for community participation. Nor are the indicators meant to be used only once and then forgotten. Rather, they are designed to be revisited periodically by the community, allowing community members to evaluate progress toward Landscape Outcomes and to identify priority actions for local innovation. As such, they are a primary mechanism for adaptive management and the sustainability of COMDEKS interventions. The latest version of the indicator set, along with guidance notes on its application in the field, can be found in a newly released Resilience Indicators Toolkit[1].

As a result of a landscape-wide baseline assessment and consultation process, communities agree on a Landscape Strategy, outlining the landscape context, identifying desired landscape resilience outcomes, and developing community-based actions to achieve landscape resilience. The Landscape Strategy adopted by stakeholders is a living document meant to be revised and updated as communities implement projects, interpret the results, reevaluate their choices and propose new actions – in essence, this is the adaptive landscape management cycle.

The consultative process undertaken for the development of the COMDEKS Country Programme Landscape Strategy for Turkey brought together more than 40 stakeholder representatives, including cooperatives and unions of farmers; fishermen; hotel owners and tourism operators; local residents; state authorities responsible for conservation and management of natural resources such as forests, water, protected areas, and agriculture; and municipalities and city councils. Also included were local and national NGOs working on nature conservation and agrobiodiversity, recycling, marine protection and underwater research, culture, art and sports, and academics.

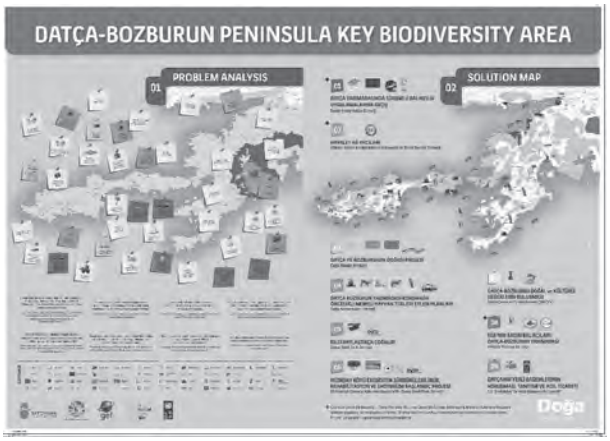

Figure 3: Landscape poster with information on landscape elements and COMDEKS funded activities developed during the baseline assessment in Turkey (Photo by Caglar Bebeci, COMDEKS Turkey)

A number of tools were used to engage local communities and participants in the baseline assessment of the landscape situation: a) an interactive mapping exercise, b) a scorecard aimed at piloting the Resilience Indicators developed by the United Nations University and Bioversity International, and c) a problem tree analysis, which was based on the discussions that took place during the baseline assessment process. During the baseline assessment, participants were asked to mark important assets, values, threats and conflict areas on a map of the proposed landscape. The resulting map not only provided valuable information on the key characteristics of the area, but also underlined the sensitive areas of interest, problems, opportunities and threats (Figure 3).

Overall, three workshops were held in the peninsula in order to maximize key local stakeholders' participation. Due to the large size of the area and the high population on the peninsula, only representatives of local cooperatives and communities, mostly men, were invited to these workshops, although if time and conditions allow, additional house visits to women are strongly advised to overcome gender barriers in such cases. After the mapping exercise, the three resilience assessment workshops were held, and later key stakeholders who did not appear at the meetings were visited individually. Then, a follow-up session was organized to discuss problem analysis. Based on the interactive mapping exercise and indicator assessment, local communities identified threats and problems in the areas. The assessment workshops lasted 3-4 hours, including an introductory presentation and exercises to create a more informal, participatory and communicative atmosphere. One challenge was adapting the terminology to the community's needs. As the language used in the indicators was difficult for most of the participants to comprehend, the COMDEKS team translated and simplified the terminology and provided examples relevant to local communities to ensure that all members would understand the terms and concepts.

The results from the scorecard exercise revealed that all stakeholders shared similar views on two main themes: agro-biodiversity and knowledge, and learning and innovation. Although the agricultural biodiversity theme received a high score, suggesting generally a positive status on the landscape under this theme, participants were wary of the threats and the negative trends affecting the agriculture sector in the target landscape.

Highest divergence in the views appeared under the ecosystems protection theme, indicating that it is one of the most controversial issues in the area. However, despite their differences in scoring, the majority of participants agreed that, given the size of the designated protected area, which is relatively large, the score should have been higher overall.

The baseline assessment clearly indicates that the resilience of the Datça-Bozburun landscape is quite good

compared to other similar landscapes in Turkey. However, according to the participants, the landscape is now under severe threat, which has already started to negatively affect the landscape's resilience and provision of ecosystem services. This was a key reason for selecting the area as the target landscape.

3.2. **Landscape Strategy**

Input from the baseline assessment workshop informed the design of the COMDEKS Country Programme Landscape Strategy for Turkey, a comprehensive document that profiles the target landscape and its challenges, lists expected goals and outcomes, and outlines key measures and strategies for community-based actions.

Table 1 shows the four Landscape Outcomes the strategy is expected to produce, as well as the performance indicators that will be used to measure these outcomes.
To date, the COMDEKS Turkey Country Strategy has a portfolio of seventeen local projects, supported by small grants of 10,000 to 39,000 USD to local CBOs and NGOs. For guidance, the Landscape Strategy provides examples of the kinds of local projects needed for each outcome:

Table 1. Landscape Outcomes and Indicators from the Turkey Landscape Strategy

Landscape Outcomes	Key Performance Indicators
Outcome 1: Improved or maintained ecosystem services, reduced land degradation/habitat loss, and species with improved conservation status through strengthened participatory land use planning and management practices.	• Number of hectares of land (by land use type: indigenous and community conserved areas, protected areas, production landscapes-seascapes, including marine/coastal areas or fishing grounds) brought under sustainable land and resource management. • Number of significant species with maintained or improved conservation status. • Number of targeted communities implementing innovative or traditional sustainable land use management practices.
Outcome 2: Increased resilience of agriculture in the target landscape through conservation of plant genetic resources and implementation of agro-ecological practices using traditional knowledge.	• Hectares of land applying sustainable forest, agricultural, and water management practices. • Number of farmers implementing traditional and adaptive practices for agro-ecosystem and landscape management.
Outcome 3: Livelihoods of people improved through eco-friendly community-based enterprises that reduce impacts on the ecosystem functions and scenic value of the landscape.	• Percentage of targeted households and communities with a more secure access to livelihood assets (disaggregated by gender). • Increased per capita income of targeted households due to measures applied (US dollar equivalent). • Decrease in number of complaints and/or cases of illegal fishing.
Outcome 4: Institutional governance mechanisms created and/or strengthened to make decisions on land use and sustainable economic development in the target peninsula through more inclusive and participatory decision making processes at the landscape level.	• Number and type of stakeholders (gender disaggregated) participating in institutional governance mechanisms created and/or strengthened at the landscape level. • Number of NGOs/CBOs (or other institutional governance mechanisms) formed, reactivated or registered to address land-use planning and management issues at the landscape level. • Number and type of participatory decisions officially taken and adopted locally or regionally affecting the landscape.

Outcome 1:

- Conservation and restoration activities within terrestrial and/or marine ecosystems, such as establishment of ecological buffer zones, no fishing zones, improved fire management systems, sustainable tourism, protection of sea grass beds via establishment of mooring sites, beach clean-up, etc.
- Activities enhancing connectivity and improving resilience of the landscape, such as re-vegetation in dry lands using native species and innovative provision of public utilities such as rainwater harvesting, optimum land use practices for transportation, and energy.
- Participatory conservation and awareness-raising activities towards priority species.
- Awareness activities reducing impact of seasonal population increase (i.e. pollution resulting from second housing, ecosystem degradation due to increased energy and transportation, etc.) with a view to prevent further fragmentation and degradation of landscapes.

Outcome 2:

- Conservation of agricultural mosaics, such as adaptation of the ancient terraces to current agricultural practices, enhancing productivity of almond and olive orchards.
- Diversification of agricultural landscapes through agroforestry, non-timber forest products, medical plants, etc.
- Establishment of low-input, low-carbon, non-

polluting agricultural systems based on local varieties (permaculture, organic production practices, efficient use of water, rainwater harvesting, fallow, intercropping, crop rotation, etc.)
- Sustainably managed marine/coastal areas and fishing grounds.

Outcome 3:
- Sustainable tourism initiatives.
- Activities reducing illegal fishing in order to sustain the traditional fishing community.
- Improving fisherwomen capacity for sustainable management of the marine landscape.
- Improving marketing of traditionally produced local varieties.

Outcome 4:
- Awareness raising and capacity building for advocacy and participation of local people in decision-making and policy dialogue.
- Establishment of local working groups, committees, and thematic platforms via networking, etc.
- Awareness-raising of non-native residents to enable their participation in monitoring and evaluation of the landscape.

3.3. Achievements and impacts to date

- *Improving the sustainability of local fisheries by educating fishers and consumers:* Important progress was made in suppressing illegal fishing in local "No Fishing Zones" through public education campaigns around the need for sustainable fishing practices and responsible consumption of locally caught fish. As part of the project, a group of experts prepared an educational kit, including audio-visuals, to help inform fishers about responsible fishing practices. "Responsible Fisher" certificates were offered to those fishers willing to adopt such practices. The effort involved 500 fishers in five fishery cooperatives, fishing in 250 boats, and resulted in substantial recovery of local fish stocks. In addition, 20 restaurant owners in the region who agreed to serve only sustainably caught local fish were awarded "Responsible Restaurant" certificates to distinguish themselves as environmentally responsible. The public education effort also extended to school children, as classes were invited to participate in an outdoor educational session where images from an underwater camera were used to enhance their learning. In a separate project, the location of ghost nets (derelict nets that kill fish and marine organisms) was mapped in 5 ha of local Marine Protected Areas; 700 m of ghost nets and 5,000 m of ghost fishing line were subsequently removed by volunteer scuba divers (Figure 4). Combined with efforts of other marine projects in the area, this has greatly improved the safety of area waters for fish and other marine organisms.

Figure 4: Divers from the "Ghost Net Hunters" project in Turkey. The COMDEKS project aims to protect biodiversity and improve ecosystem services in the region, raising awareness and educating local fishing communities about the ghost net issue in the Datça-Bozburun Peninsula (Photo by Deniz Acarli, COMDEKS Turkey)

- *Increasing the visibility of local fisherwomen and improving their livelihoods and connections:* Fisherwomen are an important part of the local fishing trade and significant contributors to their families' incomes. However, until now there has been limited information available about the particular challenges they face. By interviewing local elders and other active fisherwomen, the profile of some 70 local fisherwomen has been raised and their social standing enhanced. Networking within the local fishery cooperatives has brought new solidarity among these women, and encouraged them to organize themselves and reach out to fisherwomen in other regions. One practical effect is that the fisherwomen have been officially added to the list of eligible groups who can seek microfinance through the Turkey Grameen Micro Credit Program. In addition, local fisherwomen have begun to participate actively in meetings of marine experts, local cooperatives and local governing bodies (Figure 5). In recognition of the effectiveness of these efforts, the Mediterranean Conservation Society, the local NGO responsible for leading this work, has recently received two prestigious awards: the 2014 Equator Prize, given by the Equator Initiative, and the 2013 Whitley Award, given by the Whitley Fund for Nature.


Figure 5: Local fisherwoman in Datça-Bozburun Peninsula (Photo by Zafer Kızılkaya, COMDEKS Turkey)

- *Increasing the income, efficiency, and sustainability of local traditional almond producers:* In the past the ancient

communities intensified production due to a shortage of arable land and the need for greater productivity to feed growing communities, as in many ancient Mediterranean communities. They achieved this by introducing cultivation systems on steep slopes, primarily in the form of terraces. This traditional knowledge of land use is still being practiced in some parts of the peninsula. The project has supported these areas by increasing the income, efficiency and sustainability of local traditional almond producers in these areas. One of the most typical and economically important traditional crops in the target landscape is the Datça almond. However, local production is threatened by its labor intensive nature and poor marketing, causing it to compete poorly with cheaper imports and more profitable activities. Local production efficiency has now been greatly improved by provision of a shelling machine, which has saved 11,000 USD in labor costs. Packaging and labeling have also been improved, and growers have formed a cooperative. Just as important, a program to convert farms to organic growing methods and to certify them as organic producers to add value to the local crop has increased the number of certified growers from 7 to 20, and organic almond culture has increased by 50 ha.

- *Rehabilitating a local sacred site and promoting ecotourism:* Hacet Evi Hill is a well-known local sacred site near Hizirsah Village that has fallen into disrepair. A multi-pronged effort has re-established the cultural value of the site, rebuilt pathways, and revegetated the site with almond trees to prevent erosion, increase its visitor appeal, and bring some income to local residents. This, along with establishment of a visitor center, has set the ground for promoting Hacet Evi as a tourist site. In a related effort, aromatic and medicinal herbs are now being raised organically in nearby Hizirsah Village on 20 ha of village common land as an additional source of sustainable income for residents. The project was also significant for its effect on local land use policies by setting a precedent for the use of village common land for the herb-raising effort—a project that brought both environmental and economic benefits to the village

- *Promoting conservation plans for area forests and endangered mammals:* Local scientists and community members acted to directly inform government conservation plans in the target area. In one project, a local nature conservation NGO organized field research to identify priority forest ecosystems in the area—such as areas containing the vulnerable Turkish sweetgum tree and Datca palm trees—and recommend conservation measures. These finding were then submitted for inclusion in the new Forest Management Plan recently formulated by the General Directorate of Forestry. In another project, all the area's priority mammals were specified, their habitat mapped, and local species action plans drawn up for their management. In addition, training in mammal conservation methods was provided for 18 government personnel involved in management of the protected areas in the landscape. Training has also been provided to members of the local nature NGO who would like to take part in monitoring conservation efforts in the area.

- *Exchanging information on local landscape projects, and building community acceptance and enthusiasm for landscape interventions:* The COMDEKS project portfolio in Turkey has emphasized communicating with local community members, both to educate them about the need for action to preserve local environmental assets, cultural traditions, and livelihoods, but also to inform them of the successes already achieved through local projects and the opportunities to contribute to these efforts in the future. One part of this effort involved organizing a local festival to facilitate information exchange and communication between different groups who had undertaken projects in the area. The two-day festival involved 16 presentations on various issues and initiatives, followed by public discussions. This allowed for a wide variety of local opinions to be heard on issues relating to the impact that the community is having on the land and seascapes. The participants left the festival informed and more aware of environmental projects happening around them. Educational booklets, DVDs, and other informational tools are now being prepared to increase the longevity and the reach of the projects around Datça-Bozburun Peninsula. In a separate effort, the eight NGOs involved in the local COMDEKS projects produced a 23-minute documentary titled "Knowledge gets richer by sharing." Through images of the target landscapes and interviews, the documentary depicts how the projects are environmentally and culturally related to one another, enabling the audience to get a coherent picture of the COMDEKS Country Program in Turkey. This will increase the reach of the projects both locally and nationally, and encourage replication in similar landscapes. Finally, the Seferihisar Nature School, located near Muğla, has been designated an education center for dissemination of information on COMDEKS Datça-Bozburun cases to nature conservationists throughout Turkey.

4. Conclusions: Progress at the landscape level

The COMDEKS project portfolio in Turkey has worked extensively on two fronts within the target landscape. In the marine environment, progress has been made in pressing the case for cutting back on illegal fishing within protected waters, publicly rewarding fishers and restaurant owners who only deal in sustainably caught fish. Local physical hazards of ghost nets have also decreased. At the same time, the low social profile of women fishers in the Datça-Bozburun area has begun to be addressed.

On the terrestrial side, the portfolio has contributed to conservation efforts both through its scientific work and its advocacy for management of local mammal species, while at the same time working to safeguard the traditional land use mosaic by strengthening the income profile of local

almond producers and creating opportunities for cultural tourism. To tie these two different sets of activities together, the program has taken pains to create opportunities—through events, publications, video programs, and school programs—for the public to find out about local projects and to see how they relate to each other. In the process, a peninsula-wide network is starting to form that can begin to approach present and future work at a landscape level. This network is already having an influence on the management of designated protected areas in the region. From a public policy standpoint, the scientific data, analyses, conservation assessments and knowledge products produced as part of COMDEKS activities have begun to have an effect at the landscape level, influencing the recent release of a Datça development plan and changing the level of public discussion of the plan.

Another important link to continuity and sustainability within the landscape effort will be the process of updating and extending the Landscape Strategy with new landscape level measurements from periodic re-assessment of the resilience indicators. This will enable communities to reinterpret, extend and adapt the Strategy with additional projects to take advantage of new opportunities. COMDEKS will only truly succeed if it results in active landscape governance, where changing conditions in the landscape and in community aspirations are reflected in a living Landscape Strategy that ultimately becomes a comprehensive sustainable development plan for the land and its people. During the second half of 2014, Turkey carried out an ex-post baseline assessment, aimed at analyzing successful innovations that resulted from COMDEKS interventions and identifying priorities for future interventions. During this assessment, 30 project stakeholders were interviewed and 60 people participated in the SEPLS survey, the results of which showed a positive improvement in information sharing, learning and innovation as compared to 2012. Additionally, a peninsula-wide network is currently emerging in the target landscape as a multistakeholder landscape level governance structure. Though not yet formal, this network is a mechanism for creating larger communities of interest and connection over the landscape, and it should continuously be supported in the future to promote more effective participatory decision-making processes on matters affecting the target landscapes.

Finally, in terms of sustainability of project interventions, it is important to highlight that the GEF Small Grants Programme's rolling modality will enable incorporation of lessons learned identified during the implementation of the COMDEKS approach during its 6th Operational Phase.

5. Lessons learned

In developing and carrying out local projects, gaining the attention of local authorities is an important consideration. If their interest can be engaged and their attention gained, it can be of enormous benefit to project planning and implementation. Failing to do this will mean that more effort and planning responsibility will fall on the local grantee.

An informal network has sprung up among COMDEKS grantees and communities since the baseline assessment was undertaken. However, for this network to be truly effective at organizing efforts at the landscape level and affecting policy development, it must become more formal, visible, and accessible to local community members.

Sometimes, simple interventions can play a key role in the overall success of a project. For example, with regard to the project to increase the profitability of Datça almonds, it was found that the most problematic stage of production was almond peeling, which was addressed through the acquisition of a peeling machine managed by the local cooperative. The labor savings this provided allowed the other elements of the project, such as better packaging and marketing, and conversion to organic culture, to work. Careful analysis of the solution path for each project outcome is therefore crucial to ensure a successful outcome.

Creating a designated education center such as the Seferihisar Nature School, initially founded with the financial support of the Seferihisar Municipality, can strengthen and amplify the dissemination of the landscape conservation methodology used in COMDEKS projects, strengthening awareness and support for existing projects and building demand for new landscape projects.

Knowledge management and public information exchange—through local programs, publications, and conferences—is essential to the development of a landscape-wide sense of identity and ownership among local communities, students, and policymakers. Only when community members understand their local assets and the benefits associated with them, and make the connection between local action and the preservation of these benefits, will landscape projects become widely accepted and sustainable. Public communication plays an essential role in making this connection, as shown by the effectiveness of the publications and outreach efforts in the Datça-Bozburun area.

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Chapter 6

Raising and planting native tree seedlings in local community of Aichi Prefecture, Japan

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Abstract

In March 2013, Aichi Prefecture adopted the Aichi Biodiversity Strategy 2020 in order to realize "Coexistence between People and Nature in Aichi". The strategy contributes towards achieving the United Nation's Strategic Plan for Biodiversity 2011-2020, especially "mainstreaming biodiversity" represented by Target 1, and "conservation habitats for living things" represented by Target 5, by establishing Ecological Network Councils organized by various local stakeholders in society, including citizens, companies, nonprofit organizations, universities and local governments in nine sub-regions within the Prefecture. One of the Councils, the Nishi-Mikawa Ecological Network Council has conducted the "Circulative Raising Native Tree Seedlings Project": collecting seeds and raising seedlings through collaboration between companies, citizens and local governments, and creating biotopes in urban areas with the seedlings. The project aims at creating ecological networks by connecting nature in urban areas and enhancing "Satoyama" through the creation of biotopes in urban areas. It also provides environmental education opportunities to residents, through participation in the project. As a result, it is expected that awareness will be raised among stakeholders on "coexistence between people and nature". This is the first step toward sustainable community building that considers regional characteristics and harmonizes the surrounding environment and ecosystem.

Keywords
safeguarding ecosystem, genetic diversity, collaboration

1. Introduction

In March 2013, Aichi Prefecture, located roughly in the center of the Japanese archipelago, adopted the Aichi Biodiversity Strategy 2020 in order to realize "Coexistence between People and Nature in Aichi" (Natural Environment Division of Aichi Prefectural Government, 2013). The strategy contributes toward achieving the United Nation's Strategic Plan for Biodiversity 2011–2020, and, at the subnational level, Aichi Biodiversity Targets. From the perspective of a subnational government, Aichi in particular focuses on mainstreaming biodiversity represented by Target 1, "By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably (The Secretariat of the Convention on Biological Diversity, n.d.)," and conservation habitats for living things represented by Target 5, "By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced (The Secretariat of the Convention on Biological Diversity, n.d.)," of the Strategic Plan. Based on the Aichi Biodiversity Strategy 2020, Aichi Prefecture is promoting the establishment of regional councils organized by various local stakeholders in society, including citizens, companies, nonprofit organizations (NPOs), universities, and local governments within nine sub-regions. These councils are promoting biodiversity conservation.

One of the regional councils, the Nishi-Mikawa Ecological Network Council, is aiming to enhance the natural environment and local Satoyama area landscapes by creating ecological networks and connecting urban green spaces and Satoyama areas under the theme of "Aiming to Establish a Virtuous Living Cycle with the Latest Manufacturing and the Latest Ecology" (See Figure 1).

In order to achieve this purpose, the council has introduced the "Circulative Raising Native Tree Seedlings Project," under which native tree seedlings are raised and planted to create more natural biotopes in urban areas, with guidance from ecologists.

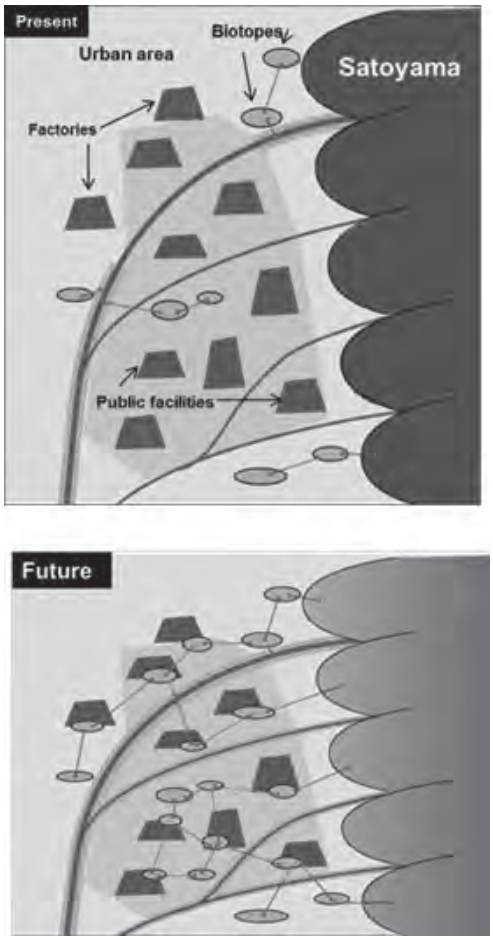

Figure 1. Image of creating an ecological network

The project also provides environmental education opportunities through participation in raising and planting the seedlings. The project could be replicated in other areas of Aichi through the creation of a technical manual that describes how to raise and plant seedlings.

In addition, it is important to maintain the original species and genes in a given area when undertaking ecological restoration and establishing ecological networks. The best way to prevent gene introgression is to use seeds collected from naturally grown trees. However, the amount of seed produced is small, and the shortage of seedlings is one of the major hurdles to creating ecological networks in the region. This project is designed to become one of the approaches used to resolve this problem. From these perspectives, the project is an approach designed to achieve better management of socio-ecological production landscapes (SEPLs).

2. **Method**

The Nishi-Mikawa region is located in the center of Aichi Prefecture. It is home to industrial clusters, including the automobile industry. Some companies promote cutting-edge environmental protection measures; moreover, citizens are willing to implement environmental activities such as creating biotopes and nature restoration. Local governments, not only the Aichi Prefectural Government but also cities and towns, including Toyota City and Okazaki City, also promote advanced environmental administration on the national scale, for example, forest management and the prevention of global warming.

In the Nishi-Mikawa region, urban areas are located close to rice paddies in valleys and Satoyama areas. The latter consists mostly of secondary-growth forest and artificial forest of Japanese Cedar and Japanese Cypress planted after World War II. Recently, people have given up the management of Satoyama areas because of the reduced demand for firewood and other domestic wood requirements. In order to restore and conserve the Satoyama areas, it is necessary to consider new approaches to managing these areas that correspond to changing social circumstances.

Within the Nishi-Mikawa region, Aichi aims to create sustainable ecosystems, including cities, which strive to achieve a sustainable balance between nature and economic activities, and ensure preservation of the energy cycle in the area. The Nishi-Mikawa Ecological Network Council aims to contribute to this objective by creating ecological networks. The council was established by universities, companies, agriculture associations, forestry associations, NPOs, and local governments. Important features of the Circulative Raising Native Tree Seedlings Project are that companies play a central role as members of the council, and that the project involves the use of company properties. The project is led by Sony EMCS Corporation Kohda Site (hereinafter Sony EMCS) which maintains nature on its site in the Sony forest. The Japanese Consumers' Co-operative Union Aichi called upon CO-OP AICHI, residents, specialists, and local governments (Aichi Prefecture, Okazaki City, and Kota Town), to collaborate on the project. "Creating a green industrial park has been an objective of Sony EMCS Corporation's Kohda TEC since this manufacturing site was established" (Sony EMCS Corporation, 2015). Initially,

Figure 2. Target area for planting native tree seedlings
(ecosystem conservation society-japan, 2013)

employees of Sony EMCS planted trees to restore nature on its site, and have continued to maintain conservation efforts in hopes of creating a habitat for owls. CO-OP Aichi has held nature watching with its members and parents and children, the "CO-OP Aichi Forest," and rice farming experiential activities and nature watching in collaboration with Japan Agricultural Cooperatives (the Japanese Consumers' Co-operative Union Aichi, n.d.). It aims to establish a system that secures and supplies native tree seedlings for creating biotopes in urban areas. Areas proposed as planting sites are the Yahagi River Basin, Sakai River Basin, and Nagata River Basin (See Figure 2).

The Circulative Raising Native Tree Seedlings Project has one cycle of three years. A single cycle includes collecting seeds of native trees, screening, and seeding; distributing seedlings to residents; and planting and creating biotopes in urban areas using the seedlings raised by residents. Specialist surveys and studies are conducted at each stage. In order to deepen our understanding of how this Satoyama area works, study sessions are held during which seeds are collected, and seedlings are distributed and planted. Specialists have prepared a technical manual on seedlings, which includes descriptions of the seed bearing stage, screening method, raising method, and germination stage. At intervals, the Nishi-Mikawa Ecological Network Council conducts evaluation and monitoring (See Figure 3).

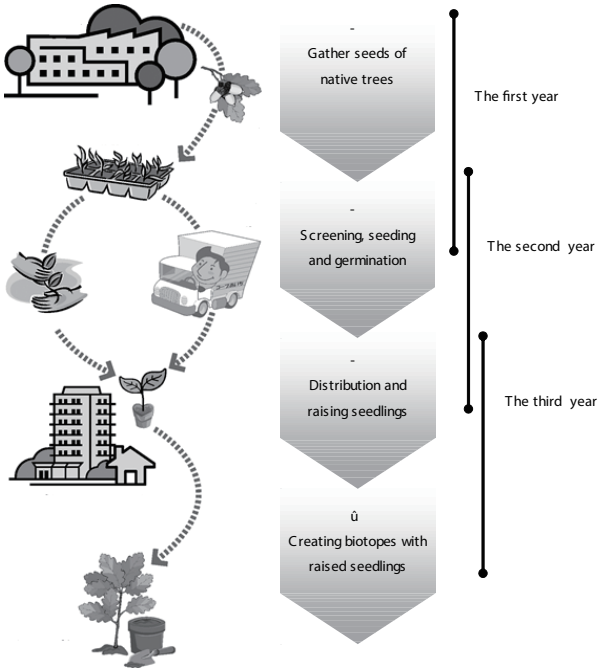

Figure 3. Flow chart of the Circulative Raising Native Tree Seedlings Project

Prior to the project, specialists selected trees suitable for the project. Firstly, they confirmed the vegetation zone of the forest from the potential natural vegetation zone based on an investigation of vegetation, birds, and insects. The forest comprises three forest types: evergreen, deciduous broad-leaved, and red pine. Secondly, specialists selected a deciduous broad-leaved forest where the seeds of main tree species could be collected with certainty. From the deciduous broad-leaved forest, they selected 20 tree species, including main tree species and characteristic tree species. Finally, 11 species were selected for the project based on seed distribution and seed-bearing capacity (See Table 1).

The investigation was implemented in 2012. Volunteers from the Sony EMCS Corporation collected and planted seeds as a trial. The project started in 2014, and by the end of the year, a manual was compiled that details the collection of seeds of native tree species, screening, and seeding as the first year action.

During the seed collecting stage, the Sony EMCS Corporation hosted an event for collecting native tree seeds and a study session. Volunteers from Sony EMCS and their families took part in the event. CO-OP AICHI notified its members, who also took part in the event, as did local government employees. The "Nature Watching and Seed Collection Event in Autumn" was held in October 2014 in the forest. Ninety-one people, including 32 children, participated in the event. Prior to the event, specialists monitored seed tree distribution and seed-bearing capacity. They also prepared a "nature bingo card" for nature watching, showing the types of nature that participants could see at the event. Participants were asked to seek certain aspects of nature, such as mushrooms or a good smell, etc., and completed the card, while having a great time. They also collected the seeds of nine native tree species, including *Quercus glauca, Quercus serrata,* and *Eurya japonica,* from among 20 native tree species. At the end of the event, specialists explained the next stages of the project, with the day's event being the first step to restore the natural environment. They also explained that the collected seeds will be raised and planted in the local area, expanding the habitats for fauna and flora in the area.

A questionnaire relating to the event was handed out to the participants. One respondent said, "My child gathered acorns delightedly. The nature bingo card was great not only for my child but for us. Parents had more fun than our child." One child said, "Some acorns were big, others were small, but both of them were pretty." Another said, "I felt that a place for plants and insects to live is needed." These answers revealed that many participants recognized the importance of nature.

Seeds were separated into nuts and fruits, and selected based on their shape. Various methods were used, for example, to eliminate pulp, fruits were soaked in water for several days, and then the seeds were picked out. Acorns were also soaked in water for several days, and those that floated in water or showed signs of insect damage were discarded. As a result, 60% of the collected seeds were available for seeding. A total of 2,104 pots were seeded and will be distributed in the second year of the project. At the end of the first year, the Nishi-Mikawa Ecological

Table 1. Selection of native trees for the Circulative Raising Native Tree Seedlings Project (ECOSYSTEM CONSERVATION SOCIETY-JAPAN, 2013)

tree species				representatives of tree-shrub of type of forest			Ripening season (month)											
		evergreen ／deciduous tree	Tree height	natural forest type	second-growth forest	early stage of secondary succession	3	4	5	6	7	8	9	10	11	12	1	2
Pinaceae	Pinus densiflora	evergreen	tree			●								■				
Fagaceae	Castanopsis cuspidata	evergreen	tree	●										■				
	Castanopsis sieboldii	evergreen	tree	*										■				
	Quercus glauca	evergreen	tree	○	●	●								■	■			
	Quercus salicina	evergreen	tree	*											■			
	Quercus serrata	deciduous tree	tree		●	○							■	■	■			
	Quercus variabilis	deciduous tree	tree		○	*							■	■				
Ulmaceae	Celtis sinensis	deciduous tree	tree		*									■	■			
Schisandraceae	Kadsura japonica	evergreen	vine	*										■	■			
Lauraceae	Cinnamomum japonicum	evergreen	tree	*											■	■		
	Machilus thunbergii	evergreen	tree	●							■	■						
Lardizabalaceae	Akebia trifoliata	deciduous tree	vine			*								■				
Theaceae	Camellia japonica	evergreen	tree	○									■	■				
	Cleyera japonica	evergreen	tree～arborescene	●	●									■	■	■		
	Eurya japonica	evergreen	arborescene～shrub	○	○	○								■	■			
Rosaceae	Pourthiaea villosa	deciduous tree	shrub		●	*								■	■			
	Prunus jamasakura	deciduous tree	tree		○	*			■	■								
	Rubus buergeri	evergreen	shrub	*											■	■	■	
	Rubus palmatus	deciduous tree	shrub			*			■	■								
Aceraceae	Acer crataegifolium	deciduous tree	arborescene～shrub		*					■	■	■	■	■				
	Acer palmatum	deciduous tree	tree		○						■	■	■	■				
Aquifoliaceae	Ilex crenata	evergreen	shrub			○								■	■	■		
	Ilex integra	evergreen	tree	*	*										■	■		
	Ilex pedunculosa	evergreen	arborescene	●	○	○								■	■			
Cornaceae	Aucuba japonica	evergreen	shrub	○			■	■	■							■	■	■
Araliaceae	Dendropanax trifidus	evergreen	tree～arborescene	●	●									■	■			
	Evodiopanax innovans	deciduous tree	arborescene	●	●								■	■				
Clethraceae	Clethra barvinervis	deciduous tree	tree～arborescene		○	○									■			
Ericaceae	Lyonia ovalifolia	deciduous tree	arborescene～shrub		○	○							■	■				
	Pieris japonica	deciduous tree	shrub	*		*							■	■				
	Rhododendron macrosepalum	deciduous tree	shrub		*	●							■	■				
	Vaccinium bracteatum	evergreen	shrub	●	●	●							■	■				
Myrsinaceae	Ardisia crenata	evergreen	shrub	*			■	■							■	■	■	■
	Ardisia japonica	evergreen	shrub			*								■	■			
Symplocaceae	Symplocos prunifolia	evergreen	arborescene			*									■	■	■	
Oleaceae	Ligustrum japonicum	evergreen	shrub			*								■	■	■		
Apocynaceae	Trachelospermum asiaticum	evergreen	vine	*										■	■			
Caprifoliaceae	Viburnum dilatatum	deciduous tree	shrub		*								■	■	■			
	Viburnum erosum	deciduous tree	shrub			*							■	■	■			
Compositae	Pertya scandens	deciduous tree	shrub		*										■	■		

total 40 species

●：Recommended species of each vegitation (main tree species/characteristic tree species)
○：Same as above (high frequency species)
＊：Relatively high appearance species of each vegitation

＜Selection of mother trees for the project＞

9	：Easy to find mother trees. Fruited well.
2	：Easy to find mother trees. Cannnot collect seeds in Autumn, but expects to collect in ripening season.
	：No mother trees in the forest. There are mother treesm but fruited bad.

Network Council evaluated the project. As a consequence, certain future objectives were proposed, namely, the exchange of information on raising seedlings, collecting methods, and the selection of planting sites, and also preparation of a manual for children.

Figure 4. Distributed seedlings

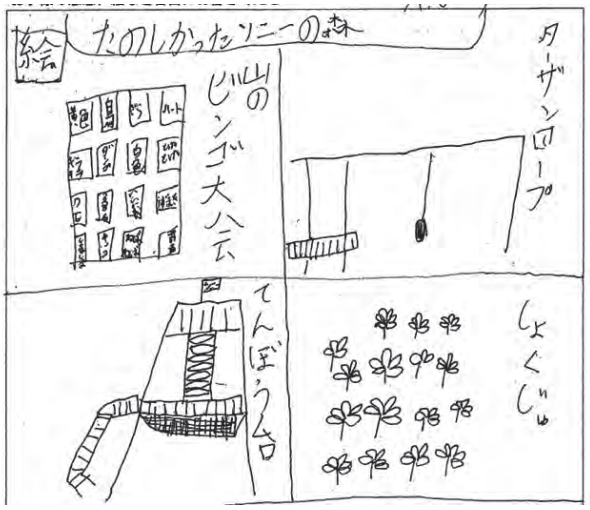

Figure 5. A picture of the event drawn by a child

In spring 2015, 1,455 seeds—half of the seeds that were seeded in autumn 2014—had germinated (the germination rate was low; however, some of the species require two years for germination). Similar to the seed collecting event held in 2014, an event was held to distribute these small seedlings to local people for them to raise. Participants included 153 people, of which 68 were children. Five species of native tree seedlings, including *Quercus serrata* and *Vaccinium bracteatum,* are suitable for raising by local people. To each participant, 6 to12 small seedlings were handed over.

The event included nature watching and planting seedlings that volunteers of Sony EMCS had collected as seeds in 2013 and raised in the Sony forest. In addition to the event, we requested the assistance of local elementary schools and junior high schools in raising seedlings. Some of the schools accepted; in particular, a few elementary schools told us that they would raise the seedlings as part of their environmental education curriculum. We also distributed the seedlings to local people through a junior high school event. A satoyama management group, which is active around Sony forest, supported our project and agreed to cooperate with us. Along with the seedlings, we gave people a leaflet describing how to raise the seedlings. In addition to these activities, we collected seeds of *Prunus jamasakura* in early summer and these were seeded in the autumn. This stage will be led by CO-OP AICHI and local governments.

When native tree seedlings grow large enough for planting, seedlings are gathered and planted. The tree planting sites will be located in three types of areas. The first is a Satoyama area. The second type is at biotopes created during landscaping by local governments and companies. The third will be at a biotope creating event, so as to raise awareness on the meaning of biodiversity and ecological networks. Moreover, seedlings will be planted in backyards by volunteers and members of CO-OP AICHI, who have raised native tree seedlings. Local elementary schools are suitable for creating biotopes with seedlings. This will be the third-year action of the project.

The Circulative Raising Native Tree Seedlings Project will establish a process from collecting seeds to planting. At the same time, it will expand areas of the target native tree species. The greater the number of tree species the project targets, the more detail will be written in the manual. In addition, target areas will include other sub-regions in Aichi, as well as in the Nishi-Mikawa region.

3. Expected results

Native tree seedlings prevent gene introgression in the creation of biotopes in urban areas; however, a supply shortage of seedlings is a problem. It can be expected that the Circulative Raising Native Tree Seedlings Project will establish and ensure a stable supply system of native tree seedlings through the collection of seeds for planting. Moreover, a technical manual was prepared for this process. This will ensure that knowledge of and the know-how to raise native tree seedlings is accumulated. When a new similar project starts, it will thus be easy to share knowledge and know-how. For this reason, this project will hopefully stimulate other stakeholders in other areas of Aichi to start similar projects to raise native tree seedlings.

Through volunteers from a private company and appeals from CO-OP AICHI, citizens, including children, take part in each stage of the project: seed collection, raising seedlings and planting seedlings. Nature watching is held on the occasions of seed collection, seedling distribution, and planting. In other words, the project provides environmental education opportunities. According to the above-mentioned questionnaire, participants understood the importance

of nature, and learned about nature restoration. It shows that opportunities to get in touch with nature make people more concerned about local nature. Hence, citizens are expected to be aware of participation in nature restoration and conservation activities through such projects.

Progress on the Circulative Raising Native Tree Seedlings Project is periodically reported to the Nishi-Mikawa Ecological Network Council, with discussion on how to promote it and deal with future challenges, based on each member's views. Information on demand and supply of seedlings and planting sites is shared at Council meetings.

Moreover, it is anticipated from a sustainability point of view that Satoyama areas will be managed as part of an economic system. For example, the Satoyama Vision of the Nishi-Mikawa Ecological Network Council has proposed creating a new management system of Satoyama areas as one of its basic policies. Satoyama areas include artificial forest of planted Japanese Cedar and Japanese Cypress; however, people have given up the management of this type of forest. In order to manage it, cutting down artificial forest and restoring broadleaf forest is one example of a management system for biodiversity. In this case, the best way to treat wood is by adding economic value through utilizing it as woody biomass or timber.

4. **Expected lessons**

The establishment of a system promotes the participation of various sectors of the community, including citizens, in the project. Compiling a technical manual on raising seedlings is one example of a means to promote participation. The Nishi-Mikawa Ecological Network Council has two roles in the project. One is as an information hub; the other is as a database. Through sharing information and collaboration, participants enhance awareness of the co-management of Satoyama area landscapes. As a result, it is expected that the creation of biotopes in urban areas using seedlings from Satoyama areas may foster links between people.

Due to a decrease in the economic value of Satoyama area, there has been a progressive decline in its management. On the other hand, a new management method, which is compatible with today's society, such as environmental education, is required. In the Circulative Raising Native Tree Seedlings Project, seed collection is implemented as an event, with the participation of volunteers and their families from the Sony EMCS Corporation. Since CO-OP AICHI also participates in the project, it calls for its members' participation in the event. Consequently, citizens participate in the project. This means that collaboration between stakeholders provides citizens with opportunities to join in nature conservation activities. Collecting seeds and raising seedlings are activities suitable for citizens, including children, and provide opportunities to learn about the environment. The project is expected to raise awareness that growing native tree seedlings is one of the steps toward the conservation of local nature and ecosystems, and can thus trigger an interest in local nature. Moreover, interest in the local natural environment promotes a sense of affiliation with the place where people live. "Coexistence between people and nature" is a precious step in the establishment of community and the happiness of its citizens.

Another result is the efficiency of collaboration among various stakeholders in raising native tree seedlings and creating biotopes. In the collaboration process, key elements are opinion exchange, sharing of information, and the establishment of trustworthy relationships. These elements require some time.

The Circulative Raising Native Tree Seedlings Project still faces future challenges. Once a supply system of native tree seedlings is established as a model, the next questions are whether it is a sustainable system or not, and how to expand the system to other areas.

Matching the demand and supply of native tree seedlings is a key point in meeting these challenges. In this regard, the Nishi-Mikawa Ecological Network Council plays the role of coordinator. In terms of expanding the project, one contingency plan is creating a separate manual for different target audiences, such as children and adults. Another is appointing an educator who has knowledge of raising native tree seedlings to participate in a new project. In this case, the Nishi-Mikawa Ecological Network Council would coordinate the sharing of a lot of information among stakeholders. The more people who participate in the project, the stronger will be the supply system of native tree seedlings. Furthermore, the establishment of an economic Satoyama area management system will support expansion of the system.

5. **Conclusion**

The Circulative Raising Native Tree Seedlings Project in the Nishi-Mikawa region is a system designed to supply seedlings that takes into consideration genetic diversity and seeks to promote the stable and continuous creation of biotopes in urban areas. The project promotes connecting nature between urban areas and Satoyama, without forgetting its importance in a changing society, by means of creating ecological networks with various stakeholders' collaboration.

In the project, citizens collect native tree seeds, raise seedlings, and create biotopes around their homes using these seedling, with assistance being provided by NPOs, companies, and local governments. It is expected that these activities will help citizens to recognize the meaning of nature restoration in urban areas and provide an understanding of the ecological networks created through their activities. Furthermore, it is also expected that the project will raise awareness on "coexistence with nature". Raising seedlings and nature watching are good opportunities to turn environmental education into

enlightenment.

As a result, two results are expected. One is realizing "coexistence between people and nature," since various local stakeholders expressed interest in nature in the area, and the other is taking action to conserve nature where people live. A further consequence of the project is nurturing a love of the places where people live, work, and learn. These aspects contribute to realizing "Coexistence Between People and Nature in Aichi" of the Aichi Biodiversity Strategy 2020.
The Circulative Native Tree Seedlings Project connects growing cities and Satoyama areas with nature, and enlarges habitats for various life forms in suitable locations. Thus, overall, the project contributes to biodiversity conservation. The project is a step toward sustainable community building that considers regional characteristics, and is in harmony with the surrounding environment and ecosystems.

Figure 6: Seeding (Photo by ecosystem conservation society-japan, 2014)

Figure 7: Satoyama in Aichi (Photo by Sony EMCS, 2015)

Acknowledgements

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Chapter 7

The importance of the Farmers Field School approach: A case study - Farmers Field School practical training programs, Vietnam

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Abstract

Farmers Field School (FFS) is a group-based learning process for achieving farmer empowerment, community development and education on eco-friendly farming methods. In Vietnam, the Social Policy Ecology Research Institute (SPERI) started a network of FFS's around end of 2006 to address numerous issues: the losses of traditional knowledge from previous generations in the upland landscapes; the lack of access-to-education for disadvantaged ethnic minority youths; and the need to secure locally situated knowledge and practices whilst also increasing farmers-to-farmers learning in the upland regions. This paper provides detailed information on the FFS education program of SPERI, specifically on the three core hands-on training programs: forest regeneration/ conservation, ecological farming practices and the nurseries program. The focus on learning/knowledge generation and knowledge enhancement (learning from experiences/real exposures, and also from failures) from the FFS-SPERI approach could provide a useful contribution to Socio-ecological Production Landscapes and Seascapes (SEPLS) management, restoration of degraded forest landscape, and conservation of ecological systems and biodiversity.

Keywords
Farmers Field School approach, training programs, forest landscape management, ecological farming practices, indigenous minority students, learning experiences.

1. Introduction

The introduction of the FFS approach to organic vegetables farmers in Vietnam occurred in the early 1990s. During the period 2000 to 2009, FFS was adopted largely through agricultural projects supported by international donors, such as Agricultural Development Denmark Asia (ADDA). ADDA projects used the FFS structure to provide farmers with the technical knowledge to enable them to increase their income through growing various short-term crops.

The Social Policy Ecology Research Institute (SPERI), Vietnam, also used the FFS approach for slightly different reasons. SPERI witnessed that many minority youths lack access to an education that incorporates minority culture, particular ways of thinking, and wisdom. At the same time, ethnic youths do not have the financial resources to access education. Deforestation in many areas of Vietnam and Lao P.D.R., especially the upland, is a serious issue (FAO 2011b) that results in increased poverty (Mellor & Desai 1996), increased food insecurity (FAO 2011a) and also landscape/ ecosystem degradation. In the context of an increasingly urbanized and industrialized country, many minorities find it very hard to maintain their way of life (Baulch et al. 2007; Lanh 2009).

The name *Farmers Field School* itself, by SPERI's adoption, reflects the dream of how to approach and facilitate ethnic minorities' access to education from an 'easy-to-understand, simple and low-cost' entry-point. FFS's work with ethnic minorities to help improves their lives and landscapes using parts of their own knowledge and culture. By establishing and running FFS's in remote mountainous upland areas, SPERI hopes to contribute to empowerment and enhancement of practical knowledge on how to address the various issues mentioned. SPERI has a network of four active FFS's across Lao Cai, Ha Tinh, and Quang Binh provinces of Vietnam, and one extending to Luang Prabang province, Lao P.D.R.

The FFS's are located in remote upland areas where limited infrastructure and rough mountainous terrain are present.

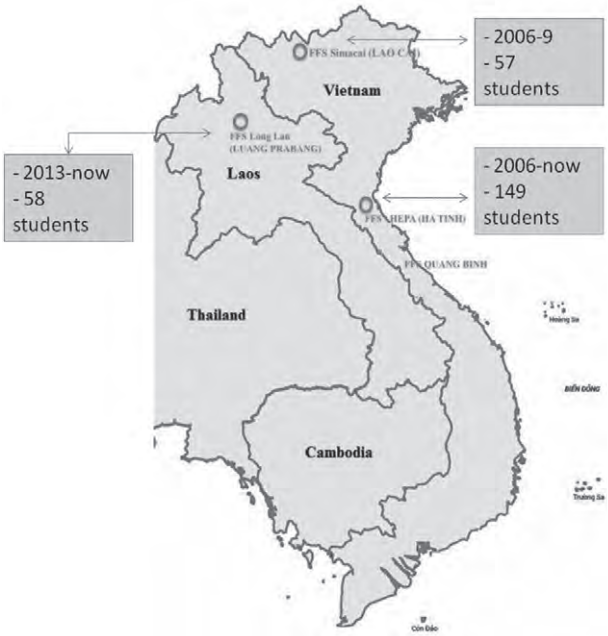

Figure 1: Map of the network of four Farmers Field Schools in Vietnam and Lao P.D.R. (SPERI, 2015).

SPERI facilitates hands-on trainings through FFS's. The curriculum is composed of various topics that are critical for securing and recovering the integrity of forests and associated ecosystems in the target areas, including forest regeneration/ conservation in the upper and mid elevations, ecological farming practices in the mid and lower zones and a nursery program in the lowest land. SPERI refers to these combinatory actions undertaken simultaneously in a landscape as our operational definition of 'landscape approach'. The aim of the curriculum is to provide skills useful for maintaining traditional knowledge and ecological services, restoring degraded forest landscape, as well as conserving species and biodiversity values. Over years of operation, results have indicated an improved management of SEPLS. The FFS-SPERI approach could be a useful contribution to SEPLS management, restoration of degraded forest landscape, and conservation of ecological systems and biodiversity. In the long-term, FFS's should demonstrate harmonious interactions between humans and nature within the Satoyama Initiative framework.

2. **Method**

2.1. **Strategies**

FFS-SPERI strategies are applied to nurture and train one or more groups of ethnic youths from varied upland landscapes and to build a strong network amongst them in varied scales (i.e. individual farm houses, community farms and regional farms). Students are selected from villages by community members and also by SPERI. The selection process targets those who wish to learn but do not have the finances, have the land area at home for later application, have a strong wish to maintain ethnic pride and community values or are recommended by family, village elders or the local authority. FFS facilitates and strengthens the linkages between ethnic minority youths and senior farmers by inviting these senior farmers to be direct teachers to the younger ones in training programs. This helps promote sharing of traditional knowledge and experiences. Collective thoughts and actions among them are also sought to look for local solutions to improve local community land use planning and resources management.

2.2. **Training methodology**

FFS-SPERI training methodology is based on 'learning-by-doing' (1). This methodology was introduced by SPERI in 2006 and is currently in use. After students identify their needs and concerns, the FFS training programs are set up according to these students' needs. Long courses are often one-to-two years; short courses are often one-to-two weeks, although in some situations courses are three months long. The usual hours for learning are about 5 hours average per day. Depending on theme or topic, the shortest class would be 3 hours. Depending on season, the length of classes may reach an entire day, with two hours in the morning spent for classes and three-to-four hours in the afternoon for practical sessions. The number of hours and frequency of classes very much follow the natural calendar of the crops and plants. Every week, there is one community day that has no class and one question-and-answer session, where students can voice questions from observations and findings of interesting things from nature or regarding practical work and engage in shared seeking of solutions together with friends and staff. All the training programs' topics are designed and operated by re-creating a place similar to the students' home landscapes. For the ethnic minority youths, it is essential to build curriculums that contain certain similarities to the environment where they came from, in order to garner their interest and provide learning connected with their background (instead of disconnected). This appears to be a crucial point for students to relate better to knowledge, and for the knowledge to be better received and more easily practiced by the students.

2.3. **Learning environment**

The FFS-SPERI practical learning environment often includes actual farms and forests. Providing students with access to real farms of manageable size for running, and chances for rotationally taking on the role of management, as well as learning sessions within the forest areas, help students learn more quickly and relate more easily to the FFS learning environment and think about its applicability to their home villages. Further, students participate in field trips in-and-out of FFS environments which are also helpful to increase their exposure to new situations, and hence knowledge generation. Questions are often raised during the trips that allow students to relate what they

have learnt and seen to issues in their home communities. Other key learning environments provided at FFS are study tours to various pilot sites, either successful pilots (e.g. good community forest management models, small organic farms) or failed examples (e.g. degraded sites or conventional agricultural farms).

2.4. **Knowledge enhancement**

In order to enhance knowledge in the wider community, study tours for external stakeholders (e.g. students, farmers association, governmental officials and non-governmental organizations) from various regions are invited to visit the FFS's. Knowledge exchange commonly occurs between scientists and traditional knowledge holders, as well as between international volunteers and local students. Knowledge exchange also occurs among policy makers, agricultural extension officers, practitioners, farmers, community leaders, elders and the youths. This allows students to improve their level of understanding and engage with different actors to facilitate changes.

The following sections provide details on the three training programs.

2.5. **Training program on forest conservation/regeneration**

The training program on forest conservation and regeneration plays a key role in raising awareness on how to address forest degradation. All FFS sites are located within forest areas. The training program is designed to involve courses and also on-the-ground activities within the forest areas. Studying and observing forest ecology, the relationship between forest and fauna ecology, and forest health and landscape patterns in the upper catchment have helped students understand the multiple values obtained from forests, and hence realize the importance of conserving forests. The program also includes training on how degraded and regenerated landscapes influence ecosystem services, such as watershed function, water generation for downstream agricultural production, and other cultural/aesthetic values.

Figure 2: Students conducting a practical learning session in the forests (Photo by FFS-HEPA, 2011).

Figure 3: Students studying ecology of a species from a Sach minority herbalist (Photo by FFS-HEPA, 2013).

Practical learning sessions teach students how to identify forest species with daily-use values, such as edible plants and herbal medicinal plants. Elders from the students' villages, female herbalists, and also botanists are invited to teach. Forest vegetables provide added-nutrition and medicinal plants cure illnesses. This helps students to build a stronger connection with the forests and benefits their daily lives. After identification of edible and herbal plants, students organize trips to the forest to collect these plants. The plants are then propagated at the students' experimental farms or at the nurseries.

In the upper part of all FFS sites, an area is designated for strict protection. The area includes a sacred Banyan tree and a special rock. A ritual ceremony to greet the Forest Spirit – located in the Banyan tree – has been organized monthly. Incorporating the spiritual values of the forests into the learning process is important for behavioural change. Conservation messages such as, "if anyone cuts the sacred trees it could affect the spirits, and they might get sick", have been transferred to students and everyone else to promote conservation. The monthly ritual ceremony teaches students and visitors alike the importance of protecting and nurturing nature. No damages, violation and wrong-doings are acceptable in this upper part.

Another key part of the training program on forest conservation is the organization of weekly forest patrols in order to prevent illegal logging and wildlife trapping. Often a group of three to five students has been organized to patrol the forest. This weekly or monthly activity is integrated into the program as an important part of assessing the study results. Whilst patrolling the forest, students also learn how to identify local species of value mother trees and to develop regeneration strategies. Forest patrolling teams also invite people from the border army and nearby local community. Strong collaboration amongst the FFS, students, and local authorities including provincial and district authorities, border army officers, the

watershed management authority, and the neighbourhood community, has been established.

2.6. Training program on ecological farming practices

Given that the FFS training program takes the landscape approach, it is crucial to not only train in protecting the upper part but also nurture good practices in the middle hill followed by the lower zones through appropriate farming and management practices. The training program educates students on the ecological farming system as a system approach, as well as provides specific ecological farming skills.

Figure 4: Students and elders observing nature and recording (Photo by FFS-HEPA, 2012).

The ecological farming program is based on a combination of permaculture and information gathered by SPERI from indigenous minority communities (3), based on the indigenous minority communities' values – beliefs, ethics, natural patterns, local knowledge and wisdom towards nurturing nature. In 2005, permaculture was first introduced to SPERI's farmers' network (4). Permaculture highlights the meanings from the natural landscapes. This is illustrated by the need to maximize learning from nature and strive to leave the smallest footprints upon nature. The integration of this science and traditional knowledge from ethnic minorities has continued to develop. Ecological farming knowledge respects the landscape approach, and logically connects with the earlier forest conservation program. It is seen as a method to maintain all the natural nutrients from the forests in the upper part to be re-used on the farms and the nurseries located in the mid to lower hills.

Ecological farming training is delivered on actual farms (5). These farming areas have been carefully designed to follow the natural patterns of landscapes to maximize ecological function and resilience. Students can learn-by-doing on the allocated farm. The size of the allocated farm is often just less than one hectare. Students share one farm in a group of three to four people. On the farms, they grow various crops, raise animals, and also run trial research. Students can experiment to learn which ways plants grow better, and/or combine plants-and-plants or plants-and-animals.

Specific ecological solutions have also been taught. The table below illustrates an example of a yearly eco-farm training program. Topics included are: erosion control through terracing systems, forest watershed management and patrolling, water management through banana circles and the reed bed system, waste management through banana circles, worm farms, 18-day compost, mulching, bio-fertilizer, natural soap, herbal tea, garden bed design, animal systems, animal silage, fruit trees, multi-functional plants, bio-gas, bio-char, handicrafts, and wood carpentry.

Table 1: An example of a yearly eco-farming training program (FFS-HEPA, 2013).

Student A	Student B
Making herbal and medicinal tea	same
Environmental awareness and consumption: processing detergent and body soap from natural materials	same
Processing of different local food products from Huong Son (fermented eggplant, jackfruit, taro)	Advanced diversity farm management (vegetable garden, ecological animal raising, design, planning, maintaining and developing eco-farm)
Techniques for harvesting and processing bamboo shoots according to Khmu local knowledge	Managing ecological animal systems (buffalo, chickens, pigs, geese)
Basic tailoring	Sowing methods according to local knowledge of Australian farmers
Natural dyeing	Designing energy-saving stoves
Technique for cotton cultivation	Technology for making and applying Biochar
Knitting techniques	Field training in forest volume measurement
Traditional weaving and dyeing	Water management and contour design on the farm (by swales, ditches, terrace fields, etc.)
Advanced tailoring	Seed saving methods
	Technique for making liquid fertilizer with micro-organisms
	English language (intermediate)

Besides specific skills, the training program also includes a theoretical approach focusing on the ecological returns of land and resource management and nurturing cultural beliefs whilst encouraging leadership skills and creative and critical thinking.

On a farm site, there are often three major activities: food production, animal raising, and housing and crafting. Although almost no vegetables come from outside the FFS's, the current vegetable production is not sufficient. According to a recent estimate from Rào An's farm output records, the minimum vegetable production to supply the Rào An farm area (in case around 10 people are eating there 3 times per day) is about 130 kg per month. 130 kg per month for 10 people is the estimated real harvest on average (929.9 kg/7 months = 132 kg/month), which is generally sufficient (Muijlwijk et al, 2014). FFS production of vegetables or any other organic produce is not exceeding internal demand hence it is insufficient to sell to consumers. At a few farms, students raise bees near the forest margin to collect natural honey.

2.7. **Training program on nurseries**

The nurseries program of the FFS's is also set up, often in the lowest area of the FFS terrain and near the forest edge (6). The nursery often has four main tasks. It nurses all the locally available native species to help forest regeneration and rehabilitation in degraded areas. It collects local species from various regions to nurse and builds up a seed bank for seed conservation. The nursery also links strongly with other eco-farm networks at the community and household levels. It also provides hands-on training courses for many student groups, farmers' groups and anyone interested.

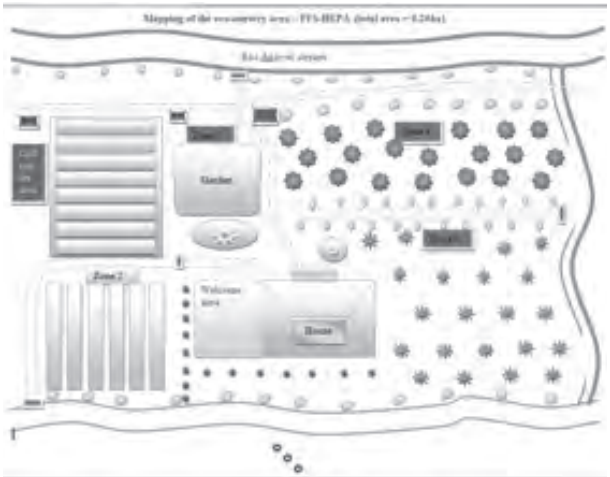

Figure 5: An example of the current area and zones at a nursery (FFS-HEPA, 2012).

The nursery has a collection of four types of tree plants: landscape trees (trees providing landscape function/ decoration), timber trees (trees providing hardwood, e.g. house poles, coffins), material trees (i.e. trees providing materials for roofing such as rattan, bamboo), and forest vegetables and others vegetables/herbs/flowers).

Figure 6: Students collecting seeds in the forest (Photo by FFS-HEPA, 2014).

Figure 7: A hands-on learning session with farmers at the nursery (Photo by FFS-HEPA, 2014).

Specific activities have taken place. First is the collection of seeds from the forest, largely mother trees and locally valuable pioneer species. Second is the nursing of these seeds into seedlings, small trees and matured trees good enough to replant in the degraded area within the FFS's and also neighbourhood areas. Third is the testing of new sites for species. When other tree, flower, and vegetables seeds are brought in from other regions or countries, they are tested in the nursery to determine if they will grow well. New knowledge can be generated from these trials. However, work in collaboration with seed scientists, experts and botanical specialists, as well as traditional knowledge holders, is also being continued regarding the extension of this work and to what degree it is appropriate to avoid invasive alien species overtaking native species. Final the aim is to deliver this extension function to anyone interested.

3. Results

3.1. Number of students trained

Since 2006, SPERI FFS's have educated more than 200 disadvantaged ethnic minority students with a high school equivalent degree conferred in Vietnam or Lao P.D.R. A few graduates received recognition from the Australian Permaculture Research Institute. Some graduates are now working to expand SPERI's vision on ecological farming practices in the ASEAN region. Some chose to be mobile trainers to help with re-training others at household farms in Thailand, Myanmar, and Lao P.D.R. Many of the graduates got jobs as local agroforestry extension officers or are involved in gardening or forest groups within a village. Some graduates sought further education or chose a different career path.

Table 2: Number of students trained at Farmers Field Schools (SPERI, 2013).

FFS courses included HEPA, Simacai sites and number of students

Long courses

- Course (2006-2008) on eco-farming foundation: 29 students
- Course (2007-2009) on eco-farming foundation: 14 students
- Course (2006-2010) on eco-farming foundation and intermediate: 57 students
- Course K Lao 1 (2010-2011) on eco-farming foundation: 7 students
- Course K Lao 2 (2012-2013) on eco-farming foundation: 7 students
- Course (2011-2012) on advanced eco-farming: 5 students
- Course (2012-2013) on advanced eco-farming: 7 students

Short courses

- Permaculture in 2007: 50 people (including farmers and students)
- Refresher course on permaculture in 2009 and 2010: 30 students

3.2. Number of visiting groups

FFS training programs have received various visitors including students and lecturers from other universities, international volunteers, experts and specialists, local authorities including high-level government officials, provincial and district authorities, functional offices, agencies, and farmers from many provinces to learn and share knowledge. In total, there have been nearly 200 visiting groups and thousands of people since 2006. The number of visiting groups has been decreasing primarily due to stricter border control regulation. A total number of 50 international volunteers have contributed to knowledge sharing and better management of forest landscape and ecological farming practices at all FFS sites.

Table 3: Number of visiting groups to Farmers Field Schools (SPERI, 2014).

Year	Number of visiting groups	Number of people
2006-2010 (Simacai site)	55	100 people per year
2011	29	74
2012	15	52
2013	18	75
2014	09	23

3.3. Long-term results from forest conservation/regeneration program

As a result of continuous protection of the forests, the data has indicated a reduction of illegal logging cases over the years in the area. The number of trappings of animals/wildlife from the forests was also reduced. Since 2002, landslides have not reoccurred in the region due to more forest plantings and restoration/preservation has contributed to retain water level and also the soil surface structure.

Table 4: Results from forest patrolling from 2010 to 2014 (FFS-HEPA, 2014).

	2010-2013	2013-2014
Results from patrolling the forests	Found > 500 traps; Captured 6 illegal loggers; 4 guns for illegal hunting;	Captured 3 illegal loggers; Captured 6 illegal logging cases without knowing who is responsible.

The program of forest conservation and regeneration is most outstanding at FFS-HEPA. The yellow boundary (polygon) indicates the total land area of FFS-HEPA. Forests conservation and regeneration have been proven through Landsat satellite images. The changes on satellite images reflect both actual on-the-ground efforts from forest patrolling and tree planting activities. These satellite images, when reflected as Normalized Differences in Vegetation Index (NDVI) values, indicate significant

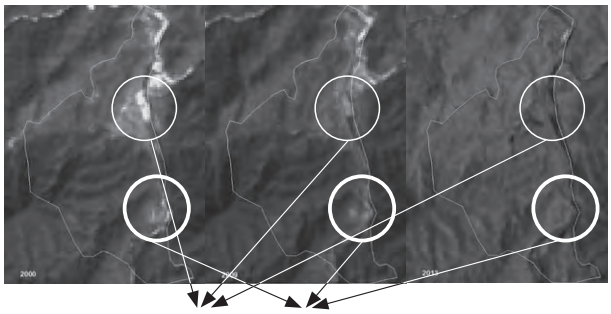

Figure 8: Two areas through images indicating significantly positive changes in forest coverage by on-the-ground forest protection and planting efforts (FFS-HEPA, 2013).

positive changes from 2000 to 2009, and recently in 2013 in the coverage of forested areas.

3.4. **Mid-term results from ecological farming program**

One of the interesting results from the ecological farming program is the number of students after graduation that continue working on promoting eco-farming practices in their communities. About 50 percent of the total graduates from FFS training programs have returned to their home communities to build ecological farming sites on small farms, and also engage in forest regeneration activities. About 10-15 percent of students have managed their farms close to eco-farming principles. This happens in both Vietnam and Lao P.D.R. About 30 percent of the graduates now have jobs as agricultural/forestry extension officers, or have taken on other formal responsibilities in local communities. About 20 percent of the graduates have proceeded to further education.

The other remarkable result is the extension of application of the banana circle, an important ecological solution to resolve household wastewater grey water and composting of organic waste materials. Banana circles have five to seven banana trees – arranged in a ring-like structure. The banana circle contains further wastes and pollution. Students from FFS training have successfully attempted to introduce and extend banana circles into other countries in Southeast Asia. It has been widely socially accepted and applied in various rural areas in Vietnam, Lao P.D.R., Thailand and Myanmar by farmers' groups as a cheap and affordable option. In early June 2015, the banana circle solution was awarded as one of the Top 25 most outstanding solutions in the Action for Water Competition 2015 in Vietnam.

Figure 9: Student train-by-practice 'banana circle' with people in Thailand (Photo by SPERI, 2014).

Figure 10: Student train-by-practice 'banana circle' with people in Myanmar (Photo by SPERI, 2014).

Table 5: Nursery provides seedlings to other farms (FFS-HEPA, 2014).

Time planting July – Oct 2014	Khe Soong farm	Thu'o'ng Uyên farm	Cây Khế farm	H7 farm	Pao Zoong farm	Rào An farm
TOTAL	732	99	190	36	150	98
Total timber trees:	**620**	**90**	**120**		**150**	
Cồng tía (*Calophyllum saigonensse*)	410	60	90		100	
De/Dê sìng (*Pasania thomsonii*)	210	30	30		50	
Total timber fruit trees:	**87**	**9**	**70**	**36**		**18**
Sấu tía (*Sandoricum indicum*)	33	5	26			
Trám nâu (*Canarium littorale*)	20	0	0			
Mít (*Artocarpus heterophyllus*)	7	4	10			10
Sa Nhân (*Amomum* sp.)	27	0	34	36		8
Total material trees:	**25**	**0**	**0**			**80**
Tre (Bambuseae)	25	0	0			20
Mây (Calameae)	0	0	0			20
Tro kè (*L. Chinensis*)	0	0	0			40

3.5. Short-term results from nurseries program

According to the latest data, from July to October 2014, the nursery has successfully nursed 1,500 small tree plants at FFS-HEPA. The table below provides data on seedlings coming from the nursery that were extended to another six running farms of FFS-HEPA. For the 2015 spring season, the nursery is nursing 3,000 seedlings including timber trees, landscape trees and seasonal vegetables.

4.Discussion

4.1. Lessons learnt

FFS training programs have indicated a certain extent and scale of effectiveness. Likewise, there are lessons to be learnt. What makes FFS's continue is the ongoing dedication and strong will, guided by the leadership structure, toward the necessity to improve ecological systems. FFS's address poverty and create autonomy for each disadvantaged ethnic minority youth and thus their associated local community. The autonomy allows them to improve local community land use planning and resources management. These are achieved through enhancing knowledge, largely learning-by-doing knowledge, and at the same time facilitating different means of learning:

1. ***Learning from elders:*** FFS facilitates and strengthens the linkages between youths and their senior farmers by inviting the elders to directly pass their knowledge to students in training sessions. Discussions have led to local solutions to improve local community land use planning and resource management issues.

2. ***Learning by doing:*** The key point is offering of a practical learning environment where students can practice and relate their knowledge to home villages; they can see certain similarities but also recognize differences. Also, it is important to include actual farms and forest areas in the training fields for real training and actual exercises. Students are able to exercise learning-by-doing, and can experiment by trial-and-error during their learning process.

3. ***Mutual learning:*** Study tours are held to various sites, pilots and/or practice sites, either successes or failures (e.g. degraded sites or conventional agricultural farms). Interaction between farmers, scientists and traditional knowledge holders, international volunteers and local students are important to increase mutual learning. Knowledge exchanges, especially on management strategies, occur between policy makers, government officials including agricultural extension officers, practitioners, farmers, community leaders, elders and also the students.

4. ***Collaboration with local authorities:*** Strong collaboration between the FFS and the local authority to prevent illegal logging is an effective approach given that all FFS sites are located at remote border areas and are working to address forest degradation, illegal logging and wildlife hunting. Fostering strong collaboration with local authorities and authorized agencies is crucial to increase the effectiveness of joint actions.

5. ***Nurturing the cultural and spiritual values of the forests and landscapes:*** Forests and landscapes are not just timber, wood resources or any other economic means. Each forest and hence landscape has a history, a cultural message linked to it since its original formation. The will of people to attempt to conserve resources is often observed in their cognitive realization of the spiritual/cultural meaning attached to a forest and or landscape.

6. ***Integration of traditional knowledge and modern science:*** The integration of traditional ecological knowledge from ethnic groups is essential for enabling the students to feel proud of their beliefs and local knowledge systems, to not feel disconnected in learning, and to feel empowered to practice.

7. ***Innovation of knowledge:*** Innovative knowledge is built in the process of running experimental farms and trials. Students are given space to experiment and learn through trial and error. The nursery program has allowed students to test and try new species which can result in the creation of new knowledge. Innovative learning or knowledge enhancement (*in order to turn thinking into actions*) should be sought from the individual student level to allow students to exercise and create change(s) from the small scale through to a bigger scale.

4.2. Challenges

Despite significant positive changes, change has taken years to obtain. There are also challenges involved in FFS operation. The setting up and running of FFS's is not easy, not only due to the remote locations but also limited access to infrastructure, opportunities and resources. The motivation to provide an alternative learning experience to disadvantaged youths in upland communities - unlike topics offered in the formal schools, e.g. mechanical agriculture, chemical agriculture - is also challenged. While Vietnam is moving towards becoming a modernized and industrialized country, FFS operation encounters another mainstream challenge, especially when young people are tempted to move to cities in search of jobs instead of staying at local places to learn from elders and community members how to revive, conserve, and better manage local resources and ecosystems. Environmental awareness, forest conservation, landscape restoration and/or healthy and safe farming practices continue to be practiced at a relatively low level amongst the Vietnamese public. This hinders FFS operation and certain on-the-ground uptake

activities. Financial resources for some graduates to apply knowledge after FFS training programs are also limited.

5. Conclusion

This paper provides further information on FFS training programs, methods, results and also challenges - specifically regarding the three hands-on programs. What is crucial in our message is that positive changes and better management of SEPLS can be possible if education takes place at the grassroots level, reaches out to many groups including disadvantaged ones, and is delivered with the most practical hands-on components. Promoting further on-the-ground activities as well as increasing farmer-to-farmer learning and action-taking would be the most effective way to allow target groups at the grassroots level to participate and benefit from managing their landscapes. Likewise, it would also create positive changes in their resources management, including the land, forests, biodiversity and other intangible values that are significant to their lives.

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Chapter 8

Landscape conservation in the Black Forest, Germany

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Abstract

The German Association for Landcare (DVL) is the umbrella organization of 155 Landcare Associations (Landschaftspflegeverband, LA) distributed all over Germany. The independent local LAs manage various cultural landscapes in Germany, which have been shaped during the last centuries by regional land use systems. Not only many species, but also large parts of the German cultural heritage depend on those socio-ecological production landscapes. It is the task of all LAs and the DVL to restore and maintain the cultural landscapes by working in cooperation with local municipalities/authorities, farmer organizations and nature conservationists to strengthen local communities, protect biodiversity and create benefit for man and nature.

The Landcare Association Central Black Forest (LACBF) is committed to preserving the cultural landscape of the Central Black Forest in the southwest of Germany. Due to its traditional land use this region reflects a mosaic of forests, pastures and grassland. Many species have adapted to the mosaic rich landscape and are dependent on its continued use. The LACBF works together with farmers to enhance sustainable pasture management to keep the grasslands open; it supports regional marketing and offers consulting and educational trainings to raise awareness on the very specific countryside in the Black Forest and its land management. The approach of Landcare and the way they are working has brought many benefits for man and nature to the region.

Keywords
cultural landscapes, cooperation, nature conservation, landcare, Black Forest, Germany, farmers, sustainable

1. Introduction

The Black Forest is located in the southeast of Germany, Central Europe. In former times Europe and the region of the Black Forest were originally covered by thick forests. But as the first human hunter-gatherer societies started to settle, they began to cultivate the land and thus influence the landscape. They used forests as pastures for their animals and chopped down the valuable wood for either fuel or construction purposes. The resulting open spaces were used as pastures or ploughed to cultivate field crops. The diverse structure was also shaped by the regional characteristics of the Black Forest, which are steep slopes and deep valleys. The traditional land use created and preserved a mosaic rich structure of forests, grasslands and cultivated fields, which represent the characteristics of the Black Forest.

Figure 1: Cultural landscape in the Black Forest (Photo by Hans Page)

By the traditional land use system several ecosystem services are offered. Three important services are described as follows:

1) Because of the mosaic rich landscape, many species of flora and fauna have found their habitat in the cultural landscape of the Black Forest. Many light dependent and also endangered species can be found there. The species-rich grasslands and pastures also provide high quality fodder for animals.
2) The beautiful landscape with traditional villages and high quality local products attracts many tourists to the region.

This strengthens the rural economy and also gives a local identity to residents.

3) The open grasslands and fields also provide fresh air in the valleys. Open spaces let the air cool down faster in the evening and at night fresh air flows down to the villages in the deep valleys.

Figure 2: Traditional farm house in the Black Forest (Photo by Susanne Kopf)

Despite these benefits for people, food and nature, the cultural landscape of the Black Forest faces big challenges. Much grassland has fallen fallow in recent years because traditional—and mostly sustainable—land use is too expensive and elaborative. Although technical development offers new options, still many slopes in the Black Forest have to be cut and harvested by hand labour. The cultivation of field crops is focused only on cost effective fields in the lowlands, which causes an unsustainable intensification of those fields and results in the abandonment of extensive grasslands and pastures in the mountains. Also the traditional way of life, which formed the typical landscape of the Black Forest, is in the process of being lost. Being a farmer and the hard work involved is no longer attractive. In southern Germany "the number of farmers decreased, and even those who continue to operate farms have difficulty in turning a profit from farm products alone" (Matsuhima, 2010, S. 163).

For these reasons the Landcare Association Central Black Forest (LACBF) was founded to moderate processes and provide stimulus to the region. It is committed to promoting sustainable development and conservation of the cultural landscape to maintain benefits for the socio-ecological production landscape in the Black Forest. The LACBF members are eight communities with 43,551 people, as well as 14 organizations/institutions and 37 private persons. In 2010 there were 329 farmers working in the region, 70 full-time and 259 part-time farmers. The average farm size is about 19.6 ha, and land is either owned or leased (mostly from former farmers). From the total area of 29,232 ha in which the LCABF is working, 4,892 ha are still grasslands. The biggest challenge right now is to stop the loss of traditional land use carried out by small agricultural holdings and private persons. The resulting changes, the loss of biodiversity, cultural landscape and its services, have a big impact on people and nature. Consequences are change in the landscape (e.g. reforestation) and the quality of life (e.g. fresh air) in the Black Forest. Therefore the LACBF works together with municipal authorities, conservationists and farmers to find cooperative ways of sustainable development. Also all decisions in the management board of the LACBF are made together by an equal number of representatives from municipal authorities, nature conservation organizations and farmers' organizations. In this way the defined working arrangements are based on cooperation among these often opposing parties to find common ways and solutions.

Figure 3: Cooperative way of Landcare Associations with nature conservationists, farmers and local politicians

As a non-profit organization the LACBF contributes to and organizes discussions amongst the stakeholder groups. In cooperation they find solutions for sustainable land use systems and measures that can be carried out to conserve the landscape. This cooperative way of nature conservation and regional development has proved its success over the years and an effective and trustful network has been built amongst stakeholders in the region.

2. Methods

To reach its vison LACBF professional experts work with specific methods to actually support farmers and nature conservation for socio-ecological benefits. First of all LACBF experts talk to land users and owners (e.g. farmers, shepherds or municipalities) to find out about the situation on farms or the common land.

Figure 4: Consultation discussion with farmer(Photo by DVL)

It is important to get an in-depth view of the area to detect zones which could be improved and thus managed in a better way. Regarding development plans, nature regulation and biodiversity strategies in the region, experts define specific areas that can address specific goals by specific measures. After these decisions are made, experts analyze the possible implementation of measures. It is important to keep in mind that these measures also have to provide some value for land users (e.g. soil conservation or actually payments for the provided services). Very few farmers can engage in voluntary measures because they need incomes from farms. Therefore LACBF workers investigate the possibility of subsidies and other monetary compensation mechanisms. As soon as a measure benefitting nature and land user/owner is found, experts explain it to the land user/owner. Land users/owners are not forced to carry out measures, rather they are shown the options and often long-lasting benefits. If the land user/owner initiates the measure voluntarily, LACBF workers help with the application for funding and communication with the local nature authority.

Therefore, in general a consultation process is involved in reaching targets for socio-ecological production landscapes. Sometimes (i.e. on common ground) the LACBF even applies for funding for measures itself, and then contracts farmers for the implementation of measures. A typical measure implemented in this manner is the cutting of hedgerows in the landscape. By this measure, the LACBF supports farms to gain reliable income by landcare work. Subsidies often come from the German federal state or the European Union. The LACBF passes much of the acquired money on to local farmers. In 2013 75% of subsidies for landcare measures (from EAFRD funds) were forwarded to farmers for their work (Metzner, 2013, S. 302) (figure 3).

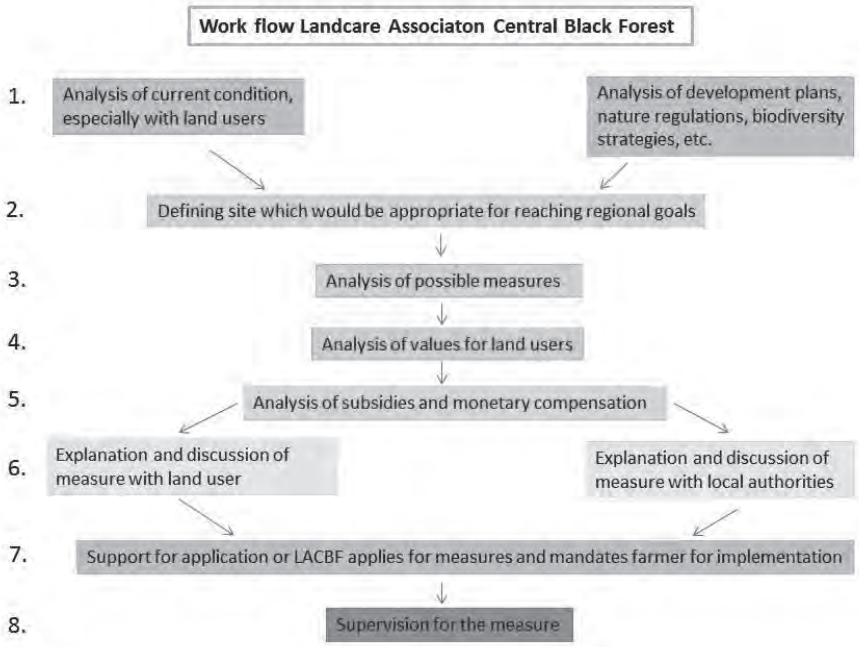

Figure 5: Schematic work flow of the LCABF's work

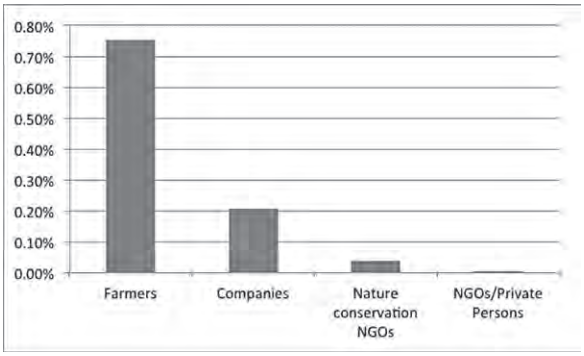

Figure 6: Percentages of subsidies of EU-co-financed EAFRD funds in Germany which are acquired by LAs and forwarded to workers for specific measures (e.g. clearing shrubs, preserving species-rich grassland) (Metzner, 2013, S. 302).

Also during the implementation process permanent staff assists land users/owners with occurring problems or questions. A trustful network and communication is crucial for this work. As farmers come to understand that the LACBF keeps in mind the benefits for man and nature, they ask for advice and are willing to put more effort into sustainable land management with the help of the experts. This refers to other highly valuable sites of farmland or common land as well as the marketing of local high quality products. LACBF uses its networks with municipalities and farmers to bring producers and consumers together, including a high number of tourists. They support the setup of marketing chains which offer an additional income for land users.

An important factor is the independence of the Landcare Association and its non-governmental status. Thus the partners do not fear any restrictions, regulations or even penalties. Through its network the LACBF tries to create win-win situations and sets up stakeholder discussions to find common solutions.

Another way of improving the management of SEPLs in the Black Forest is implementing trainings, for example on awareness-raising or tree-pruning, organized by the LACBF.
All these methods are used in the daily work of the LACBF and other Landcare Organizations all over Germany.

3. **Results**

The work of the LACBF consists of different projects. In general they can be divided into four main tasks. There are other responsibilities of the LACBF, but the following points are selected to give an overall impression.

3.1. **Landcare measures**

As described above, traditional land use is crucial for the existence of open spaces and biodiversity in the Black Forest. If the land falls fallow, shrubs will invade very fast and even spruce trees will start growing after a short time. In the long run, the forest will return to the fields. Regarding already abandoned fields, the LACBF engages in discussion with the local municipality and land owners on cost effective and ecologically reasonable ways to carry out landcare measures to clear the fields and restore the grasslands. If carried out, the LACBF will mandate a local farmer to do the selected measures on the ground. Accordingly, farmers can earn money by helping to protect the landscape.

But implementing landcare measures to clear a single patch only makes sense if the land will stay in use afterwards, because if not, shrubs will reinvade. Therefore the future way of use and the farmer who will use the land have to be specified before measures are initiated.

Figure 7: Landcare measure to open up pastures (Photo by Susanne Kopf)

3.2. **Pasture management**

For land which has already been restored or is in danger of falling fallow, the LACBF conciliates with farmers to ensure land use. The proper use of these sites is pasture management because of the land's species-rich fodder due to high biodiversity, as well as the ability of the grazing stock to prevent reforestation, which is important to ensure the flow of fresh air to the deep valleys. The LACBF acts as kind of a broker. It either finds a farmer who can use the fields as additional pastures or supports farmers to set up their own herds of cows, sheep, or goats. The network of the association is crucial for communication and overall success. A lot of confidence is needed to speak directly and clearly with land users about possibilities. With the right choice of management system, the LACBF cannot only support landscape conservation but also contribute to the farmers' incomes.

Figure 8: Pasture in the Black Forest (Photo by Christoph Ziechaus)

3.3. **Regional products and added value in the region**

Permanent land use is essential for the diverse landscape in the Black Forest. Technical revolution and land-use intensification have made farming on steep slopes ineffective. If the yield of intensified fields in the lowlands is higher than the extensive and elaborate farming on the slopes, why should the farmers keep those fields in use? The LACBF is searching for alternative ways of land use to make the farming on the slopes worth the effort. As an example, the restoration of orchards shows the connection between land use, biodiversity, prevention of soil erosion and added value to the region. One example is the sale of local juice from orchards in the region, which supports the work of its owners. The local juice initiative has already developed a regional identification. It also stands for high quality and sustainability. Local people, who care for their orchards, can now earn money from this traditional land use system. Species-rich orchards are preserved and in use due to regional marketing. People cut the meadows underneath the trees, prune the trees and harvest the fruits to generate an additional income which makes all the work worth it. Not only tourists, but also people in the region, buy this local product and generate an added value chain in the region of the Central Black Forest. The marketing initiative "echt Schwarzwald" (original Black Forest) sells many local products in the region, e.g. smoked ham, liquor, honey, bread, and dairy products. Even "show kitchens" or public production sites can be visited. Here local people and tourists can learn about products and their impacts on the landscape. The LACBF supports the exchange of network contacts and experiences and gives a hand to foster the marketing, and on the other hand offers advice on sustainable land use which is adapted to the Black Forest. A small brochure, which is available in all town halls, informs people about direct marketers of agricultural products. Special events are organized to show the connection between the landscapes and the products.

3.4. **Awareness raising**

It is very important to raise public awareness on the connection between the regional landscape, land use and nature conservation. It is essential that local people get ideas and feelings about the landscape where they live. Therefore the LACBF organizes public events to explain the link between pastures, forests, grasslands, biodiversity, ecosystem services and the resulting quality of life in the region.

School kids are very important groups to educate, because it is crucial to raise their awareness on their home landscape. They will also discuss what they have learned with their families and spread their knowledge. The LACBF organizes school projects right in the local orchards to educate the children. Different age-specific modules for pupils have been developed. The aim is to bring the children closer to nature with all the natural linkages, dependencies and changes, and to arouse interest and convey knowledge in a playful manner. Each class participates in three or four action days a year. The field trips are carried out in local orchards, as here in particular changes during the year and different habitats can be observed beautifully and clearly. Actions during the field trips include writing diaries about experiences on the ground, solving riddles or making fresh juice from self-harvested apples.

Figure 9: Exploration of local orchards by school kids (Photo by Susanne Kopf)

Together with the marketing organization "echt Schwarzwald" and the farmers' organization, the LACBF arranges local events, e.g. markets, to introduce local products and to illustrate the work farmers perform to the public. Technical guidance and discussions on topics regarding the conservation of the landscape and regional development are offered as public forums, too.

To inform local politicians and decision makers about the progress in the landscape, the LACBF offers daytrips to explain specific projects or discuss ongoing issues. They bring together all stakeholders to get an impression and overview of their commitments and challenges.

4. **Discussion**

Overall it is the general task of the LACBF to moderate processes and bring stakeholders together, to discover the fears and challenges and look for common solutions. The organization's aim is to find a cooperative way to support regional sustainable development in the landscape without losing its functions for people, food and nature. This comprehensive approach is also confirmed in the publication of Sayer, (Sayer, 2013, S. 8349) that states "the integration of agricultural and environmental priorities will require a people-centred approach applied at landscape scales". Landcare Associations are recognized by the European Commission for their work to benefit man and nature. Thus LAs are mentioned several times and also presented in a case study in the Guidance Handbook "Farming for Nature 2000", which will be published soon. In the international network Landcare International there are 30 countries listed with Landcare Groups all over the world. They all are adapted to local specifications—which is important—and they all work on social-ecological production landscapes to offer sustainable and good lifestyles within their landscapes.

5. **Conclusions**

As a conclusion, the Landcare approach is based on some key factors which enable the local Landcare Association Central Black Forest to work on its vision.

In order to start and finally reach the conservation and development goals for the region, an important factor (**key factor 1**) is that the institution is driven from the bottom up and that the local people support its vision. It is crucial that "all stakeholders need to understand and accept the general logic, legitimacy and justification for a course of action, and to be aware of the risks and uncertainties associated with it. Building and maintaining such a consensus is a fundamental goal of landscape approach" (Sayer, 2013, S. 8351). The foundation of the LACBF was driven by local forces, like mayors, nature conservation groups and farmers. Together they set up the local NGO to create benefits for the region. **Key factor 2** is the establishment of a trustful and long lasting network in the region. Without this key factor the experts of LACBF could not do their beneficial work, because they would not learn enough details to actually consult land users/owners and implement measures, because "trust among stakeholders is a basis for good management and is needed to avoid or resolve conflicts"

Figure 10: Training for farmers about healthy livestock (Photo by Susanne Kopf)

To establish and improve this network, permanent and trained workers (Landcare Facilitators) play a crucial role. This is also noted by Abrogar, (Abrogar, 2009, S. 39) that states that Landcare facilitators are "working at an appropriate pace, they carefully facilitate development, consensus, ownership and implementation of solutions – economic, social, environmental and political – for sustainable improvement of livelihood". In Germany 92% of all Landcare Associations work with employed experts of which 64% work full-time (Metzner, 2013, S. 301) (figure 11).

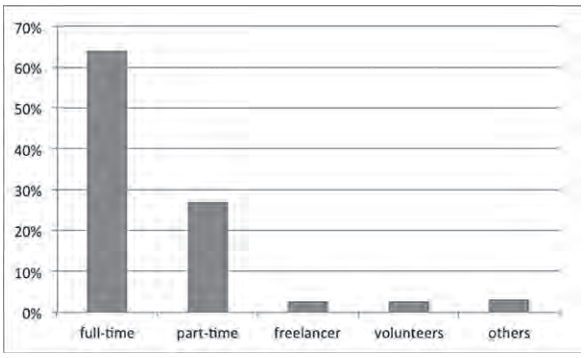

Figure 11: Employees at Landcare Associations in Germany in 2013 (Metzner, 2013, S. 301)

In this manner, farmers, conservationists, municipalities and other interested persons can always contact the association and ask for advice and assistance. This supports improvement of the local network. This is very important, because "fostering bottom-up approaches and promoting the participation of diverse stakeholders are seen to benefit participants by allowing them to influence decisions, contribute to landscape management, share knowledge and build networks" (Prager, 2015 , S. 62). Since local experts have a healthy partnership with all stakeholders, they can also give feedback to local authorities (**key factor 3**). Many measures and land management activities are funded by regional or national (most of them EU co-financed) programmes. But even if they are planned with

very good intentions, problems in the implementation on the ground can occur. To realize high quality measures in the future it is necessary to give back feedback and propose appropriate changes, because it is "a key challenge in traditional farming landscapes to develop policies that foster socioeconomic development but also safeguarding biodiversity" (Fischer, 2012, S. 168).

This case study shows a range of typical tasks LAs carry out all over Germany. Most German federal states have their own specifics, and it is obvious and essential that the LAs are adapted to these to find a cooperative way together with conservationists, farmers and local authorities to care for landscapes and their sustainable development on the ground.

Acknowledgements

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Measuring multidimensional aspects of SEPLS

Chapter 9

Enhancing knowledge of socio-ecological production landscapes and seascapes in Vava'u, Kingdom of Tonga

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Abstract

The Vava'u archipelago in the Kingdom of Tonga was identified as a priority area by the Tongan Government for implementation of a Global Environment Facility (GEF) funded biodiversity conservation project executed by the Secretariat of the Pacific Regional Environment Programme. The *Integrated Islands Biodiversity Project* (IIBP) includes the Cook Islands, Nauru, Tonga and Tuvalu and is assisting these Pacific island countries to implement their commitments under the Convention on Biological Diversity (CBD) Island Biodiversity Program of Work. This paper focuses on the project work undertaken in Vava'u to establish the ecological and socio-economic knowledge base essential for determining the best options for long term conservation, management and development of this important area.

The paper reviews the methods and findings of a rapid biodiversity assessment and a subsequent socio-economic assessment undertaken in 2014, and provides suggestions for ways to increase our understanding of socio-ecological production landscapes and seascapes. The surveys have greatly enhanced the knowledge base for sustainably managing the land and seascape of the Vava'u archipelago, confirming the value and linkages between natural ecosystems and the livelihoods and economic development of local people and the country as a whole.

Keywords
Vava'u, Tonga, biodiversity, socio-economic assessments, BIORAP

1. Introduction

The Kingdom of Tonga is identified by Burley et al. (2012) as the location for the founding colony of Polynesia by Austronesian speaking seafarers who voyaged from Bismarck Archipelago in western Melanesia almost 3,000 BP. From this location the geographically diverse volcanic, raised limestone and atoll islands of Polynesia (Figure 2) were settled through further voyaging across the Pacific Ocean over several hundred years (Diamond 2005). As a consequence of early human settlement the terrestrial ecosystems of most Pacific islands underwent significant modification through land clearing for agriculture, burning and introduction of invasive and alien species. Hundreds of species became extinct within relatively short time frames (Steadman et al. 2002; 2003). Today Pacific island countries are part of the global economy and have established largely democratic societies that aspire to the benefits of modern development while striving to maintain their culture and traditional connections to the land and the sea. The Vava'u Archipelago, like most Pacific

Figure 1: Vava'u Archipelago, Kingdom of Tonga. (Photo by Stuart Chape)

Islands, is a prime example of socio-ecological production land and seascapes (SEPLS) where communities live closely connected to the natural environment. Dependence on the goods and services provided by marine, coastal, and terrestrial ecosystems remains high. Freshwater, timber, fish and agriculture are important for subsistence purposes and a major component of national economies, especially tuna fishing, cash crops, and commercial logging.

A crisis of species extinction commenced with the first human settlement of Pacific islands and continues today. The *State of Conservation in Oceania* assessment (SPREP 2014) reports that 1,327 species are vulnerable, endangered or critically endangered and 45% of the surviving endemic species are under threat of extinction.

The role of the Secretariat of the Pacific Regional Environment Programme (SPREP) is to work with its member Pacific island countries at the nexus of environmental, social, and cultural values and how they adapt to development demands and climate change. This paper provides an example of an approach taken by SPREP and its partners to bring knowledge and clarity to the critical issues of environmental sustainability at a landscape scale. Specifically, it describes two recent surveys, one biological and the other socio-economic, undertaken in the Vava'u archipelago in the Kingdom of Tonga as part of the Global Environment Facility (GEF) *Integrated Islands Biodiversity Project* (IIBP). Although they were implemented independently at different times, both were planned and coordinated by SPREP to provide a basis for medium to long term decision making by the people of Vava'u and the Government of Tonga to improve the environmental management of land and seascapes for the benefit of local and national economies and for biodiversity. It is intended that the approach will be replicated in other Pacific island countries.

2. Background, approach, and methods

The Vava'u Archipelago is part of the Kingdom of Tonga located in the tropical southwest Pacific (18.6oS 174.0oW, Figure 3). It comprises the main island of 'Uta Vava'u (95.95 km2), bounded on its southern side by a cluster of 57 smaller islands (c. 0.02–9.0 km2) and the outlying islands of Late (17.5 km2) to the west, and Fonualei (4.2 km2) and Toko (0.43 km2) to the north-northwest. 'Uta Vava'u and most of the adjacent smaller islands are formed of karst limestone, have a stepped topography with prominent elevated, marine-eroded terraces, and are mantled with thick volcanic soils.

Much of the original native forest cover of 'Uta Vava'u and the adjacent smaller islands has been removed during the three millennia of human occupation of this group, but remnants of mature forest are still present in some areas that are too steep or rocky for cultivation, including

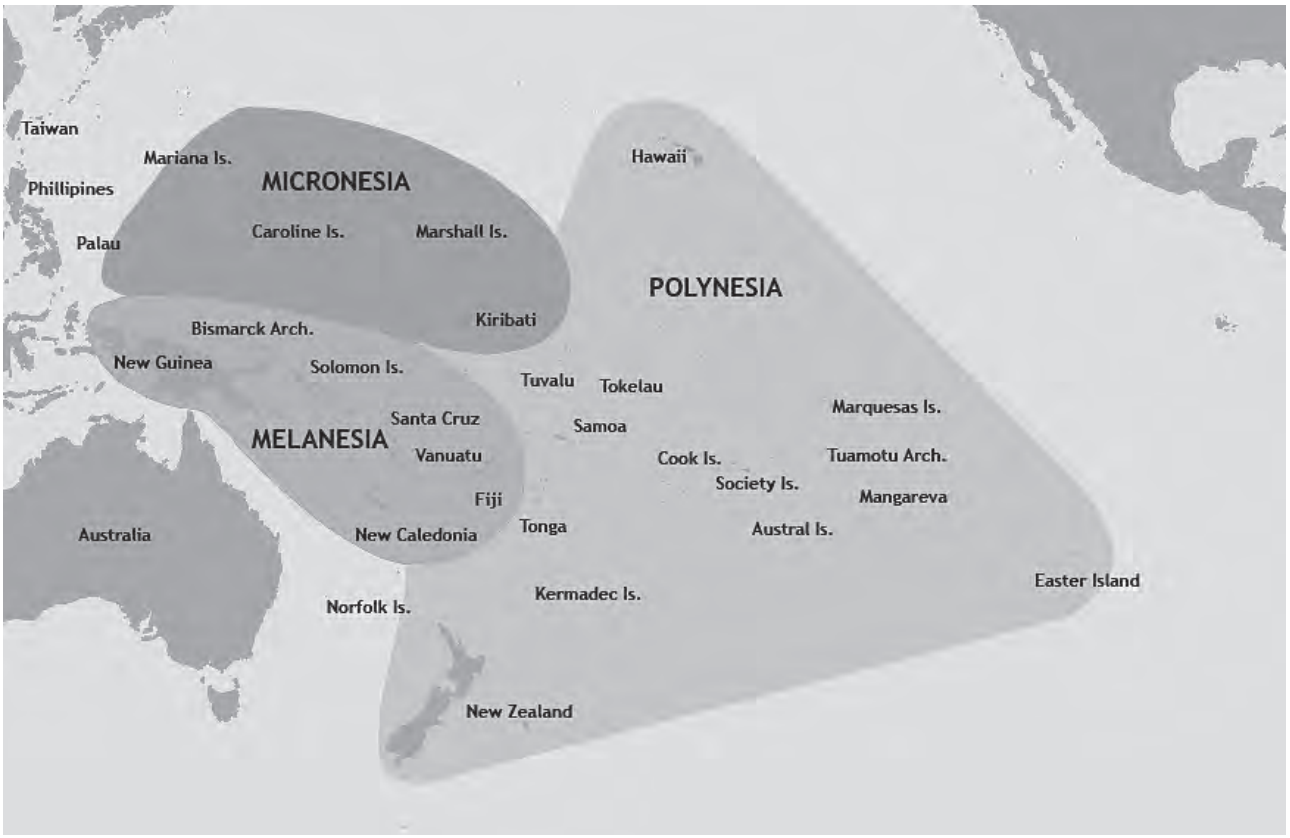

Figure 2 : Ethnographic regions of the Pacific islands region

steep coastal slopes and inland scarps and knolls, and on some of the smaller cliff-bound islands (e.g. Kitu, Kulo and Luamoko). Areas of mature native forest have also persisted on some of the small, low, southern islands (e.g. Maninita and Taula), and in some more gently sloping parts of 'Uta Vava'u, most notably on coastal terraces and beach flats in the vicinity of Utula'aina Point and Vai-utu-kakau.

Surrounded by deep oceanic waters, Vava'u has a wide range of marine habitats and species, most notably its coral reefs and migrating humpback whales which are attracted by the sheltered deep lagoons.

In 2014, there were about 106,000 people living in Tonga, with more than two thirds of the population living on Tongatapu island where the capital, Nuku'alofa, and the only international airport are located. About 15,000 people live in Vava'u. The 2009 Household Income and Expenditure Survey estimated 20,432 households in Tonga; 3,447 in Vava'u (GoT HIES 2009).

Figure 3 : Location map of Vava'u Tonga

2.1. **Rapid biodiversity assessment survey**

The Biological Rapid Assessment Programme (BioRAP) is a biological survey based on a concept developed, and first implemented, by Conservation International in 1990. BioRAP methods are designed to rapidly assess the biodiversity of highly diverse areas and to train local scientists in biodiversity survey techniques. It is designed to use scientific information to catalyse conservation action and since 2012, SPREP has conducted three BioRAPs, in Samoa, Nauru and Tonga. It is a useful approach when time and financial resources are limited.

The Vava'u BioRAP provided a spatial and temporal snapshot of the full range of biodiversity in the archipelago (Atherton, McKenna and Wheatley 2015). The survey did not visit all sites of conservation value in the archipelago and was conducted over a relatively short period of 16 days. However, the BioRAP is the most comprehensive biological survey conducted in Vava'u to date, and it generated a huge volume of useful information on the biodiversity of the archipelago that the Government of Tonga can use for conservation planning and management. While many biological surveys have been conducted in Vava'u in the past, there had never been a comprehensive and multi-disciplinary assessment of marine and terrestrial biodiversity in the island group, prior to the BioRAP.

The objectives of the BioRAP were to:

- Develop and document appropriate survey methodologies for marine and terrestrial biodiversity assessment
- Assess the status and distribution of biodiversity with particular attention to special conservation priorities such as rare, endemic and/or threatened species and ecosystems
- Identify constraints and opportunities for on-going conservation activities including the identification of new conservation areas and approaches
- Train and mentor counterpart staff including the transfer of appropriate skills and technology

Criteria generally considered during BioRAP surveys to identify priority areas for conservation across taxonomic groups include: species richness, species endemism, rare and/or threatened species, and habitat condition (Morrison and Nawadra 2009). Measurements of species richness can be used to compare the number of species between areas within a given region. Measurements of species endemism indicate the number of species endemic to a given area and give an indication of both the uniqueness of the area and the species that will be threatened by alteration of the habitat (or conversely, the species that may be conserved through conservation efforts).

The Vava'u BioRAP was conducted from 13 to 28 February 2014. The survey involved 17 scientists and 18 Tongan government staff. Fourteen islands were visited over the 16 days of the survey. The terrestrial survey involved assessments of land and sea birds, bats, plants, reptiles, land snails and insects while the marine survey included assessments of coral reef fish and commercial fish, corals and other marine invertebrates, sea turtles and cetaceans. The BioRAP was coordinated by SPREP, the Vava'u Environmental Protection Association (VEPA), the Waitt Foundation (which provided a ship for the marine

survey work) and the then Tongan Ministry of Lands, Environment, Climate Change and Natural Resources (MLECCNR). Staff from the Ministry of Agriculture, Food, Forestry and Fisheries (MAFFF) also participated in the survey. Specialist support was provided by scientists from BirdLife International, the New Zealand Department of Conservation, and the United States Geological Survey.

Terrestrial site selection was based on the following criteria: sites where past biological surveys had been done and had recorded significant biodiversity values (in particular Steadman et al. 1999); sites with currently intact native forest (using satellite imagery and recent land cover maps); and sites already managed as a national park (e.g. Mt Talau) or proposed as national parks (e.g. Maninita). Furthermore, sites were selected to obtain a good geographic spread of the islands, and with a range of different island types and geology. In all cases, approval from local landowners was obtained before sites were visited. Thirty-three different sites were surveyed by the terrestrial survey teams (Figure 4).

Figure 4 : Sites visited by the BIORAP terrestrial team

For the marine component 27 coral reef survey sites (Figure 5) were chosen in cooperation with the Ministry of Lands, Environment, Climate Change and Natural Resources. These selected sites were predominantly fringing reefs, which are commonly associated with limestone islands such as those found in Vava'u.

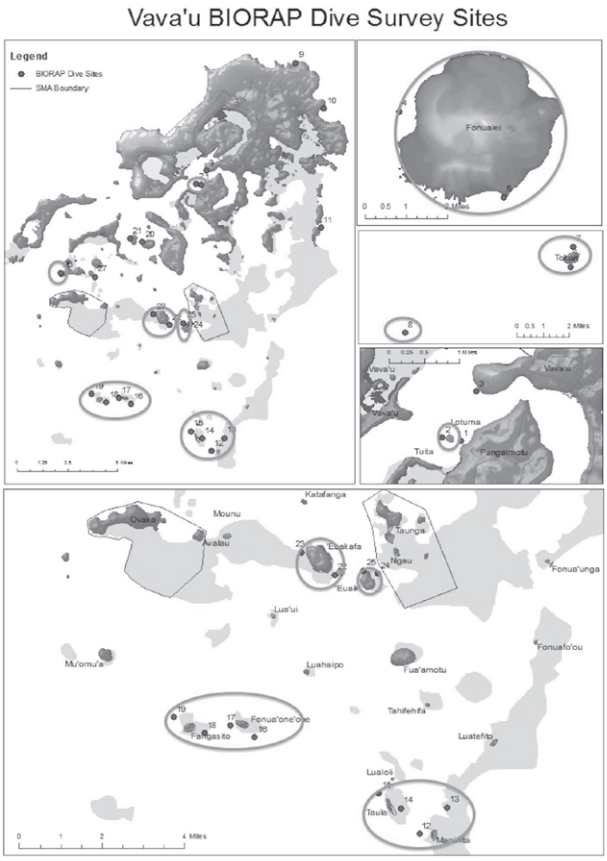

Figure 5 : Vava'u BioRAP Marine Survey Sites

The detailed methodologies for each specialist discipline that carried out the BioRAP survey work is available in the full report (Atherton, McKenna and Wheatley 2015).

2.2. Economic assessment of natural resources and livelihoods

The processes and functions of natural ecosystems are the building blocks of household livelihoods and human well-being. Ecosystems provide a wide array of benefits, such as food, shelter, and treatment of human wastes, and facilitate or support recreational, spiritual, and cultural activities. The full value of the human benefits from nature's goods and services is not often recognized and relationships between natural ecosystems and communities, households, and businesses are often poorly understood or taken for granted (TEEB 2008). Quantitative measurements of ecosystem benefits can be used to guide natural resource management decisions such as cost-benefit analyses of climate change adaptation options, natural resource use policies, or business development initiatives. Failure to recognize the role natural ecosystems play in supporting livelihoods, economic activity, and human well-being has in many instances led to inequitable and unsustainable resource management decisions.

This socio-economic assessment (Salcone 2015) was implemented by the International Union for Conservation of Nature (IUCN) in July 2014 and complements the Vava'u BioRAP. The research was commissioned by SPREP and funded by the Australian International Climate Change Initiative component implemented by SPREP. The implementation of the survey falls under the umbrella of the MACBIO project, a five-year regional project funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety to support and strengthen conservation and management of marine and coastal biodiversity through economics, marine spatial planning, and protected area policy. The Vava'u Environmental Protection Association (VEPA) was a key partner in the assessment.

The objectives of the economic assessment were to:

1. Quantify the value of ecosystem services in the Vava'u Archipelago including the adjacent marine exclusive economic zone (EEZ).
2. Analyze linkages between ecosystems, households, businesses and livelihoods to support a Marine Spatial Planning Process leading to an integrated approach to marine management and decision making, establishment or re-design of protected areas, or cost-benefit analyses of adaptation options.

The assessment analyzed household activities, subsistence and monetary, and quantified the magnitude of key ecosystem services in the Vava'u group. Where sufficient data allowed, the economic value of these ecosystem services was estimated. Economic value refers to quantification of the net benefits humans derive from a good or service, whether or not there is a market and monetary transaction for the goods and services.

The relationship between people and natural ecosystems was analyzed using two distinctly different methods: surveys conducted especially for the study focusing on households and businesses; and identification and quantification of the value of ecosystem services using existing data.

A comprehensive household survey was developed based on economic assessment work that had been conducted in Fiji by Landcare New Zealand. In total, the survey contained more than 200 questions and took nearly 2 hours to complete. Surveys were conducted by local Tongan women, who were employed by VEPA. Surveyors typically worked in teams of two to complete a total of 150 household surveys over three weeks in July 2014, in five different villages. The villages surveyed were selected to produce a representative sample of Vava'u and the number of households surveyed in each village was calculated to be representative of the total population. Households were chosen at random. Survey teams successfully returned data from 144 households. Each household was asked a series of questions about four natural resource sectors: agriculture, livestock, forests, and fishing.

A small survey of tourist businesses was conducted to identify the connections between natural resources and the tourism industry. Eighteen businesses were surveyed, mostly in Neiafu, the capital of Vava'u. The sample of businesses included restaurants, resorts and guesthouses, and dive and whale-watching operators. Many businesses offer a combination of these services. One boat service and repair business was also surveyed. The survey included questions about the ownership, employees and earnings of the business, as well as the relationship between business success and natural ecosystems.

3. Results

Both the BioRAP and the socio-economic survey produced a wealth of results that cannot be presented in detail within this paper. Accordingly only highlights and key findings are presented.

3.1. Rapid biodiversity assessment survey

3.1.1. Terrestrial ecosystems and species

Plants

- The flora of Vava'u was determined (from the BioRAP and previous surveys) to comprise about 262 native vascular plant species, divided into 188 dicots, 39 monocots, two gymnosperms, 30 ferns, and three fern allies. Eight Tongan endemic species are found in Vava'u, two of them endemic to Vava'u – *Atractocarpus crosbyi* and *Casearia buelowii*.
- 12 new native species were recorded for Vava'u, including one new record for Tonga: *Boerhavia albiflora* (Nyctaginaceae).
- Of concern, 42 new weed species were recorded for Vava'u, 18 of them new for Tonga.

Reptiles

- 417 terrestrial reptiles were recorded representing 11 species of lizard.
- 29 new species records were collected for reptiles across the Vava'u island group.

Birds

- 38 bird species were recorded.
- The blue-crowned lory (*Vini australis*), which had not been recorded on Vava'u for over 100 years, was found at two sites.
- The friendly ground dove (*Gallicolumba stairii*), which had been found at only one site during surveys in 1995-96, was located on three islands in this survey.
- Islands in the south of the group were found to hold very large numbers of seabirds.
- Two of three islands subject to rat control programmes in 2002 appeared to be free of these invasive rodents.

Bats

- No sightings were made of the endangered Polynesian

sheath-tailed bat (*Emballonura semicaudata*).
- Small colonies of the insular or Pacific flying fox (*Pteropus tonganus*) were seen on many of the small forested islands and larger colonies on 'Uta Vava'u with up to 250 bats present.

3.1.2. Marine ecosystems and species

Reefs and coral

- The reefs of the Vava'u group have a good diversity of hard corals, with a total of 206 species in 55 genera observed.
- 197 species were found that had not been reported before from Vava'u, 95 species were found that had not been reported before from Tonga, and 67 species were recorded that represented extensions of their known biogeographic ranges.
- Four species of giant clam (*Tridacna maxima, T. squamosa, T. derasa* and *T. crocea*) were recorded in the survey. The boring giant clam (*Tridacna crocea*) is a new species record for Tonga.
- Observations of rubbish and fishing debris were highest at the sites closest to the town of Neiafu. The incidence of rubbish was low at all other sites. One site showed evidence of eutrophication from septic tanks associated with a nearby tourist resort.
- Large marine fauna including sharks, dolphins and turtles were more frequently observed at more remote northern sites. For most other sites there were very few or no sightings of large marine fauna. Low species numbers of piscivores and carnivores, including sharks, were recorded throughout the survey.
- A reef condition index was calculated based on coral, fish and invertebrate biodiversity, coral cover and the density of target fish. Sites with a reef score of more than 85% and a low incidence of disease, predation and pollution were considered the most eligible reefs for Marine Protected Area (MPA) status. In total seven sites, all located in the southern part of Vava'u, scored more than 85% and are considered the most suitable areas for protection as MPAs.

Cetaceans and marine turtles

- Ten groups of small cetaceans were encountered, representing at least three species: spinner dolphin (*Stenella longirostris*), short-finned pilot whale (*Globicephala macrorhynchus*) and bottlenose dolphin (*Tursiops* sp.).
- Evidence was found of the presence of two species that were not previously recorded in the waters of Tonga: the Cuvier's beaked whale (*Ziphius cavirostris*) and the rough-toothed dolphin (*Steno bredanensis*). With these findings, there are now 14 cetacean species officially listed in Tonga.
- The humpback whale population for Tonga has recently been estimated at over 2,000 individuals. Some movement of individuals between other regions of Oceania occurs, but a high level of site fidelity has been shown within the region that is also supported by genetic analyses of population structure.
- Few turtles were seen during the surveys and these were mostly green turtles (*Chelonia mydas*).

Subsistence targeted and commercial fish species

- Strong indications of overexploitation of both sea cucumbers and giant clam species were noted across sites in the survey.
- Fish communities were highly dominated by the families of surgeon fishes (Acanthuridae) and parrot fishes (Scaridae). Families of snappers (Lutjanidae) and goat fishes (Mullidae) were poorly represented. Families of groupers (Serranidae), snappers (Lutjanidae) and emperors (Lethrinidae) were underrepresented while sweetlips (Haemulidae) appear to be on the edge of local extinction for the reef sites surveyed.
- The structure of fish communities was unbalanced with a high rate of herbivore species and a very low rate of predators such as large carnivore species and piscivore species.
- At least six species were under the minimum maturity length.
- Strong signs of overfishing were observed. There is an important need for management measures to ensure sustainable fish-stock use and food security over time.

3.2. Socio-economic survey and assessment of ecosystem services

3.2.1 Household survey

Forest products

- Residents obtain firewood and food products from the forest. Households were asked about the quantity and species of firewood and wild foods collected from the forest. Much of this forest is to varying degrees managed horticulturally, so it is difficult to distinguish between forest products and agriculture. Most use of forest products is for subsistence.
- About 60% of the 144 households successfully surveyed collect forest foods, predominantly coconut, breadfruit, limes, giant taro, wild yams and wild oranges.

Agriculture and livestock

- Most Vava'u households participate in some type of agriculture, with 70% of households responding that they raise crops for food or sale; less than one third of those surveyed reporting earning income from selling crops.
- The crops most commonly grown by Vava'u households are starches, including plantains and root crops: yams, cassava, and three types of taro. Coconuts, a leafy green called *pele* (*Hibiscus manihot*), and kava are the most commonly cultivated crops.

- Husbandry of animals is very common in Vava'u. Of the 144 households surveyed, 85% reported raising animals for food or for sale. More than 75% of households raise pigs, about 50% raise chickens, and 45% raise cattle.

Fisheries

- 45 households (31%) responded that they went fishing at least once per month in the past year, including reef fishing (23%), deep-water fishing (3.5%), or near-shore gleaning (20%).
- Households were asked which species were the most important for household consumption or sale. The most important reef fish were groupers, parrot fish, and surgeon fish. Arc clams (*Anadara* sp.) were by far the most common important invertebrate harvested in Vava'u, followed by crabs and octopus. Sea cucumbers and shellfish were also commonly part of households' three most important invertebrate species.
- Most households fish primarily for their own consumption or to share with family and community members. Only 13 households (29% of fishing households) reported selling at least some of their catch.
- Households were asked a series of questions about the Ovaka special marine management area (SMA) in order to gauge support for community-based conservation measures and the perceived efficacy of locally-managed marine protected areas. The survey indicated that most people are not sure about the rules that apply to the SMA. However, five out of six heads of household who had fished near the SMA in the past year found that it was easier to catch fish and that they caught more fish, and four of the six reported catching bigger fish.

3.2.2. **Tourism business survey**

In order to understand the relative importance of different ecosystems to businesses in Vava'u, businesses were asked the following two questions: 1) What percentage of your guests have experiences related to particular ecosystems; 2) Rate the impact that a 25% decline in given ecosystems would have on your business.

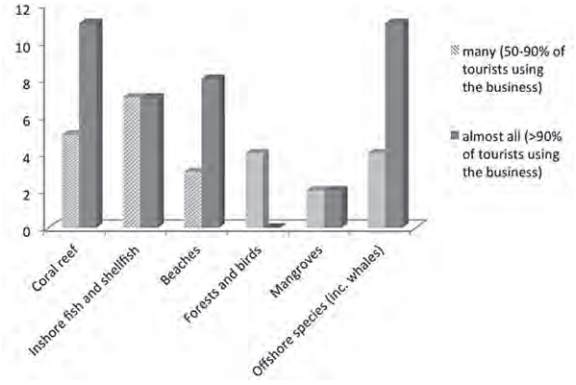

Figure 6 : Guest experience related to different ecosystems

- Coral reefs and offshore marine areas are the most commonly experienced ecosystems for patrons of tourism businesses in Vava'u. 15 of the 18 businesses report that "almost all" (>90%) of their guests have experiences directly related to either coral reef or offshore areas (Figure 6).

- When asked about the impact that a 25% decline in ecosystem health would have upon businesses, businesses responded that they are most threatened by a decrease in reef species, followed by a decrease in coral health with 15 and 14 businesses respectively reporting an expected "Big" or "Very Big Impact" (Figure 7).

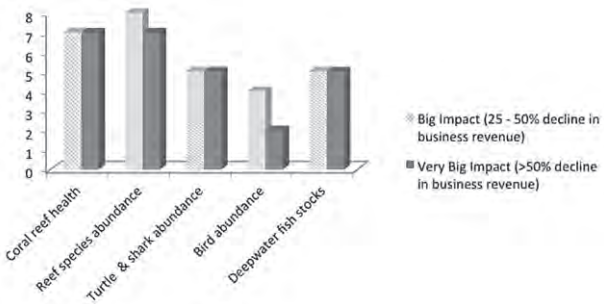

Figure 7 : Expected business impact of a 25% decline in the health of various ecosystems

- 12 of 18 businesses believe climate change poses a high or very high threat to their business and the natural resources it depends upon.
- Businesses report a willingness to pay a local village to limit fishing, including sharks and turtles, if it could lead to a 25% increase in abundance and diversity of reef fish.
- Most of these businesses purchase the majority of their fish, meat, and fruits and vegetables within Vava'u. Three businesses report catching more than 75% of the fish they serve; only two businesses report importing fish or meat from overseas.

4. **Discussion**

The BioRAP survey has identified key issues related to the status of biodiversity conservation and terrestrial and marine species that are important for subsistence and commerce. The identification of new species and new records for Vava'u is an encouraging sign that fauna and flora species can survive in highly modified landscapes. Conversely, the identification of 42 new weed species records for Vava'u, 18 of them new for Tonga, indicates that prevention and control of invasive species is a major issue, as it is for all Pacific islands. The apparent shift in trophic levels indicated in the marine survey by the decline in predator level species is of concern since this can create a shift in reef ecosystems to a dominance of herbivore species.

The socio-economic survey has determined that local communities utilise terrestrial and marine resources, but that

subsistence harvest of fish is dominated by a few species and the level of harvest is not as high as anticipated. The report notes that of the 150 households surveyed only 31% responded that they go fishing once a month, which was surprising given their proximity to the sea (Salcone 2015). Vava'u has relatively smaller reef areas compared to the rest of Tonga (70km^2 compared to 3,210km^2 nation-wide), so fishing pressure per area may be greater. The 'boom and bust' cycle of the commercial beche-de-mer (sea cucumber) industry in Tonga highlights the vulnerability of species to over-exploitation (Lokani et al. 1996) driven by large, lucrative international markets. Aside from beche-de-mer, the commercial fisheries that contribute significantly to national GDP (deep-sea demersal and tuna) are not very important to households in Vava'u.

Marine ecosystems are, however, very important to the tourism industry. Whale watching and whale swimming brings significant revenue to local businesses, including food and accommodation providers. Tourist operators are reluctant to share details about their revenue and expenditures, but they exhibit a willingness to pay for species and ecosystem conservation that will benefit the experiences of tourists. Most tourist businesses are foreign owned. Although most businesses employ Tongan natives, tourism income was not a significant contributor to incomes of the households surveyed for this study.

According to a 2013 study conducted for the Tongan Ministry of Tourism and Commerce, of the approximately 60,000 international air visitors that came to Tonga in 2012-2013, about 15,000 (25%) traveled to Vava'u (MCTL 2013). Vava'u also welcome six cruise ships in 2013-14, and in 2011, the last year a survey was conducted, about 1,000 yachts came to port in the Vava'u group. Figures 5 and 6 clearly show the dependence of the tourism industry on natural resources. Tourism benefits not only Vava'u but the economy of Tonga as a whole, and one of the most important income generating attractions is whale watching. Tonga is one of the few places in the world where tourists can enter the ocean with humpback whales and watch them at close range. Expenditures associated with whale watching in Tonga were 4,675,000 USD for the 2009 season (Orams 2013). Only a small amount of this economic activity reaches households. Of the 15% of residents who reported having wage-earning jobs, about 30% of them were employed in tourism related businesses (restaurants, drivers, whale-watch operators, handicrafts).

Recent predictive habitat modelling around the Vava'u island group has shown that a favourable habitat for mother–calf pairs of humpback whales includes shallow, nearshore regions, whilst areas of predicted suitable habitat for adult-only groups includes deeper areas further offshore around the periphery of the island region and including seamounts and banks (Lindsay 2014). This suggests that to ensure the longevity of the whale watching industry in Vava'u, a full range

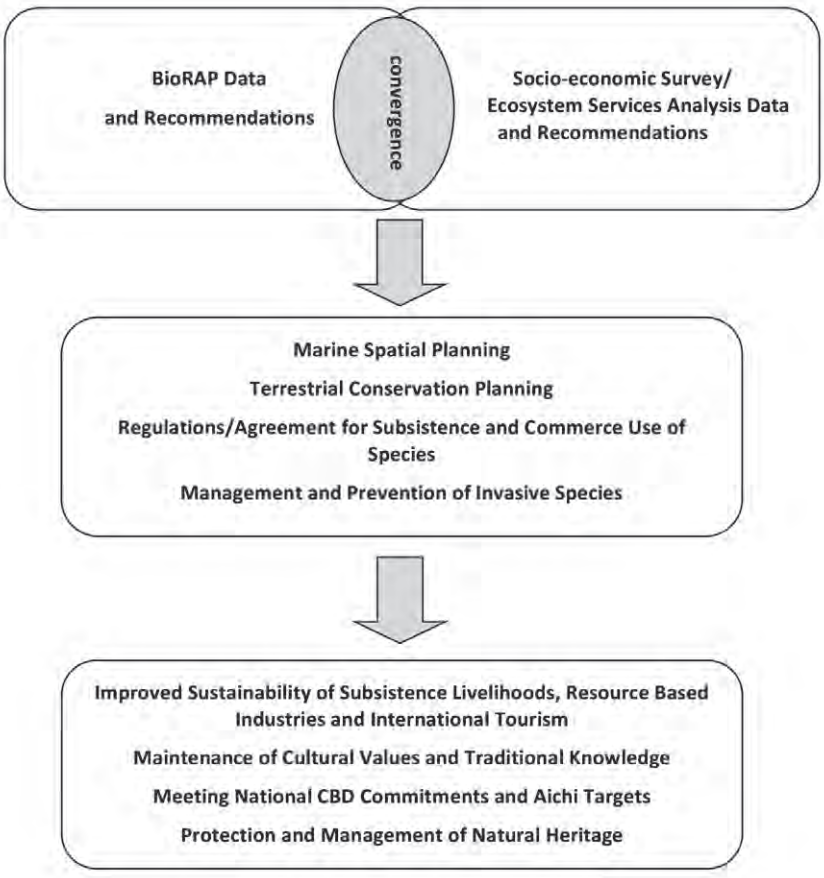

Figure 8 : A schematic representation of the linkages between the biological and economic assessments

of protective ecosystem management measures need to be taken across the range of nearshore and offshore ecosystems, including careful assessment of the viability of deep sea mineral mining, in conjunction with relevant whale species management action.

Because agriculture and livestock are so important to Vava'u households, environmental conservation efforts need to approach biodiversity preservation within the context of agro-ecosystems. Two directions should be considered: 1) Species conservation within agricultural and horticultural habitats, and 2) Preservation of sparse tracks of virgin habitat where they still exist on steep slopes and rugged terrain and on distant islands.

5. Conclusion

Both the biological and economic surveys have provided invaluable information that has substantially increased the level of environmental and socio-economic knowledge of the Vava'u archipelago, which can be applied to improve policy decisions and management interventions of this important land and seascape where the livelihoods of the local people are dependent on ecosystem services. A schematic representation of these linkages is shown in Figure 8.

A set of convergent recommendations emerged from these complementary assessments that can be applied not only to Vava'u, but also similar tropical island land and seascapes:

- Develop socio-economic and ecological information gathering methods together, to meet joint objectives
- Conserve sites of significant conservation value
- Recognize community dependence upon natural areas for horticulture and animal husbandry and value of agroecosystems
- Improve conservation of threatened species
- Improve management and use of marine resources, including by implementing marine spatial planning processes
- Manage threats to key sites from invasive species
- Raise public awareness on conservation and linked economic values of the Vava'u Archipelago
- Raise awareness on and enforce existing environmental laws
- Improve knowledge of the ecology and biodiversity of the Vava'u Islands
- Ensure ecotourism, including whale watching, is managed sustainably
- Reduce runoff, pollution and sedimentation
- Establish environmental quality monitoring systems

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Chapter 10

Socio-ecological production landscape definition and issues assessment – a case of Uganda's drylands

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Abstract

Achieving sustainability of Socio-ecological production landscapes and seascapes (SEPLS) depends on identifying issues that threaten them. Hitherto however, there is limited characterization of SEPLS and associated sustainability issues. This study shares Nature and Livelihoods' effort to identify a SEPL in Uganda and to describe opportunities and challenges associated with its sustenance as a basis for action. Information was gathered through literature review and scoring of structured questionnaires administered to randomly selected members of target communities. The dryland landscape was identified as a SEPL. It was found that some of the traditional practices (opportunities) that have sustained biodiversity in different parts of this landscape are retention of indigenous plants for forage production, the existence of native trees in crop fields through a "parkland" farming system, and relegation of swamps to pasture and fish production. Other opportunities identified during the survey were potentials for sustainable wild meat and wild fruit production, and recreation. Challenges included but were not limited to excessive bush clearing, cultivation expanding into agriculturally marginal areas, overexploitation of wild meat, wood overexploitation, and abandonment of the traditional practice of leaving uncultivated borders between crop fields. Actions are urgently needed to build on these opportunities and to address the challenges.

Keywords
drylands, agriculture, socio-ecological production landscapes, wild foods, land use change, livelihoods

1. Introduction

Socio-ecological production landscapes and seascapes (SEPLS) are dynamic mosaics of habitats and land uses where the harmonious interaction between people and nature maintains biodiversity while providing humans with the goods and services they need for their survival and well-being in a sustainable manner. However, in recent years, many SEPLS have been destroyed, damaged or abandoned for various reasons. The loss or degradation of SEPLS has inevitably led to a decline in biodiversity and the various ecosystem services that they provide, with consequences to the lives of people depending on them (IPSI Secretariat 2014).

Drylands have unique intrinsic characteristics that qualify them as socio-ecological production landscapes (SEPLs). Perhaps the overriding one is that, depending on the level of aridity, dryland biodiversity is relatively rich and still relatively secure compared to other ecosystems. Further, more than in any other ecosystem, sustenance of biodiversity is critical for the well-being of the local people. Drylands, perhaps more than any other biome, offer opportunities for achieving both conservation and development objectives simultaneously (Davies et al. 2012). Outstanding ecological features of drylands include: i) an abundance of grasses and other C4 plants characterized by adaptation to habitats with high daytime temperatures and intense sunlight (Rewald et al. 2012); ii) a high species diversity of large mammals typical of semi-arid and dry sub-humid drylands; iii) a high functional diversity of invertebrate decomposers; iv) a high abundance of mammals supporting cultural services, and the critical role of decomposers in nutrient cycling, and v) a high structural diversity of plant cover contributing to rainfall water regulation and soil conservation, hence to primary production and diversity of dryland wild and cultivated plants (Millennium Ecosystem Assessment 2005). Social features include pastoralism, smallholder parkland farming, and fishing. Nevertheless, transformation of rangelands and other silvipastoral systems in drylands to cultivated systems, extreme reduction of rangeland vegetation cover through heavy grazing and browsing, and collection of fuelwood is exposing the soil to erosion and degradation (Millennium Ecosystem Assessment 2005; Habiba et al. 2012).

This paper derives from a case study earlier submitted to the International Partnership for the Satoyama Initiative (IPSI) as a case study by Nature and Livelihoods (Olupot 2012). It is aimed at sharing more broadly the process used to identify the dryland SEPL and sustainability issues associated with it, as well as discussing some thoughts about actions needed to achieve sustainability in the SEPL. Since no SEPLS had been described in Uganda prior to this study, the study was also intended to identify one and to develop understanding of issues that threaten this and potentially other related SEPLS in order to promote discourse about SEPLS identification and characterization.

2. **Methods**

2.1. **General**

The SEPL was identified by characterizing various landscapes using the following criteria: i) land use type (e.g. crop lands, livestock grazing areas, built-up areas, and protected areas); ii) terrain and elevation characteristics (mountainous, high altitude, low altitude, hilly, and plateau); iii) amount of annual rainfall (humid areas and drylands); and iv) hydrological characteristics (wetlands and uplands).

A suitable landscape was selected on the basis of having established norms and practices that have facilitated coexistence between people and nature. A SEPL was thus defined as "a landscape in which people are strongly dependent on indigenous biological resources, the persistence of which can to a large extent be attributed to that dependence". Of the landscapes listed, the dryland landscape had characteristics most fitting to this definition. In Uganda, the dryland landscape is a semi-arid to dry sub-humid zone with annual rainfall ranging from 500-1500 mm and averaging 1,350 mm per year. This rainfall is bimodally distributed with peaks occurring in March – June and August – November. Commonly known in Uganda as the "cattle corridor", dryland landscape forms a belt stretching from the southwestern to the northeastern corner of the country (Figure 1). It covers 43% of the country's land area and supports 90% of its cattle population (UNDP 2009).

After selecting the SEPL, sustainability issues (challenges and opportunities) associated with it were assessed. This was achieved through the choice of sample sites spaced to cover the landscape evenly. The clear cut and somewhat linear nature of the boundaries of this SEPL facilitated systematic location of sampling sites. Three sites were selected (Figure 1). Site 1 is comprised of the Mbarara, Kiruhura, and Isingiro Districts; Site 2 of the Nakaseke, Nakasongola, and Masindi Districts; and Site 3 of the Teso sub-region with field sampling based in the districts of Katakwi, Amuria, and Bukedea.

2.2. **Data collection**

Information was gathered through literature review and field surveys involving administration and scoring of structured questionnaires. As it was determined that adequate literature existed for Sites 1 and 2, but not 3, questionnaire surveys were conducted only in Site 3 during this assessment. Coincidentally however, a substantial amount of information generated from literature review had been gathered by the respective researchers through questionnaire interviews and focus group discussions.

Field surveys were conducted in Site 3 during January 2012. Prior knowledge of this site provided the understanding that a focus on native plants would be the foundation of efforts to achieve sustainable livelihoods for the people here. The intent of the questionnaire survey was therefore to record the challenges and opportunities associated with conservation of the indigenous plant populations. Questionnaires were administered to 75 randomly chosen local residents in focal sub-counties of the three districts. Only adults were interviewed, selected to ensure gender representativeness. Each respondent was asked to name up to 20 plants of high socioeconomic value in their localities by category of fruit, leaf, flower, wood, and medicinal value in the order of importance from the most to the least important. They also scored up to 20 most abundant species by the categories of "decreasing", "increasing", or "remaining the same" over the previous five years. Finally, they provided information about trends of the bushlands (uncultivated areas) in their localities, which were scored as "increased", "decreased", or "remained the same" over the last five years.

Analyses of plant value and causes of decline were conducted for 23 species for which the net number of scores (Scores for "decreasing" - Scores for ["increasing" + "remaining the same"]) were ≥10. Ranks were used to relate plant values to causes of loss. Use value ranks (Table 1) were derived from values of harmonic means of all ranks assigned by respondents to each species for each use value. Ranks of causes of loss were assigned to correspond to the total number of returns for each species and cause, with the highest rank (no. 1) assigned to the cause with the highest number of returns for each species.

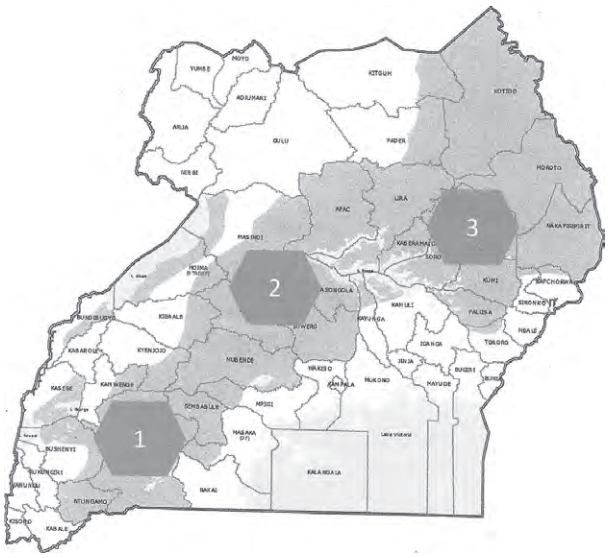

Figure 1: Map of Uganda showing the dryland landscape (darker shaded area), based on Barihaihi (2010). Sample sites are shown as numbered polygons. Words stand for names of districts or lakes.

Table 1: The top 23 most declining species listed by rank from the greatest to the least declining. Use value ranks are taken from a ranking of 73 species. Ranks of the top five causes of decline are provided. All ranks are based on feedback from interviewees.

		Ranks of use value					Ranks of causes of decline				
Species	**Rank**	Fruit	Leaf	Wood	Medicine	Flower	Charcoal	Firewood	Wood	Agriculture	Bushfire
Vitellaria paradoxa	1	1	18	1	6	1	1	3	2	4	
Combretum collinum	2		27	4	18	6	2	1	3	4	5
Combretum fragrans	3			6	29	12	2	1	3	4	5
Tamarindus indica	4	2	3	12	44	2	1	2	3		4
Combretum mollis	5		29	15	25	8	2	1	3	4	5
Terminalia macroptera	6		10	7	34	19	2	3	1	4	4
Ficus platyphylla	7	24	5	5	48		3	2	1	4	4
Acacia sieberiana	8		21	3	10	23	3	2	1	4	
Albizia coriaria	9			2		9	2	3	1		
Diospyros mespiliformis	10	6		9		21	3	2	1	5	4
Vitex spp.	11	5		14		10	3	2	1		
Ficus glumosa	12	20		20			1	2	1	3	3
Ximenia americana	13	4	42	62	22	14	4	4	3	2	1
Albizia zygia	14			8		34	3	2	1		
Harrisonia abyssinica	15	28	11	22	5	4	3	2	1	2	2
Ficus mucuso	16	16		17			2	3	1		4
Sclerocarya birrea	17	22		19			2	2	1		
Grewia tricocarpa	18	10		21	26	22	3	2	1	5	4
Balanites aegyptiaca	19	8	1	13	19	5	1	3	3		2
Ficus dekdekena	20	15	30	36			2	1	2	3	3
Bridelia micrantha	21	18		23	23		3	2	1		
Zanthoxylum chalybeum	22	14	33	28	1	13		3	3		1
Piliostigma thonningii	23	13	32	18	16	32	2	2	1	3	
Average of Ranks							2.3	2.2	1.7	3.6	3.4

3. Results

3.1. Literature review

Study Site 1:

People in this area have traditionally practiced a nomadic pastoral lifestyle (Emerton 1999; Kamukasa & Bintoora 2014). In recent years, however, there has been a move away from the pastoral lifestyle due to pastoralists being settled starting around 1986 (Ococh, Otim & Napeyok 2004) as well as farming activities resulting from an influx of people from neighboring farming districts (Turyaho & Infield 1996). Because of close proximity to a National Park and to some extent taboos against eating wild meat, wild animals are common on private lands within this area. However, because of conflict with humans, carnivores like lions and hunting dogs have been poisoned out (Turyaho & Infield 1996). Until 2001 when the Uganda Wildlife Authority which manages the Park instituted a program of sport hunting under which the proceeds are shared with the local community, people were not happy about wild animals living on their properties (UWA 2010). Bush clearing increased in recent years, perhaps driven by the understanding that at least in the short term, it results in greater yield. Increases in forage growth and improvement of body condition, reduction of age to maturity, higher milk yield, and higher calving rate have been reported for cattle on farms where bush has been cleared as opposed to those in which bush was left intact (Mugas et al. 2000). Bush clearing to open up land for cultivation is also ongoing (Kamukasa & Bintoora 2014).

In recent years however, the negative consequences of overstocking and bush clearing have been observed. Overgrazing has become evident as a result of the "squeezing" out of pastoralists from traditional rangeland into floodplains, wetlands, and steep slopes (Bagenda, Nagaga & Smith 2003), leading to soil erosion, emergence of low value grass species, and reduced livestock productivity (UNDP, UNEP & UNCCD 1999). Both livestock trampling and loss of woody vegetation cover are believed to be leading to poor water infiltration in the soil. For example in May 2009, Tenywa and Ssengendo (2009) reported two lakes forming abruptly in the Kiruhura District following heavy rains. Agricultural clearing and bush burning are also leading to increased incidences of human-wildlife conflict, wildlife loss, soil erosion, loss of soil fertility, and siltation of local water bodies (Kamukasa & Bintoora 2014). Human-wildlife conflict takes the form of crop destruction, livestock kills and the perception that wild animals transmit disease to domestic herds (Marquardt, Infield & Namara 1994; Namara, Infield & Sumba 1998). Settlement of pastoralists has had its negative consequences. Sale of land by pastoralists to wealthy individuals and property fencing led in the early 2000s to the influx of the new landless into other parts of the corridor, sparking off conflicts about land ownership rights (Uganda Human Rights Commission 2004).

Study Site 2:

This area is a wooded savanna dominated by ranches interspersed with small-sized crop fields. It is one of the most naturally wooded areas outside of protected areas in the country (Forest Department 2002), and like the private lands around L. Mburo National Park in Study Site 1, is rich in fauna (Uganda Wildlife Authority unpublished reports). However, it witnessed drastic deforestation during the last decade (Oluka 2014). For example during a study of 2007-2008, Olupot, McNeilage and Plumptre (2009) observed rapid changes in land use within the area including extensive bush thinning for pasture (Figure 2). Land fencing, hunting of wild animals, charcoal burning, conversion of bushlands to agricultural fields, and bushfire outbreaks were also common (Olupot 2012). A low incidence of de-bushing had been seen here by Olupot, McNeilage and Plumptre (2008) during a pilot study in December 2006. But by January 2008, bush clearing was widespread. Antelopes such as Oribi (*Ourebia ourebi*), Uganda Kob (*Kobus kob*), and the Bushbuck (*Tragelaphus scriptus*), and birds such as the Crested Guinea Fowl (*Guttera pucherani*) that were very common in the area were being hunted intensively. Charcoal production was also ongoing on a high scale. In one district, the rate of charcoal burning was so high in the 1990s that revenue collected from charcoal production constituted 60% of the total district revenue (National Environment Management Authority 2008). The area is witnessing what is now termed "termite overburden" whereby termite destruction of property has reached levels never previously experienced (Tenywa 2008) and thought to be a result of widespread bush clearing. It has also experienced frequent incidences of sheet erosion (National Environment Management Authority 2008) believed to be caused by both bush clearing and overgrazing.

Figure 2: Clearing of bush and land fencing in Nakaseke District. Oribi antelopes are visible in the centre of the photo near fence posts. Practices like this need to be done with proper planning to maintain habitat for wildlife. Photo taken in Nakaseke District (Site 2).

Study Site 3:

People in this area practice an agro-pastoral lifestyle, with most rural families engaged in both cultivation and livestock keeping. Pastures are restricted to the seasonal

swamps which are expansive in this area (Figure 3), and to areas with shallow lateritic soils considered unsuitable for crops. Little has been reported about impacts of grazing and cropping, but over-cultivation is an ongoing problem with lands being cropped without investment in soil conservation. Overfishing has also been reported on Lakes Bisina and Opeta (NatureUganda 2009), and digging for lung fish (*Protopterus aethiopicus*) is reported to be degrading some swamps (Soroti District n.d.). Perhaps more than other site within the corridor, the area is experiencing the greatest impact of climate change with increasing frequency of droughts and floods. Crop productivity has in recent years been impacted by droughts and floods (Uganda Red Cross Society 2007; Oxfam 2008; Barihaihi 2010). Like other parts of the country, urban growth is probably one of the leading causes of deforestation, with growth occurring without supporting afforestation programs (William Olupot, 2012-2015, observations conducted during a socioeconomic survey of wild plants and monitoring of wild fruit production). Abandonment of the traditional "parkland" farming system in which trees are left in cultivated fields (Figure 4) is an emerging threat resulting primarily from overexploitation of wood for various purposes (Olupot, W. et al., unpublished data; Figure 5). Available information from the area also suggests a high potential for conservation of wild plants for fruit production (Olupot, W. et al. in progress). This potential is high, compared to other areas of the cattle corridor, and perhaps the wetter regions within the country as well, where existing studies of non-timber forest products have not shown the existence of such a diverse array of wild plant species valued highly for edible fruit (e.g. Olupot, Barigyira & McNeilage 2009).

Figure 3: Permanent residency of cattle in grass swamps of the Teso sub-region is suggested by use even during flood periods. Grazing needs to be managed to reduce the emergence of low forage value grasses, and the practice of cultivating shallower wetlands, which would normally supportlivestock during flood periods, needs to be guided. Photo taken along Katakwi/Soroti District border (Site3).

Figure 4: Illustration of parkland farming and the practice of leaving uncultivated strips between gardens. Both practices have in the past supported conservation of native species in a region lacking in protected area coverage. Both are being abandoned in favor of extraction of charcoal and timber. Photo taken from Katakwi District (Site 3).

3.2. **Questionnaire survey results**

The majority (88%) of respondents reported that wild plants and the extent of bushes had declined in their villages during the five years preceding the survey. The main reported causes of this were charcoal burning cited by 27% of the respondents, building wood exploitation (22%), fuelwood extraction (20%), wild fires (15%), and agricultural clearing (9%). However, causes of decline varied by species (Table 1). The majority of the 23 (15, i.e. 65%) species perceived to be undergoing the highest rate of loss to wood harvesting also rank highly (within the top 10) for one or more of the non-wood values of fruit, leaf, medicine, and flower value (see Table 1).

Figure 5: Charcoal burning in the bushlands of the Teso sub-region. Lucrative trade in charcoal is undermining the traditional practice of parkland farming and retention of natural trees in uncultivated strips between gardens. Trees such as Vitellaria paradoxa that are valued for fruit and other non-wood uses, are some of those most sought out. Photo taken from Amuria District (Site 3).

Both the literature review and the questionnaire survey helped to uncover several issues related to SEPL sustainability. Across the study sites, most of the issues were cross-cutting, but there were some that were site-specific (Table 2).

4. Discussion

4.1. SEPL definition

The definition of a SEPL used here was intended to apply to an existing SEPL with strong features of both social and ecological production. It was not intended to apply to potential SEPLs. However, it is the author's opinion that new SEPLs can be created. For example, new SEPLs can be created from landscapes that are heavily human-influenced, such as built-up areas and farmlands. Under the definition given here, "landscapes" (such as wetlands) that have inherent resilience to support biodiversity despite heavy human modification may be considered potential SEPLs until deliberately managed to support both social and ecological production functions.

4.2. Some actions for achieving greater sustainability (management of the landscape as a SEPL)

Whereas it is not clear how questionnaire interviews and focus group discussions with local communities as reported in the literature of Sites 1 and 2 influenced the perceptions of the local communities, it was clear from Site 3 that they generated a great deal of interest and concern. Therefore, raising awareness can rally communities towards actions for SEPL sustainability. However awareness in itself may not achieve much impact without "hands-on" actions. The following are some of the tangible approaches needed to strengthen the sustainability of this SEPL:

4.2.1. Maximizing opportunities provided by wild foods

This study has identified potentials for wild food production at different points along the corridor. Potential wild foods include fruits, vegetables, mushrooms, roots, tubers, corms, edible insects such as termites, fish, and wild meat. For Site 3, wild plants, mushrooms, and termites have the highest potential, while wild animals have a high potential in Sites 1 and 2, and potentially termites and mushrooms in Site 2 as well.

Animal-based wild food production is however potentially complicated by several factors, including illegal hunting, cultural taboos, the perception that wild animals compete with livestock for forage and transmit diseases to them, conflict in crop gardens, and by the fact that some threaten lives and property (Olupot, McNeilage & Plumptre 2009). Promotion of wild meat production therefore depends on careful selection of species to match local potentials and sound management of natural sites. For plants, the challenges for many species, especially those used for fruit are: i) the perception that the fruits are food for children, ii) the difficultly of harvesting fruits, iii) the slow-growing nature of plants that take a long time to produce fruit, iv) the potential for fruit plants to not fruit abundantly, v) the unknown health benefits of eating fruits, and vi) and the lack of market for fruits. Therefore, there is need to increase willingness to plant or retain fruit plants by changing attitudes, developing ways of increasing production, acquiring appropriate processing technologies, and establishing markets. Some work on propagation techniques (Akinnifesi et al. 2007) and processing has been tried or is underway in some countries. But this is still limited in Uganda.

Results from the questionnaire survey suggest that although wild resources such as fruit plants may be appreciated by local people, this opportunity has not translated into their active retention, and instead resources are being decimated by unsustainable uses, for example wood over exploitation. In addition to the need to improve production systems, for all wild foods, a major requirement for their use as tools to realize SEPL sustainability is value addition. Successful promotion for subsistence use and the market depends on understanding nutritional factors as well as storage. Studies of fruit pulp, edible seeds, and nuts in some countries have shown a remarkably high nutritional value of wild fruits. For example, analyses of *Balanites aegyptiaca* seed (e.g. Elfeel 2010; Okia 2010) and *Vitellaria paradoxa* nuts (Maranz et al. 2004) (Fig. 5) have shown that they are rich in essential fatty acids and minerals. In Tanzania, nutritional studies of edible seeds, nuts and fruit pulp of 18 indigenous fruit showed a remarkably high value of nutrients compared to exotic fruits (Ndabikunze et al, 2000). For example, high values of ascorbic acid were found in *Hyphaene compressae,* and the fruits of *Adansonia digitata* and *Ximenia caffra* were found to have a higher vitamin C content than mango (*Mangifera indica*) or orange (*Citrus sinensis*). Recent analyses of fruit pulps from 10 indigenous fruits by Nature and Livelihoods have also shown high fat, mineral, and Vitamin C values for some fruits compared to published values of Mango and Orange (William Olupot and Francis Omujal, 2015, Results of a study on "experimenting on production of high value market products from edible indigenous fruits" based on fruits collected from the Teso sub-region, Uganda).

For animals, there is some information available on the nutritional composition of commonly consumed bushmeat species and insects. What is known suggests that bushmeat provides an equivalent and in some cases greater quality food than domestic meats (Food and Agriculture Organization 1996). For example, wild animals are good sources of carbohydrates compared with domesticated animals from similar environments and

Table 2: Summary of land use challenges, impacts and opportunities related to sustainability of the SEPL at three sites based on both literature review and questionnaire survey.

Site	Challenges	Impacts	Opportunities
1	Overstocking on hill slopes, wetlands, and floodplains; bush clearing (manual); unregulated bush burning	Soil erosion; soil compaction; emergence of low value grass species; reduced livestock productivity; loss of wildlife habitat	Natural pastures suitable for livestock grazing
	Human-wildlife conflict; perceptions that wild animals compete for resources with livestock and transmit disease to them	Crop and livestock loss; wildlife poisoning; increased level of illegal hunting; species extinctions	Wildlife abundance on privately owned lands
	Expanding cultivation	Soil fertility loss; farmer-pastoralist conflict	
	Influx of people from other areas	Overpopulation leading to emigration and human-human conflict	
	Land fencing	Limited free movement of wild animals	
2	Bush clearing (manual); unregulated bush burning; overexploitation of wood for charcoal	Soil erosion; loss of wildlife habitat; reduction of woody cover; termite “overburden”; drastic reductions and extinctions of certain species	Natural pastures suitable livestock grazing
	Expanding cultivation; increased land fencing	Farmer-pastoralist conflict; limited free movement of wild animals	
	The perception that wild animals compete with and transmit disease to livestock	Wildlife extermination	Wildlife abundance on privately owned lands
	Overhunting of wildlife	Reduction in wildlife populations and extinctions of certain species	
3	Wood overexploitation for charcoal, building, and fuelwood; unregulated bush burning; indiscriminate and overhunting of wildlife; treeless urbanization	Loss of trees in bushlands and crop fields; near extinction of certain species at a local scale; overall deforestation, loss of wildlife habitat; possibility of exacerbated heating particularly during drought periods	Occurrence of diverse edible wild fruit plants; parkland farming system; uncultivated field borders; high value of wetlands for fish production
	Non-investment in soil conservation	Loss of soil fertility	
	Increased cultivation of marginal areas with poor soil	Loss of species of high socioeconomic value	Natural pastures suitable for livestock grazing
	Overfishing	Possibility of reduced nutritional security	
	Frequent occurrence of climate-related disasters	Food shortages and property loss	

in some cases, the protein content of bushmeat is higher than that of domestic animals. Therefore, wild foods can be important in solving malnutrition for people that cannot afford to buy a variety of foods for their daily diets. However, anti-nutritive factors in wild foods also need to be identified so as to determine ways of deactivating them. For example, indigenous fruits can contain such factors as phytic acid, tannins, and trypsin inhibitors. In Site 3 and in parts of northern Uganda, there are ongoing efforts to promote B. *aegyptiaca* for both fruit and leaf and *V. paradoxa* for fruit, but their effectiveness is still undetermined. As a way forward on this, Nature and Livelihoods recently conducted nutritional analyses and processing trials of some the highly valued fruit species at Site 3.

4.2.2. Achieving sustainable wood production

Many parts of this cattle corridor have resilient fast-growing indigenous plant species that are highly valued for firewood and charcoal production. Some of the potential species particularly in the central and eastern parts of the corridor include *Combretum* spp. and *Terminalia* sp. But communities need to be sensitized about these values if they are to actively retain and manage farmlands. This should go hand-in hand with support for acquisition and training in construction and use of wood-saving cooking technologies, as well as planting of fast-growing alternative tree species.

4.2.3. Adopting sustainable grazing practices

Solutions to unsustainable farming practices can be readily developed once negative impacts have been identified. In the central and southwestern parts of the corridor, the main impacts are soil compaction and soil erosion. Targeted solutions can be developed to better integrate livestock keeping with crop farming and wildlife conservation. In the Teso sub-region however, evidence of overgrazing is still largely undocumented, but negative impacts are likely in the wetlands due to permanent stay of cattle in some sites. Likely impacts include reduced ability of the swamps to soak up and retain water, reduced forage production, reduced ability to support fish production within the swamps and in the lakes downstream, and reduced abundance and diversity of forage plants and other biodiversity. Return to traditional seasonal grazing regimes whereby cattle are grazed in wetlands only during the dry seasons and taken back to homesteads for the night is a potential remedy worth investigation and further consideration.

4.2.4. Adopting potential approaches for sustainable crop production

Sustainable crop production is difficult to achieve in drylands as soil degradation processes are more rapid in hotter and drier climates compared to wetter and cooler climates, making it more difficult to sustain the soil-resource base. Studies have found that whenever an ecosystem such as grassland in a semi-arid region is transformed into an arable system for food and fibre production, several soil degradation processes are set in motion (Stewart et al. 1991). This is particularly the case where raindrops fall directly onto the bare soil surface, not protected by cover such as vegetation, crop residues, mulches, etc. Other effects are a decline in soil organic matter, increased wind and water erosion, deterioration of soil structure, salinization and acidification (Koohafkan & Stewart 2008).

Improved crop productivity due to loss of soil fertility can be realized through better crop-livestock integration (e.g. establishment of field borders and more effective use of manure) and soil management practices such as agroforestry, minimum tillage, cover-cropping, and so on. For the drylands in Central Uganda, there is also need to ensure better integration of sugar-cane farming with wildlife management (Olupot, McNeilage & Plumptre 2009), and for the Teso sub-region high potential for production of both domesticated and undomesticated fruit crops. These measures can be further supported through use of climate-adapted high-yielding crop varieties and promoting eco-friendly pest management.

4.2.5. Practicing sustainable wildlife management

Within the cattle corridor, tourism activities are well developed within the L. Mburo area (in Site 1) and National Parks, but not in other areas of high potential. In the L. Mburo area, both wildlife viewing and sport hunting programmes have been running for many years. High potential areas where tourism is poorly developed are the Kafu River Basin (in Site 2) where wild animals are common on private lands, and in and around the Ramsar sites outside legislated protected areas (Lakes Bisina, Opeta, and Nakuwa with globally threatened species of plants, birds, and fish) as well as in Pian-Upe and Bokora-Matheniko Wildlife Reserves (in Site 3) which have some of Uganda's most threatened fauna, an example of which is the Roan antelope, *Hippotragus equinus*. The Uganda Wildlife Authority plans to start up sport hunting in the wildlife reserves and the Kafu Basin (UWA 2010). But the potential for game viewing needs to be developed for the wildlife and forest reserves, and ecotourism for the Ramsar sites. Throughout the landscape, there is need for greater effort to reduce overhunting and reckless killing of wildlife.

4.2.6. Greening of built-up areas

Trees in dryland landscapes are essential for human well-being. Greening built-up areas in drylands is needed to provide services such as cooling, dust reduction, and amenity value, as well as biodiversity conservation. Such trees can be refuges providing secure roosting and nesting sites for birds in landscapes that have otherwise been rendered treeless and are insecure. Some of the ways to achieve this greening include developing and enforcing policies on the number of trees that must occur per unit area of land in towns and ensuring that public places like roadsides, green spaces, and facilities like government institutions are adequately vegetated. Among the areas studied, Site 3 is probably the highest priority for this

because perhaps more than the other two sites, it is hotter due to low elevation, has a relatively flat terrain, and has a sparse cover of woody vegetation. It also experiences frequent incidences of climate extremes.

5. Conclusion

Results from this study show that greater effort needs to be made to identify SEPLS and the sustainability issues associated with them. However, activities to promote SEPLS should aim not only at supporting those existing, but also creating new ones and helping those landscapes and seascapes (such as wetlands) with high potential to be managed as SEPLS.

The dryland SEPL identified here faces many challenges to its sustenance, and Nature and Livelihoods can contribute towards addressing these. These include overgrazing, land clearing, resource overexploitation, and soil degradation. Although some are suggested here, other potential solutions to these challenges need to be determined and should be applied by locality. Many possibilities exist to support relevant actions, but efforts to identify and implement workable mechanisms depend on availability of resources. More research is needed to identify challenges and opportunities throughout the landscape through a systematic field survey involving use of both questionnaires and ecological assessments.

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Chapter 11

Converting pests into allies in tea farming — a SEPL case in Hualien, Taiwan

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Abstract

Eco-friendly farming (EF) has been practiced in some tea plantations of Wuhe Tableland, Rueisuei Township in eastern Taiwan to maintain populations of the small green leafhopper (SGL), *Jacobiasca formosana*. Previously considered a pest, this insect is now an economic ally because tea shoots and young leaves "damaged" by SGL are now harvested to make a high-priced honey-flavored black tea that is welcomed in the market. However, the socio-economic and ecological impacts of EF have not been examined. In this study, we measured and compared insect (and other arthropod) and vertebrate diversity at three tea plantations with EF practices and three plantations with conventional farming (CF) practices, and interviewed relevant stakeholders to collect information on the socio-economic effects of EF versus CF practices. Our results showed that tea plantations with EF practices not only generate higher economic return but also conserve higher biodiversity. In addition, more job opportunities were created through the EF practices. We conclude that social interviews and stakeholder engagement, as well as biodiversity surveys, are not only useful but also critical tools to identify and verify a socio-ecological production landscape (SEPL) such as the tea production landscape in Wuhe Tableland.

Keywords
biodiversity survey, small green leafhopper, socio-ecological production landscape, social-economic interview, Taiwan, tea

1. Introduction

In COP 10 Decision X/32 of Convention on Biological Diversity, the Conference of the Parties recognized the *Satoyama* Initiative as a potentially useful tool to better understand and support human-influenced natural environments for the benefit of biodiversity and human well-being. To conserve human-influenced natural environments, or socio-ecological production landscapes (SEPLs), the benefits of biodiversity and human well-being need to be identified and verified. However, social and economic dimensions, particularly the ecological dimensions of many SEPLs, are not measured quantitatively.

In 2013, we found a tea production landscape in Wuhe Tableland of eastern Taiwan, where some tea farmers managed their tea plantations by eco-friendly farming (EF) practices instead of conventional farming (CF) practices, i.e., using herbicides to remove weeds and pesticide to control pests such as the small green leafhopper (SGL). SGL, *Jacobiasca formosana,* is a common and abundant insect species in tea plantations of Taiwan (Chen et al. 1978, p. 93). With its sucking mouthparts, the insect feeds on phloem sap of the tea foliage, preferably shoots and young leaves. The feeding of SGL retards shoot growth and causes shoot curling. The leaf margins turn yellow to brown and eventually fall off. The population of SGL usually reaches its peak in the summer (Chen et al. 1978, pp. 96-97) and may cause great loss of tea shoots and leaves (Chen et al. 1978, pp. 93). Therefore, the SGL has traditionally been considered a serious pest for tea plantations. Many control methods, including chemical and biological control (Chen et al. 1978, p. 103; Shiau 2004, pp.7-8), have been developed to suppress populations of SGL and protect tea crops from pest damage.

In the early 2000s, scientists of the Tea Research and Extension Station successfully developed a honey-flavored black tea processed from SGL-fed oolong tea shoots and leaves (Chen et al. 2004, pp. 81-87). This processing method was learned and further developed by a tea farmer of Wuhe, Mr. CS Kao, who outcompeted contestants from 25 countries and won the championship of the black tea group in the First

World Tea Contest held in Taipei in 2006. Ms. AD Nien, Kao's sister-in-law, won four gold medals in the Black Tea Group of the International Tea Awards Competition held in 2010. As a result of these prizes and their media coverage, the honey-flavored black tea became very famous and popular and its price rose so high that the tea farmers of Wuhe no longer consider the SGL a pest but rather their economic ally. Some, though not all, tea farmers stopped using pesticides, herbicides and chemical fertilizers and began using only organic fertilizers in order to keep a healthy population of the SGL in their tea farms to allow for production of more honey-flavored black tea. However, the effects of such EF versus CF practices on local biodiversity, as well as socio-economic impacts, have not been examined.

The purpose of this study is, therefore, to combine biological and social-economic surveys to examine the impacts of EF versus CF practices on the local community.

2. **Methods**

2.1. **Study site**

The tea production landscape in Wuhe Tableland studied is near the Tropic of Cancer Monument in Rueisuei Township, Hualien County (Fig. 1). We chose six tea plantations of 0.6-1 ha as study sites for our biodiversity surveys (Appendix 1). These sites are surrounded by a mixture of secondary forest, betel nut and/or coffee plantations, streams, orchards, and human settlements (Fig. 1).

Sites 1, 3, and 5 are tea plantations managed by EF practices. No herbicide or insecticide is applied, only organic fertilizer is used in these sites where weeds grow very fast and are controlled by frequent pulling and cutting (Fig. 2). The soil of these sites stays soft and moist in general. On the contrary, sites 2, 4 and 6 are managed by CF practices. Herbicide is applied on sites 4 and 6, where no or few weeds are observed and the ground always stays clean and compacted. The manager of site 2, however, uses betel nut leaves as mulch to reduce weed growth and herbicide is only applied to the ridges but not to furrows (Fig. 3). Managers of sites 2, 4 and 6 do spray insecticides, though they claim to only spray in spring and winter to control some caterpillars and mites and to always follow government regulations on pesticide application. In addition, chemical fertilizer and organic fertilizer were applied to sites 2 and 4. Chemical fertilizer was applied to site 6.

Figure 1 : Locations of study sites. See Appendix 1 for detailed information.

Figure 2 : Site 3 in March 2014. Note the weeds grow freely.

Figure 3 : Site 2 in March 2014. Note the betel nut leaves are used as mulch.

2.2. **Study methods**

2.2.1. **Biodiversity surveys**

We conducted field surveys to measure the biodiversity of insects, other arthropods and vertebrates (i.e., mammals, birds, reptiles, amphibians) once every season, i.e., in February-March, May, August and November, at six sites in 2013.

Insects and other arthropods inhabiting different habitats, e.g., on the ground, in the soil or tea trees, were surveyed by different methods. During each survey, one window trap (eds. Toda and Kitching 1999, pp. 35-36) was set at the center of each site to intercept and collect flying insects, and four pitfall traps (top diameter 70 mm, height 80 mm, bottom diameter 50 mm, volume 200 ml) were set at least 15m apart to collect ground arthropods (cf. eds. Toda and Kitching 1999, pp. 43). Both types of traps were set for two days. Insects and arthropods that stay on tea plants were collected by beating methods (cf. eds. Toda and Kitching 1999, pp. 58), i.e., beating the tea plants with a stick 20 times while holding a beating sheet under the area being beaten to collect fallen insects and arthropods. Four samples of beating were collected at each site. All insects and arthropods collected by the above three methods were stored in 80% ethanol and brought back to the laboratory for further examination.

Soil insects and arthropods were collected by taking four soil cores (eds. Toda and Kitching 1999, p. 49) per site. Collected insects and arthropods were extracted by a Tüllgren funnel (eds. Toda and Kitching 1999, p. 46) for seven days. All insects and arthropods collected were counted and sorted under a dissecting microscope.

Vertebrates were surveyed mainly by transect methods. The number and species of amphibians, reptiles and mammals sighted, heard, and whose tracks or signs were found, were recorded by walking along the border of each site. This transect survey was conducted twice a day per site, once during the day (from 0900 hr to 1500 hr) the other at night (from 1900 hr to 2300 hr), and was repeated for two days. Therefore, each site was surveyed four times in each season. The number and species of birds seen or heard in a 3m width band along the border transect were also recorded. However, the bird transect survey was conducted only once in the morning (within 4 hours after sunrise) at each site, and was repeated for two days. Therefore, each site was surveyed two times in each season.

In addition, ten Sherman live traps were set at least ten rows of tea plants apart to capture small mammals such as rodents and shrews at each site. All traps were baited with sweet potato smeared with peanut butter for two consecutive trapping nights and checked the next morning of each night. Captured animals were released back to the field after recording. The number of species and individuals of small mammals trapped in each survey were combined with the number of mammal species and individuals recorded in the transect survey of the same season for data analysis.

2.2.2. **Socio-economic survey and stakeholder interview**

Tea farmers, including owners or managers of the six sites and key tea farmers in Wuhe of Rueisuei Township, foremen of laborers hired by these farmers, and the General Secretary of Rueisuei Farmers' Association were interviewed to collect information on history, cultivation, production, and the ecological and socio-economic effects of EF and CF practices.

2.2.3. **Data analysis**

Residual normality and homogeneity of variance were tested before further data analysis. Repeated measures ANOVA was applied to compare data collected from sites of two types of farming practices. However, the Kruskal-Wallis test was applied if data deviated from a normal distribution even after transformation, and the variances were not sufficiently homogeneous.

3. **Results**

3.1. **Biodiversity surveys**

A total of 56,987 arthropods (mainly insects) were collected during four seasons at six sites. More than 65%

(37,228/56,987) of the total catch came from site 5. Due to the large number of specimens collected, only arthropod species collected in the first two seasons have been identified thus far. Identification of species collected in the remaining two seasons is still underway. The total number of insects and other arthropods collected at EF sites (41,793 individuals) is significantly greater than the number collected at CF sites (11,194 individuals) ($H = 8.18$, $p < 0.005$ for individuals).

A total of 887 individuals of 56 species of vertebrates were recorded in this study. A significantly greater number of species and individuals ($F = 70.14$, $p < 0.0001$ for species, $F= 43.25$, $p < 0.0001$ for individuals) was recorded at EF sites compared to CF sites.

In addition, at least five legally protected species listed in the National Wildlife Conservation Act, the ring-necked pheasant (*Phasianus colchicus*), the brown shrike (*Lanius cristatus*), the Styan's bulbul (*Pycnonotus taivanus*), the Chinese cobra (*Naja atra*) and the many-banded krait (*Bungarus multicinctus*), were found in EF sites.

3.2. Socio-economic surveys and stakeholder interviews

Based on the results of stakeholder interviews, the area of tea plantations in Wuhe reached 200 hectares in the 1960s, then dropped to less than 100 hectares before the invention of honey-flavored black tea about 10 years ago. Now the total area of tea plantations is about 100 hectares. Among the 100 hectares of tea plantations in Wuhe, at least 60% is now cultivated by EF practices. The remaining tea plantations are managed for the most part innocuously, i.e., pesticides are applied at a minimum and according to government regulations on pesticide application. Although tea farmers practicing EF saved 1,700-2,000 USD per hectare per year on the cost of pesticides and herbicides, this amount is scarcely comparable to the cost of extra labor required for EF practices (see below).
However, EF practices brought social benefits to local laborers. In the past, tea leaves were mainly plucked in spring and winter when insect damage was minor, and tea plucking laborers (mostly indigenous women and some foreign spouses) typically worked only 50 to 60 days a year. With the invention of honey-flavored black tea, tea leaves can be collected almost year round to produce various types and qualities of tea (see below). In addition, because weeds are cut or pulled manually once every 2-4 weeks depending on how fast grasses grow at an EF tea plantation, more laborers are needed. Due to the extra work of weeding and longer seasons of tea plucking, laborers hired by tea growers of EF tea farms now work more than 300 days per year, which means getting 5 to 6 times more income a year than before.

Although labor is costly (33-66 USD per day per person), the honey-flavored tea produced by EF practices sells so well that the income of tea growers has increased 2-5 times compared to 10 years ago. The price of honey-flavored black tea ranges from 60 to 120 USD per 600 gm, depending on the quality of the tea produced. Premium tea is sold as high as 400 USD per 600 gm. Tea growers now do not worry about hiring more laborers, using the more expensive organic fertilizer, or the loss in quantity caused by SGL damage because this extra cost and loss can always be compensated by the increase in unit price of various types of tea. In fact, feeding by SGLs is no longer considered to be "damage'', but "benefit." As the population of SGL decreases, tea shoots and leaves are less damaged and can still be processed into some other tea products, e.g. oolong tea, which is sold at regular or lower price. Therefore, tea plantations are managed to ensure that the SGL can feed on tea shoots and leaves. Timely weeding forces the SGL to feed on tea shoots and young leaves. The grass regrows within several days after weeding and the SGL may return to this shelter.

Results of the interview also showed that the Farmers' Association is the most important institution to tea growers, and the Tea Research and Extension Station (TRES) is the key institution for training and extension. There are about 50 tea growers in the Rueisuei Farmers' Association. However, farmers who are more actively practicing EF are in general younger farmers. Farmers do share and exchange knowledge and skills on tea growing through the arrangements of the Farmers' Association. However, there is much know-how in terms of making teas, and tea growers seldom talk about how they make their own teas. Nearly 100 laborers were hired by tea growers in Wuhe in 2014. Like other rural areas in Taiwan, Rueisuei is also facing the threat of aging as the average age of the laborers is about 55. Most of the younger generation has moved to urban areas, though there are a few who either stayed or returned from urban areas and joined the tea farming business in recent years. Gender inequality is not a big issue in Wuhe, i.e. women have equal rights in terms of voting and being voted in, working, education, property ownership, etc. A woman was newly elected as Leader of the Tea Production and Marketing Group of the Rueisuei Farmers' Association.

4. Discussion

A SEPL is shaped by interactions among evolving needs through time and requires the sustainable use of biological diversity. Therefore, a landscape qualified as a SEPL must demonstrate that its biological diversity is retained and enhanced. The purpose of this study is to simultaneously use tools such as biodiversity surveys and socio-economic surveys through stakeholder interviews to examine the impact of EF versus CF practices on the ecological, social and economic aspects of the local community. Our data demonstrated that a combination of biological, social and economic surveys is pivotal to assess and understand a SEPL. Active use of EF practices, originally aimed to "maintain" the SGL population, helps maintain higher overall biodiversity in tea plantations. The EF practices

allow weeds to grow, which provides a more extensive ground cover. Removed grass is left in furrows of the tea plantations as mulch and green manure that improves nutrients for tea cultivation. All these efforts help create the ecological stability and resilience of the tea production landscape.

The EF practices, though requiring labor-intensive management, allow the population of SGL to fluctuate in the tea plantation. Table 1 summarizes how different population levels of SGL affect damage levels of tea shoots and leaves, tea harvest, tea chemistry (honey flavor of tea), and tea prices. As the number of SGL increases, more tea shoots and leaves are damaged, which represents less harvest but stronger aroma and flavor, thus a higher quality of tea processed and higher prices of tea products.

Table 1. Cascade effects of different population levels of small green leafhopper on damage levels of tea shoots and leaves, tea harvest, tea quality and tea price

	Population levels of small green leafhopper		
	High	Medium	Low
Damage of tea shoots and young leaves	Heavy	Medium	Little
Tea harvest	Lean	Medium	Fat
Honey flavor of tea	Strong	Medium	Weak
Price of tea	High	Medium	Low

Since the SGL is the target for protection in tea plantations with EF practices, other species in this human-influenced landscape, including at least five legally protected species, are indirectly protected from harmful pesticides and herbicides. Tea plantations managed this way therefore contribute a great deal to the conservation of biodiversity.
Treating SGLs as allies also brings social benefits. Our data showed that tea growers hired more laborers, or created more jobs, for management and harvest. Laborers now work more than 300 days per year compared to the 50 to 60 days per year of ten years ago. Nearly 100 laborers are hired by tea growers in the Wuhe area now, and this greatly facilitates rural development. There are also signs that the younger generation is attracted to stay in or return to their rural hometown to join tea farming and/or run tea businesses.

In the process of conducting field work, we were approached by many local people, including land owners, foremen and laborers working in the tea plantation, and people living in nearby villages, who were curious about our presence. Apparently, local people can tell visitors from residents quite easily. During the process of stakeholder interviews, we actively sought key stakeholders to collect relevant social, economic, and environmental information. On both occasions, we took the opportunity to explain the purpose of our study, the concept of the *Satoyama* Initiative and how it is related to them. We received good responses from these stakeholders who always wanted to learn more from us and often provided feedback on how they take care of their environment and how the local economy has improved. We also encountered people who learned about our presence and work from their relatives, neighbors, or friends, which demonstrated that our survey and stakeholder interview processes helped encourage communication and engagement of people in the community.

In June 2015, six months after we had completed our study, we presented the results of our study to tea farmers in Wuhe. During this event, we introduced the *Satoyama* Initiative and the concept of SEPLs, as well as encouraged more tea farmers to use EF practices. Farmers were more aware of the *Satoyama* Initiative and SEPL and realized that their EF practices have contributed to greater biodiversity, which may be good for development of ecotourism in the future. Farmers especially appreciated our report because it is the first report on local biodiversity in the past 40 years. The risk caused by market changes and climate change was addressed and discussed. The audience responded positively and discussed the need to have a consensus on a vision of future development and more collective efforts to improve the tea production landscape. They also agreed that more communication and collaboration among farmers, especially the younger generation, are needed.

5. Conclusion

The tools we used, i.e. a combination of biological and socio-economic surveys, were not only useful but also critical to identify and verify a socio-ecological production landscape such as the tea production landscape in Wuhe Tableland. The assumption that a SEPL is sustainable ecologically or capable of conserving biodiversity must be examined by data collected through biodiversity surveys. Socio-economic surveys through stakeholder interviews were valuable in proving that tea plantations with EF practices in Wuhe benefit the farmers and local community economically and socially and help conserve biological diversity. Lessons learned from using these tools include: 1) the fact that the tea production landscape with EF practices in Wuhe did support higher biodiversity was verified by data collected through biodiversity surveys; 2) a solid case of SEPL was demonstrated by using these significant tools; 3) maintenance of a single species (SGL) may generate great benefits and more benefits may be generated by higher biodiversity, though this needs further study; 3) innovation plays an important role; 4) benefit-sharing makes a community more sustainable socially and economically; 5) engagement of local stakeholders is important at all stages, as it contributes to a positive relationship and trust between them and the research project which will further enhance multi-stakeholder collaboration to better manage SEPLs.

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Appendix 1 :

The latitude and longitude coordinates of the northeast corner, elevation, and approximate size of each site in this study:

Site 1: N23°26'46.25", E121°21'15.23", elevation: 194-201 m, area: 1 ha;

Site 2: N23°26'47.73", E121°21'21.44", elevation: 195-203 m, area: ca. 0.7 ha;

Site 3: N23°27'24.09", E121°20'44.71", elevation: 217-227 m, area: ca. 0.5 ha;

Site 4: N23°27'26.69", E121°20'42.93", elevation: 216-224 m, area: ca. 0.6 ha;

Site 5: N23°27'50.70", E121°20'32.34", elevation: 234-237 m, area: ca. 0.72 ha;

Site 6: N23°27'53.18", E121°20'33.27", elevation: 233-236 m, area: ca. 0.6 ha.

Chapter 12

Assessing farmers' perceptions of resilience of socio-ecological production landscapes in central and eastern Kenya

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Abstract

In order to understand farmers' perceptions of resilience in socio-ecological production landscapes and seascapes (SEPLS), a participatory field assessment was conducted in Kenya. A tool developed by the United Nations University-Institute of Advanced Studies and Bioversity International was used to elucidate the range of perceptions of risk faced by five communities living in different agro-ecological and socio-economic conditions. This paper presents the practical process of carrying out assessments at the community level and also lessons learned while testing the toolkit. The process of using SEPLS indicators was confirmed valuable in: 1) identifying local perceptions of threats in landscape resilience, the perception differences in various community landscapes, major causes of threats and community efforts toward mitigation, 2) improving awareness through stimulating discussions with participants, and 3) providing a perspective on future directions and encouraging local innovations and potential interventions in response to negative trends. The discussions were considered vital in creating social capital for landscape governance, community ownership of the process and identifying potential interventions. A few areas of the tool were found wanting and some amendments have been advanced for consideration.

Keywords
farmers' perceptions, resilience indicators, resilience assessment, socio-ecological production landscapes and seascape (SEPLS), Kenya.

1. Introduction

Environmental degradation has a severe impact on how ecosystems function. When an environment is degraded, many of the benefits that ecosystems provide to local communities and agricultural production are also degraded, food security is compromised and resilience is reduced (Deckelbaum et al. 2006 and 2011). Local communities, as the primary managers of the processes and resources of Socio-Ecological Production Landscapes and Seascapes (SEPLS) (Duraiappah et al. 2010), face growing challenges in maintaining these systems, especially in the face of rapid socio-economic changes and increasing uncertainty regarding the natural environment due to climate change and its impacts. Environmental degradation in Kenya is also considered to have multiple causes, including population pressure, unsustainable agricultural and rangeland practices, land fragmentation, poor infrastructure, limited livelihood opportunities and poor knowledge of environmental conservation (Rockstrom 2003, Corvalan et al. 2005, Crona 2006, Roba and Oba 2009, Walingo et al. 2009, Oluoko-Odingo 2010, *Combating Desertification in Kenya* 2013).

In order to build resilient systems that can mitigate and manage risks, while securing healthy ecosystems and the well-being of local communities, the United Nations University-Institute of Advanced Studies and Bioversity International developed an approach for monitoring and capturing the various aspects that sustain resilient landscapes using specific indicators (van Oudenhoven et al. 2010 a,b, Mijatovic et al. 2012, *Indicators of Resilience in Socioecological*

Production Landscapes 2013). The indicators consist of a set of 20 questions that cut across four main themes: ecosystem protection, biodiversity, knowledge and innovation and social equity and infrastructure.

This paper presents a practical application of SEPLS indicators and experiences and lessons gained in the process. It also presents the results of participatory mapping, Focus Group Discussions (FGD) and data assessment to elucidate farmers' perceptions regarding the status of SEPLS resilience across different landscapes in the five selected communities in Kenya.

2. Methods

2.1. Assessment workshop

The first exploratory study of the SEPLS assessments[1], was conducted in five communities in East and Central Kenya (Figure 1) in March 2012. The five were selected on the basis of their long-standing relationship with Bioversity International as well as differences in their socio-economic pursuits and agro-ecological conditions. In each community, one group of mixed age and gender was chosen for the exercise (Table 1). The participants of each group were identified by a local coordinator and gathered at a central location in the village for a day's workshop. A community resource mapping exercise was the first activity. The purpose of the mapping was to bring participants to the same level of understanding of their landscape and resources therein. This was followed by the indicators exercise. This involved administering the 20 socio-ecological indicators in the SEPLS toolkit[1]. The indicators are divided into 4 themes: (i) ecosystem protection and maintenance of biodiversity - indicators 1-4, (ii) agricultural biodiversity - indicators 5-6, (iii) knowledge, learning and innovation - indicators 7-14, and (iv) social equity and infrastructure - indicators 15-20 (Table 2). The exercise was concluded with a review of the main problems and threats identified during the exercise, their causes and possible solutions.

Table 1. Location, environmental characteristics and population density of each of the five participating villages and type of participants who attended the Focus Group Discussions (FGD).

Village		Ruku	Njarange	Museve	Nzewani	Kisaani	Total
County		Kiambu	Mbeere	Kitui	Kitui	Machakos	
Latitude		-1.207	-0.461	-1.325	-1.386	-1.384	
Longitude		36.693	37.814	38.071	38.015	37.495	
Elevation (m)		1,978	850	1,283	1,130	1,344	
Annual rainfall (mm)*		1,141	749	1,022	1,043	825	
Annual mean temperature (celsius)*		27.9	38.3	35.3	35.9	34.8	
Major Ethnic community		Kikuyu	Mbeere	Kamba	Kamba	Kamba	
Location		8km northwest of Nairobi city (peri-urban)	4km east of Ishiara town (rural)	9km northeast of Kitui town (rural)	3km south of Kitui town (rural near town)	6km southeast of Mwala town (rural)	
Person per sq. km**		2,488 (high)	193 (low)	154 (low)	380 (medium)	139 (low)	
Environmental characteristics		Cool, humid, highland with high ridges.	Hot semi-arid lowland.	Semi-humid; hilly, steep in places.	Flat landscape, on transitional zone between semi-humid Kitui Hills and the dry southern lowlands.	Low dry, undulating area with low ridges separated by seasonal streams.	
Number of participants		**6**	**7**	**7**	**7**	**7**	**34**
Gender	M	3	3	3	2	3	14
	F	3	4	4	5	4	20
Age	Average	48.8	48.7	53.4	43.3	48.6	48.6
	Max	80	70	70	68	74	80
	Min	29	23	23	22	35	22

*Source : worldclim.org (worldclim_2-5m).
**Source : 2009 census data.

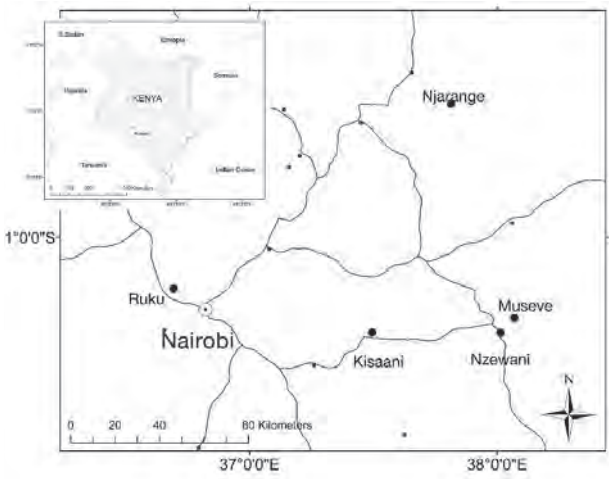

Figure 1 : Map of five study communities in East and Central, Kenya. • shows five communities of study.

2.2. **Data analysis**

The collected score and trend data were subjected to standard statistical analysis. The proportions of respondents giving different score and trend values and mean scores and trends in the five communities were obtained for each of the 20 indicators. An analysis of variance (ANOVA) was conducted with mean scores and trends obtained and pairwise multiple comparisons using Tukey's multiple range test. In order to understand the major factors contributing to the perception differences among the five communities surveyed, Categorical Principal Component Analysis (CATPCA) (Linting 2007) was conducted to elucidate major variables in score and trend values for each of the 20 indicators. Further, an ordered probit regression model (Hedeker and Gibbons 1994) was used to elucidate the relationships between gender and age of the participants. Each indicator's score and trend value was used as a dependent variable. Dummy variables were generated for each community (Ruku, Njarange, Museve, Nzewani, and Kisaani) and also for gender (M, F). The generated dummy variables and age scales of the participants were used as covariate variables. R-statistic package 3.0.2 and SPSS 16.0 were used for these assessments.

Table 2. Four themes and 20 indicators for resilience of socio-ecological production landscapes in 2014.

Theme	Indicator
i) Ecosystem protection and maintenance of biodiversity	1. Heterogeneity and multi-functionality of the landscape. 2. Areas protected for their ecological and cultural importance. 3. Ecological links between landscape components for sustaining production. 4. Rate of recovery from extreme environmental and climate change-related stress and shocks.
ii) Agricultural biodiversity	5. Maintenance, documentation and conservation of agricultural biodiversity in a community. 6. Diversity of local food system.
iii) Knowledge, learning and innovation	7. Innovation in agricultural biodiversity management for improved resilience and sustainability. 8. Access and exchange of agricultural biodiversity. 9. Transmission of traditional knowledge from elders, parents and peers to the young people in a community. 10. Maintenance of cultural traditions related to biodiversity. 11. Number of generations interacting with the landscape. 12. Practices of documentation and exchange of local knowledge. 13. Use of local terminology or indigenous languages. 14. Women's knowledge about biodiversity and its use.
iv) Social equity and infrastructure	15. Local resource governance. 16. Autonomy in relation to land and resource management. 17. Gender. 18. Social infrastructure. 19. Health care. 20. Health risk.

3. Results

3.1. Introduction/brainstorming session

In each of the five communities, assessment workshops were conducted using the FGD approach. Six to seven participants of mixed gender and age represented each community in the exercise. Each of the six participants was nominated by a much larger group of villagers on the basis of their understanding of the issues in the village and ability to participate. Altogether, 34 individuals participated. The number of participants was kept small for better management of the exercise and to ensure the optimal participation of each individual. The FGD consisted of two parts: the introduction/brainstorming session and the SEPLS indicators/discussion session. One day was dedicated to the FGD in each village. The introduction/brainstorming sessions took about 2 hours. The indicator sessions took about 4-5 hours. This time was needed to cover all 20 SEPLS indicators with discussion at the end to review problems, causes and possible interventions. Opinion leaders were given the chance to contribute their ideas during this time. In each FGD, simple demographic information on the participants such as name, age and gender were recorded at the start of the exercise.

After introductions, the facilitator explained the main objective of the exercise and the programme for the day. A participatory landscape mapping exercise was conducted as the first task in order to familiarize participants with the basic concepts of SEPLS indicators and "resilience of SEPLS". At the end of the exercise, one participant was requested to present the map and components of the map, including current meeting place, marketplaces, schools, administrative boundaries, infrastructure such as roads, natural features such as rivers, land use and places where key resources were found. Other participants were also invited to add anything that might have been missed. The community map served firstly as a basis for determining the extent of the landscape, secondly to determine the location of major landscape components within the community, and thirdly to bring participants to the same level of understanding of their landscape, its components and the services it offers. The map was also used as a reference during discussions. Mapping was then followed by listing of the major components of the landscape, including crop land, fallow land, wild land and forest. This was followed by listing of agricultural and wild edible biodiversity which included crops and their varieties, edible wild plants and domesticated and wild animals. Major historical events and changes in relation to climate and environment (e.g. droughts) were also discussed and recorded. Key technical terms such as landscape, agrobiodiversity and resilience were also described using local terms. All information was noted down on sheets of paper and pinned on the wall to serve as reference information for participants.

Figure 3 : Participants mapping their landscape. Mapping helps participants to understand their landscape better. After the drawing, the facilitator allowed participants to engage in a discussion about the different natural resources, communal facilities and rights of access or control. Such rights relate to access to forest resources, grazing areas, water sources and some health facilities.

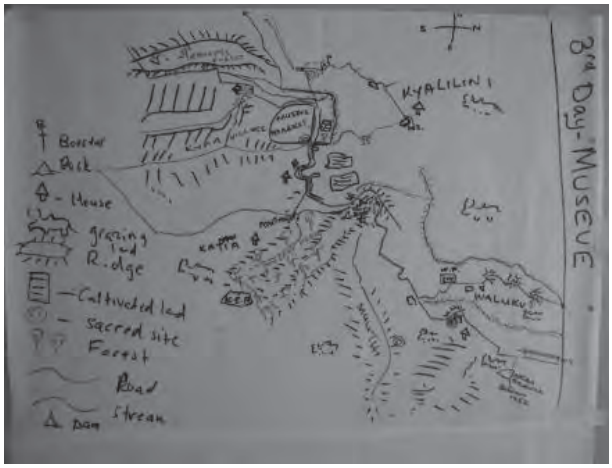

Figure 4 : A section of the Museve location map drawn on paper with the Museve market (1.325 S, 38.071 E, altitude 1,283m) as the main reference point. Two sub-locations (lowest administrative category), and 10 villages were included in the map. The straight line distance between the upper left corner indicated as "Kavonge Forest" and the lower right indicated as "Ngaa dam" is five kilometres, which takes about one hour on foot. The estimated population of the indicated community landscape is 6,400 people representing about 1,100 households. The scale at different parts of the landscape may vary. The sizes of landscapes also varied across the communities surveyed. A tendency for negative correlation was observed between population density and scale of the landscapes.

3.2. Indicator session

For each indicator, the facilitator described the indicator's question and the meaning of each multiple choice answer (five-point scale, 1-5). Scoring a "one" meant the landscape performed very poorly on that particular criterion, and a "five" meant an extremely good performance. Similarly, a five-level scale was used to determine individual perception of trend. A score of "one" meant a steep downward trend, and a "five" meant a steep

upward trend. At the end of scoring on each indicator, participants were given the opportunity to discuss their answers. A "consensus" value (collective answer) was then agreed on by the group. Individual answers (each respondent's score, trend and reason) and collective answers were then recorded separately by the note-taker. In some instances, during the indicator exercise there were some conflicting and/or unexpected results within the same indicator and/or among different ones. This is interpreted as being either due to misunderstanding of the indicator questions (which then meant the question was repeated) or to an inherent problem with the indicator. For example, the original indicator 5, "Maintenance, documentation and conservation of agricultural biodiversity in a community" was separated into two indicators – maintenance and conservation of agricultural biodiversity in a community and documentation of agricultural biodiversity in a community, and renamed 5a and 5b respectively after consultation with the participants. The indicator 5b, "Documentation of agricultural biodiversity in a community" received similar responses to indicator 9, "Transmission of traditional knowledge from elders, parents and peers to the young people in a community" and indicator 10, "Maintenance of cultural traditions related to biodiversity", as well as indicator 12, "Practice of documentation and exchange of local knowledge". These indicators elicited similar responses because to many participants, the causes and end results were similar. For each indicator the facilitator had to explain the question using different techniques, including giving examples. A component of indicator 7, "Innovation in agricultural biodiversity management for improved resilience and sustainability", was not well understood by the participants as their answers tended to focus more on adaptation to introduced practices and technologies (such as the use of chemical fertilizers, pesticides, commercial varieties and agricultural tools, including the ox-plough and drip irrigation) rather than their own innovations that come through trial and error. The term "new" and "old" technology was also found to be relative. It was noticed that the method of scoring the ecosystem status using the 1-5 number system was problematic for some participants. It was also observed that some answers were spontaneously influenced by the composition of the participants, e.g. the presence of an influential person such as a community leader in the discussions. Community expectations such as financial assistance from partners was also found to influence the kind of answers provided. The facilitator, therefore, had to be aware of all these shortcomings and find innovative ways of dealing with each situation.

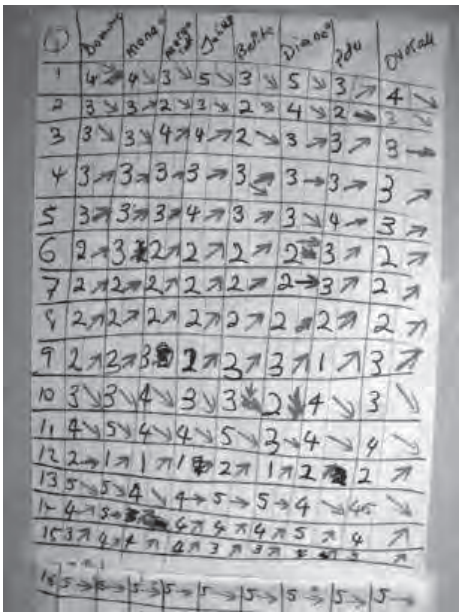

Figure 5 : Score and trend information collected during FGD in Museve, Kenya.

3.3. **Data assessment**

Through analysing the proportion of respondents that gave a score of 1 (high risk) to 5 (excellent state) for each indicator, areas of risk perception were identified (see Appendix 1, score and trend in percent). Forty one percent (41%) of the total number of respondents found resilience to be in the "medium state" (score 3). However 36% of respondents indicated some level of risk by giving a score of either "high risk" (score 1: 9%) or "risk" (score 2: 27%). More than 50% of respondents indicated either high risk or risk (scores 1 and 2) for seven of the twenty indicators (2, 3, 5b, 6, 12, 15, 20). The largest proportion (94%) was for indicator 5b, "Documentation of agricultural biodiversity in a community", followed by indicator 2, "Areas protected for their ecological and cultural importance " (79%), and indicator 20, "Health risk" (65%). Among the four themes, "Agricultural biodiversity" had the highest frequency of risk at 51%, followed by "Ecosystem protection and the maintenance of biodiversity" at 49%.

In trend status, 55% of all respondents indicated an "upward" trend (↗ = 4), and 34% indicated a "no change" trend (→ = 3) status. This implies that the resilience of SEPLS was either improving slowly or showing "no change" in their general perception. However, more than 50% of respondents expressed negative changes (↓ = 1 and ↘ = 2) for seven indicators (1, 2, 3, 10, 11, 13, 16). The largest proportion (97%) found there to be high risk or risk in indicator 11, "Number of generations interacting with the landscape". This perception is followed by indicator 13, "Use of local terminology or indigenous languages" (76%) and indicator 10, "Maintenance of cultural traditions related to biodiversity" (71%). Among the four themes, risks of "Ecosystem protection and the maintenance of biodiversity"

was the highest at 49% and "Knowledge, learning and innovation" followed at 40%. Indicator 2, "Areas protected for their ecological and cultural importance" and indicator 3, "Ecological links between landscape compornents for sustaining production" showed negative scores for both current status and future trends.

These risk perceptions, including causal problems and challenges experienced, were well articulated during the discussions for each indicator. Key issues identified for each indicator theme are summarized below.

i) Ecosystem protection and the maintenance of biodiversity - Indicators 1-4.

- Environmental degradation was highlighted in all communities surveyed and almost exclusively linked to rapid population increase and the attendant increased demand for resources (agricultural land, firewood, construction material, charcoal, animal food and wood for carving). Deforestation is resulting in floods, low ground water, smaller farm size, overgrazing, and loss of wildlife and other forms of biodiversity. Participants of the Museve and Kisaani communities pointed out that they used to have many traditional fruits and medicinal plants in the forest, however many of these have been lost and now they have to depend on cultivated crops and outside resources.
- Government policy support was articulated as generally weak in ecosystem protection, maintenance of biodiversity and documentation of traditional knowledge and cultural values. Participants also expressed weakness in traditional institutions.

ii) Agricultural biodiversity - Indicators 5-6.

- Participants articulated erosion of crop diversity and associated knowledge. There is social and economic pressure to plant a few commercially successful crops such as maize and beans and to expand crop fields. Participants said that loss of plant species was concomitant with loss of indigenous knowledge including local recipes (e.g. how to mix various vegetables) and general plant use. Other issues were limited access to pastures and farmers not being able to have large numbers of diverse animals.

iii) Knowledge, learning and innovation - Indicators 7-14.

- In general, none of the communities are making efforts to document local knowledge. Most of the knowledge on agrobiodiversity, ecosystems and culture is passed down through oral tradition. It has not been used for school education and is therefore threatened. Participants said that this is a contributing factor to poor governance of local resources, as it is influencing the younger generation to disregard local traditions. Also contributing were the decline of interaction between different generations and erosion of indigenous languages.

iv) Social equity and infrastructure - Indicators 15-20.

- The government's commitment was observed in social infrastructure and health care. A high percentage of respondents expressed "upward" and "steep upward" trends in this area.
- Participants also expressed risk due to changes in social behaviour. They said that it is due to lack of local industries and widespread unemployment of the youth, increasing the rate of young people migrating to cities for jobs. The youth are increasingly living away from their communities and hence have fewer opportunities to interact with elderly people. The youth depend more on knowledge brought from outside by the media and city people.

3.3.1. Differences in risk perceptions among the communities surveyed

Significant differences between the communities were observed in all indicators with the exceptions of three indicators (1, 5b, 17) in scores and three indicators (11, 17, 19) in trends (Appendix 1, mean score and trend). In general, the Njarange community showed negative perceptions in both total mean score and trend (both at 2.7), indicating they have the highest risks in resilience of their socio-ecological production landscapes among the communities surveyed.

Correlation coefficients among the quantitative traits were calculated for a total of 42 indicators (indicator 5 is separated in 2 different indicators 5a and 5b, and 21 indicators each for score and trend) and the first and fourth principal factor loadings and their contributions are shown in Appendix 2.

Principal Component (PC) 1 had a large positive integrated score for indicators 6, 7, 8, 13, 18, 19, 20 (29.2% of the total variance) showing that this community has optimistic perception of their infrastructure conditions (e.g. markets, roads, telecommunication, electricity and public health care facilities), access to diverse locally produced foods, income generation opportunities including high value horticultural crop production with innovative farm management technologies and practices such as use of greenhouses and drip irrigation, and good animal breed-based enterprises. This integrated component was considered most characteristic of the "peri-urban" landscape and Ruku community. Ruku community characterized by good accessibility and the influence of Nairobi city. Despite positive trends in the area of infrastructure, the participants of Ruku recognized current risks associated with the expansion of Nairobi city, leading to high land pressure due to population growth, less land for animal keeping, small crop fields and reduced crop species, as well as new health problems such as HIV, alcoholism, drug abuse, obesity and new socially unacceptable practices including crime, terrorist attacks and poor social cohesion at the community level.

PC2 was characterized by strong negative trends for indicators 4, 5a, 6, 8, 15 and 20, as concerns recovery

from environmental and climate stresses, maintenance of agricultural biodiversity, access to diversity of local food systems, local resource governance and health conditions. This integrated component (20.4% of the total variance) was considered characteristic of the "dry-land and isolated" landscape and Njarange community. Njarange community highlighted uncertainties of rainfall, fragile environments, limited food production and natural resources, poor access to markets and local resource management due to the dry weather and remote nature (mainly due to poor road infrastructure) of the landscape. Njarange participants expressed strong risk perceptions caused by decreased rainfall, frequent droughts (shorter rainy season, longer dry season) contributing to the current low harvests. Villagers are therefore forced to depend highly on external food and inputs such as seed. Opportunities for income are limited, leading to locals selling natural resources such as sand and charcoal and thus contributing to land degradation. Participants in Njarange also said that they used to keep animals to complement their agriculture and secure their livelihoods. However, they explained that the government had organized a national land demarcation programme in the 70's, subdividing the land into small uneconomical parcels. Access to communal property such as grazing land and sacred sites was limited at the same time.

PC3 is characterized by integrated positive perceptions of trends of ecosystem protection, cultural traditions related to biodiversity and a positive score for autonomous access to land and resource management (positive score on indicator 16 and trends in indicators 2 and 10). This integrated component was considered to represent the "cultural landscape and ecosystem maintenance", reflecting community efforts in ecosystem protection through cultural knowledge documentation and the transmission initiative that the Nzewani community has been implementing. The Nzewani community showed less perception of risks in terms of ecosystem protection, maintenance of biodiversity and conservation of cultural components compared with the other communities (See mean scores in indicators 5b, 12 and mean trends in indicators 1, 2, 3 and 10 in Appendix 1).

3.3.2. Perception differences in socio-demographic variables (gender and age factors)

There was some level of significance observed in the Age scores with indicator 11 (coefficient estimates 0.12, standard error 0.42, p=0.005), and 17 (coefficient estimates 0.05, standard error 0.02, p=0.009), showing that the younger generation, more so than older generations, recognized that women are more involved in community decision-making processes and have improved access to resources and education, as well as recognized the existence of opportunities for innovation. Similar observation was also noted in gender scores with indicator 9 (coefficient estimates -1.21, standard error 0.52, p=0.019) showing that women recognized that traditional knowledge such as preparing traditional foods is now being passed to the younger generation, while men felt that the knowledge was mainly confined to the elderly generation.

3.3.3. Potential local solutions and interventions for improving SEPLS resilience

Areas for potential community-based interventions were identified and key community recommendations are summarized below. The process of discussion for each indicator was identified as an essential element in creating social capital for landscape governance, community ownership of the process and improving awareness, providing a perspective on future directions and encouraging local innovations and actions in response to negative trends.

- Restoring the ecosystem through community empowerment in training and mobilizing community groups, facilitating strong community participation (e.g. of youth and women groups) in practical traditional knowledge documentation and preservation. These activities need to be recognized by the communities and integrated as part of their routine work. The participants articulated a need for government and/or partner institutions to provide support in this area through integration with on-going education programmes.
- Awareness creation for all stakeholder organizations. Local participation is considered important to create opportunities for dialogue and social cohesion among relevant local organizations and stakeholders, and to achieve ecosystem conservation, sustainable local resource governance and management of use and maintenance of biodiversity and important cultural landscapes at the community level. The strengthening of local networking and good leadership were considered important in enforcing relevant government regulations and policies and providing communities with an edge when negotiating for development projects.
- Demonstrating benefits of conservation due to ecosystem services and biodiversity. Benefits include incomes from agrobiodiversity, mitigating risks of crop failure and recipes of local foods and nutritional benefits. Technical innovations and intensified research are needed in these areas to establish new products with enhanced economic and nutritional value. This would help increase production levels of locally produced food crops.
- Technical assistance in resource use and management. This assistance could be carried out in the areas of soil conservation, new crop varieties, irrigation, use of manure, e.g. cow dung, composting, marketing, agricultural equipment, beekeeping, energy-saving stoves, use of cover crops, mulching and legumes to improve/preserve soil fertility.

3.3.4. Experience and lessons learned in testing the SEPLS indicator tool

- A group of 6-7 participants was found appropriate for managing and facilitating discussions but insufficient for statistical data assessment of the scores. However,

the discussion among community members was a fundamental element of this exercise, and the documentation of comments and exploration of development directions required a lot of time. The research team and facilitator of the discussions therefore need to strike the right balance between the two and identify the ideal number of participants for this exercise. A larger number of participants would require more time. Approximately 20-25 active participants is probably the maximum number that one facilitator can handle. If two facilitators and note takers are available, two parallel discussions can be held with different gender groups.

- For comparison purposes, target study communities need to be identified strategically taking into consideration the climatic, geographical (e.g. distance to the markets or towns, altitude), and socio-cultural characteristics of the community.
- The score and trend data are based on the subjective judgment of the participants based on observation and experience. It was considered important to understand their interpretations, the underlying facts impacting their perceptions, rather than merely recording the data of the symptoms. This understanding can be managed by creating more time for discussions (e.g. having two to three-day meetings instead of one-day), adopting several other participatory methods (Schmeer 1999, Grum et al. 2008, Regmi et al. 2010, Van de Gevel et al. 2014) in the pre-survey interactions and brainstorming sessions, and conducting post-survey interviews and literature reviews. Cross-verification from two or more information sources was considered essential.
- Periodic use of these indicators is also considered helpful, not only for validating the information but also enabling evaluation of perception changes, progress towards the project management objectives, enhancing cooperation among all stakeholders by implementing the local innovation and identifying adaptive management actions addressed by participants as well as potential local partner institutions.
- The indicators and questions need tailor-made modifications depending on local contexts and type of FGD participants, e.g. community representatives, local and national stakeholders. The process of sharpening indicators will be only possible through field testing in the target communities.
- Training facilitators is considered important in order to minimize variations caused by the way questions are administered to participants. Trainers need to be trained through a learning-by-doing approach in a participatory manner. There is also a need for capacity development to enhance the use of the tool by local communities, NGOs, development workers, policymakers, and project planners for monitoring and evaluation purposes. Training local school teachers on the use of the tool may facilitate more ownership of the process by the communities themselves.

4. Conclusion

Through the above exercise, the SEPLS assessment was confirmed valuable in: 1) identifying local perceptions of threats in landscape resilience, perception differences in various community landscapes, major causes of threats and community efforts toward mitigation, 2) improving awareness through stimulating discussions with participants, and 3) providing perspectives on future directions and encouraging local innovations and potential interventions in response to negative trends. The discussions were considered vital in creating social capital for landscape governance, community ownership of the process and identifying potential interventions. Identified solutions and recommendations should be maintained within communities and followed through based on enhanced cooperation among community stakeholders that would then develop an implementation strategy for the proposed interventions through a coordinating body or committee. With time, this indicator survey would need to move the focus from understanding the status of community resilience to research aimed at understanding the sustainable use of outcomes (incomes, dietary patterns, and knowledge of the local foods) of the interventions and the dynamic process, if any, of maintaining local crop and production landscape diversity.

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[1] SEPLS indicators applied in this study are a preliminary version (*Indicators of Resilience in Socioecological Production Landscapes* 2014) and are slightly different from the latest set of indicators (*Toolkit for the Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes* 2014). See Table 2.

Appendix 1: Percentages of respondents in different perception scores and trends, and mean scores and trends for the 20 indicators in the five communities studied in Kenya.

Indicators	Score (%)					Trend (%)					Mean Score						Mean Trend					
	1	2	3	4	5	↓	↘	→	↗	↑	Ruku	Niarange	Museve	Nzewani	Kisaani	Mean	Ruku	Niarange	Museve	Nzewani	Kisaani	Mean
Theme 1 : Ecosystem protection and the maintainance of biodiversity	7	42	39	10	3	1	48	13	38	1	2.6ab	2.5a	3.2b	2.5a	2.3a	2.6	2.9b	2.1a	2.9b	4.0c	2.6ab	2.9
1 Heterogeneity and multifunctionality in the landscape	6	21	41	21	12	0	59	12	26	3	3.0a	3.7a	3.9a	2.6a	2.4a	3.1	2.5a	2.4a	2.3a	4.0b	2.4a	2.7
2 Areas protected for their cultural and ecological importance	21	59	18	3	0	6	47	24	24	0	1.0a	2.1b	2.7b	2.1b	2.0b	2.0	3.0b	1.9a	2.4ab	4.0c	2.0a	2.6
3 Sustainable use of resources	0	56	38	6	0	0	59	9	32	0	3.0bc	2.0a	3.1c	2.4ab	2.0a	2.5	2.5ab	2.0a	3.1b	4.0c	2.0a	2.7
4 Environmental security and safety	0	32	59	9	0	0	26	6	68	0	3.3b	2.1a	3.0b	2.7ab	2.7ab	2.8	3.5b	2.0a	3.6b	4.0b	4.0b	3.4
Theme 2 : Agricultural biodiversity	22	29	41	8	0	1	18	11	70	1	2.4ab	1.9a	2.3ab	2.7b	2.4ab	2.4	3.2b	2.6a	3.8c	3.9c	4.0c	3.5
5a Local crops, varieties and animal breeds used in a community	3	6	76	15	0	0	32	3	65	0	2.8ab	2.6a	3.3ab	3.4b	3.0ab	3.0	3.0ab	2.1a	3.7b	3.7b	4.0b	3.3
5b Agricultural biodiversity documented and conserved in community classification systems and community seed	62	32	6	0	0	0	0	26	71	3	1.0a	1.0a	1.4a	2.3b	1.4a	1.4	3.0a	3.9b	3.9b	4.0b	4.0b	3.8
6 Diversity of local food system	0	50	41	9	0	3	21	3	74	0	3.5b	2.1a	2.3a	2.4a	2.7ab	2.6	3.7b	1.9a	3.9b	4.0b	4.0b	3.5
Theme 3 : Knowledge, learning and innovation	6	22	43	23	7	1	39	9	50	2	3.5b	3.1ab	3.0ab	3.0ab	2.7a	3.0	3.0ab	2.7a	3.2ab	3.4b	3.3b	3.1
7 Innovation in agricultural biodiversity management for improved resilience and sustainability	0	38	47	12	3	0	9	6	76	9	4.0c	2.1a	2.1a	3.0b	2.9b	2.8	4.0ab	3.1a	3.9ab	4.3b	4.0ab	3.9
8 Access and exchange of agricultural biodiversity	0	53	26	18	3	0	21	6	74	0	4.2c	2.1a	2.0a	3.0b	2.4ab	2.7	3.8b	2.1a	4.0b	3.7b	4.0b	3.5
9 Transmission of traditional knowledge from elders, parents and peers to the young people in a community	3	32	56	9	0	0	38	3	59	0	3.3c	3.1bc	2.4ab	2.7ac	2.0a	2.7	2.0a	2.3a	4.0b	3.6b	4.0b	3.2
10 Cultural traditions related to biodiversity	0	26	62	12	0	6	65	6	24	0	2.7a	2.9a	3.1a	2.4a	3.1a	2.9	2.0ab	2.4b	1.7a	4.0c	2.1ab	2.5
11 Number of generations interacting with the landscape	0	0	38	53	9	0	97	3	0	0	4.2b	3.6ab	4.1b	3.3a	3.4ab	3.7	2.0a	2.1a	2.0a	2.0a	2.0a	2.0
12 Practices of documentation and exchange of local knowledge	41	21	35	3	0	0	0	21	79	0	1.0a	3.1b	1.4a	2.9b	1.4a	2.0	3.0a	4.0b	3.9b	4.0b	4.0b	3.8
13 Use of local terminology or indigenous languages	0	3	18	47	32	0	76	24	0	0	5.0b	4.1bc	4.6cd	3.6ab	3.3a	4.1	2.7b	2.0a	2.4ab	2.0a	2.1ab	2.2
14 Women's knowledge about biodiversity and its use	0	3	59	32	6	0	3	3	85	9	3.3ab	3.3a	4.1b	3.4ab	2.9a	3.4	4.5b	3.7a	3.9ab	4.0ab	4.0ab	4.0
Theme 4 : Social equity and infrastructure	8	23	39	17	14	0	7	24	68	0	3.4b	2.7a	3.1ab	3.2ab	2.9ab	3.1	3.5ab	3.3a	3.8b	3.7b	3.8b	3.6
15 Local resource governance	38	18	32	12	0	0	0	29	71	0	1.0a	1.0a	3.6b	3.0c	2.1b	2.2	3.5b	3.0a	4.0c	4.0c	4.0c	3.7
16 Autonous access to indigenous land and natural resources	0	0	0	21	79	0	18	82	0	0	5.0b	5.0b	5.0b	5.0b	4.0a	4.8	2.0a	3.0b	3.0b	3.0b	3.0b	2.8
17 Gender	0	9	68	21	3	0	0	24	76	0	3.2a	2.9a	3.1a	3.7a	3.0a	3.2	3.5a	4.0a	3.9a	3.7a	3.7a	3.8
18 Social infrastructure	0	32	50	18	0	0	3	3	91	3	4.0c	2.1a	2.6ab	2.7ab	3.0b	2.9	4.0ab	3.6a	4.1a	4.0a	4.0a	3.9
19 Health care	0	24	56	21	0	0	0	0	100	0	4.0c	3.1b	2.3a	2.6ab	3.0b	3.0	4.0a	4.0a	4.0a	4.0a	4.0a	4.0
20 Health risk	9	56	26	9	0	0	24	6	71	0	3.5b	1.9a	2.3a	2.0a	2.3a	2.4	3.8b	2.0a	4.0b	3.6b	4.0b	3.5
Total (%) /Mean*	9	27	41	17	7	1	28	14	55	1	3.1c	2.7ab	3.0bc	2.9ac	2.6a	2.9	3.1b	2.7a	3.4b	3.7c	3.4b	3.3

* Different letters of the alphabet indicate different means at a 5% significant level according to Tukey's multiple range test.

Scores: 1 (high risk), 2 (risk), 3 (medium state), 4 (good state), 5 (excellent state)

Trends: ↓ (1: high downward trend), ↘ (2: downward trend), → (3: no change), ↗ (4: upward trend), ↑ (5: high upward trend)

Appendix 2: The first to fourth principal factor loadings obtained by Categorical Principal Component Analysis (CATPCA).

Indicator	Score/Trend	PC1	PC2	PC3	PC4
Theme 1 : Ecosystem protection and the maintenance of biodiversity.					
1	Score	0.081	−0.310	0.008	0.294
2	Score	−0.898	−0.088	−0.093	0.060
3	Score	0.464	0.459	0.289	0.268
4	Score	0.609	0.363	0.032	−0.333
Theme 2 : Agricultural biodiversity.					
5a	Score	−0.349	0.431	0.273	0.215
5b	Score	−0.534	0.406	0.346	−0.110
6	Score	0.711	0.274	0.005	−0.356
Theme 3 : Knowledge, learning and innovation.					
7	Score	0.817	0.335	0.085	−0.407
8	Score	0.873	0.264	0.010	−0.058
9	Score	0.528	−0.413	0.509	0.137
10	Score	−0.054	0.101	−0.502	0.157
11	Score	0.285	0.067	0.001	0.742
12	Score	−0.334	−0.635	0.588	−0.197
13	Score	0.747	0.080	0.049	0.359
14	Score	−0.019	0.068	0.277	0.591
Theme 4 : Social equity and infrastructure.					
15	Score	−0.729	0.627	−0.093	0.152
16	Score	0.284	−0.237	0.737	0.206
17	Score	−0.118	0.290	0.615	0.326
18	Score	0.949	0.223	0.100	−0.073
19	Score	0.909	0.060	0.064	−0.076
20	Score	0.733	0.169	0.016	0.192
Theme 1 : Ecosystem protection and the maintenance of biodiversity.					
1	Trend	−0.287	0.226	0.538	−0.412
2	Trend	−0.294	0.358	0.787	−0.082
3	Trend	−0.481	0.368	0.611	0.025
4	Trend	−0.142	0.879	−0.016	−0.283
Theme 2 : Agricultural biodiversity.					
5a	Trend	−0.307	0.763	−0.183	−0.034
5b	Trend	−0.816	−0.008	−0.074	−0.010
6	Trend	−0.120	0.933	−0.065	−0.183
Theme 3 : Knowledge, learning and innovation.					
7	Trend	0.048	0.673	0.030	0.141
8	Trend	−0.032	0.906	−0.168	−0.022
9	Trend	−0.694	0.537	−0.216	0.175
10	Trend	−0.414	0.167	0.746	−0.227
11	Trend	−0.031	−0.382	0.015	−0.096
12	Trend	−0.888	−0.248	−0.051	0.013
13	Trend	0.502	0.269	−0.110	0.424
14	Trend	0.686	0.237	0.024	−0.375
Theme 4 : Social equity and infrastructure.					
15	Trend	−0.396	0.751	−0.016	0.202
16	Trend	−0.949	−0.223	−0.100	0.073
17	Trend	−0.219	−0.335	−0.089	−0.246
18	Trend	−0.041	0.556	−0.006	0.011
19	Trend	0.344	−0.032	0.125	0.592
20	Trend	0.054	0.900	−0.123	0.115
Eigenvalue		12.26	8.58	4.20	3.15
% of Variance		29.18	20.43	10.00	7.50

Factor loadings larger than 0.7 are shown in bold. These indicators are highly correlated with each other. The cumulative contribution of the first to fourth components was 67.1%.

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For information on the Satoyama Initiative please visit the IPSI website :
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