SATOYAMA INITIATIVE

Socio-ecological Production Landscapes and Seascapes (SEPLS) in Africa

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Satoyama Initiative

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

UNU-IAS

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

IR3S/UTIAS

The Integrated Research System for Sustainability Science (IR3S) is a secondary research institute under the umbrella of the University of Tokyo Institutes for Advanced Study (UTIAS) which combines the world-leading research institutes within the University of Tokyo. IR3S was founded with a vision of building a sustainable society through linking global, social and human systems. While maintaining and developing research centers of transdisciplinary sustainability science of the highest global standards, it also aims to build an international meta-network that links research and educational institutions in developed and developing countries.

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FOREWORD

Over the last three decades, humans have acknowledged the growing imbalance in their relationship with nature and their central role in heralding this ongoing change. The evidence showing the rapid and irreversible decline and degradation of ecosystems and their services and loss of biodiversity across many socio-ecological regions of the world is ubiquitous. Thus, the many global agreements, policies and protocols, strategies, plans, programs, and projects aimed at documenting, communicating, and developing understanding as well as sharing knowledge on the importance of biodiversity and ecosystem services for human well-being form a step in the right direction. The Millennium Ecosystem Assessment (MA) was one such international effort, the findings of which provided the basis for a new perspective on ecosystems. Such findings should be mainstreamed into policy and decision-making and should engage multi-level stakeholders to be useful and effective on the ground at the local level.

It is against this backdrop that I have been highly impressed with the effort of the Satoyama Initiative (SI) through the International Partnership for the Satoyama Initiative (IPSI). IPSI was established at the 10th Conference of Parties to the Convention on Biological Diversity (CBD-COP 10) during 2010 in Nagoya, Japan, with the aim of contributing to the realization of societies in harmony with nature through the conservation and advancement of socio-ecological production landscapes and seascapes (SEPLS) at the local level. As chair of the IPSI Steering Committee, I have witnessed the active engagement and collaboration of the initiative with multi-sectoral and multi-stakeholder partners from academia, development agencies, non-governmental organizations, and government agencies to compile, synthesize, and share knowledge on the state, trends, and future of SEPLS across the world, thereby leading to the building of unique case studies.

This publication aims at contributing to the knowledge and understanding of the benefits of SEPLS in terms of sustainability and human well-being, the current state and threats to SEPLS and its impact to biodiversity and ecosystems, as well as efforts toward revitalization in Africa. The majority of the case studies presented in this publication are based on presentations made by invited experts from Africa at the first Satoyama Initiative Regional Workshop in Africa, which was held in Accra, Ghana, from August 10 to 12, 2015.

I would like to congratulate the authors for their submissions and commend them for painstakingly addressing the comments and suggestions on the earlier drafts of their manuscripts. Compiling this publication will not have been possible without their commitment and dedication. I heartily thank the IPSI Secretariat at UNU-IAS for the tireless work, commitment, and execution of the Satoyama Initiative.

I recommend this publication to the general reading public, development practitioners, scientists, and policy and decision-makers. I am optimistic that the information placed in this publication will go a long way in creating awareness, informing policy and decision-making processes on biodiversity and ecosystem services in order to facilitate further sustainable use and management of production landscapes and seascapes across Africa.

Prof. Alfred Oteng-Yeboah
Chairman, Ghana National Biodiversity Committee
August 2016

PREFACE

"Socio-ecological production landscapes and seascapes" (SEPLS) refers to areas with dynamic mosaics of habitats and land and sea use where the harmonious interaction between people and nature maintain biodiversity while providing humans with goods and services needed for their livelihoods, survival and wellbeing. The term was coined as an inclusive term for various forms of landscapes and seascapes observed across different regions of the world to share and highlight the importance of harmonious, mutually beneficial human-nature relationships in contributing to sustainable development.

Across Africa, noted for its ecologically rich and diverse physical and climatic conditions, diverse examples of such landscapes and seascapes are found, demonstrating the innate relationship between local inhabitants and their ecosystems. Such SEPLS in Africa, empirical research and anecdotal evidence has shown, remain the bases of both primary and secondary livelihood strategies for the majority of people while also providing social and cultural benefits.

Despite the known social, economic, cultural and environmental benefits, trends in the conditions of SEPLS in Africa at local, national and regional scales indicate varying degrees of threats and vulnerabilities due largely to unsustainable human actions. Threats such as degradation of land, water and biodiversity due to deforestation, overgrazing, overexploitation of natural resources and poor land-management practices reduce the capacity of SEPLS in Africa to provide livelihood resources and ecosystem services to the rural populations that depend heavily on them.

The Satoyama Initiative is a global effort to promote conservation and revitalization of SEPLS around the world toward its vision of "realizing society in harmony with nature". *Satoyama* is a Japanese word denoting a model of harmonious existence between humans and nature in a landscape with a mosaic of different land uses such as woodland, grassland, paddy field, farmland, irrigation ponds and canals, and human settlements, which has been maintained in an integrated manner, providing a bundle of goods and services for humans. The Satoyama Initiative was jointly proposed by the Ministry of the Environment of Japan (MOEJ) and the United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS), based in Tokyo, Japan, to share and highlight the importance of SEPLS and actions to address various issues that SEPLS may face. The initiative was first recognized at the 10th Conference of the Parties to the Convention on Biological Diversity (CBD COP 10) in 2010 in Nagoya, Japan, and the International Partnership for the Satoyama Initiative (IPSI) was established at that time in order to undertake and facilitate a broad range of activities to implement the concepts of the initiative through a network of diverse stakeholders – NGOs and civil society organisations, government agencies, academic and research institutions, local and indigenous community organisations, private sector organizations and international organizations – around the world. IPSI provides a unique platform for organizations working with SEPLS to exchange knowledge and experiences and to find partners for collaboration. It is intended to create a positive change in the understanding and awareness of different stakeholders on the need to embrace a sustainable pathway to development in the human society and to facilitate concrete actions at all levels.

This publication is a compilation of selected SEPLS case studies building on the Satoyama Initiative Regional Workshop in Africa, which was held in Accra, Ghana from 10 to 12 August 2015. Of the twelve case studies presented in this publication, ten were presented at the workshop by the authors, with the remaining two authored by invited authors (Chapters 4 and 6). The workshop offered the opportunity for more than 75 participants, including experts, practitioners, scientists and policymakers from Africa and beyond to discuss and share knowledge on SEPLS in Africa with specific emphasis on the status of, trends in, and threats facing SEPLS and what needs to be done to revitalize, conserve and ensure their sustainable management. This publication builds on these discussions while also intending to introduce readers to the concept of SEPLS. Each case study presented in this publication attempts to explore these critical issues by providing readers with concise, informative and easily understandable information on a particular SEPLS. To ensure

consistency, authors were encouraged to structure their case study with a focus on the biophysical nature, socioeconomic and ecological functions of the SEPLS; the values, local knowledge and beliefs affecting its utilization and management by inhabitants; threats and challenges to its sustainability; and past or current efforts at revitalization and restoration where applicable. Each of the case studies was thoroughly reviewed by the editorial team, offering the authors the opportunity to address comments and suggestions to improve the quality of the manuscripts.

Although the case studies in this publication represent only six African countries — Benin, Ethiopia, Cameroon, Ghana, Kenya and Uganda — they involve many natural resource management issues common to SEPLS across the African continent as a whole. By highlighting some of the underlying causes and drivers of transformation in SEPLS, a good understanding and appreciation can be gained of common vulnerabilities, actions and programmes for revitalization on a broader scale. This publication focuses primarily on inland landscapes rather than coastal seascapes. Nonetheless, it is important to note that these issues — functions and values, threats and challenges, and revitalization efforts — commonly apply in a similar way to seascapes in Africa.

IPSI continues to work with stakeholders and partners at all levels across the continent in collecting, sharing and disseminating knowledge on the functions, values, current status and trends, threats and challenges, and on-the-ground actions toward conservation and revitalization of SEPLS in Africa using different communication tools. The IPSI website (http://satoyama-initiative.org/) hosts a large and growing number of case studies from around the continent and the rest of the world.

In an era of unmatched environmental, social and technological change, the path toward societies in harmony with nature through sustainable use and management of resources in SEPLS cannot be achieved without a higher level of awareness and commitment among stakeholders on their current status. Although research and interest in SEPLS in Africa continues to grow, there is still limited sharing of information. This publication is one attempt to contribute to a solution to this challenge.

The editors would like to thank all of the authors who contributed their case studies. We would also like to express our special appreciation to Prof. Alfred Oteng-Yeboah (Chair, Ghana National Biodiversity Committee) and his colleagues in the Government of the Republic of Ghana—the Forestry Commission of Ghana and the Ministry of Environment, Science, Technology and Innovation of Ghana (MESTI)—as well as A Rocha Ghana and Conservation Alliance, for their efforts in co-organizing and cooperating toward the above-mentioned workshop in Accra, Ghana in August 2015. Our 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.

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CHAPTER 1: SYNTHESIS

Understanding the current status, trends and efforts at revitalization of socio-ecological production landscapes and seascapes in Africa

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Summary

With mounting evidence of growing disruption of the ecological balance, the challenge of ensuring human well-being for present and future generations is of concern from local to global levels. Critically, sensitivity and vulnerability to ongoing changes cannot be underestimated in Africa, with its disproportionately high percentage of people directly dependent on ecological resources provided by natural ecosystems. Given current conditions, Africa requires extra attention and action for its population to reduce vulnerability and improve resilience in the face of predictable and unpredictable changes. Promoting the concept of "socio-ecological production landscapes and seascapes" (SEPLS) on the continent is proposed as a useful means for creating awareness and deepening understanding of the inextricable interactions between humans and nature that maintain biodiversity and ecosystem services. In this chapter, we assess the status and trends of SEPLS in Africa through the lens of 12 case studies from 6 countries, namely Benin, Cameroon, Ethiopia, Ghana, Kenya, and Uganda. Using these case studies as concrete examples, this chapter examines the current status and trends of SEPLS in Africa under the following themes: functions and values; major threats and challenges; and efforts at conserving and revitalizing in the face of increasing challenges.

Keywords: Biodiversity, Ecosystem services, Livelihood, Sustainability, Satoyama

1.1 Introduction

Over the last century, humans' domination and modification of the biosphere has been occurring at an unprecedented rate. To put the situation into context, scientists are referring to the current geological epoch as the "Anthropocene" (Crutzen 2002) in reference to the unparalleled intensity and magnitude of humans' role in the changes affecting the earth's ecological system. Following up on earlier empirical studies by de Groot (1987), Costanza and Daly (1992) and Daily (1997) among others, recent multilateral efforts including the Millennium Ecosystem Assessment (MA), Intergovernmental Panel on Climate Change (IPCC) and Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) affirm human actions and productive activities such as agriculture, transportation, mining, and manufacturing as major contributors to the rapid changes in human-environment interactions (MA 2005; IPCC 2014; Diaz et al. 2015). Despite the immeasurable social, economic, medical and technological benefits derived from these activities,

the costs associated with these benefits are having negative effects on the capacity of natural ecosystems to deliver services sustainably, which has created a downward spiral of ecosystem degradation and increasing poverty for a significant percentage of the world's population. Against this backdrop, efforts at restoring balance in the human-nature relationship have gained momentum at local, regional and global levels. Along these lines, a number of scientific studies (Agrawal 1995; Takeuchi 2010; TEEB 2010; Parrota & Trosper 2012) have called for such efforts to pay attention to, collaborate with and recognize the rights of local communities in regards to their traditional knowledge systems and practices of land use and management, which have long been applied in the sustainable use of ecosystem services and have shaped social-ecological systems (Berkes et al. 2000).

In this context, the concept of "socio-ecological production landscapes and seascapes" (SEPLS) was coined to help focus understanding and awareness, and to drive actions toward more sustainable human-environment interaction. The term originated from the work of the "Japan *Satoyama Satoumi* Assessment" (JSSA), which investigated the interaction between humans and terrestrial-aquatic ecosystems (*satoyama*) and marine-coastal ecosystems (*satoumi*) in Japan, following the framework of the MA (Duraiappah et al. 2012). SEPLS are broadly described as "dynamic mosaics of habitats and land and sea uses where the harmonious interaction between people and nature maintains biodiversity while providing humans with the goods and services needed for their livelihoods, survival and wellbeing" (IPSI Secretariat 2015). The concept is in alignment with seminal existing works (Folke 2006; Walker et al. 2006) that maintain that social and ecological systems are inextricably linked, but it also particularly underscores that these are areas that produce goods and services beneficial to human well-being. SEPLS are often places with a long history of human-nature relationships in which traditional management practices have allowed the effective use and maintenance of biodiversity while safeguarding ecosystems.

All over the world, there exist mosaic landscapes and seascapes that have been sustainably used and managed by local inhabitants through traditional norms, beliefs and practices and customs. The socio-ecological characteristics of these SEPLS differ depending on where they are in the world. Some places have particular local names, such as *satoyama*, while others do not, but irrespective of how such landscapes and seascapes are referred to locally, they share common and similar functions and values as far as providing essential ecosystem goods and services needed to meet livelihood needs while maintaining biodiversity.

Africa's ecological zones, ranging from tropical rainforest in the Congo Basin to desert scrub in the Sahara regions of northern Africa (**Figure 1**), have supported the evolution of diverse mosaic landscapes for centuries. Such landscapes have underpinned the social, cultural, economic and technological development of the continent and the world at large. In a continent where the majority of livelihood systems have always centred on agriculture and the yield of the natural ecosystem (Fabricius 2004), the use of sustainable and traditional land and resource management practices have also supported resilience in the landscape (Davies 2002). Ample evidence over the last century, however, points to rapidly changing trends in the application of these sustainable resource management systems due to a range of socio-economic and environmental drivers, making many SEPLS more vulnerable. In many parts of Africa, lack of appreciation for local knowledge and practices pertaining to the use and management of ecosystem services that have helped local communities and households to enhance their resilience presents a major challenge. Among the many reasons for this, the dearth of awareness, education, understanding, knowledge and data on the status and trends of SEPLS at local and national levels cannot be underestimated. The inextricable relationship between human well-being and ecosystem services has often been not considered and not incorporated into national development policies and plans. This publication aims to share knowledge on the current status and trends of SEPLS in Africa as a way of providing evidence of the importance of linkages between natural ecosystems and human well-being.

In this chapter, we provide a descriptive assessment of the status and trends of SEPLS in Africa using empirical examples from the twelve case studies from experts in six African countries collected in this publication, ten of which were presented by the authors during the first Satoyama Initiative Regional Workshop in Africa, held in Accra, Ghana in August 2015 (Oteng-Yeboah et al. 2016). In the next section

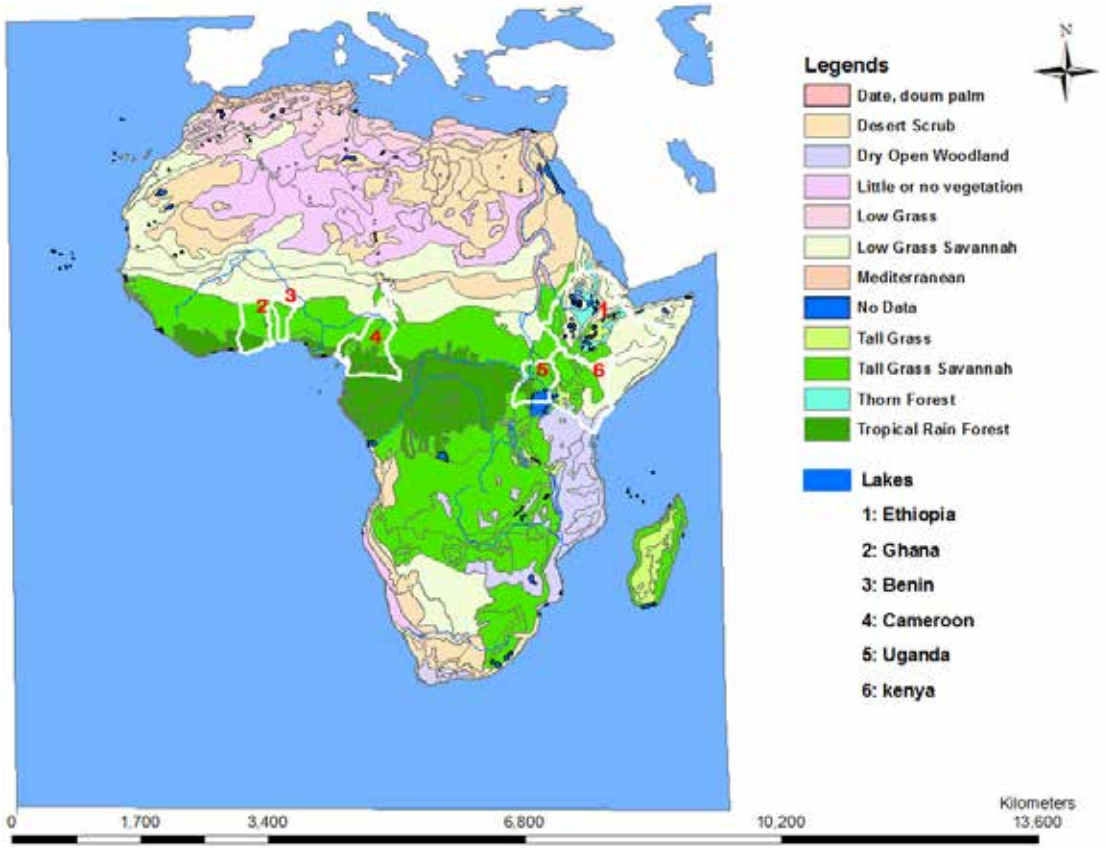

Figure 1: Map of Africa highlighting ecological regions and case study countries
Source: Yaw Agyeman Boafo, Akinola Komolafe 2016

below, the functions and values of SEPLS in Africa are reviewed, followed by a section exploring the major human and natural threats and challenges affecting the resilience and sustainability of SEPLS on the continent. The fourth section discusses the nature and direction of ongoing efforts and intervention strategies for conserving and revitalizing SEPLS in Africa, and the fifth section concludes the chapter with an analysis of the relevance of SEPLS and proposals towards enhancing human well-being and ecosystem sustainability in Africa and beyond.

1. 2 Functions and values of SEPLS in Africa

SEPLS in Africa have made invaluable contributions to socio-economic, cultural and ecological well-being and sustainability. The values of SEPLS in Africa arise from the fact that they are the bases for the regular supply and production of substantial ecosystem goods and services that directly support primary and secondary livelihood strategies for the majority of the continent's population. Although they are more prominent in rural areas, the diverse goods and services they provide offer values for various actors and settings. In this regard, we will discuss the functions and values of SEPLS for different populations under the different but interrelated categories of ecosystem services-provisioning, regulating, cultural and supporting services (MA 2005).

1.2.1 Provisioning services

SEPLS in Africa provide the foundation for the extraction, collection and production of various goods including crops, wild foods, fresh water, medicinal plants, fodder and forage, raw materials for building and firewood, and fish catches used directly by people to meet daily and seasonal livelihood needs, to generate income and as a way to move out of poverty. The diversity of ecosystems on the continent has contributed to the undertaking of different livelihood activities such as small-

scale agriculture, poultry and livestock production, extensive pastoralism (transhumance), forest-based activities and fishing by households and communities for centuries.

Several examples of people's dependence on landscapes for goods and services are given in this publication. Compound farms of subsistence farmers in semi-arid regions Ghana offer much-needed ecological space for households to cultivate staple crops like maize, yams, peppers and groundnuts during the year, thus ensuring that food security is improved during times of poor harvest on their main bush farms (*Chapter 6*). In the Gedeo agroforestry zones of Ethiopia (*Chapter 4*), enset, coffee and maize cultivation form an important land-use system that is an integral pillar of the region's food security and income sources. Commercial sale of coffee provides locals with a source of income to supplement maize, which is mostly for home consumption.

Wild foods from plants and animal sources provided by SEPLS in Africa also contribute significantly to ensuring food security, and represent an important piece in coping strategies used by locals in times of food shortages. The case study from eastern Uganda (*Chapter 12*) identifies parkland and pastureland ecological systems as important sources of fruits, edible mushrooms and fish, which all contribute to food security.

Quite a number of studies from southern Africa (Shackleton et al. 2007) provide evidence of the role of SEPLS in poverty alleviation strategies by providing locals with alternate livelihood systems, including what Cavendish (2000) refers to as "environmental income" gained from harvesting and selling tangible goods from the natural environment. In Benin (*Chapter 2*), local communities living around the Gbévozoun and Gnahouizoun sacred forests in close collaboration with external stakeholders have been able to effectively apply traditional knowledge of genetic resources to produce some 24 laboratory-tested traditional medicine types for treating a variety of diseases. Although the income from these may be small, for many communities with a limited social support system, they can be important for household sustenance in times of socio-economic and environmental shocks and stresses.

1.2.2 Regulating services

Regulating services are benefits obtained from the regulation of ecosystems. Although these services are often poorly recognized by people in Africa, their value for rural livelihoods and the global ecosystem cannot be underestimated (Adekola, Mitchell & Grainger 2015). Considering that Africa is dominated by smallholder agricultural systems, regulating services including water regulation, soil fertility maintenance, disease and pest control and pollination represent significant factors for sustaining not only the agricultural sector but livelihood systems in general. In many dryland landscapes of the continent, especially in the north where agriculture accounts for more than 75% of water use in areas well-known for water scarcity (Oweis & Hachum 2006), water capture and storage through improved irrigation management options are widely practiced. Cultivated cash crops from forest ecosystems, such as cocoa in Cote d'Ivoire and Ghana and coffee and tea in Kenya and Ethiopia, are dependent on pollinators. Parklands, pasturelands and coffee gardens in Uganda (*Chapter 12*) are also identified as being effectively regulated by biodiversity via pollination.

1.2.3 Cultural services

African SEPLS are valued for the spiritual, ceremonial, aesthetic and recreational services they provide to many inhabitants in both rural and urban environments. In rural landscapes especially, inhabitants' cultural values and belief systems, use of biodiversity, and coping and adaptation mechanisms against socio-economic and environmental challenges are inextricably linked to local landscapes and seascapes that have evolved over centuries through shared traditional and ecological knowledge (Berkes & Folke 1998). Within such rural settings, sacred forests or groves perceived as harboring spirits, sites for ritual ceremonies and offerings, and burial sites where ancestors reside are common features of the landscape. Sacred groves often show less evidence of degradation and species loss, and in most regions have been instrumental in protecting habitats and biodiversity and enhancing landscape diversity. The case study from Benin (*Chapter 2*) describes how the use of local values, customs, and rites are important for the conservation of more than 2,940 remnant sacred groves that cover 18,360 hectares and contribute to the livelihoods of local

communities. In another example from one of the two case studies from Ethiopia (*Chapter 4*), the effective combination of local knowledge with socio-political, religious, cultural and environmental institutions has proved useful in promoting genetic species and landscape diversity in the Gedeo agroforestry system for a long time. A similar example is the Mijikenda people's *Kaya* (forest patches originally for sheltering small fortified villages) in Kenya (*Chapter 9*), which for hundreds of years were protected and sustainably managed through the application of strong ritual and ceremonial practices.

Many SEPLS in Africa also function as ecotourism destinations. Increasingly, local communities have come to acknowledge ecotourism development as a means of protecting and educating people about their ecological resources, as well as for earning revenue. At the local level, ecotourism jobs and incomes come from the sale of local handicrafts, accommodation, food sales and transportation. With their diverse natural attractions and biodiversity resources, African landscapes and seascapes represent a major destination for eco-tourists and recreationists who want to have an authentic experience of culture and biodiversity. Although ecotourism is still a developing industry in Africa, there is a conscious effort to make communities an integral part of its development, thus providing locals a reason to want to protect local ecosystems and have a hand in preserving endangered species. The growth of safari tourism in the Kenya's northern and southern rangelands (*Chapter 10*), which are important hotspots for wildlife and diverse plant species, illustrates the existing and potential recreational functions and values of SEPLS.

1.2.4 Supporting services

Ecosystems in Africa remain a hotspot for more than one-quarter of the world's biological and genetic diversity (UNEP 2008). Forest ecosystems in Africa provide support for endangered and vulnerable wild species including chimpanzees (*Pan troglodytes* and *Pan paniscus*), mandrills (*Mandrillus sphinx*) and pygmy hippopotamus (*Choeropsis liberiensis*). Seascape ecosystems, for example those around the Mediterranean shores of Egypt, are also known to be among the most important spots for migratory and wintering water birds (BirdLife International 2005).
The case studies presented in this publication particularly highlight the contribution of unique local landscapes in providing habitats for plant and animal genetic resources. Sacred forests in Benin (*Chapter 2*) are valued significantly for their role in supporting diverse plant genetic resources used in traditional medicine. In Kenya, the Laikipia forest ecosystem (*Chapter 11*), which provides water resources to over 165,000 households in the region, is highlighted for its rich biodiversity.

1.3 Major threats and challenges facing African SEPLS

SEPLS face a number of threats and challenges from multiple interrelated and interacting natural and anthropogenic factors in Africa. Major factors including climate variability and change, unsustainable natural resource extraction, governance and institutional issues and population pressure are negatively impacting the resilience of production landscapes and seascapes that have long sustained livelihood systems for the majority of the continent's population.

1.3.1 Climate variability and change

Due to its geographic location, the African continent is highly vulnerable to the effects of climate variability and change (Boko et al. 2007). Climate change effects are being felt by poor rural households and communities both because of their dependence on biodiversity and ecosystem services and their limited capacity to adapt (Muller et al. 201). Changing rainfall and temperature patterns are leading to increased water scarcity, severe impacts on rain-fed agricultural production and, subsequently, food security. Severe drought conditions over the past decades in semi-arid and arid landscapes have resulted in the loss of fish and wildlife habitat, loss of wetlands, increased wildfires, poor soil quality and erosion of soil. Current projections indicate that the area of land suitable for cropping and crop yields is expected to decrease, with many ecosystems facing further degradation (Niang et al. 2014). This scenario presents one of the biggest challenges to sustainable development in Africa as many SEPLS may no longer be able to support the livelihood needs of the people who rely on them.

As is amply highlighted in the case studies presented in this publication, negative impacts on both primary

and secondary livelihood systems built around the ecosystem services provided by the local landscape result from households' and communities' increased exposure and sensitivity to climate-related extreme disasters such as high temperatures, prolonged drought and floods. For example, in the Bogo landscape of Cameroon's Sahelian region (*Chapter 3*), climate variability coupled with soil degradation remains a major threat to sustained food security among local communities. In the semi-arid rural landscape of Ghana (*Chapter 6*), cropping on compound farming systems is increasingly becoming unproductive due to irregular rainfall and prolonged drought conditions. As one of the case studies from Uganda (*Chapter 13*) discusses, forest-edge households and communities around the Rwoho Central Forest Reserve face exposure and sensitivity to prolonged dry seasons and high temperatures, and their negative effects on plantation establishment and crop yields, meaning that increasing numbers of locals are engaging in illegal activities such as charcoal burning within the forest reserve in order to earn a living.

1.3.2 Land-use changes and unsustainable natural resource extraction

Conversion of large tracts of land for plantation agriculture and mining concessions among other purposes has been negatively influencing SEPLS in Africa over the last half century. For example, at the turn of the 21st century, a number of African countries were targeted by foreign investors for large-scale land acquisition for plantation agriculture, especially for biofuel production (Cotula et al. 2009). As the demand for mineral resources and fossil fuels grows around the world, it is common for Africa's governments to give out large areas of rural landscapes as mining concessions to local and foreign investors for exploration. Linked to this, a growth in artisanal and small-scale mining is contributing significantly to the destruction and degradation of biodiversity and ecosystem services in many of the continent's tropical rainforests. Disruptions to landscapes and costs borne by local communities, who typically receive few of the benefits of such land transformation schemes, are often overlooked. In many rural landscapes, reductions in farmlands, trees and fuelwood stocks per capita are common, often resulting in high-intensive use of remaining resources. A study in western Ghana by Schueler, Kuemmerle and Schroder (2011) on the impact of surface gold mining found it to be significantly contributing to deforestation and loss of farmland.

In a desire to meet daily food and energy needs in the face of challenges associated with land-use changes, and lacking sufficient understanding of the long-term consequences of some production practices for the surrounding environment, local communities may have no choice but to extract and use ecosystem services for the sake of short-term benefits, often unsustainably. As the case study from Cameroon (*Chapter 3*) highlights, practices such as cultivation along riverbanks, sandbars and river valleys and extensive application of chemical fertilizers by farmers are among the major drivers of flora and fauna loss, soil degradation and erosion in the Bogo landscape, as shown by a baseline assessment using the "Toolkit for the Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes (SEPLS)". In Ethiopia's Gigil Gibe catchment area (*Chapter 5*), local communities' dependence on biomass as the primary source of energy and lack of alternative livelihoods are resulting in the adoption of unsustainable practices for accessing goods provided by the local ecosystem. In the Weto landscape in Ghana (*Chapter 7*), illegal logging, illicit hunting and incessant wildfires were found to be among the most significant causes of local landscape degradation prior to the introduction of "COMDEKS Project" activities in that country.

1.3.3 Weak governance structures and institutions

Historically, the importance of local-level and traditional institutions and structures in enabling access to, and sustainable use and management of, ecosystem services cannot be overemphasized. With rapid transitioning of societies from traditional authorities and institutions to more modern systems, however, such governance and ecosystem-management structures and institutions are declining (Fabricius et al. 2004). There are often problems reconciling local or traditional governance institutions with national ones, resulting in increased conflicts between local resource users and formal governance institutions. An outcome of this is a disregard — especially among the younger generations — for local rules, beliefs and regulations or norms that have maintained the use and management of ecosystems (Boafo et al. 2015). For example, the creation of national parks or conservancies and tourism development

have emerged as integral components of natural resource governance and management systems, meaning that local communities have increasingly limited and selective control over, access to, and cultural use of resources. In most cases, the role of traditional authorities and institutions is diminished as formal conservation authorities are cutting off local communities' use of ecosystems for livestock grazing lands, fuelwood collection and others.

One case study from Kenya (*Chapter 10*) reflects this ongoing trend, providing empirical evidence in that nation's context. Based on field evidence, it indicates that the conservancy model and safari tourism development in Kenya's southern and northern rangelands is disenfranchising local communities from full access and use of ecosystem services in the local landscape. Farmers in the Rwoho forest-edge communities in western Uganda (*Chapter 13*) are increasingly being forced to convert forest vegetation into monoculture plantations due to restrictions from formal forest managers. Consequently, some of the effects being experienced by inhabitants include rapid loss of biological diversity, frequent landslides, floods, silting, severe soil erosion, loss of soil fertility and a decline in agricultural productivity.

1.3.4 Population pressure and urbanisation

Rapid population growth across many regions of the African continent is putting great strains on ecological resources and human well-being. Although the relationship between population growth and the degradation of ecological resources is still being vigorously debated (Boserup 1965; Hardin 1968; Turner et al. 1990; Carr, Sutter & Barbieri 2006), there is no denying the fact that an increasing human population has meant more pressure on ecosystem goods and services provided by SEPLS. Available evidence suggests that increasing demand for food, energy and housing in both rural and urban locations has significantly altered land-use practices and degraded most forests productive landscapes across the continent (Christiaensen, Demery & Kuhl 2010).

Closely connected to the above, rapid urbanisation and urban expansion in peri-urban areas of Africa (World Bank 2013; Friere, Lall & Leipziger 2014) are having detrimental effects on human and natural capital in African SEPLS. With the high rate of urban growth, natural ecosystems such as wetlands, despite being important sources of water and nutrients for biological productivity, are fast being modified and converted for settlements and industrial purposes. There is often limited consideration of ecosystem services in urban planning or management processes. In many African towns and cities, the pace of urbanization is too rapid for authorities to keep up with providing services. Contamination of water supplies from growing urban and peri-urban populations where water and sanitation systems are badly situated or not safely managed can be a threat to water provisioning. Urbanizing populations are becoming sinks for many outputs of SEPLS, including charcoal, fuelwood and food crops. In the Laikipia County ecosystem, located in the Rift Valley Province of central Kenya (*Chapter 11*), the rapidly-growing human population is a major driver of environmental degradation, an outcome of land fragmentation and inappropriate farming and settlement practices. A case study from Uganda (*Chapter 12*) shows that population pressure in the country's eastern regions is forcing people to move to marginal lands with low fertility, which is also contributing to the loss of traditional practices that sustained biodiversity in parklands and pasturelands in the past.

1. 4 Conservation and revitalization efforts

In this section, we examine the "what and how" of SEPLS revitalization efforts in Africa as seen in the case studies presented in this publication. Most of the efforts here operate at multiple spatial scales and are led by multiple actors and stakeholders. Scales of operation can be assessed at the national, regional, local and community or household level. Actors in this context include local people at the community or household level, civil society or non-governmental organisations, local governments, national governments, international agencies, and various combinations of these. The nature and direction of ongoing intervention strategies aimed at ensuring that SEPLS in Africa can continue to deliver goods and services to people through sustainable use and management are discussed in the subsections below.

1.4.1 Development of local capacity for improved access and management

In many landscapes across Africa, customary tenure systems provide access to land and natural resources

as a social and cultural right based on an individual's membership in a community. Access to and use of the biodiversity and ecosystem services provided by SEPLS therefore require land tenure security for the local population. Farmers, for example, cannot produce enough food for their households if access to land is inadequate. This has serious implications for food security.

In the Laikipia County ecosystem in central Kenya (*Chapter 11*), the formation of the Laikipia Wildlife Forum (LWF) allows different actors in the local ecosystem—including local community groups, pastoralists, small-scale farmers, private ranches, large-scale farmers and tourism ventures—to understand limits to access and utilization of the ecosystem and to offer sustainable ecosystem-management skills. Among the multiple aims of the LWF is to increase the capacity of the people of Laikipia to manage their natural resources including rangelands, forests and water, using strategies such as training at the group-ranch and producer-group levels for improved governance and decision-making skills related to the management of natural resources.

1.4.2 Recognition and incorporation of local knowledge and management strategies.

Due to global recognition of the important role that local knowledge systems and practices can play in sustainably managing ecosystems, a number of intervention strategies have been exploring opportunities for including them in SEPLS conservation and rehabilitation. More importantly, there appears to be official recognition and institutionalization of resilient local knowledge practices and systems relating to genetic resources in some SEPLS in Africa. The case study from Benin (*Chapter 2*) provides a good and practical example of how building local knowledge of the genetic resources provided by sacred forests, through collaboration between formal and informal knowledge systems, can promote sustainable use of biodiversity and ecosystem services. This case also offers lessons on why putting local actors and their knowledge at the forefront of SEPLS conservation and revitalization is necessary for successful implementation of intervention strategies. Similarly, under the COMDEKS Project local communities in the Gigil Gibe catchment area in Ethiopia (*Chapter 5*) are improving the use and management of plant and animal resources through the adoption of sustainable and traditional local knowledge systems and practices. Lessons and experiences from this case study are particularly promising for up-scaling in similar landscapes in Africa.

In a case study from Kenya (*Chapter 9*), the strengthening of the traditional *Kaya* elders' council and courts—through an effort spearheaded by donor-funded projects through the Kenya Forestry Research Institute (KEFRI), National Museum of Kenya (NMK), United Nations Development Programme (UNDP) and World Wildlife Fund (WWF)—is expected to enhance their capacity to enforce local norms, beliefs and customs on the use and management of local forests as a step toward protecting them from further degradation. This case study also provides a good example of how value-added products from resources like *Tamarindus indica* and *Ancylobothrys petersiana* can be used to increase their economic value and lessen pressure on forest ecosystems. In this way, the cases show that recognizing traditional institutions and their knowledge systems can be an effective way to promote sustainability.

1.4.3 Promotion of participatory and multi-stakeholder approaches for ecosystem conservation and livelihood improvement

Interventions that consider the needs of all actors at an appropriate spatial scale can be most effective for restoring and protecting SEPLS, especially if they are integrated within multi-sectoral approaches, linked to socio-economic development, and community-owned. In socio-ecological terms, this enables households and communities to have access to alternative livelihood strategies and income sources, thus reducing pressure on natural ecosystems. In addition to such approaches helping with poverty alleviation, they can also increase landscape connectivity and resilience. The case from the Effutu traditional area in Ghana's Central region (*Chapter 8*) provides a prime example of how multi-stakeholder engagement including traditional authorities, community members and relevant groups has been critical to revitalizing degraded landscapes. Key to this project's goals is the engagement and empowerment of community members through various collaborative biodiversity conservation initiatives like awareness-raising regarding tree planting, behavior-changing activities and the integration of indigenous traditional knowledge

and modern approaches. In addition, efforts at enhancing income levels in fringe communities through alternative livelihood activities such as soap-making have offered employment opportunities to women and increased household incomes by around 20%, thus reducing dependence on nature-based resources. Similar interventions which have been undertaken under the COMDEKS Project in the Bogo landscape of Cameroon (*Chapter 3*) and the Weto landscape in the Mid-Volta region of Ghana (*Chapter 7*) show the positive contribution of such projects to livelihood development and improvement of ecological integrity (GEF/SGP 2015).

1.5 Conclusion

The potential contribution of SEPLS to human well-being and healthy ecosystems in Africa cannot be overemphasized. With its large rural population and widespread poverty conditions, the functions and values of Africa's SEPLS can best be understood through the people's high direct dependence on biodiversity and ecosystem services. SEPLS are valuable for a whole range of provisioning, regulating, cultural and supporting services, not only for Africa but for the world as a whole. The ongoing trend of degradation and decline of SEPLS across the continent—driven by interrelated human and natural factors including climate change and variability, land-use changes, unsustainable ecosystem use and extraction practices, population pressures, and weak governance and institution structures—is therefore of great concern for the sustainability of livelihood needs and the healthy functioning of local ecosystems.

The case studies presented in this publication show that there are considerable efforts involving communities and national, regional and global-level institutions that aim to conserve and revitalize SEPLS in Africa. In this context, SEPLS-based practices such as those seen in this volume can complement current governance regimes and proven traditional resource management practices being carried out by various stakeholders and actors.

Effective sharing of knowledge on best practices, project activities and outcomes at local, national and sub-regional levels is important for conservation and revitalization of SEPLS in Africa in order to avoid reinventing the wheel as well as for up-scaling and replication. Conservation and revitalization projects need to employ diverse means of dissemination beyond producing annual reports. Communication platforms including peer-reviewed articles, newspaper articles, policy briefs, magazine articles, pamphlets and factsheets, radio and TV programs, and social media, as well as community-based activities such as theater and participatory flora and fauna surveys, should be explored. The platform provided by the Satoyama Initiative is one effective way to promote activities for finding solutions to the challenges facing SEPLS in Africa (Oteng-Yeboah et al. 2016). It is the authors' hope that this volume will provide one step towards this type of platform by providing readers with insight on the status and potential of SEPLS-based approaches for Africa.

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CHAPTER 2: BENIN

Sacred forests: valorization of traditional knowledge associated with genetic resources for sustainable management

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Summary

An investigation of the valorization of traditional knowledge associated with genetic resources for sustainable management has been conducted in two sacred forests: Gbévozoun and Gnahouizoun. In the Gbévozoun sacred forest, 256 plants species are identified, 75 of which are exclusively encountered in the sacred forest. From the inventory, 191 plants out of the 256 are reportedly used for medicinal and nutritional purposes. Overall, 61 diseases and sicknesses could be treated with these plants. In the Gnahouizoun sacred forest, 168 plant species are identified, of which 81 plants (48.21%) are encountered only in the sacred forest. Of the 168 plant species, 110 are used in medicinal and nutritional programs, and 35 pathologies or sicknesses are treated with the use of these plants. Through collaboration between the Institute of Experimental Research in Medicine and Traditional Pharmacopeia (IREMPT), the CBRST pharmacognosy laboratory, and the NGO CeSaReN, a total of 32 traditional medicines, made using genetic resources and traditional knowledge, were tested via photochemical analysis, cellular and sub-chronic toxicity with rats, and microbiological assessment. Of the 32 traditional drugs reviewed, 24 traditional medicines proved safe and effective to be used for treating diseases for which they are traditionally used.

Keywords: Benin, Genetic resources, Sacred forests, Traditional knowledge

2.1 Background

Benin is a country located in West Africa. Geographically, it lies between latitudes 6–13° N and longitudes 0–4° E. With a hot and humid climate, Benin has more than 2,940 remnant sacred forests covering a total area of 18,360 ha. The majority of Benin's population lives in rural areas. The most important socio-economic activities in the country center on agriculture, fisheries, livestock, commerce, and craft-making. Agriculture is the main source of wealth, with a contribution of more than 27% of the GDP. The sector employs more than 55% of the national workforce. Agricultural systems are dominated by extensive farming with shifting cultivation and slash-and-burn practices. Over 90% of sacred forests are adjacent to, or surrounded by crop fields. The practice of shifting cultivation threatens sacred forests across the country and is a cause of increased land pressure.

Ramsar sites 1017 and 1018 contain over 500 sacred forests (**Figure 1**). The sites are located in southern Benin, in the coastal area between latitudes 1° 37'

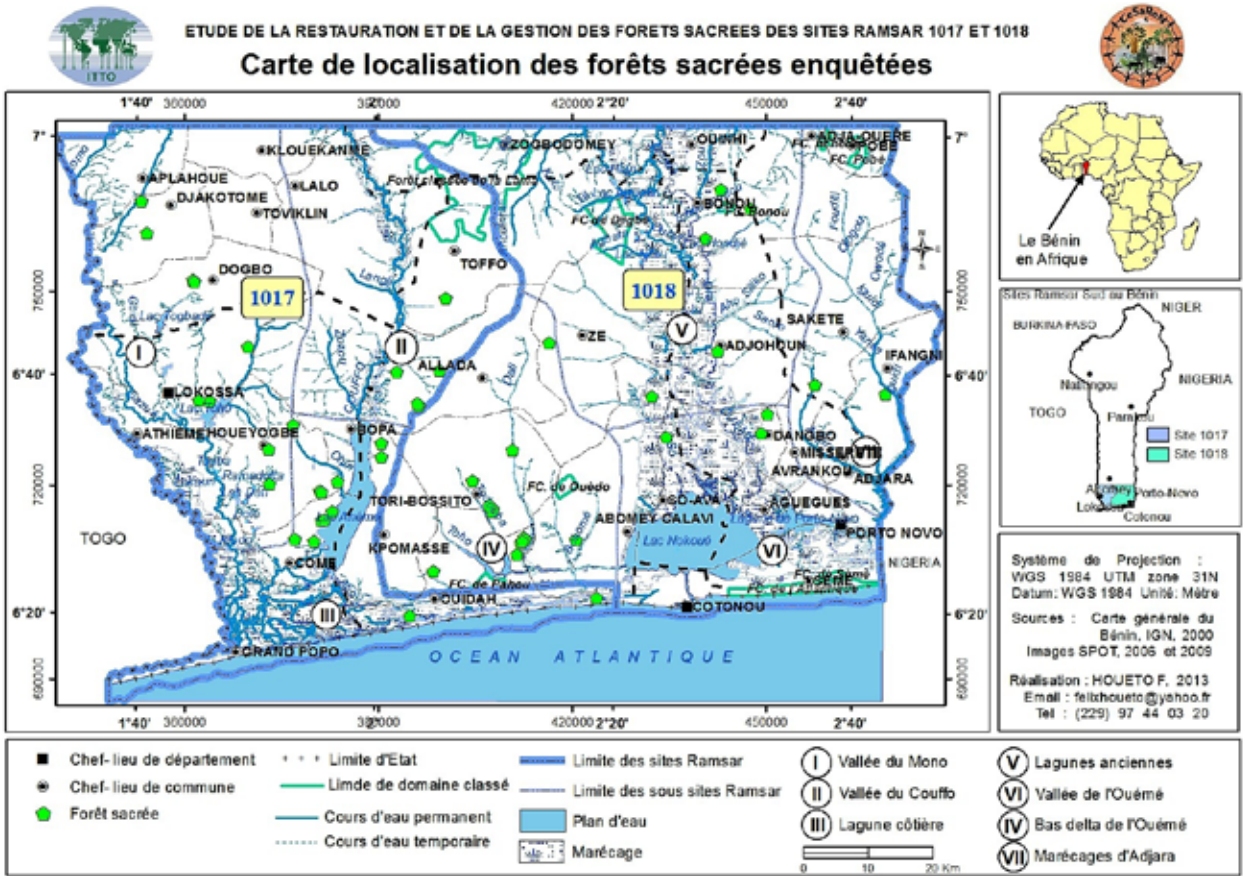

Figure 1: Location of Ramsar sites 1017 and 1018
Source: Bienvenu Bossou

45''–2° 42' 35'' E and longitudes 6° 12' 37''–7°1' N. Sacred forests in Benin are generally small in size (2–20 ha) but rich in biodiversity.

2.2 Functions and values

Sacred forests play many important roles and functions for human well-being. These include conservation and management of natural ecosystems, ecological functions (protection of water sources, protection of soils against erosion, and provision of habitats for animals and sacred plants), religious function (house the deities, place of worship, rituals or other ceremonies), economic function (harvesting of fuel wood, medicinal plants, and food plants), and sociocultural function (cemetery, places of initiation, meetings, blessing/curses, etc.).

The forests act as effective traditional laboratories. Dignitaries act as living libraries who are the repository of local knowledge based on these sacred forests. Furthermore, a sacred forest provides a refuge and sanctuary for native biodiversity of local ecosystems. They contain many rare plant and animal species, and even some red list species. Although these forests have not received legal or official protection status from the State, they had nevertheless been able to maintain the integrity of their resources until recently. They stand for a successful model of traditional biodiversity management and conservation. The principle of this method of conservation is based on awe and respect, inspired by traditional local beliefs, the strength of traditional authority, and the power of dignitaries and religious leaders.

2.3 Challenges and threats

Currently, through the combined effects of a number of factors, such as the emergence of new religions, high population growth, the weakness of traditional power and decline of associated beliefs, and the aggravating impoverishment of the rural population, religious taboos and restrictions are no longer observed. As a result, most sacred forests have

become the subject of overuse and uncontrolled exploitation, leading to the degradation of their status or even total destruction. Studies recently undertaken on sacred groves in southern Benin (Lokossou 2012) have shown that 60% are in a state of advanced degradation. Between 1998 and 2013, 34% of sacred forests have experienced a significant reduction in area, and 14% have disappeared. The regressive trend affecting these ecosystems is a major threat to biodiversity and the lives of surrounding communities who rely heavily on ecosystem services. Despite their socioeconomic and ecological significance, these particular ecosystems have long been neglected by the scientific community and the forest administration. Indeed, they have been considered fringe elements of vegetation, and as such, have received little attention.

2.4 Responses towards sustainable use and conservation

During 2012, with the financial support of the International Tropical Timber Organisation (ITTO), an inventory study for the rehabilitation and sustainable management of sacred forests within Ramsar sites 1017 and 1018 in Benin (ITTO 2012) was implemented by the NGO Club for the Conservation of Natural Resources (CeSaReN). CeSaReN was primarily tasked to collect baseline information on the sustainable management of sacred forests. The outputs of the implementation of this pre-project confirmed that:

i) Sacred forests are true reservoirs of biodiversity and traditional laboratories and represent a successful model of traditional management and biodiversity conservation;

ii) Dignitaries and local communities are living libraries that hold traditional knowledge (TK);

iii) Genetic resources (GR) and their associated TK can offer both existing and potential markets for scientific research, development, and marketing of pharmaceuticals, food, agricultural, and industrial products;

iv) Erosion of GRs and the loss of associated TK are very real threats;

v) Local people fear that their TK will be ridiculed.

Based on this information, the NGO CeSaReN, with the support of United Nations Development Programme (UNDP) (GEF Small Grant Programme) decided to valorize the GRs and TK of two sacred forests, *Gnanhouizoun* and *Gbevozoun,* both located in Ramsar site 1018. For this project, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization, to the Convention on Biological Diversity, was employed (CeSaReN 2015). This protocol recognizes, supports, and protects the rights of local populations and communities to their traditional resources and knowledge (Article 12 of the Protocol). The general objective of this pre-project was to strengthen conservation and sustainable management of these sacred forests. The specific objectives are as follows:

i) Strengthen the capacity of communities on Access and fair and equitable Benefit-Sharing, arising from the utilization of GRs (ABS).

ii) Develop a Bio-cultural Community Protocol (BCP) in accordance with the principles of the Nagoya Protocol on Access and Benefit-Sharing, from the use of GRs.

iii) Increase the income of the owners of sacred forests and TK, through development activities and promotion of the value chain concept, for some biogenetic resources (species) and TK, based on the ABS mechanism.

iv) Ensure the effective involvement of local communities in the implementation of the ABS process in Benin.

2.4.1 Methodological approach

Towards achieving the objectives of the project in the two selected sacred forests, four main field activities were implemented:

(a) Information

Awareness of the stakeholders involved in the management of the two sacred forests. Information notes such as leaflets on the project and main concepts (ABS, Bio-cultural Protocols, and Nagoya Protocol etc.) were designed and used during the meetings, gathering together various actors at sites (as describe by photo 1) or in a room;

(b) Inventory

The GRs, the TK associated with the GRs, and the rules of access. For this study, botanists, herbalist, and sociologists were used to conduct the activities. The GRs of plants and their use in the preparation of traditional medical products were identified and documented.

(c) Valorisation of GRs and TK

i) The first phase consisted of identification by local communities themselves; criteria for the selection of TK associated with GRs that should be promoted.

ii) In the second phase, the criteria of local actors have been cross-reference with those of the reference laboratories: the pharmacognosy laboratory of the Benin Scientific and Technical Research Centre (CBRST) and the National Program of the Pharmacopoeia Promotion and Traditional Medicine (PNPMT); to choose the GRs and TK that may be useful locally and internationally, as well as for research. Through a partnership with CBRST, the analysis and testing of the effectiveness of traditional medical products was conducted by CBRST, using World Health Organization criteria.

(d) Strengthening the capacities of the stakeholders

One of the major concerns of the TK holders is the fear of theft of their knowledge practices and systems. Stakeholders were trained on the value chain and protective processes, of GRs and associated TK, on the negotiations in the framework ABS (general information on negotiation skills), and on how the development of Bio-cultural Protocol process is being driven.

2.4.2 Output of activities

(a) Information, awareness of the stakeholders involved in the management of Gnanhouizoun and Gbevozoun sacred forests

More than 350 actors in all socio-professional categories were informed of and familiarized with the project activities. Actors had a good understanding of the project and their responsibilities in the project implementation. Fifteen different categories of actors were involved in the process:

Photo 1: Field visit with dignitaries at *Gnanhouizoun*
Photo credit: Bienvenu Bossou

communal authorities, dignitaries, TK holders, local development associations, local press, youth associations, women associations, and international organizations. Traditional medicine practitioners and local farmers who voluntarily pledged to follow the process gathered together and formed within them a committee to promote the management and the valuation of GRs and associated TK. Many field visits by the staff of the project were organized with the dignitaries (**Photo 1**) to exchange precious information. To monitor the project activities, three local committees are put in place: 1) Access and Benefit-Sharing Committee; 2) Sustainable Forest Management Committee; and 3) facilitators group for the Bio-Cultural Protocol.

(b) Inventory the GRs, the TK associated with the GRs and the rules of access

With the support of TK holders (**Photo 2**) and the women's association (**Photo 3**), information was collected on various plants used from the sacred forests. Information on the processes and techniques of the preparation of traditional medicine products was also collected from the women's association. In the *Gbevozoun* sacred forest, 256 plants species were identified, of which 75 are encountered exclusively in the sacred forest. From the inventory, 191 plants out of the 256 are reportedly used for medicinal and nutritional purposes. Overall, 61 diseases or sicknesses could be treated with these

Photo 2: Gathering information on genetic resources with traditional knowledge holders
Photo credit: Bienvenu Bossou

Photo 3: Women's association processing medical plants
Photo credit: Bienvenu Bossou

plants. In the *Gnahouizoun* sacred forest, 168 plants species are identified. Of these, 81 species (48.21%) are encountered only in the sacred forest, and 110 species out of the 168 are used in medicinal and nutritional programs. There are 35 pathologies or sicknesses treated by medicines produced from these plants.

A directory of GRs and associated TK for each sacred forest was drafted. With regard to the Nagoya Protocol on ABS, this activity helped to:

i) Draft the access mechanisms of the GRs;

ii) Facilitate discussion on the structures or persons responsible for the deliverance of access to GR;

iii) Analyze the adequacy of measures identified in connection with the guidelines of the Nagoya Protocol on ABS and to make appropriate proposals.

(c) Valorization of GRs and TK

Through the memorandum of understanding for collaboration signed between IREMPT, the CBRST pharmacognosy laboratory, and the NGO CeSaReN, a total of 32 traditional drugs, developed on the basis of genetic resources and TK, underwent photochemical analysis, cellular and sub-chronic toxicity using rats, and microbiological assessments. The report was composed on each of the 32 traditional drugs. After these tests, 24 traditional drugs have proven effective and safe for use against those diseases for which they are traditionally used to treat.

(d) Strengthening the capacities of the stakeholders

In terms of strengthening the capacities of the stakeholders, training sessions have taken place and financial agreements negotiated. Training sessions on GRs and the associated TK value chain and right protection processes were organized for the benefit of communities, managers of the sacred forest and TK holders, by experts. This helped to inform and strengthen the capacity of TK holders and sacred forests managers on the following:

i) The concept of value chain in the context of the Nagoya Protocol on ABS;

ii) Criteria and procedures to select products to value through the value chain;

iii) Identification of actors and their functions;

iv) The assessment of the weight of transactions in the final cost of a product;

v) The explanation of the circuit followed by a product;

vi) Understanding or pricing mechanisms, revenue, margins/profits and added value, and distribution of added value per link and for the whole sector;

vii) Highlighting the most recurring constraints and bottlenecks by genuine links and the entire chain;

viii) Description of the strengths and weaknesses, constraints and opportunities.

The various group sessions helped to strengthen the capacity of TK holders and managers of natural resources on the opportunities offered by the Nagoya Protocol for poverty reduction, sustainable use of the biological resources, and the role assigned to them in the implementation of the protocol. Local communities have understood that the Protocol fills a gap and that its implementation could contribute to a fair collaboration between traditional and modern medicine. However, reaching this level of collaboration requires long-term action.

2.5 Lessons learnt

The outcome of this project has highlighted relevant issues for consideration, by different actors and stakeholders involved in the efforts to revitalize socio-ecological landscapes, faced with natural and anthropogenic challenges.

Photo 4: Exhibition of some pharmacopeia products
Photo credit: Bienvenu Bossou

i) The Nagoya Protocol on access to GRs and the fair and equitable sharing of benefits arising from their utilization can be applied to GRs and associated TK of sacred forests.

ii) There is heavy reliance of some populations on traditional medicine.

iii) The high exploitation of medicinal bio-GRs could lead to an over exploitation of these resources and expose them to the risk of extinction (some of these species are already on the national red list (Neuenschwander *et al.,* 2011).

iv) A partnership between TK holders and research institutions can promote the use of GRs.

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CHAPTER 3: CAMEROON

The Bogo landscape in Cameroon drylands: contribution of local communities to adaptive management

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Summary

The Bogo landscape is unique in the Cameroon Sahelian region. It is endowed with diverse natural resources with agricultural systems, rich alluvial soils (despite the dry climate), and a diversified pasture and cultural system, which is conducive to tourism and provides a solid foundation for economic activities and sustainable development. The main environmental and social challenges associated with the landscape are linked to food insecurity resulting from climate variability and soil degradation; unsustainable agricultural and forestry practices that lead to soil erosion and crusting; a lack of sustainable livelihood options and women empowerment; recurrent health issues linked to a lack of clean drinking water and occurrence of extreme weather events; widespread poverty; and weak institutional capacity to support conservation and production. To promote healthy socio-ecological production systems for biodiversity conservation while satisfying the socio-economic needs of landscape dwellers, a participatory transformative strategy was developed with the long-term objective of improving the socio-ecological production and resilience of the landscape through community-based activities. With this aim, seven projects have been funded and implemented within the Bogo landscape to increase resilience through raising environmental awareness, improving access to water and alternative sources of energy, promoting sustainable agriculture and agroforestry practices, and improving stakeholder engagement in environmental governance.

Keywords: Bogo landscape, Drylands, SEPLS indicators, Adaptive management, Local communities

3.1 Background to the Bogo landscape

Located in the Sahelian zone of Cameroon, Bogo represents a socio-ecological production landscape (SEPL) for the Community Development and Knowledge Management for the Satoyama Initiative (COMDEKS) program in Cameroon. Administratively belonging to the Diamaré Division in the far northern region of Cameroon, the Bogo district extends from 10° 35' 05" to 11° 01'30" N and from 14°30' 00'to 14° 49'39" E. It is bordered by the Dargala district to the southwest, by the Maga district in the northeast, by Petté and the Maroua III municipality in the north, and by the Moulvouday district in the southeast (**Figure 1**). The district covers an area of 93,000 ha with a population of 95,230 inhabitants, 48% of which live in rural areas (Bureau Central des Recensements et des Etudes de Population 2010).

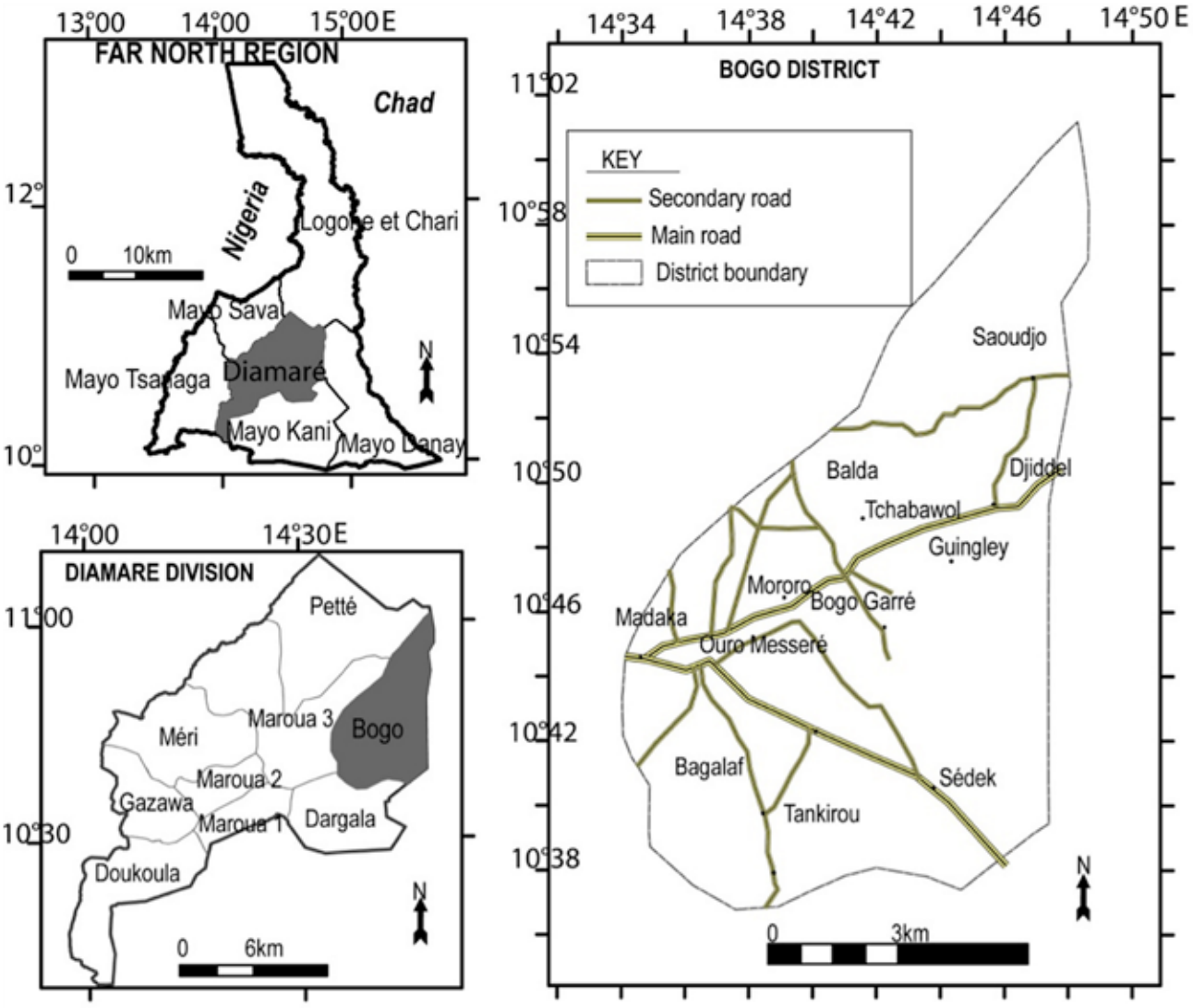

Figure 1: Location map of the Bogo landscape in the Diamaré Division
Source: SGP/COMDEKS Cameroun Landscape Strategy 2014

The population is composed of 51% men and 49% women, with a density of 102 inhabitants per square kilometer. The district is jointly ruled by an administrative authority (sub-divisional officer) and a traditional authority called the "*Lamido.*" Bogo is made up of twelve cantons, each of which is ruled by a "*Lawan*" and assisted by local neighborhood leaders called "*Djaouros.*"

The Mayo Tsanaga River flows through Bogo and provides freshwater that supports the livelihoods and activities of most of the rural and urban population. The Bogo landscape consists of two major topographic features: 1) a large plain (310–330 m average altitude), which gradually descends towards Lake Chad, and 2) a few hills toward the south western township of Bagalaf (*Hosséré* Goboré, 493 m) and the north western township of Balda (*Hosséré* Balda, 679 m).

Located within the dry tropics (seven to eight dry months and four to five rainy months/year), Bogo is characterized by a Sahelian climate with a low rainfall regime and one peak (500–700 mm per year), high temperatures (28–35 °C) and low humidity, and swept by hot and dry winds (Harmattan). As in the African Sahel, since the early 1970s, this vast plain has faced persistent drought that has resulted in shrinking resources and weakened food security (Tchindjang *et al*. 2015). This Sahelian area hosts two types of landscape plants: 1) thorn-like plants, such *Acacia seyal*, *Acacia nilotica*, *Tamarindus indica*, and *Balanites aegyptiaca*; 2) plants inhabiting periodically flooded prairies called "Yaérés." Some dominant grassland plants such as *Echinochloa stagnina*,

Vetiveria nigritana, *Hyparrhenia rufa*, and *Oryza* spp. (wild rice) are also present.

The Bogo landscape is a unique environment in the Sahelian region as it is endowed with diverse natural resources. The landscape supports agricultural systems due to rich alluvial soils (despite the dry climate), and a diversified pasture and cultural system, which is conducive to tourism and provides a solid foundation for economic activities and sustainable development.

The production system in Bogo, similar to other Sahelian production systems, is heavily dependent on rainfall: food crop production is mostly rainfed, and livestock rearing is through transhumance. Local communities are predominantly composed of farmers and breeders, representing at least 98% of the families. Agriculture, artisanal fishing, hunting, and small businesses constitute the main livelihood activities of these populations, among which more than 50% on average lived below the national poverty threshold during 2011, equating to less than US$ 1.6/day for an adult (Institut National de la Statistique du Cameroun 2014). Agricultural plots rarely exceed 0.50 ha in size, with land reserved for agroforestry being an exception. Animals are used for farm labor and transportation in this very isolated region. Overall, only 2% of household revenues are generated in the formal sector.

The importance of biodiversity management and building resilient rural communities in socio-ecological production landscapes has increased due to their relevance in supporting key ecosystem functions and the role of biodiversity for the livelihoods of millions of people worldwide. Thus, the conservation of biodiversity involves not only preserving pristine environments but also the natural environments influenced by humans, such as farmland, pastures, and water systems that people have developed and maintained sustainably over centuries.

3.2 Functions and benefits of the Bogo landscape

3.2.1 Biodiversity and ecosystem hotspots

Due to the presence of migratory birds and the "Yaérés" wetlands, Bogo represents a hotspot of avian biodiversity of national and regional significance, which has received little attention by other parts of Cameroon, and the value of the region through ecotourism remains to be realized. Furthermore, Bogo contains unique natural assets in the Sahel region to facilitate livestock transhumance from Cameroon, Nigeria, Chad, and the Central African Republic. Hence, the important location of Bogo provides ecosystem services, which include:

i) Integrated agriculture with a mosaic of crops and the use of cattle dung as well as bird droppings as organic fertilizer;

ii) Transhumance for large herds originating from Chad and transiting to Nigeria (and Niger), which also contributes to milk production potential to sustain local livelihoods;

iii) Agroforestry through the neem tree (*Azadirachta indica*), *Acacia seyal*, and fruit trees including mango and guava.

At the level of ecosystems services, Bogo forms a mosaic of landscapes combining picturesque hill environments with diverse habitats and high possibilities of intra and inter population gene flows through a diversity of land use patterns, including urban environments (Bogo Garré) and rural (villages and townships) farmlands and rangelands for livestock and transhumance, natural afforested areas, agroforestry plantations of mango and guava trees, periodically flooded meadows, wetlands, and water ponds.

Local agriculture covers a large variety of crop species consumed locally. Included are a variety of cereals, such as sorghum (*Sorghum bicolor*), mouskwari, sesame (*Sesamum indicum*), finger millet (*Eleusine coracana*), millet (*Panicum miliaceum*), corn, rice, groundnuts, cowpea, onions, beans, sweet potato, and tubers such as cassava. Traditional African vegetables are also grown, including okra (*Hibiscus esculentus*), foléré (*Hibiscus sabdariffa*), calabash (*Crescentia cujete*), cucumber (*Cucumis sativus*), melon, squash (*Cucurbita maxima*), eggplant, and tomatoes. Cotton is the only plant farmed on an industrial level, which requires numerous inputs for its cultivation (SGP/COMDEKS Cameroun landscape strategy 2014). Several products, such as cassava, sweet potatoes, and millet are consumed locally as well as sold in rural markets. Seafood and livestock products are also produced, although they are not integrated into urban markets. Agriculture is

generally practiced on clay and alluvial deposits (karal), and sandy or loam soils.

The ability of this landscape to retain water during the dry season explains the abundance and diversity of livestock, including cattle, sheep, goats, donkeys, and horses. Bogo is a popular transhumance zone where animals are used for traction in agricultural work, the practice of night paddock manuring in farming systems, and transportation within the Diamaré plain. Due to the strong local hydrographic network, the Bogo landscape provides a habitat for a diversity of seasonal birds, including cattle egret (*Bubulcus ibis*), intermediate egret (*Egretta intermedia*), African cormorant (*Phalacrocorax africanus*), and egrets (*Egretta ardesiaca*). In addition, guinea fowl (*Numida meleagris*), ducks (*Anas*), and geese (*Anser*) are frequently encountered, and other local wildlife includes wild warthogs (*Phacochoerus africanus*) and hyena (*Crocuta crocuta*). In the Mayo Tsanaga River and floodplain, fishing is promoted, and species such as catfish, *Tilapia sp.*, and carp, are both locally consumed and sold.

3.2.2 Contribution to livelihood sustenance and well-being

The livelihoods and well-being of local communities are predominantly based on agriculture, livestock, and fisheries, and to a lesser extent on small business or small trading activities. Land and property are common household assets in the Bogo landscape. Other current assets include livestock, cash crops such as cotton, food crops, and household appliances such as televisions (mostly in urban areas) or radio sets. Generally, radios are not found in rural communities. The average annual household income lies between US$ 126 and US$ 251, indicating that a large number of people live below the poverty line (Institut National de la Statistique du Cameroun 2014).

By virtue of their involvement in the various economic activities, the main actors of the Bogo landscape are farmers, cattle breeders, fishermen, firewood collectors, herbalist healers, traditional authorities (Lamido, Lawanes, and Djaouros), administrative authorities, religious authorities and communities (Muslims and Christians), as well as women, elderly, and youth groups. All these groups are closely dependent on the landscape ecosystem services.

Other elements that contribute to the well-being of communities in the landscape include functional primary schools, health centers, and community drinking water points. Some government infrastructure and services exist, including a sub-divisional office, a city hall, and security and defense forces. The economic sector has been expanding with the presence of the large cattle market at Bogo Garré and microfinance institutions (such as "Express Union," "Credit du Sahel"), which are the only banking services available.

The Bogo SEPL contributes to improve national and local livelihoods through rehabilitation and management of endangered habitats for the conservation and promotion of community development sites. This approach supports the sustainable use of biodiversity through training in the establishment and sustainable management of community development projects. It also contributes to the empowerment of communities in the landscape through the promotion of the micro local economy. The development and promotion of handicrafts, ecotourism, good agricultural and environmental practices, and the promotion of culture and consumption of local medicinal plants are opportunities to improve local livelihoods.

The forest and non-timber products emerging from this landscape result from voluntary reforestation and agroforestry by the communities and serve as the sources for fuel wood and traditional medicines. As an opportunity, it is worth mentioning that very few bush fires (usually intentionally started and controlled as a means for growing fodder) are practiced today, except within the "*Yaérés.*"

Afforestation can be mentioned as another opportunity. Indeed, multidisciplinary studies have attempted to recover the production capacity of "*hardés.*" The latest techniques used appear to have been more successful when implemented through an afforestation program called the "Green Sahel Operation," which was launched by the Ministry of Environment and Nature Protection since 2008. The program consists of removing the first 50 cm of the tatters (which are battleships) and establishing the agroforestry nursery. This afforestation, coupled with the distribution of improved stoves among the local population, has momentarily solved the problem of fuel wood in this area (Tchindjang et al. 2012).

3.2.3 Role of local knowledge practices and systems

Local knowledge is particularly relevant with regard to the management of biodiversity and innovations in agricultural and pastoral areas to improve the resilience of the Bogo landscape and the livelihoods of resident communities. Access and exchange of information and knowledge of local agricultural biodiversity, ancestral customs and ceremonies, and traditional knowledge and practices are passed on by word-of-mouth or learning-by-doing between generations. The documentation and sharing of local knowledge, the use of the native language for knowledge sharing, and the acceptance of the knowledge of women on the use of biodiversity are critical for the sustainability of local ecosystem management approaches.

3.3 Challenges and responses

3.3.1 Challenges and implications for socio-ecological resilience

Five main environmental and social challenges affecting the Bogo landscape that are closely related to the local climatic conditions and the poor resilience of resident communities can be discussed.

(a) Food insecurity linked to climate variability

The already low rainfall distribution is coupled with an intensification and increased unpredictability (with regard to duration and intensity) of droughts and rainfall over the past three decades (1972–1973 and 1983–1985), with a variability of rainfall of up to 40%–80%. These droughts have resulted in the desiccation of crops and reduced yields, as well as superficial crusting leading to decreased soil fertility and more widespread poverty.

(b) The destruction of natural vegetation

This is characterized by the dispersion, loss, and reduction of the spatial density of certain species from most of the Bogo cantons as well as deforestation, causing land degradation, erosion, and loss of biodiversity habitats. The surface crusting due to old fire practices, the extension of grazing, climatic degradation, and erosion are responsible for deteriorated soil quality, reduced agricultural productivity, and the loss of biodiversity. Sediment loads of rivers during the rainy season undermine the riverbank and gully slopes and negatively impact soil quality and surface waters.

(c) Unsustainable use of landscape resources

Baseline data show that chemical fertilizers provided for cotton production are also being used in subsistence agriculture. In addition, riverbanks, sandbars, and river valleys are cultivated, and artisanal fishing is conducted in streams that dry quickly because the riverbanks are not afforested. A reduction in soil fertility has occurred, as well as a loss of flora and fauna and an increase in erosion and flooding. The root causes of these problems are population growth, lack of hydrological and grassland ecosystem management plans, total consumption of resources by agriculture, insufficient recognition of the importance of local ecosystems, lack of skilled competence and of sustainable livelihoods options, as well as no access to credit.

(d) Health hazards

Health hazards are a challenge that can be linked to the limited availability of drinking water, drought, and the occurrence of extreme weather events. People are exposed to water shortages, particularly during the dry season, and wells and boreholes do not always provide water with adequate drinking quality. Frequent floods during the rainy season increase the spread of waterborne diseases such as cholera and parasitic infections, which cause casualties every year. In addition, increasing average temperatures cause the spread of air-borne diseases such as endemic malaria, meningitis, and measles, as well as the appearance of parasites including hookworms and roundworms.

(e) Insufficient administrative and institutional governance

This challenge arises from shortcomings in the control of access to land and access to basic social services such as health, education, and water, with an overall low institutional capacity to support production and conservation. Ecologically, the production landscape is threatened by the expansion of cultivated areas and pastures, increased erosion, and the increase in wasteland (*hardés*) due to poor agricultural techniques. As agriculture is practiced on clay and alluvial soils (*karal*), sandy or loam soils and sterile soils (*hardés*) are abundant and sometimes left to the pasture. However, competition among farmers and

grazers in the ownership of these unfertile lands has raised conflicts among the landscape stakeholders.

3.3.2 Responses

Between September and October 2013, a landscape-wide baseline assessment was conducted along with the communities of Bogo to assess the resilience of the landscape and to subsequently design a strategy that encourages practices that strengthen resilience. As part of the baseline assessment and consultation process, a set of indicators for resilience in SEPLS collaboratively developed under the leadership of the International Partnership for the Satoyama Initiative were used as a tool to facilitate understanding in the communities and to strengthen resilience of the target landscapes (UNU-IAS et al. 2014). These indicators of resilience were measured in four interrelated dimensions, namely: 1) ecosystem protection and biodiversity conservation; 2) agricultural biodiversity; 3) knowledge, learning, and innovation; and 4) social equity and infrastructure.

Consultation and participatory evaluation were conducted between September and October 2013 by a team of researchers, in compliance with social conventions in the far northern region of Cameroon, namely with men and women consulted in separate groups. Such a process has allowed efficient, effective, and increased participation of women (30%–40%) in the planning process, and subsequently in the implementation of the landscape strategy. Consequently, focus groups were held with each Lawan and neighborhood leaders (Djaouros) to discuss problems and challenges faced by communities and to address the changes related to SEPLS indicators.

The overall synthesis of the indicators of SEPLS for Bogo (means of measurements collected from eight communities) shows a balance of perception in learning knowledge and innovation, social equity, and infrastructure that have relatively low standard deviations. However, as shown in figure 2 and table 1, there is some divergence between ecosystem protection and agricultural biodiversity: 0.62 & 0.60, (SGP/COMDEKS Cameroun Landscape Strategy 2014).

Following the landscape-wide baseline assessment, a landscape strategy was developed to address the key challenges identified. Based on the priority areas and challenges identified in the landscape strategy, seven community projects were designed by civil society organizations (CSOs) and twelve communities. To address the various challenges and issues raised above, these community projects have provided local solutions to improve ecosystem and community resilience through the implementation of key resilience-strengthening activities as outlined in the landscape strategy.

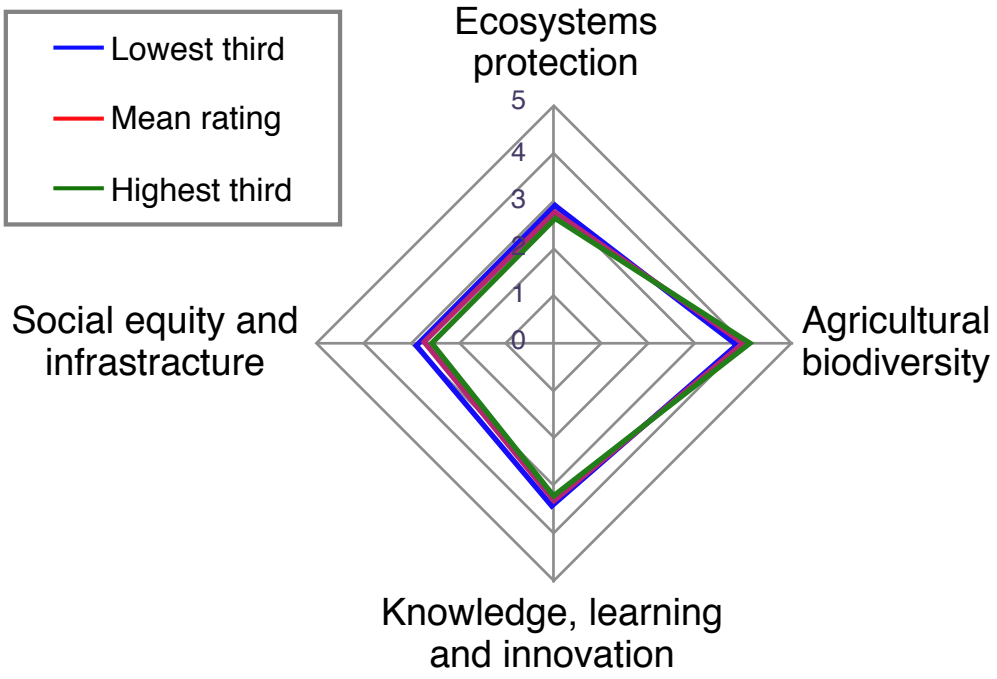

Figure 2: Synthetic radar diagram of SEPL performance indicators at Bogo
Source: SGP/COMDEKS Cameroun landscape Strategy 2014

Table 1: SEPL performance score synthesis for the Bogo landscape

General synthesis of SEPLS at Bogo	Ecosystems protection	Agricultural biodiversity	Knowledge, learning and innovation	Social equity and infrastructure
Lowest third	2,85	3,87	3,41	2,84
Mean rating	2,73	3,98	3,31	2,72
Highest third	2,60	4,11	3,19	2,55
Standard deviation	0,62	0,60	0,45	0,44

Source: SGP/COMDEKS Landscape Strategy 2014

(a) Improving drinking water

Activities to improve access to potable drinking water included the construction of boreholes (**Photos 1a** and **1b**) with solar powered pumps for pumping water to an elevated storage reservoir, providing collection water taps for communities, and establishing drinking water points for livestock. To improve and sustain access to water, more than 300 community members were trained on management and conservation of local water systems.

(b) Cleaning and deepening natural ponds

In addition, natural water ponds previously invaded with mud were cleaned and rehabilitated by communities, and local plant species that had disappeared decades ago were planted around water ponds in an effort to re-introduce these species into the landscape. Water from these natural ponds is now used for gardening, livestock watering, and also for washing laundry.

(c) Improving food security

In an effort to improve food security and promote agro-biodiversity, high quality seeds of different varieties of onions, maize, and sorghum resistant to climate change were promoted and provided to farmers. The use of drought-resistant onion varieties and training on post-harvest technologies for processing agricultural products such as onions were promoted to sustain crop revenues in this changing climate with more severe and frequent droughts.

Photo 1a: Boreholes with solar powered pumps
Photo credit: Hajara Haman *(MBOSCUDA)*

Photo 1b: Animal drinking point
Photo credit: Hajara Haman *(MBOSCUDA)*

Photo 2: Presentation of iron improved stoves
Photo credit: Fadi Kadi (CADEPI)

Photo 3a: Mixing components with the binder to produce biofuel pellets
Photo credit: Fadimatou Hassimi (Association Horizon Info)

(d) Promotion of biofuel and improved stoves use

To create an alternative to the use of fuel wood, which has substantially driven deforestation and loss of vegetation in the Bogo landscape and continues to exploit the few remaining trees and woody shrubs of the landscape, a community initiative established a production enterprise for biofuel and improved stoves, which is mostly operated by women (**Photos 2, 3a,** and **3b**). Biofuel pellets are produced from various household and agricultural waste such as groundnut, maize, and sorghum waste.

(e) Reforestation and agroforestry practices

More than 10,000 seedlings of various tree and shrub species (including *Balanites aegyptiaca, Tamarindus indica, Diospyros mespiliformis, Moringa oleifera, Acacia nilotica, Acacia Senegal,* and *Acacia albida*) produced in various community nurseries were planted to restore and revitalize the landscape. This afforestation, coupled with the distribution and use of improved cooking stoves among the local population, will certainly reduce deforestation for fuel wood consumption. By promoting water and soil conservation techniques coupled with agroforestry methods, >20 ha of impoverished land has been restored and is now being used for agriculture across several partner communities in the Bogo landscape.

(f) Funding and literacy

To promote economic empowerment of women and to diversify income-generating activities, a Women Sustainable Development Fund was established in several communities with the aim of supporting income-generating, women-led activities. More than one hundred income-generating activities undertaken by women benefited from small loans provided through this fund. Families acknowledged the evident benefits of the supported income-generating activities, with more children being sent to schools and women increasingly contributing to family subsistence and health care. Through adult literacy programs, more than 340 people (including women and youth) were trained, further contributing to the development of social capital and economic development of the partner communities. Although the landscape is located in a Muslim area, women and youth voices are now heard, and they are involved in decision-making processes regarding landscape management. These programs have also contributed to the empowerment of communities in the landscape through the promotion of a micro local economy. The development and promotion of handicrafts, ecotourism, good agricultural and environmental practices, and the culture and consumption of local medicinal plants are opportunities to improve local livelihoods.

Photo 3b: Woman displaying produced biofuel pellet at Guinglay
Photo credit: Fadimatou Hassimi (Association Horizon Info)

(g) Knowledge and learning

Training on leadership and conflict management, in response to the mostly agro-pastoral conflicts (between sedentary farmers and nomadic herders), was provided to community leaders and representatives, as well as religious authorities. Moreover, local community institutions were strengthened through the legalization or revamping of community natural resources management and development committees. Platforms for dialog for different communities sharing common ecosystems (water plain or woodland) have been established to promote collaborative natural resource management in the landscape. Local knowledge is particularly relevant with regard to the management of biodiversity and innovations in agricultural and pastoral areas to improve the resilience of the SEPL and resident communities. Access and exchange of information and knowledge of local agricultural biodiversity, ancestral customs and ceremonies, and traditional knowledge and practices are passed on by word-of-mouth or learning-by-doing between generations. The documentation and sharing of local knowledge, the use of the native language for knowledge sharing, and the acceptance of the knowledge of women on the use of biodiversity are critical for the sustainability of local ecosystem management approaches.

3.4 Recommendations

After visiting some project sites in different communities of Bogo, the government of Cameroon and certain international organizations are considering support of pilot activities for replication and up-scaling within the National Adaptation Plan. With support of the Ministry of Forest and Wildlife and as part of an effort to establish resilience-strengthening management practices in the Bogo landscape, a site of almost 3,500 ha shared among three communities will be soon established as a community forest.

As the community-initiated and COMDEKS supported efforts to improve SEPLS management only started two years ago, it is recommended to continue the monitoring of the Bogo SEPL for the next three to five years to ascertain the current impacts and benefits on ecosystems and community resilience and, if necessary, adapt the integrated sustainable management plan as pursued by the landscape strategy.

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CHAPTER 4: ETHIOPIA

Home garden agroforestry practices in the Gedeo zone, Ethiopia: a sustainable land management system for socio-ecological benefits

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Summary

Current agricultural intensification approaches focus on the narrow objective of boosting yield and tend to neglect the socio-ecological value of home garden agroforestry systems. Unlike other agroforestry systems, Gedeo agroforestry has myriad unique features. It is not a supplementary production system in which only fruit and vegetables are grown to supplement field grown staple crops. Instead, it is a principal livelihood system in which all forms of crops, including staple, cash, and supplementary crops grow together. The system also supports a population of close to 900 persons/km^2. The main component crops, enset (*Ensete ventricosum*; a herbaceous monocarpic banana-like plant) and coffee (*Coffea arabica* L.), are the pillars of food security. The Gedeo agroforest hosts diversity as high as 50 woody plant species belonging to 35 families in each plot of 100m^2. Its uniqueness also emanates from its exclusive reliance on indigenous knowledge (IK). IK allows the perpetuation of both production and protection functions. Recently, wrong perceptions of agroforestry productivity, erosion of IK, and expansion of monocrops driven by market forces have challenged its survival. If these are not quickly and properly addressed, Ethiopia will lose the indigenous Gedeo agroforestry system, leading eventually to a great loss of agro-biodiversity and socio-ecological benefits.

Keywords: Agroforestry, Gedeo, Home garden, Diversity, Ethiopia

4.1 Introduction

Agriculture in natural ecosystems has gradually evolved into more resilient and dynamic systems where trees and crops coexist on the same unit of land (Geist & Lambin 2001). Most of these agroforestry systems have evolved from forests. Rainforests are closed systems with high species diversity. In contrast, commercial agriculture is an open system with low species diversity. An agroforest is a continuum between closed forest and monocrop agriculture with intermediate complexity and species diversity. Agroforestry practices stand for the intentional integration of trees, crops, and livestock on the same unit of land. Agroforestry is an integrated approach using benefits of interaction between agriculture and forestry technologies to create more diverse, productive, profitable, healthy, and sustainable land use systems (Tewabech & Efrem 2014; Daizy et al. 2008).

Agroforestry is a widespread practice throughout the tropics. It is also a long-time practice in all regions of Ethiopia except the semiarid lowlands of Gambella, Somale, Benshangul Gumuz, and Afar. According to Brandt (1984) cited in Negash, Yirdaw & Luukkanen (2011) agroforestry began with agriculture 7000 years ago in Ethiopia. In another study (Tadese 2002) the beginning of agroforestry was traced back to 5000 years ago. The model of agroforestry in Ethiopia depends on geography and locality. It can be practiced on the whole agricultural landscape or only on farmer homesteads.

Cultivation of planned and intensively managed trees, crops, and livestock in the home garden is home garden agroforestry. Home garden agroforestry is a more complex multi-stratum than other agroforestry systems (Zebene et al. 2015). It is known for its diversity, ecosystem balance, sustainability, household food security, and rural development in Ethiopia (Tesfaye, Wiersum & Bongers 2010; Tadese 2002). At present, home gardens maintained by 20 million people in the south and southwest represent one possible strategy for biodiversity conservation (Kindu 2001; Kabir & Webb 2008). The Gedeo home garden agroforestry is unique from many perspectives. According to Bishaw et al. (2013), Gedeo agroforestry is the most structurally complex agroforestry system in Ethiopia. Unlike other agroforestry systems, Gedeo agroforestry is not a means of supplementary food production but the principal means of livelihood (Ayele, Ewnetu & Asfaw 2014). Although the Gedeo agroforestry system is often cited as a model for land use, the system has not been described in detail. This short review paper summarizes the unique features of the Gedeo agroforestry system, identifies the components, describes their interactions, and discusses the management aspects, and the underlying indigenous knowledge (IK).

4.2 General description of Gedeo zone

The Gedeo zone is located 369 km from the capital, Addis Ababa, and 90 km from the regional capital Hawassa, to the south on the main highway from Addis Ababa to Moyale toward Kenya (**Figure 1**). Administratively, it lies in South Nation Nationalities and People Regional State (SNNPRS) one of the nine self-administering regions in Ethiopia. Geographically, the zone is located north of the equator from 5°53'N to 6° 27'N latitude and from 38° 8' to 38° 30'east longitude. The altitude ranges

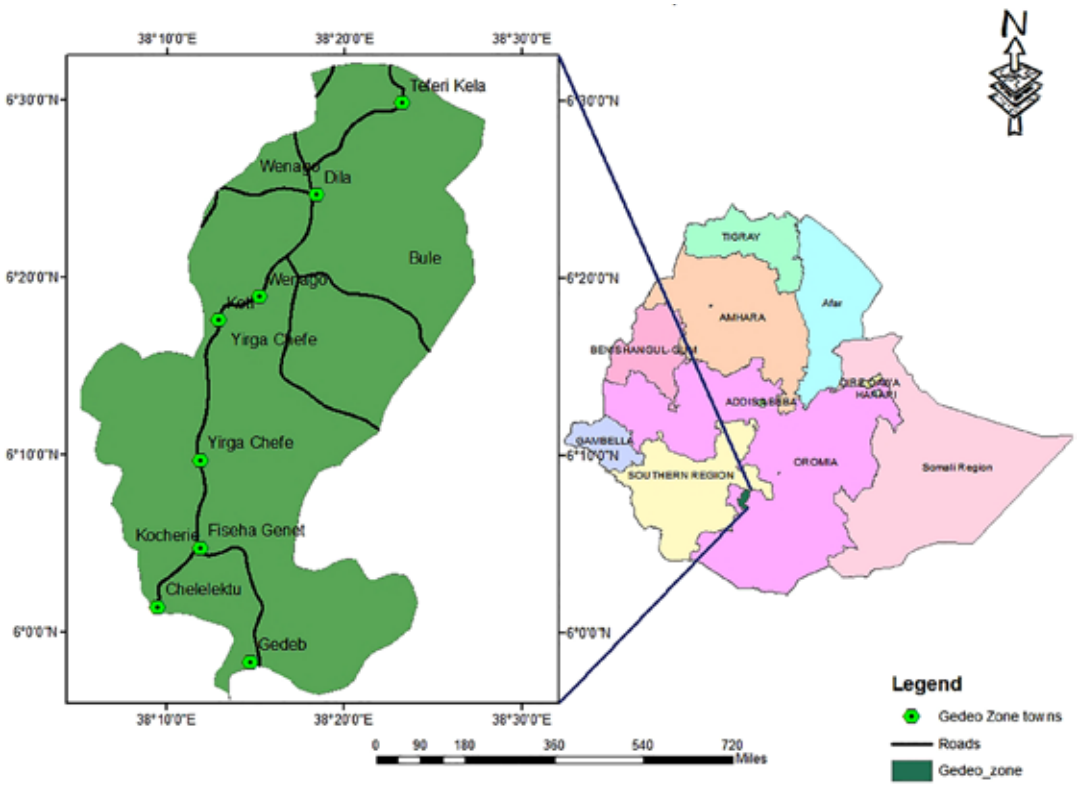

Figure 1: Gedeo zone location map
Source: Sileshi Degefa

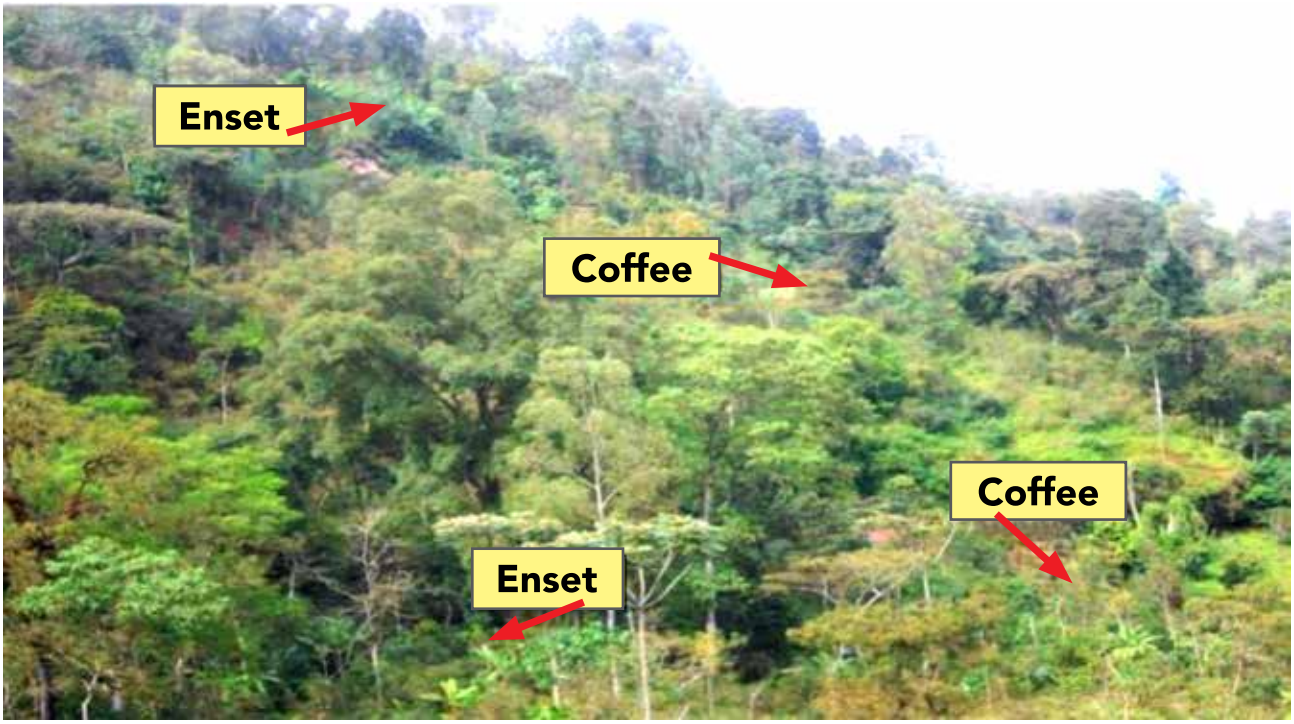

Photo 1: The dominant crops enset and coffee on a high slope of a Gedeo agroforest
Photo credit: Gebrehiwot & Maryo 2015

from 1500 to 3000 m above sea level. The Gedeo highland receives both equatorials and monsoons, the two most important trade winds in the region (Tadese 2002). It has a subhumid tropical climate and receives a mean annual rainfall of 1500mm. The mean annual temperature range is 12.6–22.4°C (Bishaw et al. 2013).Gedeo is one of the major coffee (*Coffea arabica*) and enset (*Ensete ventricosum*)-producing zones of the region. Coffee and enset are the dominant perennials in the Gedeo agroforest. This agroforest is also the home of the internationally recognized organic coffee "Yirgachefe." The land use of Gedeo comprises 80% cultivated, 19% pasture, and 1% forest (Bishaw et al. 2013). According to (Gebrehiwot & Maryo 2015) the agroforestry area covers 89,239.7 ha, approximately 69.3% of the total area of Gedeo zone.

4.3 The genesis of the Gedeo agroforestry system

The origin of the Gedeo agroforestry system is uncertain, but Tadesse (2002) stated that it descended from shifting cultivation 5000 years ago. But it is clear that the geographic and demographic situation of the Gedeo landscape led to the agroforestry system. As the population increased, farmers had too little land to continue with specialized production of staple crops, cash crops, and supplementary crops cultivated separately. Unlike in other home garden agroforestry systems, the Gedeo people do not use their home gardens for supplementary crops such as fruits and vegetables alone. Instead, all forms of crops for example, staple crops such as enset and maize; cash crops such as coffee (*Coffea arabica)* and chat (*Catha edulis* a stimulant plant); fruits; and vegetables are cultivated together. Trees are also another important resource for the livelihood of the farmers. With the increasing population, the communal forest system used previously is not sustainable for Gedeo farmers. Thus, trees are also integrated with the crops on the same unit of land. Livestock is also a component of the Gedeo agroforestry system. Crops such as enset and banana and trees such as *Millettia ferruginea* are used as feed sources (Birhanu, Getachew & Adugna 2013).

The present complex system cannot be constructed simply by combining the components. Instead, through empirical observation by farmers, the integration process reached evolutionary maturity, with beneficial interactions enhanced and hostile interactions nullified. The optimization of spatial and temporal arrangement of the components is embedded in IK, which is transferred orally along the chain of generations (Abiyot 2013). The cultural

and archeological amenities in the area are the living witness of long time human–nature intervention. Among them, the Chelba Tutti, Sede Tuttefella, and Sakarosodo megalithic sites and the Odola Gelma Ancient Rock Engraving Site can be mentioned. The Gedeo has also a traditional structure of ranks and age classes called *Baalle*, similar to the egalitarian Geda system of neighboring Guji Oromo (Abiyot 2013; Tadese 2002). The Geda system is the oldest living traditional socio- political, religious, cultural, and environmental institution for managing common-pool resources (Derara 2015). The similarity between the two systems shows the role of *Baalle* in natural resource management.

4.4 Categorization of home garden agroforestry in Ethiopia

Ethiopia is one of the tropical countries in which home garden agroforestry is ubiquitous in the highlands. Agroforestry is the major component of Ethiopian farming systems. On the basis of the components, Gedeo agroforestry is categorized as the agrosilvo pasture type (Nair 1993) where trees, crops, and animals are part of the system. The three common types of agroforestry practices are home garden, parkland, and woodlot (Aklilu et al. 2015). In the cereal crop-based farming system, staple food crops such as barley, teff (*Eragrostis tef*, a small grain), wheat, and maize are grown in the outer farm with trees while vegetable species and fruits are grown in the home garden. This type of agroforestry system is known as parkland agroforestry. Parklands are the traditional agroforestry systems of central and northern Ethiopia where naturally growing, valuable trees are protected and nurtured on cropping and grazing lands. The second type of agroforestry system is perennial-crop based home garden agroforestry systems, in which perennial crops, fruits, spices, vegetables, trees, etc. are grown in the home garden. The prototype perennials are enset and coffee. Such a home garden agroforestry system is common in the south and southwestern highlands. The third type of agroforestry system in Ethiopia is woodlot agroforestry. An example of woodlot agroforestry is the bamboo-based agroforest in the Dawuro zone (Madalcho & Tefera 2016).

Photo 2: Gedeomultistory agroforestry system
Photo credit: Bishaw et al. 2013

The Gedeo agroforestry system can be categorized into perennial-based agroforestry with special aspects. The unique aspect of Gedeo agroforestry is that all crops including staple food, cash, and supplementary crops are integrated together. The shortage of land does not allow Gedeo farmers to grow specialized crops. For instance, in the Guraghe zone and the central highland of Ethiopia, perennials are grown on the homestead while staple food crops such as teff, wheat, and barley are grown in outer fields. In this kind of system, the mainstay of the farmers is cereal crops grown in outer fields, while crops in the home garden are supplementary.

The Gedeo agroforest is also further categorized into three types (Negash 2007; Negash, Yirdaw & Luukkanen 2011; Negash 2013) based on the dominant component species. Enset and trees dominate the agroforest at the altitude of 2000 masl. This type of agroforest is an enset–tree-based agroforest (**Photo 2**). At middle altitudes, coffee and enset co-dominate the forest. This type is categorized as enset–coffee–tree-based agroforest located in altitude ranges of 1600–2000 m (**Photo 4**). At lower altitudes, enset is rarely seen, and coffee and fruit occupy the most space. This type of agroforestry is coffee–fruit crops–tree-based agroforest, located at altitudes below 1600 masl (**Photo 3**).

4.5 Characteristics of Gedeo home garden agroforestry

Home garden agroforestry represents a high degree of compositional, structural, and functional diversity playing key roles in on-farm conservation and

Photo 3: Coffee-based agroforestry in Gedeo zone
Photo credit: Bishaw et al. 2013

ensuring environmental well-being while contributing to livelihood support systems (Habtamu & Zemede 2011). Mainly indigenous tree species such as *Ficus spp., Cordia africana, Croton macrostachyus,*and *Millettia ferruginea* and fruit trees such as mango (*Mangifera indica*) and avocado (*Persea americana*) form the upper story. Dominant species such as coffee (*Coffea arabica L.*), an evergreen shrub, and enset (*Ensete ventricosum*), a large non-woody evergreen perennial herb, form the middle story, as illustrated in photo 4. The low story is often occupied by vegetables, spices, and herbs. The coffee component decreases with altitude, but enset is found at all altitudes (Gebrehiwot & Maryo 2015). The architectural design of this system helps to use space effectively in such a way that the combination enhances beneficial interactions and nullifies adverse ones. In some cases, productivity of crops in an open field is far below productivity in the combination. For instance, coffee can be grown in an open field as a monocrop in some parts of Ethiopia; however, the quality as well as quantity is considerably lower than that of the coffee on an integrated farm. Indeed, the other typical characteristic of Gedeo home garden agroforestry is its productivity on slopes as steep as 80% (EPA 2004), which is steeper than the optimal slope for agriculture.

4.6 Ecological benefits of Gedeo home garden agroforestry

The ecosystem services and ecological benefits of agroforestry are often masked by farmers' mere expectation of maximum yield from the monocrop farm (Shibu 2009). The home garden as a traditional agroforestry system in many regions has shown great value in maintaining high degree of diversity. In country such as Ethiopia where the deforestation rate is extremely high, agroforests serve as a refuge for many plants and animals. For instance, Negash, Yirdaw & Luukkanen (2011) identified 58 woody species belonging to 49 genera and 30 families on 60 agroforest farms of the Gedeo zone. Similarly, in a study conducted in Gununo Wolayita, 32 woody species belonging to 19 families were recorded (Bajijo & Tadese 2015). A total species of 50 plants of 35 families was recorded (Negash 2013) in a home garden of size 100m^2 in the Gedeo zone. In general, the Gedeo agroforest is endowed with nationally and globally significant biodiversity and genetic resources.

Many factors enable the Gedeo agroforest to host maximum diversity. Among them is the upper story species, providing supplementary habitat for shade-tolerant species (**Photo 5**). As an example, coffee (*Coffea arabica*) is well adapted to growing under the shade of indigenous tree species. Home garden agroforestry enhances land use efficiency. As the agroforest land is individually owned, the indigenous tree components are buffered from the pressure on communal forest land. Furthermore, the agroforestry systems have created a connectedness as a movement corridor for different species, facilitating gene flow.

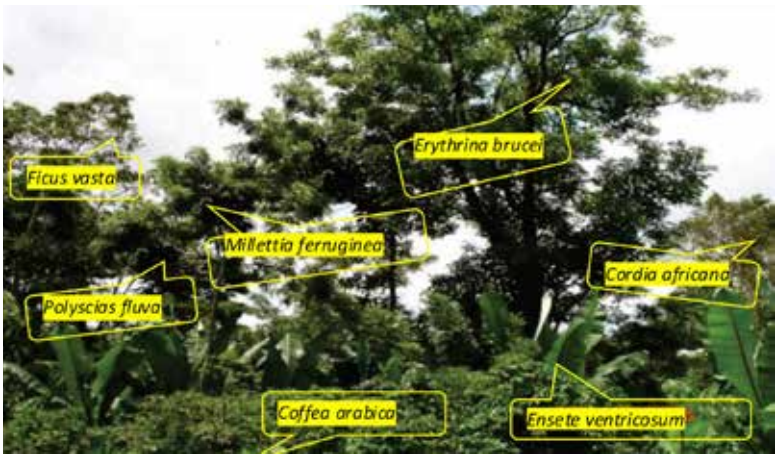

Photo 4: The upper- and middle-story species in a Gedeo agroforest
Photo credit: Negash 2013

Photo 5: Supplementary habitat provided by upper story of *Ficus* spp
Photo credit: Tadese 2002

The diversity of plants in the home garden, associated with other organisms, contributes to the formation and maintenance of soil structure and the retention of moisture and nutrient levels and promotes the recycling of nutrients (Verchot et al. 2007). This is particularly important in hillside farming, where agriculture may lead to rapid loss of soil. According to Tadese (2002) for instance, agroforestry land use is suited to the mountainous Gedeo area, as it protects against erosion. The agroforestry system plays a significant role in soil fertility maintenance. A study by Madalcho & Tefera (2016) in Gununo Wolayita showed that the chemical property of the top soil is significantly high in home garden agroforestry. Its nitrogen content also far exceeds that in other types of agroforest.

Furthermore, the slow-growing upper story serves as carbon storage (Bishaw et al. 2013). For instance, *Ficus sur* is the most dominant species in Gedeo agroforestry system. Furthermore, whole tree harvest is uncommon in the tree management tradition of Gedeo people. Twigs are removed for domestic uses and most carbon remains in the trunk.

4.7 Socioeconomic benefits of Gedeo home garden agroforestry

There is a very high population density in the Gedeo zone, whose mainstay is agriculture. For instance, there are 956.2 persons/km^2 in Wonago district (Bishaw et al. 2013) and 652 in Yirgachefe (Ayele, Ewnetu & Asfaw 2014) far exceeding the average of 122 in the SNNPR. The high productivity of this agroforest helps the community to be food secure although there are many other factors which affect food security in the area.

Gedeo agroforestry is economically more viable than other land use systems because of the constituent high-value cash crops and staple crops (Tesfaye 2005). It is also the best-performing among agroforestry systems in Ethiopia. A study conducted in Yigachefe (Ayele, Ewunetu & Asfaw 2014) described the high economic performance of the coffee-enset-based Gedeo agroforestry system as compared to parkland agroforestry. It offers multiple products including construction materials, food for humans and animals, fuels, fibers, and shade. Women in Ethiopia actively participate in home garden management than other farms. They selectively domesticate useful species in their homesteads. The products of home garden agroforestry are highly used by women (Galfato, Gabiso & Tewodros 2015).

4.8 Current challenges and future prospects

Recently, home garden agroforestry has been challenged by demographic, economic, technological, and social pressures (Habtamu & Zemede 2011). The growing population pressure in Gedeo has destroyed the agroforestry practices (Bishaw et al. 2013). The population size is beyond the carrying capacity of the system, creating an imbalance between consumption and maintenance. The population burden leads to the degradation of forest species, which are the backbone of the system.

Under pressure from land fragmentation and environmental and societal change, many Ethiopian smallholders are in the process of transforming their farming strategy toward market-oriented monocropping to meet their needs for household food security and income. Bishaw et al. (2013) stated that cash crops have affected the production of food crops in Gedeo Zone. The stimulant plant, khat (*Catha edulis*) is expanding at the expense of dominant crops such as enset and coffee.

In the management of agroforestry, IK plays a crucial role. IK includes different sets of complex practices. Tadese (2002) described two kinds of agroforestry-related IK. The first is knowledge of the selection of component species (core and subsidiary) and the second is knowledge of how to arrange the species in space and time. The spontaneous combination of different elements may not help to achieve production and protection objectives. The IK helped Gedeo people to create an ideal agroforestry for socio-ecological well-being. The erosion of the IK is among the factors accelerating the deterioration of the Gedeo agroforestry system.

This IK is transferred to generations with some modifications. But the rate at which this IK of agroforestry is transferred is slowing (Madalcho &Tefera 2016). Young people who attend school are no longer interested in becoming farmers (Abiyot, Bogale & Baudouin 2013). They place more value on the knowledge obtained from formal schooling. However, still there is a practice of gathering together to acquire knowledge from elders. The local knowledge and management practices shaped over centuries can be lost unless thoughtful attention is given and proper documentation is put in place (Habtamu & Zemede 2011).

4.9 Conclusion

Agroforestry systems have contributed to biodiversity conservation and production of diverse products to maintain the livelihood of the farming households in Ethiopia. In particular, it has served as a mainstay in the highly populated Gedeo zone. The influence of markets, land scarcity, and population pressure has accelerated a shift from subsistence home garden agroforestry to market-based farming. With the expectation of producing more food to feed the rapidly growing population using high inputs and monocropping systems, farmers are inclining toward producing one or two crops in a monocropping system by abandoning the traditional agroforestry system. In addition, little attention has been paid to IK. The rate at which IK is transferred from elders to the younger generation is slowing down. The pressure from untested and ever-expanding monocrop farming systems and the dying out of IK together have facilitated the decline of the agroforest in quality and quantity. If this decline is not quickly and properly addressed, Ethiopia will lose a traditional agroforestry system, ultimately leading to great losses in agrobiodiversity and to socioeconomic calamity.

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CHAPTER 5: ETHIOPIA

Torwards sustainable livelihood and environental management in the Gilgil Gibe 1 catchment: Oromia Region, Jimma Zone, Ethiopia

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Summary

Most Ethiopians live in rural areas and are engaged in agricultural activities. Over the years, increasing population, small average landholding area, and continuous land cultivation have led to the transition from heterogeneous land use practices to monocropping. In the socio-ecological production landscape (SEPL) of the Gilgil Gibe catchment located in Oromia Regional State, Jimma Zone, Ethiopia, the previously rich biodiversity resources have gradually depleted to a level that cannot sustain livelihood requirements. Efforts have been made by different development organizations to halt or even reverse land degradation and loss of biodiversity for people to benefit from the natural resources. However, unsatisfactory results have been achieved as a result of several factors such as limited knowledge on alternative livelihood and small land holding systems. To help reverse and revitalize this SEPL, the Community Development and Knowledge Management for Satoyama Initiative (COMDEKS) through the Global Environmental Facility Small Grants Programme (GEF SGP) has supported efforts by various development partners to create awareness on the importance of combining biodiversity conservation with livelihood improvement, which has contributed to positively change the landscape. This study examined the Gilgil Gibe catchment area as SEPL by identifying the diversity of ecosystem services provided for livelihood sustenance. It then explored threats and challenges affecting the sustainability of the landscape as well as current intervention efforts initiated under the COMDEKS program aimed at revitalizing and sustaining this landscape.

Keywords: Ecosystem services, Ethiopia, Livelihood, Local, Socio-ecological production landscapes

5.1 Natural and social background

Ethiopia is the second most populous country in Africa with an approximate population of 98.1 million (PRB 2015). Most people live in rural areas. The country is endowed with diverse socio-ecological production landscapes (SEPLs) (Satoyama 2013), which provide a range of services to poor rural people, including crops and livestock, timber and firewood, and fresh water. The country is heavily dependent on agriculture, with crop production being the key pillar of the economy and the most important source of growth and poverty reduction for the country. Agricultural production is mainly in the hands of small-scale farmers and is

predominantly dependent on rainfall. Ecosystem services are provided by natural resources such as soil, water, forests, and biodiversity, and these services play a significant role within the livelihoods of the large majority of the population. Although most of the agricultural produce serves for subsistence purposes, the produce by these smallholders also generates most of the export earning of the country.

Ethiopia is included in the first round of ten countries selected for piloting the Community Development and Knowledge Management for Satoyama Initiative (COMDEKS) approach. The site for assessing the SEPL and supporting community initiated projects was selected by the Global Environmental Facility (GEF) Small Grants Programme (SGP) National Steering Committee (NSC). The aim of the projects was to contribute to the efforts of other development actors working to reverse the serious environmental degradation affecting the landscape. The target landscape is located in the Oromia Regional State, Jimma Zone (**Figure 1**). The landscape covers four "*Woredas*" (districts), namely Sokoru, Omo-Nada, Kersa, and Tiro-Afeta, which are located in the Gilgil Gibe 1 (GG1) catchment with a total area of approximately 127,800 ha (1,278 km^2). According to the Jimma University baseline assessment report, the target area is found within 8° 0′–7° 30′ latitude and 37° 50′–37° 25′ longitude at an altitudinal range of 1,590–3,350 m above sea level. The climate of the landscape can be classified as sub-humid, and the main annual rainy season occurs between June and September, with an annual rainfall ranging from 1,300 to 2,000 mm.

The landscape of the GG1 catchment consists of a diverse mosaic of ecosystems, and the local farming community depends on subsistence agriculture. As a result of the sharp increase in population, the target landscape has changed over the years. To encourage concerted efforts, key actors such as local communities, local governments, non-governmental organizations (NGOs), donors, and private sector actors within the SEPL were identified from the onset. A landscape-wide baseline assessment of the SEPL was conducted using the resilience indicators developed by the Satoyama Initiative, which is a tool for engaging

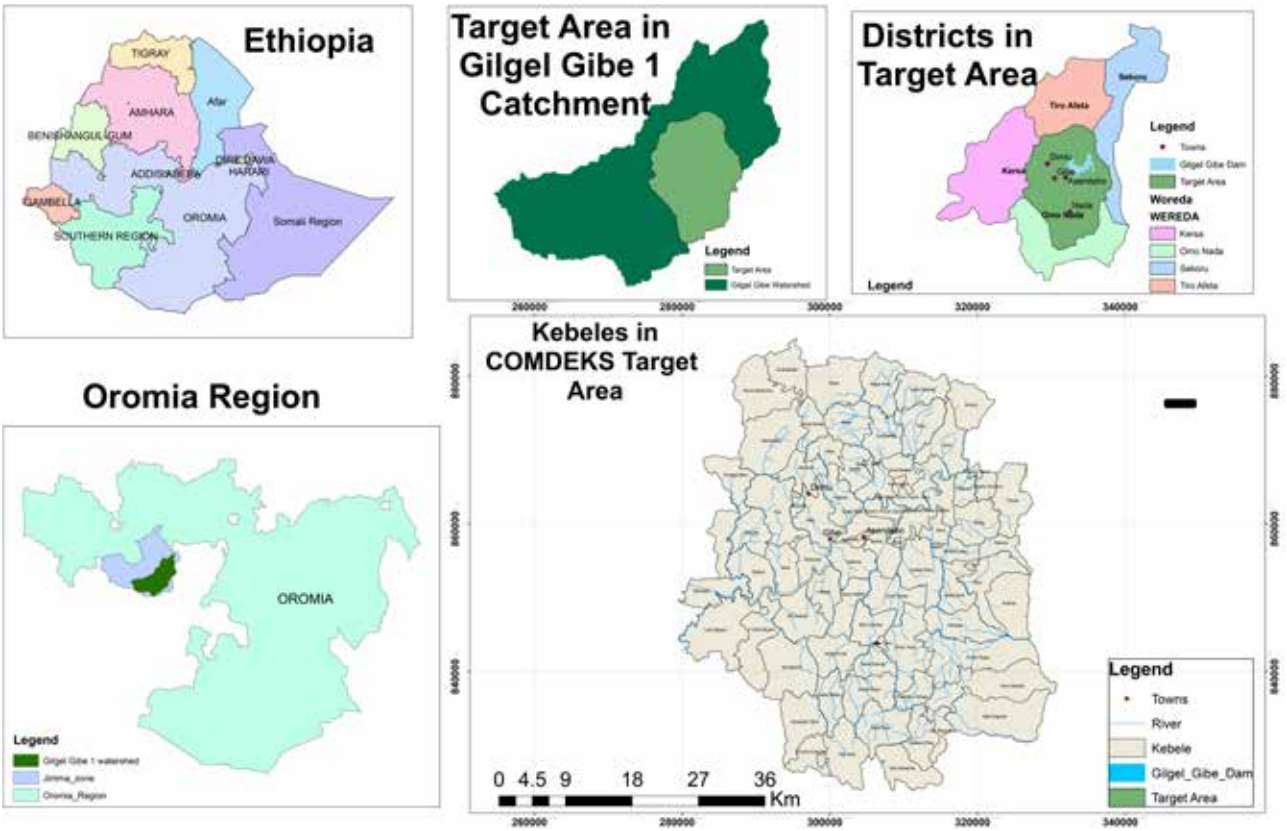

Figure 1: Map of the Community Development and Knowledge Management for Satoyama Initiative (COMDEKS) target area
Source: Jimma University, Country Program Landscape Strategy 2012

Photo 1: Gilgil Gibe 1 catchment area in Kersa District
Photo credit: Zeleke Tesfaye

local communities in adaptive management of the landscapes (UNU-IAS, Bioversity International, IGES and UNDP, 2014). SGP then supported 22 projects that covered a wide range of activities generally contributing to natural resource conservation and livelihood improvement.

5.2 Functions and benefits

5.2.1 Benefits of biodiversity and ecosystem services

Similar to other parts of the country, the diverse production landscapes of the GG1 catchment area provide a range of tangible services to rural communities, including crops, livestock, fuel wood, construction materials, potable water, and fresh water for irrigation. However, these landscapes are under pressure due to continuous land degradation that affects agricultural productivity. Agriculture is an important source of growth and poverty reduction for the project area. According to different sources, the sector accounts for almost 48% of Ethiopia's gross domestic product (GDP) and 85% of export earnings. Agricultural production is largely rain-fed and dominated by small-scale farmers that produce >90% of the country's crops.

According to the World Bank, it is estimated that 30,000 ha of land is lost annually as a result of soil erosion, representing >1.5 billion tons of soil per year that is lost by a variety of land degradation processes. On the other hand, the land area of individually owned farms in the project area is very small, resulting in insufficient crop production to support subsistence farming. As a result, farmers and their families move elsewhere to search for employment to augment their income. The sustainable use of natural resources is important to sustain the lives of both humans and other living creatures within the identified landscape to ensure their smooth co-existence. Using this approach, we made certain observations during the baseline assessment and subsequent project activities.

Understanding of the SEPL approach (i.e., the relationship between people and the ecosystems they inhabit and which sustain them) by all concerned parties is key to take appropriate actions and share responsibilities to reverse, or at least to halt the negative impact of humans on ecosystems. This

Photo 2: An example of a community discussion
Photo credit: Zeleke Tesfaye

facilitates awareness of the value of protecting the natural environment for the benefit of the current and future generations. The approach of using the indicators developed by the Satoyama Initiative has facilitated a better understanding of the relationship between people and ecosystems through creating a sense of belonging. The participatory planning approach has encouraged conservation of the natural environment, while simultaneously diversifying livelihoods. As a result, the local communities were able to strengthen their resilience due to the increased awareness and the improvement to their livelihoods generated through the support of the project.

In addition, a noticeable improvement of the ecosystem within the rehabilitated watershed is evident, as more diverse vegetation has created a favorable environment for insects such as honey bees. Through negotiation, communities have agreed to demarcate degraded land and create exclosures closed from human and animal interference to allow rehabilitation. Enrichment plantation conducted in these closed areas, particularly in areas with sufficient rainfall and fertile soil, has enhanced growth of natural vegetation and improved biodiversity. Local communities have agreed to the exclosures to avoid misunderstanding and conflict regarding the closing of the land among community members at a later stage. They have also developed bylaws that clearly state the rights and obligations that govern members and non-members of the Community-Based Organization (CBO). These measures have substantially contributed to the rehabilitation of the closed areas in addition to the reduction in runoff and soil erosion.

5.2.2 Role of local knowledge practices and systems

There are various different local practices and systems in place in the GG1 catchment area, and their role during interventions and beyond is important. Local knowledge includes community practices such as traditional beehive construction using locally available materials, management of bees, and honey production. People have traditionally built beehives and are able to manage bee colonies. These skills and experiences have assisted them to easily adopt new technologies (such as modern bee hives), as they are already aware of the volume of production achieved using traditional beehives, which can be compared with the production from newly introduced technology. Similarly, their experience in managing bee colonies has allowed them to rapidly familiarize themselves with new beekeeping practices.

The use of local knowledge and indigenous practices with respect to animal fattening is an additional example worth mentioning. Animal fattening through a group arrangement did not work well due to a lack of commitment and insufficient contribution by some members of the CBOs. To improve the productivity from the animal fattening intervention, communities started to employ a more traditional arrangement used for livestock sharing by indigenous communities in the past. Here, the oxen that are bought for fattening are given to individual members of the CBO, and the person responsible for the fattening agrees to share the profit with the CBO and obtains his share for the contribution that he/she has made. Within this arrangement, the benefit sharing is based on a prior contract agreement between the CBO and the individual. This is an important hybrid institutional arrangement (mix of formal and informal institutions) that enabled the animal fattening to be achieved smoothly in the target area. In addition, the person responsible for fattening the oxen is entitled to receive a dividend together with other members of the CBO in addition to the share obtained for his/her contribution.

The local communities in the GG1 catchment area also have traditional experience in producing seedlings of some plant species around their home, as well as picking and growing seedlings germinated

naturally. All of this local knowledge has contributed to the adoption of the technologies introduced and the improvement of biodiversity in the SEPL.

5.3 Challenges and responses

5.3.1 Challenges and implications for the local socio-ecological system

Multiple and closely-related socio-economic, cultural, environmental, and political factors pose challenges to the development of strategies to enhance resilience. From the baseline assessment of the GG1 catchment socio-ecological production landscape, four of the major challenges are discussed:

(a) Unsustainable agricultural practices

Communities depend almost entirely on biomass for their daily energy needs, particularly for fuel wood and construction purposes, which has a direct negative impact on the continually diminishing forests and crop residues. The use of ox-plowing, improper cultural practices, and hoe culture are commonly used in farming, all of which contribute to the loss of fertile top soil, leading to low productivity. In addition, local communities have emphasized the increasing flood hazard as a result of vegetation clearing on the upper hills.

(b) Deforestation

Although the area was once covered with forest, the dwindling forest resources have resulted in loss of water, soil, and biodiversity in particular, as well as forest ecosystems in general. As sustainable forest management is crucial for future generations, actions to tackle the underlying problems are required. The conversion of heterogeneous landscape into homogeneous land has numerous negative consequences, which are not well understood by local communities. It was agreed that efforts have to be strengthened to create awareness on these local environmental issues.

(c) Lack of alternative livelihood

The major causes of land degradation and poor harvests are the lack of alternative livelihoods and the poor living conditions of the communities. Conservation of natural resources and poverty have a direct relationship. It is the lack of alternative livelihoods that forces communities to unsustainably exploit available natural resources, not a lack of understanding of the consequences if they continue this behavior. Rapid population growth beyond the carrying capacity of ecosystems further exacerbates poverty and overexploitation of natural resources. Therefore, efforts have to be made by all development actors to address the issue of poverty and lack of opportunities and knowledge to ensure the sustainable use of natural resources. Fertile soil loss and siltation/sedimentation of reservoirs have affected communities and water reservoirs used to generate electricity.

Photo 3: Livestock fattening in close area
Photo credit: Zeleke Tesfaye

(d) Large population of livestock

Many areas in Ethiopia, and in particular the project area, are known for their tremendous livestock population. Livestock graze in the open, which results in trampling and loss of pasture. Due to poor pasture management and increased livestock population, land degradation has progressed even faster. An increase in the number of livestock is actually considered as indicator of wealth by the community, whereas the resulting land degradation is not directly perceived as a loss. The lack of awareness among the communities regarding the need for integrated landscape management has further contributed to the dwindling of natural resources.

5.3.2 Responses

During the course of supporting communities in their effort to address both environmental and livelihood issues, COMDEKS through GEF SGP has advised and encouraged the establishment and strengthening of CBOs. Working with and through CBOs has multiple advantages, despite their limitations in project implementation. CBOs often understand issues faced by local communities better than externals parties, and their participation contributes to ownership and sustainability.

Working with local governments for technical and financial support is inevitable to ensure sustainability. The engagement of relevant government institutions from the onset of each project is imperative. This has facilitated smooth working relationships between concerned stakeholders at the grassroots level. The willingness of the local government to incorporate these activities as part of its development plan and to assign focal persons has been critical to ensure collaborative efforts. During this process, multi-stakeholder engagement is necessary, since problems are multi-dimensional, and the genuine involvement of these stakeholders contributes to increasing the resilience of communities. Local communities, government, planners, researchers, private sector, NGOs, and policy makers, among others require a complete understanding of the status of the changes in the landscape to strengthen resilience.

In its support to community, the SGP highly discourages the distribution of project inputs as handouts. Experience has shown this practice to increase dependence and lower confidence among the community. Therefore, the support provided by COMDEKS through SGP to the community must be considered as seed money, should revolve within the CBO, and should address more people, depending on their need and interest. An additional requirement is that grantees leverage resources from micro-finance institutions at the local level. Micro finance institutions (MFIs) exist in the nearby areas that are meant to support communities in their effort to overcome poverty.

An additional recommendation by the SGP is the need to mobilize savings (both individual and group) on a regular basis to cover part of the financial requirements of the communities in their effort to undertake different activities. Communities have to save to obtain loans from MFIs. As mismanagement of natural resources is partly due to a lack of knowledge in addition to a lack of alternative means, efforts were made to develop capacities of communities to build their resilience within the SEPL.

The ex-post assessment has indicated that the project has started showing results at the landscape level regarding the provision of ecosystem services and biodiversity conservation. Apart from economic uses, such as using the rehabilitated areas for beekeeping, cattle fattening, seedling production, and similar activities, the contribution of the project to the provision of ecosystem services is vast. The enclosed areas show positive responses towards vegetation restoration. Farmlands are benefiting from the organic matter associated with increased vegetation cover, the increased soil moisture as a result of soil conservation measures, and ultimately improvements to soil fertility. The positive effects of area closures and the changes are evident from improved abundance of flora and fauna. In certain rehabilitated watersheds, springs that had dried up in the past are now returning through the enhancing of infiltration. The interventions have already prevented further degradation of the natural environment and have contributed to an increased vegetation cover in the buffer zone.

According to the ex-post baseline assessment report, provision of training, capacity building, and awareness creation were among the key components that contributed to the success and sustainability of the project. These components contributed to raising awareness and developing capacity of CBO members to build strong CBOs that can work collectively. Similarly, the financial support provided by COMDEKS has assisted the implementation of appropriate interventions that fit the social and environmental conditions. From the inception of the current project, existing governmental structures have been used to implement activities. This approach ensures the continuity of the intervention. Since the CBOs have legal statuses, they can acquire credit services from other financial institutions to enable them to continue future activities without external financial support.

5.4 Proposed interventions

Addressing food security objectives without protecting the natural resource base will not be attainable among the majority of small-scale farmers in the project area. The CBO approach through integrated natural resources management has created linkages among all stakeholders for improved soil, water, crop, and livestock management at the *kebele* (lowest government unit) level. The CBO approach involving the management of their development has the advantage of creating positive synergies to tackle poverty, food insecurity, and natural resources degradation. The local government has now also started following this approach.

The ex-post baseline assessment showed that interventions implemented by the CBOs through the support of the COMDEKS program has produced promising benefits to the income of members, and also maintained and improved the local environment. As a result, several promising practices have been observed at a landscape level that could be replicated in the surrounding area or elsewhere where a similar socio-economic and environmental context applies. The lessons learnt from the COMDEKS approach at the landscape level will also be replicated by GEF SGP in different countries during OP 6.

The developed watersheds in the COMDEKS *Woredas* are being utilized for diverse livelihood activities (beekeeping, cattle fattening, commercial seedling production) that are environmentally friendly (non-destructive). They are also activities that do not take away time from other household activities and provide the opportunity for households to generate income at different times of the year. Therefore, the experience of including diverse and non-destructive/ non-extractive livelihood activities on the developed watershed is a best practice that can be scaled.

Food production, sustainable rural livelihoods, conservation of biodiversity, and ecosystem services at a landscape level requires balance on ecological, social, and economic considerations. For this to happen, the SEPL approach could provide viable activity options.

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CHAPTER 6: GHANA

Compound farming system in semi-arid Ghana: a socio-ecological production landscape in decline

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Summary

In rural semi-arid Ghana, individual families and households deliberately use lands and plots around their homesteads or family compound homes as farms through the effective combination and interaction of cropping, livestock, poultry, and agroforestry schemes. These farms, known as sambankoli (local Dagbani), represent an integral component of rural agroecosystems in this socio-ecological landscape. For centuries, these spaces have been an essential source of provisioning ecosystem services such as food, medicine, fuelwood, and more latterly income to supplement household needs. Compound farms have also served as the ecological space for various cultural, supporting, and regulating ecosystem services necessary for maintaining local livelihood systems in the harsh semi-arid savanna ecosystem. Against the backdrop of challenges linked to rapidly changing socioeconomic, cultural, political, and environmental conditions in semi-arid Ghana and beyond, this once-resilient agroecosystem is vulnerable and threatened. This study documents the current state of compound farming systems in semi-arid Ghana based on a 3-year in-depth field survey of six communities in the Tolon district of the Northern region. The present study examines the defining characteristics, functions and values of compound farming systems in semi-arid Ghana. Current threats and challenges as well as recommendations for the sustainability of compound farming systems is discussed.

Keywords: Compound farms, Households, Semi-arid Ghana, Ecosystem services

6.1 Natural and social background

Ghana's semi-arid landscape consists primarily of three autonomous administrative and ecologically homogeneous regions namely Northern, Upper West, and Upper East. Located in the Guinea and Sudan Savanna agroecological zones, the regions account for approximately 41% of Ghana's total land area (238,539 km^2). Generally, human population density appears to be the lowest in this semi-arid savanna landscape among other parts of Ghana. Semiarid Ghana is characterized by harsh physical environmental and high poverty levels, resulting in a large disparity with the rest of the country in terms of economic development and human well-being. These conditions prevail despite the substantial socio-economic growth and reduction in poverty experienced across Ghana's other regions over the past three decades (Songsore 2011; Ghana Statistical Service 2013). Thus, this socio-ecological

production landscape is regarded as one of the most climatically and ecologically vulnerable regions in sub-Saharan Africa.

The focal study area is the Tolon district in the Northern region (**Figure 1**). In Ghana's local governance structure, districts represent the second-level administrative subdivisions in its decentralization system (Institute of Local Government Studies and Friedrich-Ebert-Stiftung Ghana 2010). Tolon district lies between latitudes 10 and 20° N and longitudes 10 and 50° W. It was formerly part of Tolon-Kumbungu, until it was carved out in 2012. The district capital, Tolon is an approximately 20-min drive from Tamale, the regional capital. The Tolon district shares borders with Kumbungu District to the north, Tamale Metropolitan Assembly to the east, North Gonja to the west, and Central Gonja to the south (Ghana Districts 2015). Dagombas are the dominant ethnic group in the area.

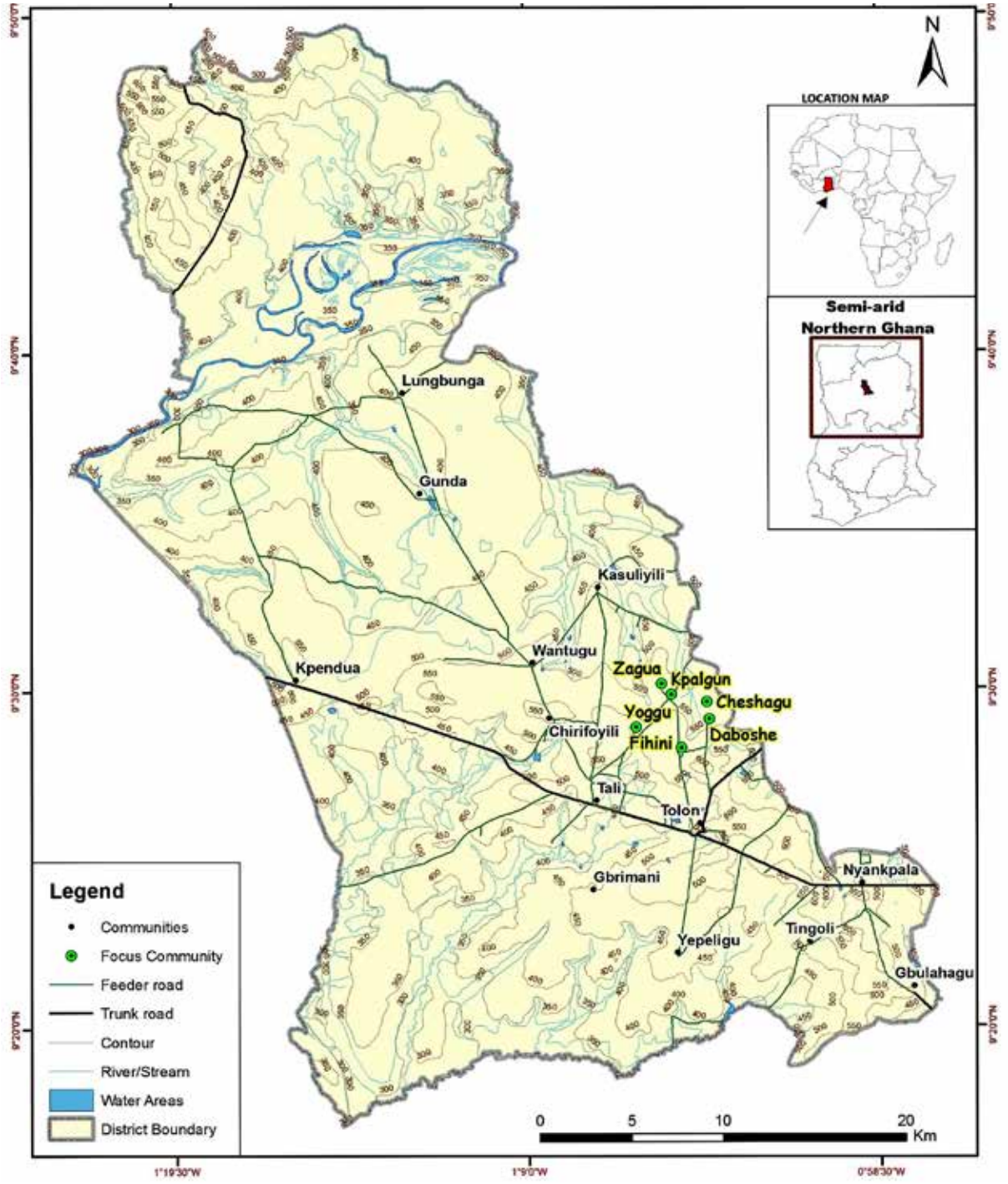

Figure 1: Map of Tolon district showing the survey villages in relation to semi-arid Ghana
Source: George Senyo & Yaw A. Boafo

The area has a peculiar sub-humid and semi-arid climate marked by a distinct wet and a dry season. Rainfall usually commences in May and ends in the latter part of October. The peak period is from July to September, though it is highly variable. The rest of the year is dry. The average annual rainfall is 1,000 mm. Characteristics of the rainfall are great variability, patchy pattern, and uneven distribution, often leading to farmers planting more than twice because of intermittent drought that impairs plant growth. Temperature is warm, dry, and hazy around February to April. It is cool and moist with high relative humidity between May and October. The *harmattan* (a dry and dusty northeast trade wind emerging from the Sahara Desert) is experienced between late November and January. It is generally hot during the daytime, with nights being cold with a wide range of temperature.

The vegetation of the district is Guinea savanna, characterized by tree species including locust ("dawadawa") (*Parkia biglobosa*), shea (*Vitellaria paradoxa*), kapok (*Ceiba pentandra*), baobab (*Adansonia digitata*), and whitethorn (*Faidherbia albida*). Such perennial grasses as *Andropogon gayanus* are ground cover vegetation. The geology that supports the growth of these trees and grass and other agricultural crops is the Voltaian sandstone, which produces light soils prone to concretions and hardpan (Runge-Metzger & Diehl 1993). However, the natural vegetation has been severely depleted as a result of anthropogenic factors such as wild bush fires, illegal logging of trees for charcoal and fuel wood, hunting, farming, and construction. The only exception in the district and the communities is the protection of sacred groves, which still maintain a diversity of plant species (Boafo, Saito & Takeuchi 2014), but remain under threat from farming activities encroaching into their boundaries.

Farming is the foremost socio-economic activity of households in this predominantly rural landscape. Over 80% of residents are involved in farming, which is a mix of food crop cultivation and animal rearing (Ghana Statistical Service 2013). Despite this activity, chronic food security is one of the biggest challenges facing rural populations in semi-arid Ghana. Small-scale trading and youth outmigration to urban centers in southern Ghana are also important livelihood strategies among the population. Farming is predominantly on a smallholder and rainfed basis. Some irrigation with water from small-scale dams is undertaken in most communities. Most small-scale dams dry up almost completely during the dry season with its associated drought conditions. The most widespread small-scale farming system is the bush fallow system with a mosaic pattern of land ownership and land use. This system is characterized by rotation of fields rather than of crops, the use of fire for clearing vegetation, the use of simple hand tools for cultivation, mixed cropping for domestic consumption, and the use of fallow to restore the nutrient balance (Gyasi 2002). Compound farms, which are established around settlements, are important sources of food and income for households. Although extensive fieldwork for this study was performed in six villages (*Zagua, Kpalgun, Yoggu, Cheshagu, Fihini, and Daboshe)* (**Figure 1**) in the Tolon district, compound farming is not restricted to this area. It is widely practiced across households and communities in semi-arid Ghana.

Major crops cultivated by farmers across farming systems include maize, yam, groundnut, cowpea, pepper, millet and sorghum, tobacco, rice, and Bambara bean. Livestock and poultry rearing are common in most households. The main livestock and poultry are cattle, sheep, goat, guinea fowl, and chicken. The adverse climatic conditions across semi-arid Ghana are the largest challenge to farming and other livelihood sustenance strategies, all of which are related to the provisions of the local savanna ecosystem. Seasonal extreme shocks and disturbances such as flooding of farmlands and prolonged drought, bush fires, water shortage, and declining soil fertility with the removal of shade trees in the area are evidences of this condition. Some of these disturbances can be blamed partly on human factors, including poor environmental management associated with inefficient farming practices, hunting for fuelwood, and shea butter and groundnut oil extraction.

6.2 Characteristics of compound farming systems

Compound farms are intensively cultivated fields found around or close to homes or compound houses in semi-arid Ghana (**Photos 1** and **2**). Among the Dagombas in focal area, compound farms are popularly called *Samban Koli* (local Dagbani). As one of the oldest forms of land use forms, compound farms are known differently in other regions of the world. For example, they are called *home gardens*

Photo 1: An illustration of the interrelationships found in compound farming systems
Photo credit: Yaw A. Boafo & Abdallah Alhassan 2015

Photo 2: A typical compound farm planted with maize, with neem trees dotted around at Kpalgun village
Photo credit: Yaw A. Boafo 2014

in India, Nepal (Kumar & Nair 2004), *Kandyan forest gardens in* Sri Lanka (Landreth & Saito 2014), and *Pekarangan* in Java, Indonesia (Marten 1986). In semi-arid Ghana, compound farms remain an important subsystem of traditional agricultural farming systems and have been part of the local physical and socio-cultural milieu for centuries. Compound farms are normally under permanent cultivation. However, in sparsely populated villages, small patches may be left fallow for tethering livestock during the farming season. Compound farms integrate various arable and tree crops with livestock and poultry.

Major arable crops found on compound farms in the Tolon district consist of cereals: maize (*Zea mays)* and millet (*Pennisetum glaucum*); pulses: cowpea (*Vigna unguiculata*) and groundnut (*Arachis hypogaea*); vegetables: chili (*Capsicum annuum*), tomato (*Lycopersicon esculentum*); and tobacco (*Nicotiana tabacum*). Examples of indigenous tree crop species on most farms include baobab (*Adansonia digitata*), neem (*Azadirachta indica*), and kapok (*Ceiba pentandra*). In semi-arid Ghana, the above tree crops are sub-spontaneous and are protected by locals. Exotic trees such as teak (*Tectona grandis*), cashew (*Anacardium occidentale*), moringa (*Moringa oleifera*), and mango *(Mangifera indica*) have increasingly become integral components of compound farming systems. Examples from the livestock and poultry component are sheep, goat, cattle, guinea fowl, chickens, and pigeons. Arable and tree crops are essential components of compound farming systems.

Primarily, compound farms serve as the main source of livelihood sustenance through the provision of critical ecosystem services such as food, medicine, building materials, soil improvement, drought regulation, recreation, and aesthetic experiences. Soil fertility on the compound farms is maintained by addition of house refuse as well as droppings from livestock such as sheep, goats, and cattle. This is performed more effectively in the long dry season when areas around the homestead become bear with almost no vegetative cover (**Photo 3**). Dung beetles also aid in converting some of these animal wastes into organic material. Crop sequencing by farmers, which involves a deliberate inclusion of legumes such as groundnut and cowpea on farms, greatly improves soil nutrients. Composting has lately been an essential means of improving compound farm soil fertility.

Regarded as a legitimate agroforestry subdivision, compound farms vary considerably in size and shape. In Tolon, the average area of cultivation on a compound farm is one half acre per household. Cultivable area is significantly influenced by socio-demographic and economic characteristics such as family size, diversity of income sources, and land ownership systems being major determinants. The

Photo 3: Compound field in the dry season in Fihini village. Livestock graze on these fields, generating manure as dung and urine
Photo credit: Yaw A. Boafo 2015

main farm implements used by farmers include hoe, machete, and ax. Labor for compound farms comes from individual households despite the variety of activities engaged in by members at stages of production. Although mainly men are in charge of land preparation and weeding, women often help in sowing, harvesting, and marketing excess produce. Children also help by taking care of animals or making ridges and mounds as well as transporting food from home to the farm for consumption, where applicable. Elderly members of household also help by preventing stray animals from consuming or destroying farm products. Farmers usually work on their compound farms in the early morning before going to their bush farms as well as in the evening when they return.

6.3 Functions and values

Compound farms provide multiple essential functions needed for directly and indirectly improving human livelihood and sustaining the natural ecosystem of the semi-arid landscape. The farms contribute significantly to household food supply. In an area known for its high level of food insecurity (World Food Programme 2009) and poverty, the variety of food obtained from compound farms contributes significantly to daily household food needs. Compound farms supply households with both staple and non-staple food sources when needed, in contrast to bush farms farther from the homes. Further, products of compound farms are sold by households for income to supplement food needs or acquire ancillary assets including farm implements and fertilizer. Other socioeconomic and cultural obligations are fulfilled with proceeds from the sale of crops or livestock. For example, most households who cultivate tobacco in the Tolon district on their compound farms do so mainly for its value in income generation. Exotic fruit trees such as *Mangifera indica,* commonly found on most of the compound farms, are important components of household diet, providing vitamins. For a majority of households in the Tolon area, *parkia biglobosa* is a condiment that promotes good eyesight.

For most farmers, compound farms serve as testing grounds for new crop varieties. It is also common to see well-developed compound farms being used as nurseries for seedlings before they are planted on bush farms. As a result of their subsistence nature for many years, compound farms serve as ideal locations for maintenance of wild plant species and traditional crops. As a field survey found, traditional healers are cultivating scarce and critical medicinal plant species, particularly shrubs and browsers otherwise found in bushes on compound farms in order to ensure quick access to herbal medicine when necessary. Compound farms thus provides an avenue for ex-situ conservation practices. Linked to this is the low level of application of chemical fertilizers, herbicides, and pesticides on compound farms, promoting microorganism diversity (Birol, Bela & Smal 2005).

In villages where compound farms are well developed, tree crops such as *Ficus trichopoda*, *Ceiba pentandra*, and *Mangifera indica* help control soil erosion and are used as windbreaks. With their characteristic richness in genetic diversity, compound farming systems promote pollination. Tree crops and surroundings of compound farms provide essential cultural services to community members including recreational, spiritual, folklore, and religious uses. Compound farms thus form part of the culturally constructed spaces within rural communities (Eyzaguirre & Linares 2004). Several sacred groves identified during field surveys in Yoggu, Kpalgun, Daboshe, Fihini, Cheshagu, and Zagua villages are surrounded by compound farms.

6.4 Threats and challenges to sustainability

Despite the centuries of resilience shown by compound farming systems, rapidly changing socio-economic, cultural, environmental, and political conditions threaten the contribution of compound farming systems to both human livelihood sustenance and healthy ecosystem functioning. Four main closely related factors are discussed.

6.4.1 Climate change and variability effects

Climate change and variability remain one of the greatest threats not only to farming systems but also to ecosystem resilience across many regions of the world. However, as research has confirmed, much of the effects will be felt by poor, rural farmers in semi-arid regions, owing to their high dependence on the natural ecosystem (WRI 2005). In many communities of semi-arid Ghana, changing rainfall and temperature patterns are increasing water scarcity and severely hindering rainfed agricultural production. Compound farms that have always served as a primary source of staple food crops are becoming uncultivable. In cases where they are cultivated, soil fertility is low, resulting in poor yields. Infertile soils can also be attributed to erosion of soil. Low rainfall and prolonged drought are causing drastic changes in local vegetation, implicitly affecting genetic diversity. Common plant species and micro-organisms on compound farms, which contribute to sociocultural, economic, and ecological functioning of the local ecosystem, are expected to disappear.

6.4.2 Prevailing poverty

A majority of rural communities in semi-arid Ghana are faced with poverty and limited access to critical resources needed for livelihood improvement. The prevailing poverty leads people to use and manage unsustainably the bundle of services provided by the semi-arid ecosystem. With the lack of money to buy food, cultivate, and/or acquire the necessary inputs to improve bush farms, compound farms are becoming the only source of food crop production for locals. Most rural farmers are unable to adopt to improved farming practices. They are unable to buy drought- or disease-tolerant seeds because such seeds are sold at prices beyond their purchasing power. Deepening poverty means that people are becoming more vulnerable to the expropriation of their land by both local and foreign investors for large-scale agriculture. When people become overly dependent on the compound farms, they are forced to abandon traditional knowledge systems and practices that have been associated with and have contributed to the resilience of such farming systems. For example, pressure is now being placed on tree crops on compound farms, as they are being harvested for firewood (Boafo, Saito & Takeuchi 2014). In the past, most firewood was collected from woodland areas. With the increasing scarcity of firewood, restrictions as well as rules and regulations regarding the collection and utilization of the tree species found on compound farms are not being strictly enforced. Compound farms are therefore changing their critical function of maintaining biodiversity to that of degrading it.

6.4.3 Population pressure

Expansion of households as result of increased human population growth is placing greater demand on resources including land for settlements. In rural communities of semiarid Ghana, land is generally considered to be in abundance. Much of the land, however, is regarded as too infertile for crop production. With increasing family sizes comes high population density, thus making it impractical to leave enough space around settlements to use for cropping. The tree component on the local landscape is also declining with increasing population. Linked to this is the increasing change in the traditional political structure and land tenure arrangements. Labor outmigration is accelerated with the lack of space for farming, inevitably affecting compound farming.

6.4.4 Increasing use of chemical fertilizers and pesticides

Although soil fertility can be improved with the application of chemical fertilizers, transitioning to their exclusive use instead of combining them with organic fertilizers, as is currently occurring in semiarid Ghana, is expected to degrade micro-organismal and biological diversity. Chemical fertilizer compounds and salts that are not absorbable by plants contribute to changes in soil chemistry that are detrimental to plant growth. Similarly, pesticides endanger both plant and human life if not used properly. The

increasing use of these elements on compound farms across Ghana's semiarid ecosystem thus poses a major risk to efforts at safeguarding ecosystems.

6.5 Going forward

As a subsector of the agriculture production sector in Ghana, compound farming systems, from our investigation has not been received the needed attention from key stakeholders despite the significant socio-economic and ecological benefits associated with this farming system. There appears to be a general lack of knowledge, awareness, and appreciation of the ecological functions and values of compound farms beyond serving as a hotspot for food crop production and income for rural households.

Generally, intervention strategies and efforts by relevant stakeholders to help address the many threats and challenges facing Ghana's agricultural sector range from providing advisory or extension services to smallholder farmers on farm preparation and management practices to subsidizing or offering inputs. These efforts have often aimed at helping poor rural farmers to cultivate more land and harvest more, especially in the case of semi-arid Ghana. Whereas existing efforts such as intensive use of agrochemicals on farmlands may be helping to increase productivity in the short term, the long-term implications have been found to be undesirable. Ample evidence indicates that the continual application of modern techniques such as tractors for ploughing coupled with the intensive use of agrochemicals including fertilizers, herbicides, and pesticides negatively affect the ecological functioning of agroecosystems. Degradation and loss of genetic resources and diversity, excessive erosion, reduced soil fertility are some of the widely discussed negative effects. In the case of compound farming systems in semi-arid Ghana, the ongoing trend is worrying. The loss of genetic diversity, particularly where poor farmers in rural semi-arid Ghana communities is concerned, is associated with reduced food security, increased economic uncertainty, increased vulnerability to pests and diseases, reduction in the possibilities for adaptation and for future generations and accelerated loss of local knowledge about diversity.

In the face of the existing and looming threat of climate variability and change, conserving genetic diversity is critical for building resilience and adaptability in socio-ecological production landscapes in vulnerable semi-arid regions. Sensitization programmes on the importance of compound farms as a mean for promoting healthy ecosystems and improving the livelihood of households should be undertaken. Such programmes need to promote climate smart agriculture practices, agroforestry schemes in addition to prioritizing the integration of resilient traditional knowledge practices and systems of communities associated with farming and ecosystem services utilization and management.

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CHAPTER 7: GHANA

The Weto socio-ecological production landscape in the mid-Volta region

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Summary

The Weto socio-ecological production landscape is a dynamic, mountainous mosaic landscape characterized by tropical climatic conditions with moist semi-deciduous vegetation and diverse habitats and land use. It forms the southern part of the Togo-Atakora Mountains, measuring 343,549 ha. The landscape has been shaped by cultural beliefs that have guided the conservation of agro-biodiversity and protection of highly ecologically sensitive areas. However, the landscape has been challenged by increasing habitat destruction, loss of biodiversity, land degradation, and widespread poverty. In enhancing landscape connectivity and resilience, a participatory strategy was implemented in June 2011 under the Community Development and Knowledge Management for the Satoyama Initiative (COMDEKS). The program covered 45 ecologically distressed communities in the landscape. After 5 years of implementing the program, the landscape has witnessed widespread adoption of agroforestry and other sustainable land management practices. This adoption is helping to rehabilitate watersheds and reverse land degradation trends. New agro-based enterprises, including bee-keeping, small ruminant rearing, grasscutter rearing, a piggery, and ecotourism, have emerged, creating new livelihood opportunities and expanding the landscape's economic base. The COMDEKS program has witnessed the formation of the Weto Platform as the landscape-wide governance system for sustainable natural resource management.

Keywords: Biodiversity, Ghana, Landscape, Livelihood, Socio-ecological

7.1 Natural and social background

The Weto landscape area in Ghana forms the southern part of the Togo-Atakora Mountains. This socio-ecological production landscape (SEPL) spans 11 traditional areas and three political administrative districts: South Dayi District (Kpeve), Afadzato South (Dzolokpuita), and Ho East in the Volta region. It measures about 59,000 ha and stretches from Peki to Logba on the Asikuma to Hohoe road, Have to Vakpo on the Have to Kpando road, and Sanga to Gbadzeme on the Asikuma to Amedzofe road (CERSGIS 2011). There are 126 settlements within the landscape with an estimated population of 85,500. The landscape is a dynamic, mountainous mosaic landscape with diverse habitats and land uses, including towns and villages; farmlands with adjacent cocoa, oil palm, avocado, and mango plantations; and natural forests, sacred groves, fallow grasslands, wetlands, and water bodies (streams, rivers, ponds, and Lake Volta). These resources have served the Weto communities for several generations. The landscape is inhabited mostly by the Ewe ethnic group with deep cultural beliefs that have guided the conservation of biodiversity, agricultural

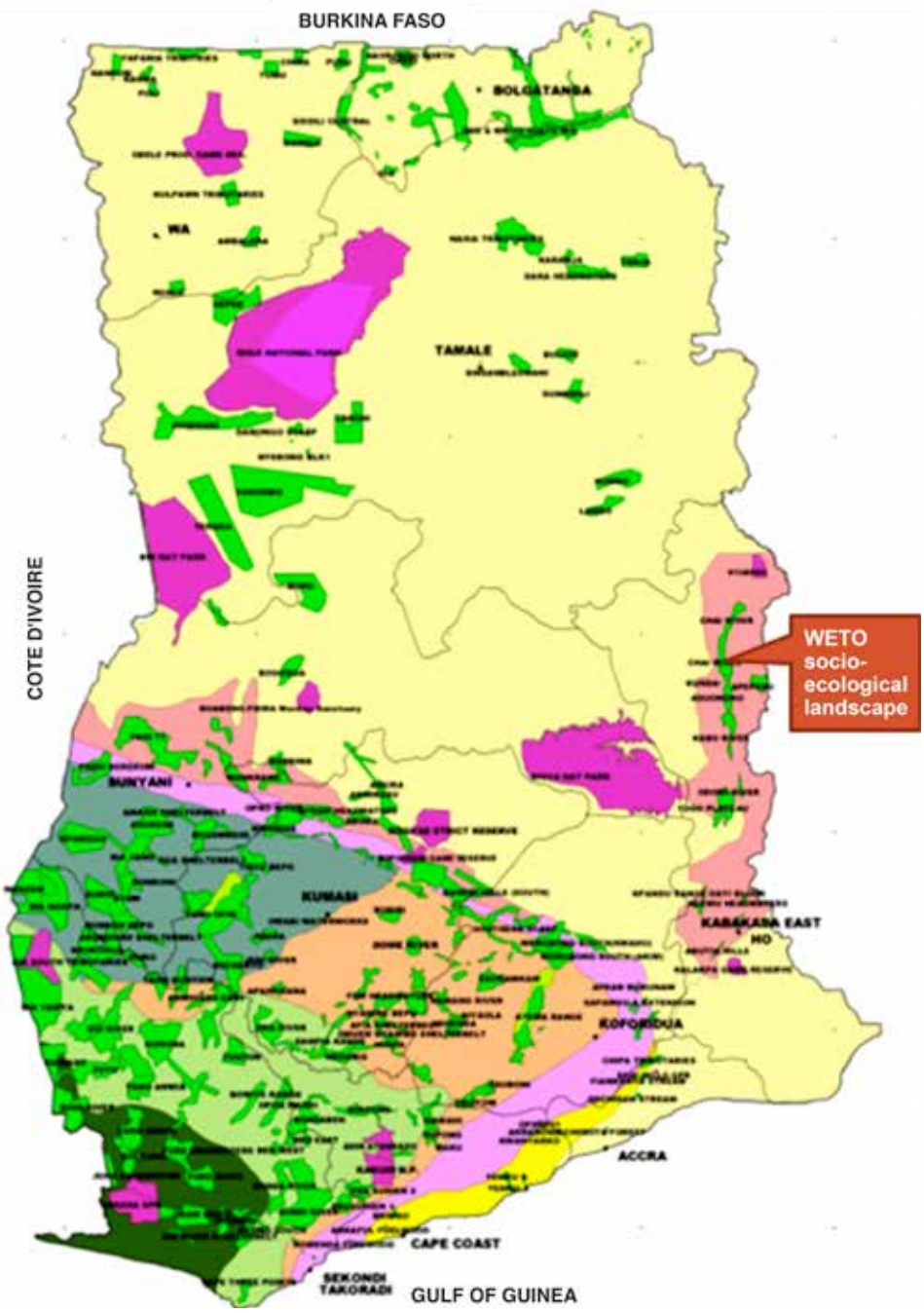

Figure 1: Map of Ghana showing the location of the Weto landscape area
Source: Ministry of Lands and Forestry 2014

practices, and the protection of ecological sensitive areas (Development Institute 2011).

The Weto landscape has a tropical climate, characterized by moderate temperature, 12–25°C for most of the year. The rainfall pattern is bimodal, with two rainy seasons from March to July and from mid-August to October. The annual rainfall is between 713.9 and 1099.88 mm and is spread throughout the year. As part of the Guinea forest of West Africa, the Weto Range has been identified as an important biodiversity hot spot with a Genetic Heat Index >200 (FAO 2012). It contains at least 1,500 species of vascular plants (>0.5% of the world's total) as endemics, although it has lost at least 70% of its original habitat (Conservation International, 2000). In addition to its rich endemic flora, the landscape is home to abundant wildlife, including birds, bats, rodents, monkeys, waterbuck, and butterflies. There are 180 streams with their sources in the landscape and emptying into Lake Volta and the Dayi River,

Photo 1: Aerial view of portions of the Weto landscape
Photo credit: UNDP SGP/GEF, COMDEKS Annual Report 2014

which are the two major aquatic resources used for aquaculture and irrigation. The most common vegetation in the landscape is open forest (18% of the total land area), which consists of a mixture of food crop farms, bush fallows, and cash crops such as oil palm, oranges, and timber plantations. Closed forests (18% of the total area) are mostly community-conserved areas, sacred groves, and mountain vegetation on >80% slopes. The built-up area constitutes 23% of the total area.

The population of the three districts is 580,588 (2010 census) with an annual growth rate of 1.9% and a comparatively high literacy rate. The major ethnic groups are Ewes (90%), Akans (6%), and Northerners (4%). The average annual household income in the area is US$1,200 and the average per capita income almost US$400.00. Approximately 20% of the population lives below the national poverty line (SGP/COMDEKS Ex-poste Study 2014). Farming, hunting, and petty trading are the main subsistence activities. Farm holdings range from 1.5 to 2 hectares of arable land, with farmers engaging in mixed cropping along the slopes of the mountains or on the relatively flat valley terrain. Among the cash crops cultivated in the area are avocados, pears, oranges, mangoes, pineapples, bananas, oil palm, and cocoa. The main food crops are plantain, sweet potatoes, rice, maize, cassava, legumes, and vegetables. Other subsistence activities include small-ruminant rearing, cattle ranching, and artisanal fishing. Approximately 46% of all households in the area operate non-farm enterprises, with women operating 72% of these businesses**.** In contrast to other parts of Ghana, land in the Weto range is not held communally under the authority of traditional leaders. Rather, land plots belong to individual families and are managed by family heads. As there has been no process of land registration in the area to date, families do not hold formal titles to their land. Land transfer and transactions are conducted orally, as are agreements for share-cropping or leasing of land to migrants and tenant farmers.

7.2 Functions and values of the Weto landscape

7.2.1 Socioeconomic and ecological benefits

The Weto landscape is highly heterogeneous in agricultural biodiversity and food systems (**Photo 2**). Different tree species are present at high altitudes, especially in sacred sites. The savannas down foothills are used for rice and vegetable cultivation and commercial fish farming. Various traditional farming systems that promote the conservation of biodiversity are practiced along the slopes. Local knowledge about agricultural biodiversity is strong with farmers practicing traditional agroforestry that integrates trees on farms and into growing crops such as cocoa. By tradition, farmers integrate tree species such as Odum (*milicia excels*), Ahokakyen (*Canthium hispidum*), Prekese (*Tetrapleura tetraptera*), and Sese (*Haloarrhena floribunda*) on farms because they are perceived as the abode of the gods and also a good omen for people and the environment. Strips of land along water bodies are left uncultivated to protect the homes of river gods. Traditional slash and burn practices are still in use with a fallow period of three years or more needed to restore soil fertility. Local belief systems and taboos have guided the conservation of biodiversity within the landscape, thereby also enhancing food security. Locally produced food such as yam, brown rice, maize, cassava, and leafy vegetables forms the basis of more than 90% of the local dishes consumed.

It is estimated that 46% of all households in the area operate non-farm enterprises as additional sources of income, with women operating 72% of these businesses. The landscape is a net exporter of staple foods such as brown rice, *gari* (processed cassava), and indigenous leafy vegetables.

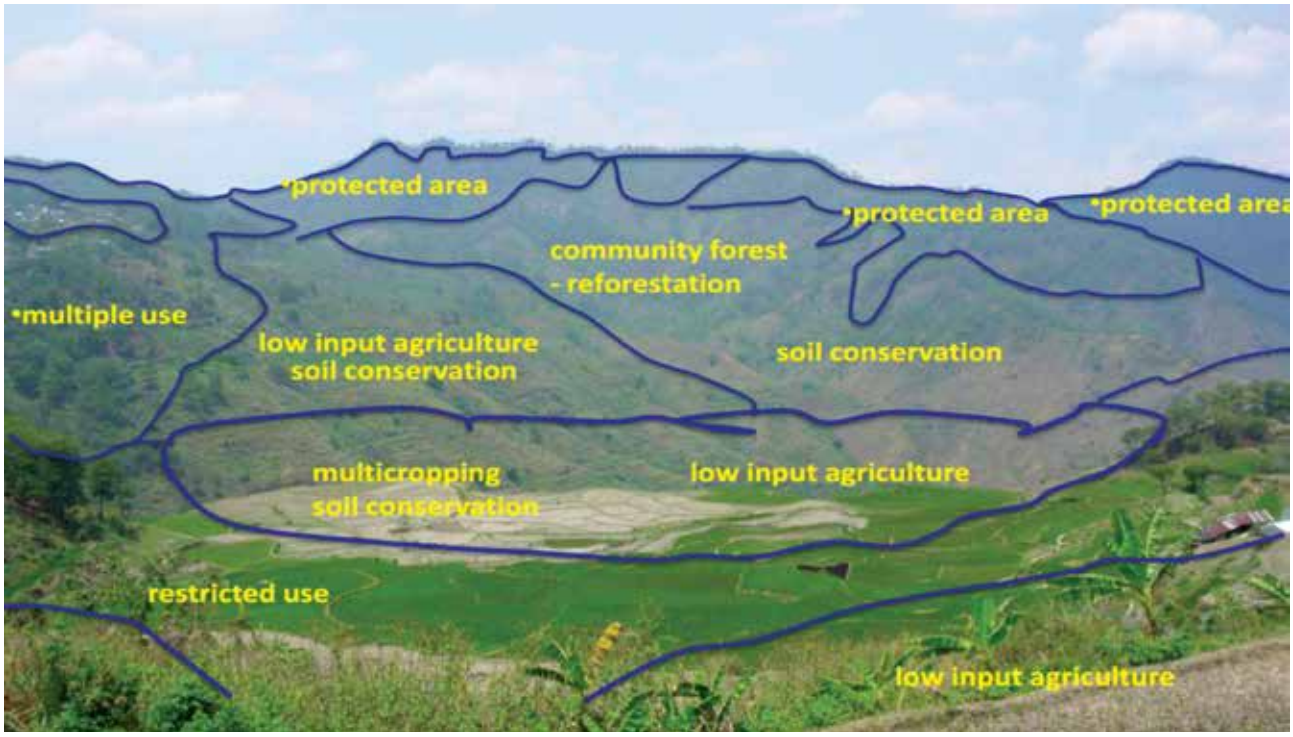

Photo 2: Illustration of land use diversity at sections of the Weto landscape
Photo credit: SGP/COMDEKS Baseline report 2012

7.2.2 Repository of traditional and cultural knowledge practices and systems

There are over 90 caves of social and religious significance. These caves are considered either as the abode of the gods, or sacred sites. The caves now serve as shelter and habitat for animals such as pythons, birds, and bats that are considered as totems by the people. There are 136 traditionally protected forests (sacred groves), with the most significant being *Kale, Weto, Tandze, Dienor, Hator,* and *Obudiaye* (a monkey sanctuary). Most of the traditional priests have their homes within these sacred sites, which are managed by traditional rules and norms. People from all walks of life consult and pay homage to the gods.

Conservation practices within the landscape are embedded in cultural values and practices that are intrinsically tied to the conservation of biological resources. Wildlife is protected through the use of totems as biocultural heritage, which are handed down from one generation to the other. The biocultural heritage includes both tangible and intangible values covering traditional laws and norms, spiritual beliefs and values, ancestral knowledge and practices, and biodiversity conservation.

Five of the seven traditional areas within the landscape celebrate annual yam festivals to consolidate cultural practices and promote spiritual linkages with nature. Various traditional methods are used to spread information and knowledge to the people. The most common ones are *Adzototo* (riddle/folklores), *Agihawo* (royal song to herald the coming of a king), *Avihawo* (dirges/mourning songs), *Lododowo* (proverbs), and *Ahloewowo* (teasing/fooling piece in a drama), to disseminate their messages.

7.3 Threats and challenges

The main challenges and threats affecting the resilience and sustainability of the Weto socio-ecological production landscape over the years include increasing habitat destruction due to illegal logging, illicit hunting, incessant wildfires, unsustainable farming practices, inadequate livelihood support systems, and weak institutional capacity to support conservation and production. The landscape is characterized by low land productivity, increasing food insecurity, destruction of mountain forest ecosystems and vegetation cover, drying up of water sources, land degradation, and widespread poverty (Development Institute 2011).

Generally, the uses of natural resources in the landscape are unsustainable. There has been increasing use of agrochemicals in vegetable farming and cultivation of lands along the steep slopes and watercourses. These practices have led to excessive erosion, reduction in soil fertility, loss of flora and fauna, and drying up of streams. Lack of employment opportunities beyond subsistence agriculture is contributing to youth outmigration.

7.4 Revitalization strategies

7.4.1 Community development and knowledge management for the Satoyama Initiative intervention

To increase landscape connectivity and resilience, a participatory strategy was put in place in June 2011 by the major stakeholders in the landscape under Community Development and Knowledge Management for the Satoyama Initiative (COMDEKS). The adaptive collaborative management strategy sought to conserve the natural and semi-natural habitats and ecosystem services in the landscape (watershed, sacred groves, wildlife habitats, agro-biodiversity areas, etc.). It also sought to promote sustainable ecological agriculture, sustain the establishment of enterprises for improved livelihoods, increase the well-being of target social groups within the landscape, and develop institutional capacity at the landscape level.

Photo 3: Agroforestry farms at Adzopoe community
Photo credit: UNDP SGP/GEF, COMDEKS Annual Report 2014

The program covered 17 community-based groups that mobilized 45 distressed communities within the landscape.

The interventions supported the diversification of agricultural landscapes by introducing agroforestry and management of trees on farms, diversification of production systems through the cultivation of a higher diversity of crops, and promotion of crop–livestock–tree integration. Improved technologies in low-input agriculture and soil conservation and improved water management and water efficiency (mulching, cover crops, rainwater harvesting) were introduced. All interventions incorporated a livelihood enterprise development component based on the needs of the local people. Each intervention introduced financial intermediation schemes that sought to mobilize financial resources from endogenous sources.

7.4.2 Key outcomes of COMDEKS intervention

(a) Ecosystem services and biodiversity conservation

The COMDEKS interventions have revived the otherwise dying cocoa industry in the landscape. The planting of the new variety species was targeted in degraded areas, on farms under agroforestry systems, and in enrichment planting using organic agriculture technologies. Besides this, 35,500 ha of ridge forestland was placed under community-managed natural regeneration. For the past 36 months since June 2011, approximately 90% of the landscape has been protected from incessant wildfires. Through the vigilance of the conservation groups, illegal logging of timber and chainsaw operations has been brought under control. Community groups now continuously patrol the forests with the cooperation of the traditional authorities in order to support the monitoring of logging activities.

(b) Agro-ecology and food security

The project has introduced improved farming methods and techniques to the farmers, which minimize the use of slash-and-burn practices in farming. The introduction of sustainable farming practices along mountain ridges, coupled with the application of compost and organic fertilizer, has minimized erosion along slopes and has increased land productivity twofold. The agroforestry practices have increased the density of trees per hectare of land, thereby increasing the vegetation cover by 60%.

Over 200 farmers are currently engaged in climate-smart agriculture on 500 ha of land. An estimated 100 farmers have been introduced to integrated farming: keeping livestock and using the manure to produce compost for the farms and processing the farm products to feed the animals. Local farmers have invested in improved technologies of low-input agriculture, soil conservation, improved water management, and water efficiency (mulching, cover crops, and rainwater harvesting) practices.

(c) Sustainable livelihood enterprises

The project adopted the sustainable livelihoods approach (SLA) as a way to improve understanding of the livelihoods of poor people and encouraging them to adopt sustainable management practices. The project supported the establishment of five rural enterprises to develop sustainable trade initiatives and markets through Non-Timber Forest Products (NTFP) processing, integrated livestock and small-ruminant rearing (rabbits, goats, and pigs), development of fodder and feed banks, and commercial fruit planting. Most of these enterprises operate in the informal economy, whereas honey production is on the brink of being incorporated into the formal small enterprises market.

(d) Strengthening of institutional and governance systems at the landscape level

At the landscape level, the most significant development in governance has been the formation of the Weto Platform, which seeks to link civil society groups, traditional authorities, and government bodies in a single institution with the goal of approaching natural resource management from a landscape-wide perspective. The District Assemblies in the landscape are involved in the Platform and the COMDEKS program by providing technical advice. Government service providers including Forestry Commission, Ghana National Fire Service and the Ministry of Food and Agriculture provide extension services and training at the community level.

The Weto Platform was initiated in 2012 by NGO beneficiaries of the COMDEKS program. The Platform has been successful in harmonizing the activities of civil society organizations in the landscape that are working on development and conservation issues. Through the quarterly meetings, but also through direct exchanges, NGOs share their knowledge and approaches and have developed common strategies and principles for their work with local communities.

Photo 4: Honey production system in Bame community
Photo credit: UNDP SGP/GEF, COMDEKS Annual Report 2014

The program has also facilitated the formation of farmer trust groups and supported them in income generation activities such as production of vegetables, soybeans, and honey.

Generally, the COMDEKS interventions in the Weto SEPL have promoted a strategy of participatory landscape management. It established a new governance system which has contributed to the following aspects:

i) formation of a network of farmer associations and other community-based organizations engaged in resource management, plantation establishment using indigenous species, and improved traditional farming practices;

ii) integration of traditional resource management systems and formal scientific knowledge to manage degraded landscapes;
iii) using a participatory social cost–benefit analysis to evaluate costs and benefits of business interventions within a livelihood support framework; and

iv) participatory land-use planning based on the classification of land carrying capacity.

The adaptive socio-ecological production landscape approach has provided a powerful tool for understanding the integration of ecology and economics. It has led to the creation of social

capital, natural capital and environmental services, and economic and financial capital. These are essential elements for livelihood development. The COMDEKS program has contributed to building a landscape resilience system that helps to regulate hydrology and microclimate, thereby providing a buffer against extreme weather events, temperature rise, floods, and droughts.

7.5 Recommendations

Based on the achievements of the project as well as the lessons learned, the following recommendations are made for replication, upscaling, and mainstreaming of the landscape model in order to revitalize resilience and sustainable use and management practices in socio-ecological production landscapes.

7.5.1 Promote an adaptive landscape management approach

The steps in adaptive collaborative landscape management should include:

i) establishing a baseline;

ii) developing an action strategy for change;

iii) selecting indicators for tracking progress toward realizing desired outcomes described in the strategy;

iv) monitoring and learning how the landscape is progressing toward the desired outcomes (goals); and

v) adapting the management strategy to reflect changes in the landscape and in the needs of people who live in it.

7.5.2 Introduce project sustainability practices

Although it is often difficult to realize immediate outcomes with environmental projects, careful application of sustainability practices during the project planning and implementation phase can sustain the interest of the stakeholders even after the project. The indicative sustainability practices are as follows:

i) consciously promote local contributions

ii) promote land tenure and land security

iii) formulate and gazette sustainable forest management policy

iv) promote marketing of produce

v) train lead farmers

vi) promote endogenous financial intermediation

vii) address family and gender issues at the outset of the project

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CHAPTER 8: GHANA

Community sacred forest in the Effutu traditional area, Central region, Ghana

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Summary

In recent times, the implementation of traditional natural resource management and conservation methods has declined because of various factors, including weak traditional regulations, increasing population, and adoption of Western lifestyles. In Ghana, the implementation of policy directives and frameworks has resulted in certain areas currently being managed by communities, notably the Community Resource Management Areas framework, which demarcates an area for the protection of wildlife resources. An example is the community sacred forest in the Effutu traditional area. Interestingly, for the preservation of cultural heritage, the Effutu traditional area has over the last 300 years been designated a forest reserve for the protection of bushbuck for an annual hunt to celebrate the *Aboakyir* festival. However, currently, because of weak implementation of regulations and anthropogenic activities, resources at the designated hunting ground have dwindled, in particular, the continuous presence of bushbuck for the annual hunt. The "Restoration of Community Sacred Forest to Enhance Socio Ecological Landscape in the Effutu Traditional Area, Ghana" project therefore aimed to restore the ecological integrity of the site to enhance biodiversity conservation while preserving the cultural heritage of the Effutu people. This study highlights the significance of collaborative engagement as a tool for revitalizing and conserving threatened socio-ecological production landscapes. Using conservation education to ignite behavioral change in favor of natural resource conservation, 5.43 ha of degraded area was replanted, and the income levels of community members enhanced, thereby reducing their dependency on the forest for their livelihood. A fauna survey confirmed the presence of bushbuck, although the population is estimated to be very low.

Keywords: Aboakyir festival, Bushbuck, Biodiversity, Cultural heritage, Effutu traditional area

8.1 Natural and social background

The Effutu traditional area with its paramount seat located in Winneba in the Central Region of Ghana lies on 5° 20' N 0° 37' W and covers an area approximately 417.3 km^2. The area lies west of Accra (the capital city of Ghana) and east of the Cape Coast (Central Regional Capital). The southern boundary follows the shoreline of the sea (Gulf of Guinea), and part of the western boundary follows the adjacent Yenku forest reserve. As a Municipality, it is bordered to the north, north east, south, and east by Agona Municipality, West Akim Municipality, the Gulf of Guinea, the Gomoa District, and the Gomoa District, respectively.

Geographically, the Effutu traditional area is low-lying with protruding granite rocks and isolated hills around Winneba. The area lies within the dry equatorial climatic zone characterized by low rainfall and a long dry season of five months. The annual rainfall ranges between 400–500 mm, and the temperature ranges between 22 °C–28 °C. The vegetation type can be classified as coastal savannah grassland, which is suitable for vegetable cultivation or dry season irrigation farming. However, the soils are dominated by highly saline clay; hence, limited agricultural activities are practiced in the area.

According to the Effutu Municipal Assembly records, the population of Winneba and its communities was estimated at 60,331 individuals in 2012. Fishing and fish mongering are the predominant occupation of locals, being practiced by 54% and 46% of the population, respectively. The dependence on the surrounding ecosystem is also high, with approximately 40% of people also participating in charcoal production, wood selling, and subsistence farming of maize, vegetables, and other food crops, which are either sold or used for household consumption. The harvesting of trees and mangroves widely used for the smoking of fish and for the sale of fuel wood has led to a dwindling quantity and quality of biodiversity found in the area. Furthermore, some rivers, which provided other ecosystem services in the locality, have dried up due to the excessive harvesting of trees in the area.

8.2 Functions and values of the Effutu community sacred forest

The indigenes of the Effutu traditional area celebrate the annual *Aboakyir* festival, a thanksgiving festival, which is also known as the "deer hunt festival." The "deer" are in fact bushbuck that are hunted by local warrior groups known as the "Asafo Company" with designations such as *Asafo* Company No 1. (*Tuafo*) and *Asafo* Company No. 2 (*Dentsefo*). For the purpose of preserving their cultural heritage, the Effutu traditional area has over the past 300 years established a communal forest reserve covering >80 ha that provides grounds for the live capture of bushbuck (*Tragelaphus scriptus)* by the

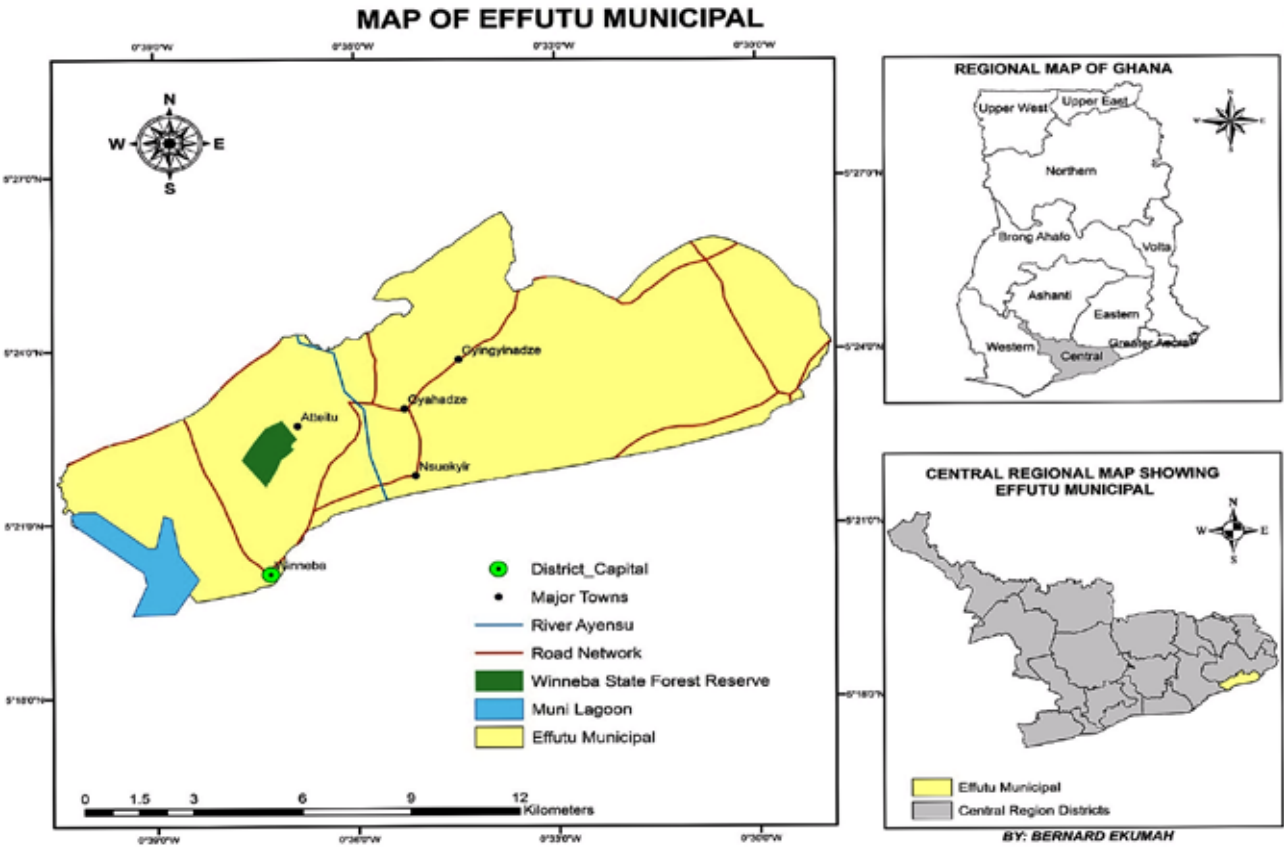

Figure 1: Map showing the location of the Effutu traditional area
Source: Wildlife Division, Winneba

Asafo company (traditional warriors). The captured bushbucks are sacrificed to the gods of the land during the celebration of their annual traditional *Aboakyir* festival. Depending on which group captures the first bushbuck (**Photo 1**), this is interpreted to determine whether the year will be one of bountiful harvest or that of famine.

Besides serving as a designated site for the capture of the bushbuck, community members also enjoy fringe benefits provided by the reserve, including the hunting of bush meat, with hunted species including *Thryonomys swinderianus* (cane rat), *Cricetomys gambianus* (Gambian pouched rat), *Xerus erythropus* (striped ground squirrel), *Philantomba maxwelii* (Maxwell's duiker), and *Oryctolagus cuniculus* (European rabbit). Resources include farming and the collection of fuel wood and other non-timber forest products for domestic use, with the surplus sold for income. Communities also harvest trees as building materials for household use. The site also holds some shrines where sacrifices are made to the gods of the land.

Given the cultural significance of the forest as a hunting ground and as a home for their ancestors, the conservation of the forest is essential for the preservation of the cultural heritage of the local population. The festival also provides a source of entertainment for the people and provides an income boost to hospitality centers as well as to women and youth selling food and other items during the festival.

Traditionally, over the past 300 years, such sacred forests have been conserved and protected through restricting access and selective resource collection. For instance, in the past, a hunter always had to present a part of the hunted animal to the chief's palace. This practice was used to keep track of species that were hunted within the area as well as to facilitate the monitoring of population trends. However, over the years, these traditional norms and regulations have been weakened by increasing population, adoption of Western culture, and infiltration of other 'so-called' civilized behavior into the communities.

The adoption of other modern conservation practices such as observance of a closed season as stipulated under Ghana Wildlife Reserves Regulations L.I.710 of 1971 has also evolved as a practice to facilitate conservation of the site. Traditional authorities and leaders of the warrior groups have, however, been

Photo 1: Local warriors with live capture of bushbuck during *Aboakyir* festival
Photo credit: Ghana News Agency 2012

able to uphold the ban of no entry into the hunting ground two months before the celebration of the festival. During the celebration of the week-long festival, which is climaxed on the morning of the first Saturday in May, the warriors perform certain rituals at dawn before proceeding on the bushbuck hunt, which is conducted with their bare hands, sticks, and clubs (Nketiah, 2011). The first group to return with a live bushbuck is adjudged the winner. Some rituals are then performed with the animal and two ritual items, of a white and red color, respectively. The outcome of which ritual item a thrown dice falls on is used to predict the harvesting season. A white ritual item represents the *Tuafo* (Asafo Company No. 1) and indicates a bumper fishing season, whereas the red ritual item representing *Dentfefo* (Asafo Company No. 2) and indicates a bumper farming season. In the event of none of the groups making a catch, the year is declared as one that would experience famine on the land.

8.3 Threats and challenges

Despite the range of ecosystem services provided by the community sacred forests for livelihood well-being and ecological sustainability, the site faces several threats and challenges. The underlying causes of biodiversity loss and a dwindling bushbuck population were identified as degrading activities such as charcoal production, bush burning (**Photo**

2), unsustainable farming practices, and illegal hunting. These have led to an increased depletion of habitat and biodiversity in the forest, thereby negatively impacting the socio-economic and cultural aspects of the lives of the local population (Andrews Agyekumhene, Ramsar site manager, personal communication 2013).

Furthermore, ignorance by the community of the implications of threats to the resource through anthropogenic activities proximate the site has also been a contributing factor to habitat degradation and biodiversity loss. Recommendations by Wuver and Attuquayefio (2006) and investigations during the project indicate that there is limited awareness of both traditional and modern conservation approaches.

Over the years, although the rate of biodiversity decline has been investigated (Wuver & Attuquayefio 2006), local participation in addressing causes of decline has not been fully explored. Research results during 2006 indicated that the rate of biodiversity decline at the site is increasing due to environmental degradation (Wuver & Attuquayefio 2006). Over the last three years, none of the two warrior groups have captured a live animal for the annual *Aboakyir* festival. This strongly indicates that the bushbuck population has plummeted and could soon become locally extinct. This has been a matter of great concern to the people regarding the perpetuation of their cultural heritage. It was also observed that the hunting ground, which shares borders with the Yenku forest reserve and the Muni-Pomadze Ramsar site, has in recent times been faced with threats of high levels of poaching and habitat degradation, leading to further loss of biodiversity within the surrounding landscape. The losses can also be attributed to outdated information on current underlying causes of biodiversity losses, inadequate awareness of threats, inadequate alternative livelihood systems, and weak traditional institutions, norms, and laws.

Photo 2: Perennial bush burning of a portion of the sacred forest
Photo credit: Muni Pomadze Ramsar Site 2012

8.4 Responses and efforts at revitalization

The "Restoration of Community Sacred Forest to Enhance Socio Ecological Landscape in the Effutu Traditional Area, Ghana" project engaged community members through various collaborative biodiversity conservation initiatives, thereby integrating indigenous traditional knowledge and modern approaches to identify and address direct threats as well as underlying causes responsible for the loss of biological and cultural diversity of the area. The methods employed under the project aimed at revitalizing the sacred forest are outlined in thematic areas below:

8.4.1 Conservation education

Community engagement through consultative fora, conservation education, and public awareness approaches were used to increase awareness of threats and integrated approaches at the community and stakeholder levels. This was achieved through participatory planning, knowledge sharing, and capacity building, thus contributing to achieving Aichi Target 1 and 18 (CBD 2012). Conservation education was held in 10 schools and seven communities. Radio broadcasts were held once monthly on two radio stations, one station using a local dialect and one using English, thereby ensuring that the conservation message extended beyond the project area. The awareness campaigns also created opportunities to promote the integration of indigenous traditional knowledge and modern conservation practices within the lifestyle of community members. The public awareness campaigns raised the awareness of over 10,000 people in the area using the various media. This is yielding evidence of a change in attitude among fringe community members who are now more receptive to conservation initiatives and are more willing to undertake initiatives such as tree planting on their farms near the sacred

Photo 3: Radio broadcast with leaders of local warrior groups
Photo credit: A Rocha 2015

Photo 4: Community planting session
Photo credit: A Rocha Ghana 2015

forest. The education on conservation contributed to enhancing local participation in biodiversity conservation, thus leading to a reduction in direct pressures leading to biodiversity loss, while also promoting sustainable resource utilization. The achievement of this objective is contributing to achieving Aichi Target 5 (CBD 2012) and the International Partnership for the Satoyama Initiative (IPSI) objective 2 (Satoyama 2013).

8.4.2 Faunal survey

Sightings, collections of animal scats, and hunter survey were the methods employed to collect data during the survey. Observations of animal signs such as tracks were very scattered and limited due to the highly degraded nature of the site. During the field survey, five footprints of bushbuck were recorded around watering holes. Two bushbucks were sighted within the thickets, and six droppings were recorded, two of which were along footpaths. The results of the interviews showed that hunters encountered less bushbucks within the site. One hunter reported having encountered a family of six bushbucks during the 2014 rainy season. Other animals encountered according to the hunter interviews included *Thryonomys swinderianus* (greater cane rat), *Cricetomys gambianus* (Gambian Pouched Rat), *Xerus erythropus* (striped ground squirrel), *Philantomba maxwellii* (Maxwell's Duiker), *Oryctolagus cuniculus* (European rabbit), *Python regius* (ball python), and *Pelusios castaneus* (West African mud turtle) along the river, and *Varanus niloticus* (Nile monitor). The results of both the survey and the interviews revealed signs of the presence of bushbucks in the area. However, the population size could not be determined as the survey was not able to collect sufficient data to make concrete conclusions. More efforts would, therefore, have to be made to secure the site and restore its vegetation as well as to conduct more surveys in the future.

8.4.3 Habitat restoration

In collaboration with community members and the Asafo Company (local warrior groups), the hunting grounds were demarcated and planted with 4,000 seedlings covering an area of 5.43 ha (**Photos 4** and **5**). Ten individual community members were trained in nursery establishment and management as an income earning occupation. Some of the seedlings for the planting were purchased from the community members and supplemented with supplies from the Forestry Services Division. Assorted indigenous tree seedlings, including Acacia and Mahogany, were planted to mimic the natural forest. The planting will contribute to restoration of the degraded ecological zone. This will not only enhance the ecological integrity of the communal forest landscape but also stabilize and potentially increase the population of bushbucks, which are hunted live by the Effutu people during their annual *Aboakyir* festival. The achievement

Photo 5: Wildlife Officer with local warrior representative during a tree planting exercise
Photo credit: A Rocha Ghana 2015

of this objective will also promote the continuous perpetuation of the rich culture of the Effutu people while providing jobs for local guides and alternative income for the locals who sell food items and other artifacts during the festival. The restoration of the habitat will also contribute to achieving Aichi Target 12 and 15 (CBD 2012). Over the project period, due to the high risk of fires, the site was managed to prevent bush fires. A firebreak was created for this purpose, and this has prevented the land area planted under the project from being destroyed by two bush fires that have occurred in the area.

8.4.4 Alternative livelihood

The project as part of its objectives aimed to enhance the income levels of fringe communities through alternative livelihoods. Therefore, 15 community members were trained in making soap (**Photos 6** and **7**). Initially, briquette production from agricultural waste was proposed. However, a major challenge faced during the project was the failure of rains during the 2015 rainy seasons. This affected the proposed training of community members in producing briquette charcoal. This was addressed by resorting to an alternative to the originally proposed activity but yielding the same outcome. The 15 community members chosen were comprised of 13 women and two men, and were trained in soap making, which has increased their monthly family income by 20%.

8.5 Lessons learnt

The project activities conducted are envisaged to restore the degraded habitat and safeguard the dwindling biodiversity to avoid overharvesting of resources from the adjacent Ramsar site and Yenku forest reserve. The activities led to strengthening of traditional conservation norms that 1) affords chiefs and traditional heads the power to punish offenders; 2) increased awareness, leading to behavioral change; 3) reduced habitat degrading activities and illegal poaching, thereby contributing to the achievement of Aichi Target 1(CBD 2012) and IPSI objective 2 (Satoyama 2013).

One important lesson through this project is that if communities are well informed and empowered, they can take steps to protect their environment. Institutional collaboration is also an essential tool when building synergies. In the past, communities and governmental bodies in charge of resource management worked in isolation. However, collaborative efforts through projects such as the Satoyama Development Mechanism have broadened the opportunities to bridge the gaps between conservation and community development.

Furthermore, the project responded to the critical needs of the target area by raising awareness of impacts of anthropogenic activities on the biodiversity and ecosystem services of the community sacred forest, and its ripple effect on the socio-economic

Photo 6: Demonstration during training on soap making
Photo credit:A Rocha Ghana 2015

Photo 7: Beneficiairies with finished products
Photo credit: A Rocha Ghana 2015

and cultural lifestyle of the Effutu people. Replanting degraded portions of the hunting ground under the project will contribute to safeguarding the ecological integrity of the site, with the long-term impact of creating a secure habitat for bushbuck and the perpetuation of the cultural heritage of the Effutu people. Again, the project through its alternative livelihood training is contributing to eradication of poverty in the area, a reason often given to justify overexploitation of resources.

In general, the impacts of the project in an environmental context centers on the replanting of degraded areas, which would in the long-term provide a secure habitat for biodiversity in the area. Socio-economically, communities have been empowered to take better care of their environment and to utilize resources sustainably. The training of beneficiaries in alternative livelihoods has also contributed to increasing income levels. Ultimately, the restoration of the site would promote the cultural heritage of the inhabitants and provide opportunities for community development through tourism activities. Efforts to gazette by-laws by the district assembly to enhance law enforcement as well as promote conservation efforts through an integration of both modern conservation techniques and indigenous traditional knowledge are laudable. By responding to these critical needs, the project contributes to Aichi Target 1, 14, 15, and 18, which are all expected to be achieved in the year 2020 (CBD 2012).

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CHAPTER 9: KENYA

Kaya forests: role in climate change adaptation among the Mijikenda community

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Summary

Kaya forests, located in Kenya's coastal landscape, are sacred forests of the Mijikenda people. The forests have been in existence since the 16th century. Despite rapidly changing socioeconomic and ecological conditions and climate change effects leading to a decline in their pristineness, Kaya forests continue to provide an array of goods and services needed for improving human well-being and livelihood systems. Sharing relevant information on the current conditions of such production landscapes can contribute greatly to creating awareness toward identifying sustainable strategies for management and conservation. This case study provides information on natural and social characteristics of the *Kaya* forests in relation to Kenya. This leads to a detailed exploration of the functions and values of the *Kaya* forests with emphasis on its contribution to the sustenance of local livelihood systems as well as its role in ecosystem sustainability. An in-depth analysis of the role of local knowledge practices and systems in the management and conservation of the *Kaya* forests is performed. Challenges facing the use and management of *Kaya* forests and the corresponding actions and responses for addressing them are also highlighted in this paper. Recommendations for practical and applicable strategies to revitalize resilient and sustainable local use and management practices in *Kaya* forests are provided for forest managers and policy makers.

Keywords: Biodiversity; Degradation; Kaya forests; Landscape; Traditional knowledge systems

9.1 Introduction

Kenya is divided into eight regions: Central, Coast, Eastern, Nairobi, North Eastern, Nyanza, Rift Valley, and Western. These regions are further subdivided into 47 counties. The Coast region stretches roughly 150 km inland from the seafront, covering an area of 67,500 km^2, approximately 11.5% of the total area of Kenya. There are six counties in the Coast region: Kilifi, Kwale, Mombasa, Lamu, Tana River, and Taita Taveta, with a combined population of 3,325,307 (Republic of Kenya 2009). The Coast region supports 8.6% of the national population. The population increased from 1.83 million in 1989 to 3.33 million in 2009, an average increase of 4.1% annually (Republic of Kenya 1989; 2009). The region is endowed with vast natural resources that include coral reefs, mangroves, lowland and *Kaya* forests, Afromontane forests, and historical sites, which provide the foundation for the region's economy.

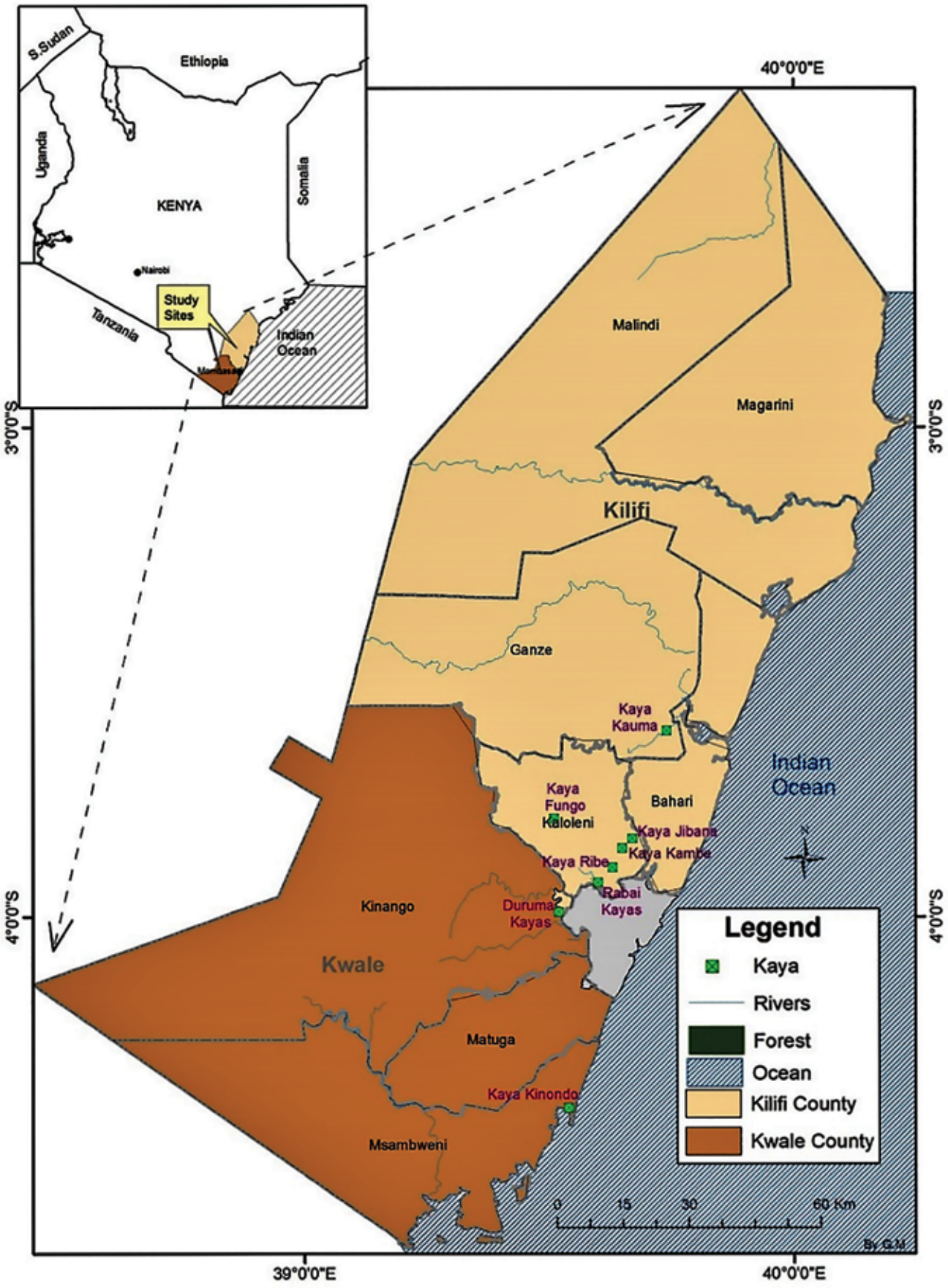

Figure 1: Location of Kaya forests in relation to Kenya
Source: GIS and Remote Sensing Department, KEFRI

The approximate area of land under forests in the Coast is approximately 8.4% of the total land area (KEFRI 2016).

Despite being rich in natural resources, the Coast region remains characterized by high levels of poverty, with up to 70–80% of residents living below the poverty line (Republic of Kenya 2009; Wekesa et al. 2015). The rural households have limited access to clean water, basic education, and health care. Moreover, the local population is heavily dependent on the provisions of the natural ecosystem for survival, with agriculture (crop and animal production) being the main source of food and income. The other economic activities undertaken in the region are fishing, tourism, trade, forestry, and mining. Lately, as reported by IPCC (2001), the region, which is low-lying, has been experiencing frequent droughts, floods, and increased incidences of pests and diseases as a result of climate change. Rapid population growth and overdependence on natural resources by local communities are causing extensive degradation of natural resources, leading to loss of biodiversity and low food productivity. The effects of climate change have further exacerbated the situation, reducing the capacity of important production landscapes to sustain and improve local livelihoods and conserve biodiversity.

9.2 Natural and social background

Located in the coastal region of Kenya, the *Kaya* forests are peculiar examples of a multifunctional landscape referred to as socioecological production landscapes and seascapes (SEPLS) (IPSI Strategy 2013). SEPLS provide both direct and indirect benefits for human well-being and are undergoing drastic transformation in an era of global environmental change. Across the world, similar landscapes ranging from grasslands, forests, and wetlands to coastal areas can be identified and are given different names as a reflection of the local social, cultural and ecological situation. For instance, in Spain and Hawaii, such landscapes are called *Dehesa* and *Ahupua'a*, respectively whereas in Japan the landscapes are usually described as *Satoyama*.

The *Kaya* forests are small isolated forest patches ranging from 2.0 to 200.0 hectares in size (Kibet & Nyamweru 2008). *Kaya* means homestead in the Mijikenda language. Historically, these forest patches sheltered small fortified villages *(Kayas*) that were set up by the Mijikenda people when they first appeared in the region many centuries ago after fleeing their enemies in the north (Githitho 2005). As security improved in the last century, the Mijikenda groups moved out and settled in the surrounding areas, but the *Kaya* forests were preserved as sacred places where prayers, rituals, sacrifices, and burials took place (Githitho 2005; Kibet & Nyamweru 2008). Protection of the *Kaya*s remains deeply entrenched in traditional Mijikenda culture, and their integrity and sanctity are safeguarded by a council of *Kaya* elders who employ a system of taboos and traditional rules to protect these forests.

Local communities living around *Kaya* forests are small-scale farmers involved mainly in intensive agriculture to sustain their livelihoods. Despite land being intensively cultivated by locals, *Kaya* forests represent areas of relatively untouched vegetation (Kibet & Nyamweru 2008). In fact, the richness of biodiversity in the *Kaya* forests was recognized in the 1980s by Robertson and Luke (1993). The *Kaya* forests form part of the once-extensive Zanzibar-Inhambane lowland mosaic known for high species diversity and endemism. As such, they are a very important part of Kenya's threatened natural vegetation communities, given the role they play in facilitating the adaptation of local communities to climate change (Burgess & Clarke 2003; Kibet & Nyamweru 2008). *Kaya* forests exhibit a very high level of biodiversity in terms of sheer diversity, endemism, and rarity in many biological groups.

Livelihoods of smallholder Mijikenda farmers who depend mainly on natural resources for survival are threatened by climate change (Ongugo et al. 2014). Poor rural communities on the Kenyan Coast are heavily affected by climate-related disasters, and although most climate change adaptation strategies have focused on large scale infrastructure for physical protection, the local initiatives of communities offer sustainable innovations for climate change adaptation. Socio-ecological production landscapes and seascapes such as *Kaya* forests play a critical role in local adaptation to climate change by strengthening the adaptive capacity of local communities in Coast region. It is worth noting that important economic activities such as agriculture and tourism depend heavily on good environmental quality. Therefore, a healthy environment is needed to sustain these economic activities now and in future. To ensure the sustainable use of *Kaya* forests for socioeconomic development in the Coast region, an integrated approach is required to manage these

resources to maintain harmony between nature and humans. This chapter presents findings of a baseline study conducted by SIFOR[1] to document the role of traditional knowledge and *Kaya* forests in climate change adaptation among the indigenous Mijikenda community in the Kenyan Coast.

9.3 Functions and values of *Kaya* forests

9.3.1 Biodiversity and ecosystem services hotspot

Biodiversity underpins human development by impacting natural processes, thereby affecting human life in different ways. The diverse flora and fauna of the *Kaya* forests and the associated processes support local communities in sectors such as biomass energy, food, shelter, herbal medicine, the ecotourism industry, and agricultural productivity. *Kaya* forests are also important sources of non-provisioning ecosystem services such as air and water purification, pollination, seed dispersal, climate modification, soil stabilization, drought and flood control, recycling of nutrients, and maintaining healthy habitats. Others include spiritual and aesthetic values, supporting indigenous knowledge systems, and education.

Kaya forests serve as a source of genetic resources for food, forestry, and agriculture. Biodiversity conservation, particularly in these primary sacred forests, mitigates the loss of variability of plant genetic resources and hence averts an economic slump in the region. The conservation and sustainable use of the genetic resources is important to the survival of the local communities and environmental conservation. The local adaptation strategies to climate change are directly supported by the rich biodiversity of the *Kaya* forests. Improvements in crop cultivars and varieties are made possible by harnessing genes from wild species and known varieties. By combining genes for different traits, plant and animal breeders develop new varieties for specific conditions. Crop wild relatives occurring in these forests are used by local communities to improve the quality and yield of their crops by helping to improve resistance against pests and diseases and tolerance to drought. In addition, crop wild relatives have high nutritional content that enhances human health. Beneficial traits of crop wild relatives such as resistance to pests and diseases and tolerance to drought have enhanced crop production in the face of climate change, making the Mijikenda community food-secure. Thus, *Kaya* forests provide the Mijikenda community with an opportunity of maintaining high level of crop diversity that is important in warding off emerging crop pests and diseases and recurring droughts. Therefore, the rich biodiversity observed in *Kaya* forests is a natural reservoir of genetic traits in crop cultivars and traditional landraces that is important in improving agricultural production.

Several plant species such as *Uvaria lucida, Vangueria madagascariensis, Ximenia americana, Polyalthia stuhlmannii, Strychnos mombasae, Oldfieldia somalensis, Manilkara sulkata, Encephalartos hildebrandtii, Dialium orientale, Brachystegia spiciformis, Dalbergia melanoxylon, Afzelia quanzensis, Brachylaena huillensis, Azadirachta indica, Vepris glometar*, and *Manilkara sansibarensis* are collected from *Kaya* forests by herbal medicine practitioners to make herbal medicine for preventing, treating, and curing many diseases and conditions of human beings, animals and plants. For instance, *P. stuhlmannii* is a herbal plant used for treating skin ailments and *U. lucida* is a remedy for digestion and stomach upsets. Herbal medicine maintains good health for the local people and is preferred for its accessibility and affordability. Other wild plants such as *Landolphia kirkii, Tamarindus indica, Ancylobotrys petersiana, Lilium orientale, Syzygium cuminii, Vitex doniana, Ziziphus mauritiana, Psidium guajava*, and *Adansonia digitata* found growing in these sacred forests are important sources of fruits and thereby contribute to food security of the local communities. With their high nutrition value, the indigenous fruits also contribute to improved health for residents, especially children.

Owing to the decreasing population of important food and medicinal plants in the natural range, wild plants including *L. orientale, T. indica, A. petersiana, L. kirkii*, and *Z. mauritiana* have been domesticated for fruit production. The fruits are usually sold for income. These plants can tolerate prolonged dry periods, ensuring that farmers have alternative sources of income in the case of crop failure or low yields due to prolonged droughts or other

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

effects of climate change. Medicinal plants such as *Monanthotaxis fornicata*, *O. somalensis*, *Fernandoa magnificia*, *Acacia mellifera*, and *Salvadora persica* are being domesticated for their medicinal value by herbalists as a response to increased incidences of crop pests and animal and human diseases that necessitate the development of local remedies to improve and sustain local livelihoods. Domestication of plants commonly used by local communities has reduced pressure on the *Kaya* forests, conserving biodiversity. Domestication has also ensured sustainability of these plant species in the wake of forest degradation resulting from anthropogenic factors and climate change. Domestication of plants is an innovative practice that has diversified communities' incomes and cushioned them against massive crop failure due to increased incidences of crop pests and diseases brought about by climate change. Income generated from the sale of fruits is used to pay school fees and provide basic needs such as clothing. This has raised the standard of living and improved education standards, resulting in a positive impact on the general life of the Mijikenda people. Well-conserved biodiversity due to the availability of alternative sources of forest products from domesticated plants has ensured that there is uninterrupted provision of ecosystem services that support local livelihoods. Such ecosystem services include continuous flow of water throughout the year in streams emerging from *Kaya* forests for domestic use and small-scale irrigation agriculture.

To promote the Mijikenda culture and enhance cohesiveness, an array of traditional festivals and ceremonies are usually held in *Kaya* forests. These festivals promote social cohesion, facilitate information sharing, and encourage values such as reciprocity that play an important role in sustaining local innovations. Reciprocity ensures that knowledge is transferred from one generation to the next, thereby sustaining the biocultural heritage and providing a platform for new innovations while at the same time improving and sustaining the existing ones. Some of the traditional festivals and ceremonies held by the Mijikenda community include New Year festival, rainmaking, initiation of *Kaya* elders, and cleansing, child naming, wedding, circumcision, funeral, birth, and harvesting ceremonies. Rainmaking ceremonies are performed by *Kaya* elders mainly in the *Kaya* forests and are often characterized by offering prayers and sacrifices mainly in the form of livestock and assorted grains. *Hanga,* a funeral ceremony, is performed to please the dead, to comfort the mourners, and also to ask the ancestors to welcome the soul of the dead person. Wedding ceremonies are a symbol of love and respect and unite the community. The New Year festival is an event for the community to honour their god and "chase away" bad omens and diseases. All of these ceremonies are used as platforms for generating income, by community members either making monetary contributions or selling goods to other members of the community as well as tourists, unlike previously, when the ceremonies were mainly for social binding, passing useful messages, and entertainment. Furthermore, the ceremonies provide rules and regulations for collective management of natural resources and show that there is local leadership (Council of *Kaya* elders). Traditional dances are the hallmark of various ceremonies and various dances are performed in different ceremonies. For instance, during funerals, *Chifudu, Kwarya*, and *Zembe* dances are performed, whereas at weddings, *Mdundiko, Sengenya, Gonda*, and *Mzumbano* dances are performed. The *Janja* dance is performed during rainmaking ceremonies, whereas *Chibwengo, Nganja, Kayamba, Ndaro*, and *Chifudu* dances are performed during healing ceremonies.

Through collective action, the Mijikenda community has established cultural villages in the *Kaya* forests as alternative sources of income. This action was in response to low crop productivity brought about by climate change. The cultural villages provide a central venue for showcasing the cultural ceremonies, rituals, and agro-biodiversity practices of the community. The villages bring together different groups who are involved either in traditional dancing or in exhibiting the cultural practices and rituals, which are a source of tourist attraction. This has enabled the community to market their culture and diversify their income sources, thereby providing additional income. The villages have diversified cultural exhibitions, making them attractive sites to visit for both local and international tourists. The collective action has also allowed the community to network through exchange of planting materials of traditional crops such as cowpeas and sweet potatoes that are grown in the *Kaya*. The cultural villages also promote social cohesion, conserving the *Kaya* forests and generating additional income for the community, and have been promoted largely through cultural festivals held by the community and coordinated by *Kaya* elders. Inside the villages, traditional huts have been built using traditional architecture, exhibiting the layout of traditional Mijikenda villages. Within the layout is a traditional spiritual healer's hut, a

shrine where evil spells are exorcised, a traditional granary, a typical Mijikenda kitchen, and an area where indigenous crops such as cowpeas and sweet potatoes are cultivated.

9.3.2 Role of local knowledge practices and systems in the management and conservation of *Kaya* forests

At present, *Kaya* forests are primarily ritual and symbolic sites rather than actual settlements, as they were historically. Although the political power of the *Kaya* elders has diminished with the abandonment of the villages, they have maintained a strong ritual and ceremonial role as stewards of the sacred forests and the associated secrets. The elders enforce the protection of these forests so that their mystery and power are retained and *fingo* (protective talismans or guardian spirits) remains hidden. Enforcement of rules is performed mainly through a system of taboos, curses, and other spiritual sanctions that have a powerful effect in the rural communities associated with the *Kaya* forests. Infringement of the use laws of the council of elders attracts a fine that the miscreant must pay to avoid spiritual retribution (Githitho 2005). Rules to protect the sacred forests include a ban on cutting of live trees, although deadwood may be collected in limited amounts in some sites within the forests for domestic use. The firewood (deadwood) is collected by women who take only as much as they can carry in their arms without using a rope. Grazing of livestock is not allowed, owing to the risk of disturbing ritual materials hidden in the forest. Livestock straying into the *Kaya* forest risk being seized and slaughtered. Wildlife, including large snakes, are not to be molested, as they are believed to represent spirits.

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

The most sacred areas of the *Kaya* are out of bounds to all except for the *Kaya* elders. The elders visit the most sacred areas within the forests to exercise their duties and responsibilities. The most sacred areas include the locality of the *fingo* or other sacred objects. The enforcement of these rules varies from forest to forest, but they all reflect a desire to conserve *Kaya* forests as a special production landscape lying at the heart of the community (Githitho 2005).

Photo 1: Sacred hut within Kaya forest where rites and rituals are performed
Photo credit: SIFOR Project

9.4 Challenges and responses

9.4.1 Major threats and impacts to livelihood

(a) Disregard for traditional knowledge systems

Indigenous institutions that have permitted the survival of *Kaya* forests over the centuries are under increasing threat from external and internal forces (Nyamweru 1996; Githitho 2001). Rapid socioeconomic and cultural changes have affected the value and cohesiveness of the local traditional values making local people abandon sentimentalities and acts that ensured preservation of sacred forests. Increasing adoption of and affiliation of locals with modern religious ideas and beliefs especially from Islam and Christianity present exceptional challenges to application and preservation of

traditional knowledge practices and systems that have been used to sustainably manage and conserve *Kaya* forests in the past. Traditional knowledge was previously passed from elders to young people, but now this practice has changed, as young people spend more time in school and less time with elders for transmission of traditional knowledge. The young generation has also become non-receptive to traditional knowledge and regard it as retrogressive. As *Kaya* elders (*Ngambi*) who are the custodians of traditional conversation knowledge, die without passing it to the next generation, there is disintegration of social cohesion, social dislocation, erosion of community cohesiveness, and a decline in respect for traditional cultural values, making the conservation of these forests seriously threatened and facing extinction.

(b) Overexploitation

Overexploitation of provisioning ecosystem services for marketable products such as herbal medicine, fruit and food, firewood, and construction materials has greatly increased pressure on these sacred forest ecosystems. Some important plants that were formerly collected from the forests by the locals for making herbal medicine, such as *Brachystegia spiciformis, Dalbergia melanoxylon, Afzelia quanzensis, Brachylaena huillensis, Vepris glometar*, and *Manilkara sansibarensis* have become rare, as their population in the natural range decreases owing to overexploitation. Furthermore, the population of important indigenous fruit trees such as *L. orientale, T. indica, A. petersiana, L. kirkii., Z. mauritiana*, and *A. digitata* has declined owing to overexploitation, compromising the food security and nutritional standing of the community.

(c) Population pressure

Nyanchoga (2015) identified population pressure as one of the main threats to the conservation and preservation of *Kaya* forests. With the rapid population growth rate in the coastal region of Kenya (Republic of Kenya 1989; 2009), more land is needed for farming. This need, coupled with declining crop productivity due to effects of climate change, has led to encroachment on forest areas in the search for more fertile land within the forest for crop farming and livestock grazing. Thus, the Mijikenda community has responded to low agriculture productivity caused by unpredictable weather conditions by seeking expansion of area under cultivation of food crops. As a result, incidents of encroachment on forests to create cultivable areas have greatly increased in the last 20 years (Ongugo et al. 2014).

(d) Unsustainable land use practices

Since the late 1980s, dwindling incomes from the two main agricultural crops, cashew nut and coconut, owing to low productivity have been observed (Kibet and Nyamweru 2008). This reduction is attributed to many factors including prolonged drought, irregular rainfall, and soil infertility. In the face of persistent poverty, local communities are being forced to look for alternative sources of livelihood, some of which are environmentally destructive. Some *Kaya* forests like the Rabai *Kaya* forests are under extreme pressure from sand harvesting and the extraction of building poles, as well as from clearing to create cropland as people seek alternative means of survival (Kibet 2002).

The main impact of these threats is the reduced area under *Kaya* forests. As the area covered by these forests decreases, there is loss of agro-biodiversity, including crop wild relatives, which is important in sustaining food security for the local population in the face of climate change. With the reduced agro-biodiversity, the adaptive capacity of the Mijikenda to climate change has also been reduced. These threats, coupled with the impacts of climate change, have made the Mijikenda more vulnerable to hunger and food insecurity, resulting in higher food prices, lower earnings, and lower-quality food. It is also imperative to note that degradation of *Kaya* forests has led to drying up of ponds and springs within these forests, which are often the only accessible source of clean water for neighboring communities. Consequently, women spend many hours traveling long distances to fetch water for domestic use. This practice eats into time that could have been dedicated to undertaking more useful economic activities that could generate additional income for households.

The World Health Organization (WHO) estimates that 80% of the populations of some Asian and African countries use herbal medicine for some aspect of primary health care (WHO 2015). Similarly, a majority of the Mijikenda community (>85%) depend on herbal medicine to maintain human, crop and animal health. These herbal medicines are gathered from the *Kaya* forests, and therefore any threat to these forests threatens human health for the local communities as well as their crops and livestock. Consequently, the decline in the population of key

medicinal species used to treat various human, crop and animal diseases has harmed local livelihoods. Agricultural productivity has declined owing to increased incidence of crop pests and livestock diseases that were formerly controlled by locally developed herbal remedies. The prevalence of some human diseases has also increased because the local community can no longer obtain adequate supplies of indigenous foods from the sacred forests, owing either to the loss of critical food plants or to reduction in their population, making their occurrence sporadic in their natural ranges.

9.4.2 Responses

At the local level, efforts are being made to strengthen the *Kaya* elders' council and the traditional *Kaya* court, as these institutions are key to the conservation of the forests. These efforts are being spearheaded by donor-funded projects through Kenya Forestry Research Institute (KEFRI), National Museum of Kenya (NMK), United Nations Development Programme (UNDP), and World Wildlife Fund (WWF). Strengthening of the two institutions (the *Kaya* elders' council and the traditional *Kaya* court) is expected to enhance their capacity to enforce rules to protect the forests from further degradation. Moreover, the role of local organizations and stakeholders such as farmers, youth, and women's groups in promoting and supporting local innovations for sustainability in the management of the landscape is being enhanced through capacity-building initiatives to complement the *Kaya* elders' council and the court. Additionally, degraded areas within the forests are being rehabilitated using tree species that are endemic to *Kaya* forests.

Nationally, *Kaya* forests are protected by a Kenyan Act of Parliament, the National Museums and Heritage Act of 2006, under which they have been gazetted. Besides, the forests have been gazetted as World Heritage Sites of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and this act has strengthened protection of these forests (UNESCO 2005). UNESCO helps countries to protect their World Heritage sites by providing technical assistance and professional training and supporting public awareness of conservation activities.

At the regional scale, through participatory action, all local innovations associated with *Kaya* forests and geared toward enhancing food production, contributing to the preservation of agro-biodiversity, and increasing resilience of local communities to climate change, have been identified and documented. The innovations are being widely disseminated to local communities through innovation fairs and farmers' field schools for wider adoption. Value addition of bio-cultural products is also being undertaken to increase the economic benefits to the community and reduce the negative impacts on the forest. Moreover, community seed banks have been established and rules and regulations developed to guide the exchange of indigenous crop varieties' seeds among communities in order to conserve agro-biodiversity.

9.5 Recommendations

Based on the above discussion, the following recommendations are being proposed for consideration in *Kaya* forests conservation and management efforts.

1. *Kaya* forest management strategies should recognize the role of traditional knowledge in conserving the resource, strengthen the capacity of local institutions such as the *Kaya* court and council of *Kaya* elders, and channel conservation funds to local organizations to support grassroots conservation initiatives.

2. Policy responses to the conservation of *Kaya* forests should be changed and institutionalized to recognize the role of indigenous knowledge and local innovations in the management of these SEPLS.

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CHAPTER 10: KENYA

Conservation for tourism in Kenyan rangelands: a new threat to pastoral community livelihoods

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Summary

The "community-owned" wildlife conservancy model was an idea that emerged from the central theme, "benefits beyond boundaries," of the 2003 International Union for Conservation of Nature (IUCN) World Parks Congress held in Durban, South Africa. This theme implied ensuring the flow of revenues and other nonmonetary benefits of parks to communities whose homes bordered the parks. This came after several years of growing criticism of the "fortress" conservation model that emphasized the fencing and patrol of parks to protect the wildlife confined therein. This new direction presented an apparent departure from the Victorian gamekeeper model that formed the basis of wildlife management structures in Kenya. Generally, this model involved prevention of subsistence use of natural resources by the proletariat in order to ensure their availability for recreational use by the elite. This sharing of benefits was further expanded into a model that proposed the establishment of conservancies outside protected areas, with the aim of creating coherent structures (conservancies) within community-owned lands where communities could formally manage their lands for the conservation of wildlife. This chapter explores how this model and the various interests embedded in it threaten the social and ecological integrity that conserved the wildlife and ecosystems for generations.

Keywords: Kenya, Conservation, Tourism, Wildlife, Pastoral

10.1 Introduction

The sites where the majority of these conservancies are located are mainly wildlife habitats in the rangelands of northern and southern Kenya, where the local community are *Maa*-speaking pastoralists (**Figure 1**). The wildlife species present in the sites include elephant and several carnivore species, including lion *(Panthera leo)*, hyena *(Crocuta crocuta)*, leopard*(P. pardus)*, and African wild dog*(Lycaon pictus*). The herbivore species include buffalo *(Syncerus caffer)*, impala (*Aepyceros melampus*), gazelle *(Gazella granti, G. thompsoni)*, zebra *(Equus burchelli, E. grevyi)*, oryx *(Oryx beisa*), and eland *(Taurotragus oryx)*.

The main benefits obtained by pastoralists from their environment are pasture and water for the livestock. They also obtain wood for fuel and construction of livestock corrals and houses. These resources are shared with the wildlife populations. These lands are community-owned and commonly grazed, so that there are no individual subdivisions of land, given that a key component of pastoralism as a livelihood is unrestricted movement across landscapes. There are no large wildlife populations in non-protected

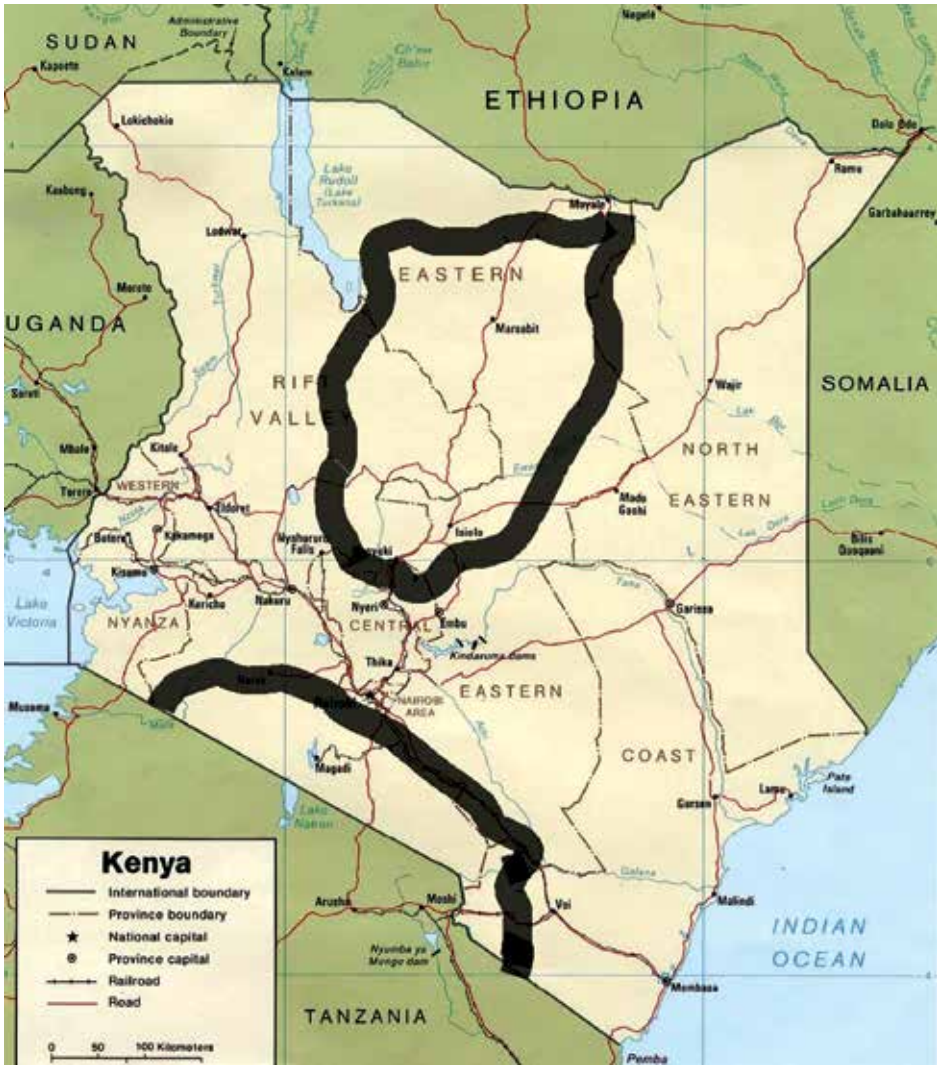

Figure 1: Map of Kenya showing the northern and southern rangelands
Source: Conservation Solutions Afrika

areas of East Africa, other than the pastoral lands, further underscoring the principle that pastoralism as a livelihood is highly compatible with conservation of wildlife populations. The geographical and temporal niches exploited by the human and wildlife communities in these areas are maintained by the connectivity of habitats and freedom of human, livestock, and wildlife movement between them.

10.2 Characteristics of conservancy sites

10.2.1 Northern Kenya rangelands

This zone covers the area from Laikipia County at the southern limit to Marsabit County bordering Ethiopia in the north (**Figure 1**). The leading exponent of the conservancies model in Kenya is the Northern Rangelands Trust (www.nrt-kenya.org), formed in 2004 in the heady "community conservation" atmosphere that pervaded the conservation sector worldwide immediately following the 2003 World Parks Congress. Adding to the impetus were the efforts of the African Wildlife Foundation (www.awf.org) to develop conservation in the Samburu Heartland. Land is probably the most important component of any terrestrial conservation plan and this new paradigm was based on what was generally described as "non-protected" areas. This term referred to pastoralist community-owned rangelands that were estimated to contain up to 70% of Kenya's wildlife populations (Western et al. 1994).

The other important component of this conservation model was the positioning of "enterprise" as the cornerstone of its financial sustainability plan.

Crucially, there was never any discussion of the sociopolitical sustainability of this model. The principal component of the conservation enterprise idea is safari tourism, which in East Africa is an industry with a rich history and high potential as a revenue earner. The community ownership of the lands in question coupled with the history and earning potential of safari tourism made the community conservancy model a highly attractive proposition, resulting in its widespread adoption and generous donor support. The geographical areas where these conservancies have been established were functional socioecological production landscapes (SEPLs) and this quality was key to their viability as wildlife habitats. The production system in place (pastoralism) provided a living for the human societies therein, while the necessary mobility of livestock and people under this system maintained viable wildlife habitats, because natural resources were used in an extensive spatial and temporal pattern.

10.2.2 Southern Kenya rangelands

This area is an approximately 100 km-wide zone along the Kenya–Tanzania border stretching from the Mara plains in the west to the arid Amboseli plains, in the rain shadow of Mt. Kilimanjaro (**Figure 1**). Nairobi city is situated at the northern limit of the southern rangelands. In southeastern Kenya, the rangelands are more densely populated than those in northern Kenya and the grazing pressure on the pasture is correspondingly greater. There has been a longer-term investment in community-based conservation dating back over 25 years and spearheaded by the African Conservation Centre in the rangelands surrounding the Amboseli National Park. This model preceded the World Parks Congress and differs fundamentally from the Northern Rangelands Trust model in not seeking to impose any particular management regime on the community-owned lands. A major challenge facing conservation in the southeastern rangelands is habitat loss and fragmentation, driven mainly by the urban sprawl from Nairobi. The plains of southwestern Kenya are the northern limit of the Mara–Serengeti ecosystem, which is one of the world's most productive wildlife habitats and includes the world-famous Maasai Mara National Reserve (MMNR). The productivity of these grasslands also makes the area a prime livestock production zone, occasioning regular incursions of pastoralist livestock into the MMNR and excursions of wildlife into the community lands and resulting in frequent human–wildlife conflicts. The fertile soils and relatively moist climate also support large-scale wheat farming in the area.

10.3 Major threats and challenges

10.3.1 Disenfranchisement of local communities

A major challenge that the proponents of the conservancy model have failed to meet in Kenya (and much of East Africa) is the inclusion of local communities as intellectual participants in conservation. This failure is a consequence of tourism's becoming a basis for rather than a byproduct of conservation. The origins of safari tourism in Africa are historically based on the curiosity of people from other continents about the abundant megafauna and landscapes that they encountered when they first came to explore this continent. The people were to be subdued and colonized, a part of this history that has seldom been told and never used in the tourism narrative. Accordingly, the indigenous social fabric of East Africa is still largely excluded from the current conservation discourse.

In general, current conservation practice still presumes that it operates in a vacuum; that is, that there was no thought or philosophy that guided the way in which indigenous African societies lived and interacted with the wild fauna and natural resources around them. One of the results of this thinking is that wildlife research in Africa is designed, implemented, and funded largely by external agents, who advance the paradigm that they have "brought conservation" to the communities among whom they work. Further evidence of this situation lies in the large amount of financial and human resources spent on "awareness creation" about various aspects of conservation. In much of Africa, there has always been and still is a large proportion of resources obtained directly from the environment. These resources include grazing, fuelwood, fish, game, and water. It thus stands to reason that these communities possess some level of knowledge of how to live among and exploit these resources in a sustainable manner (Ogada & Nyingi 2013). In Northern Kenya, the community conservancy model generally entails the demarcation of community land into a unit, which then has a committee with a chairman, secretary, and other office holders. This committee is then given the mandate of managing the conservancy, signing agreements such as leases with investors, and making decisions on resource use. There are also various subcommittees created to manage other issues such as pasture use and security. The "community structures" established by the external agents to

manage various processes in the conservancies often ignored the pre-existing community structures, and in reality were found to serve the external agents' and tourism investors' interests. Therefore, the designated "core" conservation areas tend to be located in the best and most productive parts of these communally owned lands.

10.3.2 The dominance of tourism interests over conservation needs

The tourism industry has continued to exert a strong influence over conservation practice in Kenya, as the "primary users" of wildlife populations. This influence has grown to a point where the tourism industry has grown from being a beneficiary of conservation into the basis thereof. The expected earnings from foreign tourists have been put forward by NGOs as a reason for communities to conserve their wildlife, despite all the unpredictable variables associated with this particular livelihood option to woo tourism investors to the new conservancies, conservation NGOs invested in drawing up leases that heavily favored them at the expense of communities. The communities were convinced with promises of large profits and other benefits from conservation. The first shortcoming of this arrangement is the model that gives communities a share of the profits, rather than a fixed lease fee or rent from these tourism facilities. Once the investors are brought in, the community's gain from the business is entirely dependent on the profits declared by the investor, a variable that is easily manipulated, to the detriment of the communities.

The second shortcoming is the misconception spread amongst the communities that makes them observe and perceive donor-funded projects and developments as "benefits of conservation". An example in the southern Kenya rangelands is the Shompole conservancy, approximately 160 km south of Nairobi. It was set up in the year 2000 by the local community with the assistance of the African Conservation Centre (www.accafrica.org) with the key objective of resisting the progress of subdivision and consequent loss of pasture and wildlife habitat. This aim draws from a widely held consensus that the survival of wildlife populations and pastoralism as a livelihood depends on the maintenance of open grasslands (Curtin & Western 2008). Following the establishment of the conservancy, governance structures were set up and the success of this model resulted in the conservancy's winning the Whitley award in 2003. The progress of this conservancy continued with the construction of the Shompole luxury eco-lodge at a cost of over $5 million. As a result of aggressive marketing, this lodge rapidly became a model for community-based tourism enterprises. Again, a key misconception in this discourse is people's failure to realize that use of the term "community-owned" facility does not necessarily mean that the community in question are the decision-makers in the management of the facility. The majority of such facilities are leased to external investors who are believed to have the requisite marketing skills and connections to the client source markets. Therefore, decisions such as the exclusion of livestock grazing, fetching water, firewood collection, and other resource uses from the "tourism area" around the lodge are spuriously attributed to the community members. This misconception masks the need for conflict-resolution mechanisms, which are often absent from these lease agreements. There are three fundamental threats to these tourism operations in community-owned lands;

i) The fickle nature of the tourism industry, which is easily affected by several extraneous factors such as global insecurity, economic downturns, or disease outbreaks (such as Ebola) that reduce profits and community benefits.

ii) The lack of local capacity, excluding locals from the skilled jobs in a facility of which they are the "owners."

Photo 1: Shompole lodge before it was burned down
Photo credit: African Horizons 2013

iii) Disenfranchisement: Community eco-lodges are typically small facilities whose profits cannot provide for an entire community, even at 100% occupancy. Shompole lodge, for instance, had a total of six rooms and two suites. The majority who are not participants in the tourism venture only suffer loss of pasture.

In 2012, less than 10 years after the lodge was built and after hundreds of thousands of dollars of investment in development of the conservancy, there was serious discontent in the conservancy over perceived inequitable sharing of benefits, and it came to a head in 2014 when the lodge was burned down by members of the community after the investors were ejected. The culprits were arrested, but the process of prosecuting the crime has divided the community between those who were perceived as beneficiaries of the project and the rest of the community. An important point to note is that it was impossible for the facility to provide substantial income for the community, and that the entire concept was fundamentally flawed.

In a separate case, there was an invasion of the Nguruman Kamorora ranch in October 2014 by local herders in which the foreign investor who had leased the land, and his employees were violently evicted and property, including a luxury tourist facility and vehicles, were burned. According to a local community leader, the land was "taken" from the Maasai community by the investor in 1986 on the pretext of setting up a tourist lodge and a game sanctuary but "the owners of the land do not benefit" from this arrangement." The spread of this anti- "investor" sentiment indicates shortcomings in the community conservancy model as currently practiced and calls for a re-evaluation. It is likely to be a more serious problem in the rangelands of northern Kenya, where the proliferation of small arms is an additional threat to security. However, the current model is currently expanding rapidly, driven by heavy grant inflows from various donors, including foreign governments.

10.3.3 Disintegration of pastoralism as a livelihood

Pastoralism existed in the Kenyan rangelands for several centuries before the introduction of structured conservation. The presence of large wildlife populations in the rangelands is testimony to the compatibility of this particular land use with wildlife conservation, forming vast socioecological production landscapes. However, tourism investments market a "wilderness" product that does not include pastoralists and their livestock, and conservation interests have sought several ways of separating livestock and conservation areas. A case in point is the "management of grazing"; traditionally, this is the remit of the *morans* (warrior age group) in pastoralist societies. This tradition reflects the reality that livestock are the most valuable resource (economically and culturally) and that grazing the animals is combined with the function of security. A study by Hawkins (2015) in a cluster of six NRT conservancies found that the *morans* were often described by conservancy managers as "disobedient" and "uncooperative" with reference to the objectives of the conservancy. Another key finding was that 62% of the *morans* interviewed had never heard of the "planned grazing" stipulated by the conservancy management. This exclusion was found to preclude the support of this vital demographic group for conservation objectives, leaving coercion as the next viable option. One of the tools for application of this pressure is the NRT Livestock to Markets Program, a scheme ostensibly conceived to strengthen the livestock production value chain (**Figure 2**). Cattle purchased from pastoralists under this scheme are quarantined on Lewa Wildlife Conservancy and fattened and slaughtered on Ol Pejeta (a collaborating commercial cattle ranch), with profits covering NRT Trading's costs and contributing a levy to

Photo 2: An armed Maasai moran guarding a burned tourist cottage at Nguruman conservancy in 2014
Photo credit: Daily Nation newspaper, November 9 2014

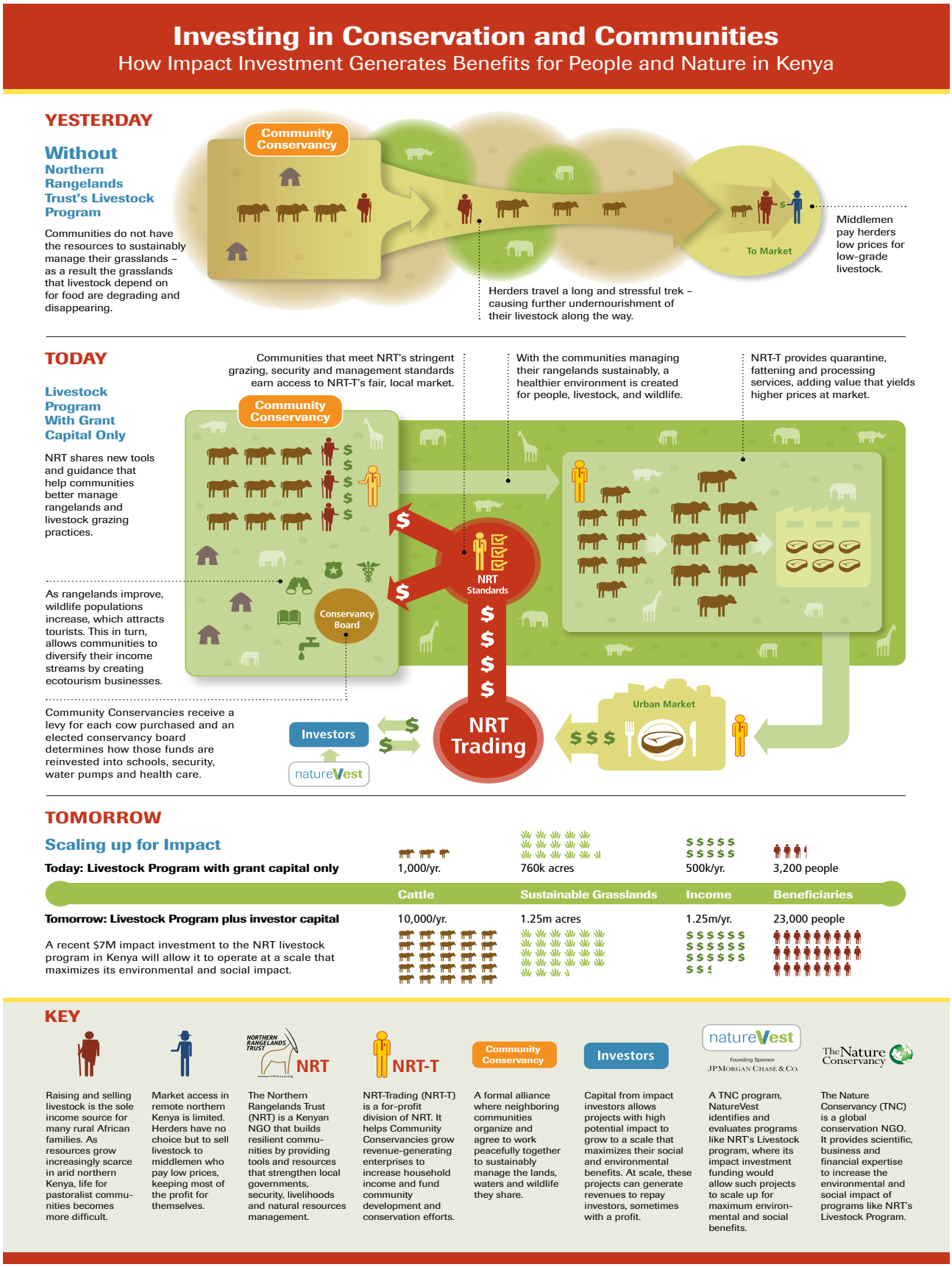

Figure 2: NRT Livestock to Market program schematic
Source: Northern Rangelands Trust

cover some of the conservancy management costs. This market aims to incentivize conservancies to practice effective, transparent governance, and sustainable natural resource management by linking local livestock owners in high-performing conservancies with ready markets (NRT 2014). However, the strict stipulations detailed in the schematic diagram (**Figure 2**) raise questions over whether the scheme is designed to economically empower the communities or impose certain regulations on them, cases in point being that;

i) Cattle are purchased only from those deemed to adhere to the strict (NRT-imposed) grazing, security, and management rules.

ii) Cattle are purchased at "fair" price as determined by the purchaser. The producer has no further participation after this point.

iii) Cattle are quarantined, fattened, slaughtered, and sold by NRT.

iv) Profits from the value addition in (c) go to NRT Trading.

v) The only other gain for the community is from expected improvement in rangeland condition (from de-stocking) that is expected to increase wildlife populations, which in turn is expected to increase tourism revenues, with this increase expected to trickle down to them.

Apart from the profits accruing to NRT Trading and the returns to the investor, the only other net effect is the de-stocking of the landscape. Even the levy imposed on every purchased cow is passed on to the group ranch committee, which decides on its expenditure. In the schematic diagram, the initial objective is to improve on a situation where grasslands are in poor condition, ostensibly due to overstocking, and pastoralists are receiving low prices from middlemen for low-quality livestock. The new system is seeking to improve the rangelands by reducing the numbers of livestock and is replacing the middleman with a grant-funded trading company, with this replacement also skewing the local livestock market against private enterprise. Pastoralism is an activity that covers extensive geographical areas, so that the market distortion from this scheme would be expected to spread beyond its target area. Without appropriate checks and balances, this system can lead to massive disempowerment of livestock producers. This weakening of pastoralist livelihoods can also damage Kenya's national economy. Over 70% of Kenya can be classified as arid or semiarid, and livestock production is the cornerstone of these vast SEPLs. Western and Finch (1986) showed that indigenous East African cattle display energy-sparing capabilities during drought. Pastoralists can thus herd cattle at great distances from water at little more cost than animals on the normal maintenance diet and watered more frequently. The physiological response of cattle to drought, the ecological constraints imposed by livestock and wildlife competition, and the energetic efficiency of mixed milk and meat pastoralism explain why herders traditionally select their characteristic management practices (Manzolillo, Western & Nightengale 2006). When these practices are restricted, replaced, or otherwise compromised, the equilibrium of the entire system is at risk.

This model poses an existential threat to pastoralism as a livelihood, exacerbated by high land prices that drive a vicious cycle whereby land is sold and the earnings are invested in even more livestock. In the last two decades, tourism has been touted in Kenya as the basis for conservation, the panacea for human–wildlife conflict, and the ultimate environmentally sustainable livelihood option in non-protected wildlife habitats.

10.4 Conclusion

The prevailing thinking that currently informs the implementation of conservation projects in Kenya has its origins in the laws and regulations that are in place to manage wildlife (enforced by the Kenya Wildlife Service). These, in turn, originated from the practice of gamekeeping in Victorian England, which was brought to Kenya by the British colonizers of the time. This paradigm is largely responsible for the difficulties currently faced in the effective and sustainable management of wildlife and other natural resources in Kenya. It presumes that there was no culture, thought, or philosophy that guided the way in which precolonial African societies lived and interacted with the wild fauna around them. One of the results of this thinking is that wildlife research and conservation practice in Kenya is largely designed, implemented and funded by external agents, who are widely believed to have "brought conservation" to the communities with which they work. In Kenya and much of Africa, there has always been a large

proportion of resources obtained directly from the environment. These include grazing, fuelwood, fish, game, and water. It thus stands to reason that these communities possess some level of knowledge of how to live among and exploit these resources in a sustainable manner. This, in essence, is the way in which socioecological production landscapes in Kenya's rangelands have functioned for centuries. It is important that movements like the International Partnership for Satoyama Initiative (IPSI) identify the reasons for the dominance of tourism interests in the conservation sector in Africa, and reintroduce support for the existing livelihoods that have maintained these ecosystems for centuries.

The creation of social, mechanical, and economic barriers to the free movement that has maintained the biodiversity in these socioecological production landscapes is serious threat to their existence and the diversity they support. The disruption of human societies that have learned to coexist with wildlife will ultimately damage the natural and human environment, an effect that will be felt far beyond the landscapes in question. It is therefore imperative that technical expertise is applied toward adjusting this balance to new realities, rather than creating a false "reality" that is socially, economically, and environmentally unsustainable.

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CHAPTER 11: KENYA

Improving natural resource management and biodiversity conservation in the Laikipia county ecosystem, Kenya

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Summary

Majority of people living in rural areas in Kenya derive goods and services from the available natural resources. However, their livelihood activities contribute to gradual environmental degradation, resulting in loss of the very resources on which they depend. The Laikipia Wildlife Forum (LWF) is a community-based organization trying to balance the livelihood needs of the people and the ecological integrity of their ecosystem. LWF focuses on participatory forest, pasture, and water resource management, aiming to enable local communities to maintain and restore the health of the ecosystem and increase land productivity. Local resource users use Holistic Management principles through which community decision-making groups such as Community Forest Associations (CFA), Water Resource Users Associations (WRUA), and Group Ranch Management Committees govern themselves. This approach has been found to benefit from the close connection with traditional knowledge and governance systems integrated with new knowledge and practices. The results of this strategy show that engagement of communities in natural resource management results in improved decision-making skills, expansion and diversification of economic opportunities, enhanced ecological and socioeconomic monitoring, and improved governance and transparency in relation to the health and management of the Laikipia ecosystem.

Keywords: Kenya, Laikipia county, Livelihood, Landscapes, Ecosystem

11.1 Introduction: natural and social background

All over the world, communities engage directly with the environment through primary activities such as farming, fishing, and gathering resources from ecosystems and by doing so have the responsibility of maintaining socio-ecological landscapes and seascapes (SEPLS). Through close interactions with nature, people have developed efficient and sustainable ways of living and producing food and other materials by adapting to and sometimes modification of the surrounding environment (Ichikawa 2012). In this case study, the Laikipia county ecosystem, located in the Rift Valley province of central Kenya, is explored as an example of SEPLS in Africa contributing to human well-being and ecosystem sustainability.

The Laikipia ecosystem is centered on the upper Ewaso Ngiro river system, with over thirty rivers and streams feeding into the Ewaso Ngiro river, which flows into northern Kenya. The forest areas lie mostly in the wetter upper part of the river catchment and include those on the lower slopes of Mount Kenya

and the Aberdare range and also five forest areas in the west of Laikipia (**Figure 1**).

Land tenure in Laikipia is characterized by both private and communal land ownership. The livelihood systems reflect the ecological and climatic characteristics of the area. Livestock-based livelihoods dominate in most of Laikipia, through large-scale ranches and nomadic/transhumant pastoralists. Small-scale cultivation can be found along the rivers where irrigation occurs and on the west and south of Laikipia where rainfall is higher than 600 mm.

There is high pressure on natural resources, notably rangeland resources and river water, in the more densely populated pastoralist and smallholder cultivation areas. Poor livestock management in addition to water scarcity and increased population has led to the degradation of large tracts of land (Gu & Subramanian 2014). Unsustainable use of forest resources has become the norm, as traditional resource management systems have mostly collapsed and have not yet been replaced by strong adapted management systems. These trends exacerbate global climate change impacts, which appear to take the form of increasingly unpredictable rainfall with more frequent storm occurrence.

11.2 Functions and benefits of the Laikipia county ecosystem

11.2.1 Production and supply of biodiversity and ecosystem services

A range of benefits accrue to the well-being of households and communities of the Laikipia County through the ecosystem services derived from various sustainable uses of land. In addition, the ecosystem contributes to creating sustainable societies, as it encompasses production activities that maintain both biodiversity and ecosystem services. Human productive activities such as agriculture, forestry, herding, and livestock rearing influence the Laikipia ecosystem. Although these engagements may have adverse effects on the environment, many such long-term human-nature interactions, as seen in other SEPLS, can in fact be favorable to or synergistic with biodiversity conservation (UNU-IAS et al. 2014).

The Laikipia ecosystem is critical for the supply of provisioning ecosystem services including food, fuel, plants of medicinal value as well as serving as a source of livelihood for the resident communities through the cultivation of various crops, vegetables, fruits, and trees for timber, forage, and fodder. It

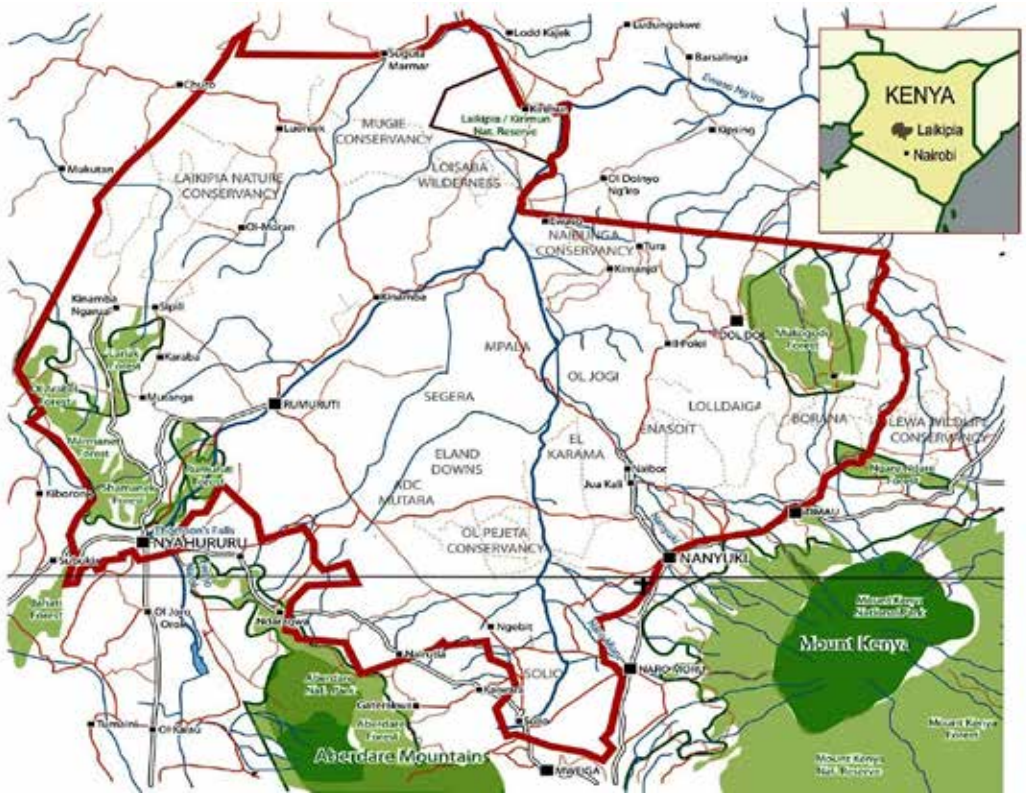

Figure 1: Geographical location of the Laikipia in the context of Kenya
Source: Laikipia Wildlife Forum

Photo 1: Group ranch grazing committee being trained on the need for proper grazing practices
Photo credit: Laikipia Wildlife Forum

Photo 2: Livestock bunching to facilitate water infiltration to enhance new growth
Photo credit: Laikipia Wildlife Forum

also provides pasture for livestock and wildlife. Another major role of the ecosystem is the provision of critical supporting, cultural, and supporting ecosystem services, including curbing soil erosion, enhancement of soil fertility, promotion of water quality, recreational values, supporting pollination, and carbon sequestration.

Forests in the wider Laikipia ecosystem are conservation-diverse. This is often attributed to their geographic spread across a steep rainfall gradient and the direct interconnectedness with the grasslands and dryland woodlands as a result of the movement of wild animals. As with river water resources, the primary mechanism to bring about effective management and restoration of forests in a human-occupied landscape such as Laikipia is community-based organizations. This is recognized in the law through the Forest Act with establishment of Community Forest Associations (CFA) and the implementation of participatory forest management (PFM) (Government of Kenya 2005).

The essential services provided by forests to the people, environment, and wildlife of Laikipia include watershed protection, emergency or dry-season grazing, a wide range of traditional non-timber forest products (food and medicinal plants, fungi, etc.), habitats and forage, and timber products such as firewood. Laikipia county forests also provide a sink for carbon, a recognized need at a global level (Pan et al. 2011).

The Laikipia Wildlife Forum (LWF) program supports the creation and strengthening of CFAs to enable effective implementation of PFM. Through these CFAs, for example, appropriate human interventions such as periodic tree cutting, coppicing, and grazing contribute to conserving the unique biodiversity of mixed woodland and grassland landscapes, particularly in temperate regions.

River water resources are a pillar of existing livelihoods and human sustenance, as well as essential for ecosystem health. The national Water Resource Management Authority (WRMA) and the Ewaso Nyiro North Development Authority (ENNDA) estimate that the water needs of 92% of the upper Ewaso Nyiro system's population is met by surface water rather than groundwater resources, the great majority being met by river water. Every piped water scheme serving rural and urban communities in the ecosystem is served directly by flowing river water. These schemes include all of Laikipia's human population and the work area of the LWF.

Based on Kenya's 2009 population census, the number of people directly dependent on surface water resources, especially rivers, is 165,600 households (Government of Kenya 2010). There is no doubt that the availability of sufficient clean drinking water for people in the ecosystem is directly linked to the overall management of river water resources and related environments.

The LWF activities have focused on three priority areas: PFM, pasture management, and water resource management. The objective of the forest management program is to enable LWF members and the local communities in Laikipia to maintain and or restore forest health and productivity.

11.2.2 Application of local knowledge practices and systems in management of the Laikipia county ecosystem

Community participation is essential, given that the community is usually the primary user and manager of the natural resources in their landscapes. Owing to their extensive and close interaction with their ecosystems, local communities possess abundant information and deeper knowledge of how ecosystems react to different management practices and how they recover from natural disasters and change over the long term.

In Laikipia local communities, particularly the transhumant pastoralists, indigenous knowledge has been key to the conservation of natural resources. Various attempts have been made to restore degraded lands, including grass reseeding, digging trenches to reduce surface runoff, and establishment of grazing management committees to enforce traditional grazing management regimes. These attempts have raised communities' awareness on the importance and potential for restoration and rehabilitation of grasslands despite the changing economic, social and cultural context.

In other approaches, the group ranches have established zonation maps to demarcate areas for settlement, grazing, and conservation, because the pastoralists are becoming increasingly sedentary. This approach involves local communities themselves designating areas for dry and wet season grazing, which allows the land to recover under the rotation. This is based on the communities' knowledge of the spatial distribution of water resources and pasture, settlement patterns, and other areas of spiritual/ cultural value.

Conventional wisdom has advocated destocking as a way of controlling overgrazing and soil erosion, but this practice is not culturally acceptable in Laikipia, where social well-being is culturally associated with livestock herds. The Holistic Management (HM) approach seems to be favorable in this landscape because it does not involve destocking. According to Savory (1999) overgrazing is a function not of number but of time. It is due not to the intensity of livestock on the land but to the time during which the livestock stays in the same area. HM thus aims at improving plant cover to increase rainfall effectiveness (reducing evapotranspiration and runoff) using animal impact to improve soil quality.

The approach resonates well with traditional practices and transhumant communities have readily embraced it in some sections of the Laikipia landscape, despite the challenges of a weakening traditional governance system under the influence of modern activism.

11.3 Major threats and impact to livelihoods

The rapidly growing human population has brought with it large changes in socioeconomic systems, such as land fragmentation and inappropriate agricultural and settlement practices (intensified cultivation, expansion of cultivated land, overgrazing, harvesting of fuelwood, charcoal burning, and inappropriate irrigation). This has contributed toward environmental degradation and a breakdown of ecosystem services. This in turn leads to major problems such as deforestation, acute water shortages, loss of biological diversity, and soil erosion, as well as deterioration of life support systems, including air, water, and land (Gachathi & Amwatta 2005).

Photo 3: Riparian degradation as a result of farming adjacent to rivers
Photo credit: Laikipia Wildlife Forum

Other challenges to ecosystem management activities result from shocks due to natural and human-induced phenomena, such as droughts, wildfires, and floods. Human activities and events such as political upheavals and economic crises further affect the landscape and inevitably affect local communities' livelihoods. In addition, global phenomena such as climate change and transformation of sociocultural and institutional structures directly and indirectly affect the use and management of the Laikipia ecosystem.

The forests of Laikipia are under threat from anthropogenic disturbances ranging from deforestation by illegal logging and charcoal production to retardation of forest regeneration due to intense grazing. The resulting forest loss has direct negative consequences for both livelihoods and biodiversity in the ecosystem, and because forests have critical watershed functions and Laikipia is a water-stressed environment, forest loss may have serious implications for the wider surrounding non-forest areas.

Additionally, the process of establishing CFAs has presented challenges, including difficulties in finding committed leadership for the associations and delays occasioned by the restructuring of the Kenya Forest Department (KFD) into the Kenya Forestry Service (KFS), a process that began in 2007. However, although committee members of CFAs understand the responsibilities attached to communities' involvement in forest management under the New Forest Act, very few people apart from these committee members have a good grasp of their rights and obligations for forest resource use and management (Government of Kenya 2005).

The larger land area of Laikipia (>70%) is semiarid rangeland supporting extensive livestock rearing among the transhumant pastoralists whose livelihoods are based almost entirely on livestock. According to a report from the Ministry of Environment and Mineral Resources these pastoralist communities own approximately 7% of Laikipia as private group ranch land, but use and depend on at least 25% of Laikipia county. Most of the land is owned by cultivating peoples. Forest areas in the Laikipia ecosystem are important dry-season and emergency grazing areas, notably the Mount Kenya forest, in periods of severe drought. Of Laikipia's rangeland, 40% is under large-scale ranching and hosts most of Laikipia's wildlife. Wildlife-based photography tourism has increased in the rangelands in the last decade, influencing land use patterns in both private ranches and communal group ranch land. Both extensive livestock rearing and photography tourism depend on the same natural resource base, namely plants to sustain wild and domestic herbivores. The land's primary productivity, particularly in communally-owned and used areas, is degraded, with concomitant negative consequences for livestock-based livelihoods (Gachathi & Amwatta 2005).

11.4 Responses

LWF is a membership-based organization that brings together local community groups, pastoralists, small scale farmers, private ranches, large scale farmers, and tourism ventures. They are united by a common mission: to conserve the integrity of the Laikipia ecosystem by creatively managing natural resources to improve the livelihoods of its people. Fundamental to the work of the LWF is the recognition that all livelihoods in Laikipia are directly dependent on locally available natural resources.

The overall goal of the LWF is to increase the capacity of the people of Laikipia to manage their natural resources including rangelands, forests, and water by using strategies such as conducting trainings that aim to improve governance at the group ranch and producer group levels, improving decision-making skills in relation to the health and management of natural resources, expanding and diversifying economic opportunities for Laikipia communities, developing a Laikipia-wide ecological and socioeconomic monitoring program to track changes in ecosystem health and human well-being, and improving governance and transparency at community and producer group levels.

The activities undertaken by the LWF have been focused on increasing natural resource management capacity in the Laikipia ecosystem. The work has contributed to the implementation of new national natural resources legislation that recognizes the need for devolution of natural resource management to the user level within the framework of management plans (e.g., Forest Act, Water Act). The LWF has been investigating mechanisms to mitigate land degradation through land restoration and has been creating economic incentives to restore land productivity through enterprise. However, conflicts over scarce resources occur with respect to

rangeland, water, and forest resources (Bond 2014).

To enable its members and Laikipia's communities to protect and sustainably use forests, the LWF has focused on building the capacity of forest users to participate actively in management. Programs have accordingly been established for PFM, pasture management, and water resource management.
To enhance the capacity of local communities in Laikipia to protect and sustainably use forests, sought to promote the capability of forest users to participate actively in their management. This was achieved by raising awareness of and providing training to community leaders and members, so as to make forest users more aware of their rights and obligations with respect to forest use and management under the Forest Act (2005). For instance, leaders of the group ranches surrounding the Mukogodo forest were trained to broaden their understanding of the group ranch's responsibilities with respect to resource management.

The rangeland management program focused on investigating and training communities in a diversity of methods to control erosion and increase grass cover on the land. This was implemented with the aid of fenced demonstration plots, branch lopping, and reseeding. It entailed the establishment of two 20-ha plots where grass was seeded, aloes planted on contours, and terraces formed. At the same time, lopping of tree branches to lay on bare ground to trap water, soil, and seed was performed and reseeding was supported on a 500-ha area. Although the demonstration plots succeeded as awareness-raising tools, showing that grass could come back to the bare land, it became apparent that the prohibitive cost of the methods (fencing, plowing, terracing, planting, etc.), and the lack of integration of these approaches within a wider rangeland management and land use decision-making framework meant that these methods or approaches could not be adopted on the necessary scale on all the land used by the pastoralists.

Another approach involved supporting Group Ranches around the Mukogodo forest to develop and implement grazing management plans. This approach comprised activities such as identification and mapping of dry and wet season grazing areas and the formulation of bylaws in cooperation with the leadership of the group ranches. This activity enabled the restoration of the land to be considered together with broader environmental conservation and management and local economic development.

Whilst focusing on introducing the Holistic Management (HM) principles in community areas, and in response to the strong interest in the approach by the different types of land owners in Laikipia (communal and private) and from elsewhere, targeted introductions and trainings aimed at getting private ranches on board the process and increase their understanding of the approach are being employed (Savory & Butterfield 1999).

Water Resource User Associations (WRUAs) are legally mandated community-based organizations involved in the management of the water resources on which their livelihoods depend (Government of Kenya 2002) The WRUAs are membership-based, anchored in the community of land (riparian and catchment) owners and water users, and established to resolve problems of water abstraction, poor land husbandry, weak water allocation systems, and catchment management at the river level. The role of the WRUAs is to establish dialogue between land users along a river (from upstream to downstream), mitigate conflicts, and put in place and implement management plans for their rivers. In order for river water management to be effective and water to be available to households, the creation of functional WRUAs is paramount (Government of Kenya 2006).

Because downstream communities and environment are vulnerable to the weak management of upstream water resources and catchment areas, the river water resources management program is initially concentrating on strengthening the management of water resources in the upper part of the catchment. A key element of the program is to raise awareness of upstream communities of the link between their activities and downstream water availability.

The LWF has successfully supported the formation and strengthening of 26 WRUAs in the Laikipia ecosystem, with work ongoing to develop Sub-Catchment Management Plans (SCMPs) to guide future water resource management activities within each sub catchment.

11.5 Recommendations

Few people understand the importance of good forest management for their livelihoods; besides, there is little understanding among community members of the relationship between the health

of the forest and the health of the ecosystem as a whole, in particular the role that forests play in water availability beyond the locality. Although various approaches are considered to help in the reversal of negative trends in SEPLS, the engagement of the local communities is essential, given that members of these communities are primary users and managers of the local ecosystem. In addition, they possess abundant information on how local ecosystems react to different management practices, recover from natural disasters, and change over the long term, as a result of their frequent interaction with the environment.

Management of SEPLS must incorporate sound decision-making processes and embrace holistic management strategies that are of direct relevance and value to the given ecosystem. This is because such strategies bring new knowledge and understanding of the range of tools (technology, rest, fire, grazing, and animal impact) available to land managers and of the impact of each on the four ecosystem processes that sustain life [water cycle, nutrient cycle, energy flow, and succession (of plant, animal, and other communities)]. Holistic management also focuses on knowledge transfer to land managers, which is vital for on-the-ground capacity and long-term sustainability.

The strategies used also revealed that management planning and better-informed decision-making is more effective in restoring health to the communal rangelands than technological interventions. In the context of Laikipia, holistic management provided guiding principles for an integrated approach to planning and decision making. But it is noteworthy that such interventions must develop through a process that is acceptable within the local economic, social, and environmental context. The challenge; however, may lie in attaining coordinated implementation among expansive populations of livestock owners, decision-makers, and managers.

Photo 5: Signing the Forest Management Agreement
Photo credit: Laikipia Wildlife Forum

There is need to ensure sufficient cooperation between users within the SEPLS. This is born of the finding that though cooperation may be difficult to achieve, such ensures that planning is more adaptive, and rely on collaboration, with a focus on livelihood activities such as herding together, moving at the same time, leaving grass to recover sufficiently. The identification and training of a core team of people to lead the process in each community enhances the uptake of the approaches, as this practice enables communities to understand more quickly the concepts involved.

Photo 4: Community Forest Association members raise seedlings in nurseries
Photo credit: Laikipia Wildlife Forum

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CHAPTER 12: UGANDA

Parklands, pasturelands, paddy rice fields, and coffee gardens as existing or potential agricultural socio-ecological production landscapes

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Summary

For conservation of biological diversity to be holistic, the diverse types of ecosystem and ecological communities occurring in a given landscape or country should be part of the conservation portfolio. Eastern Uganda has low protected-area coverage compared to other regions of the country. From the viewpoint of biodiversity conservation, the region is unique as it contains a vegetation belt (the Sudano-Sahelian photochorion) that is not adequately represented in Uganda's protected areas probably has the most extensive and diverse wetlands in the country. Sustenance of the biodiversity in this region depends on conservation in farmlands. This study describes some of the ways in which conservation on farmlands in this region can be achieved in parklands, pasturelands, paddy rice fields, and coffee gardens, these being the main agroecosystems that have high potential to combine the goals of biodiversity conservation and agriculture-based livelihood. This case study is based on literature review and direct observation. Parkland and pastureland agroecosystems are considered existing Socio-ecological production landscapes (SEPLs), while paddy rice fields and gardens of shade coffee are regarded as potential.

Keywords: Parklands, Pasturelands, Rice paddies, Shade coffee, Agroecosystems

12.1 Natural and social background

A large amount of biodiversity occurs outside protected areas. In 1989, it was estimated that approximately 50% of the world's terrestrial area is under agriculture, approximately 20% under commercial forests, and another 25% occupied by human settlements including cities, towns, and villages (Western & Pearl 1989). Only 5% was unmanaged or uninhabited land. Most species were reported to occur in land that is managed for agriculture, forestry, and human settlements. In addition to protecting the integrity of parks, therefore, it has been pointed out that efforts to conserve biological diversity must include agricultural, forest, and other managed ecosystems (Pimentel et al. 1992).

Success in that effort depends on making biodiversity an integral component of production at local levels. Nature and Livelihoods NGO has initiated these efforts in eastern Uganda (**Figure 1**). This region has the least protected area estate

in the country. The likelihood of efforts to integrate biodiversity conservation into agriculture in this region has promise for four farming types: parklands, pasturelands (pastoral areas), paddy rice fields, and coffee gardens. Parkland farming and livestock grazing are traditional systems in which biodiversity is an integral component of production. In this respect, they can be considered as existing agricultural Socio-Ecological Production Landscapes (SEPLs) (Satoyama Initiative 2013). Paddy rice farming and coffee growing are relatively new systems that unintentionally benefit certain native species or have high potential to do so.

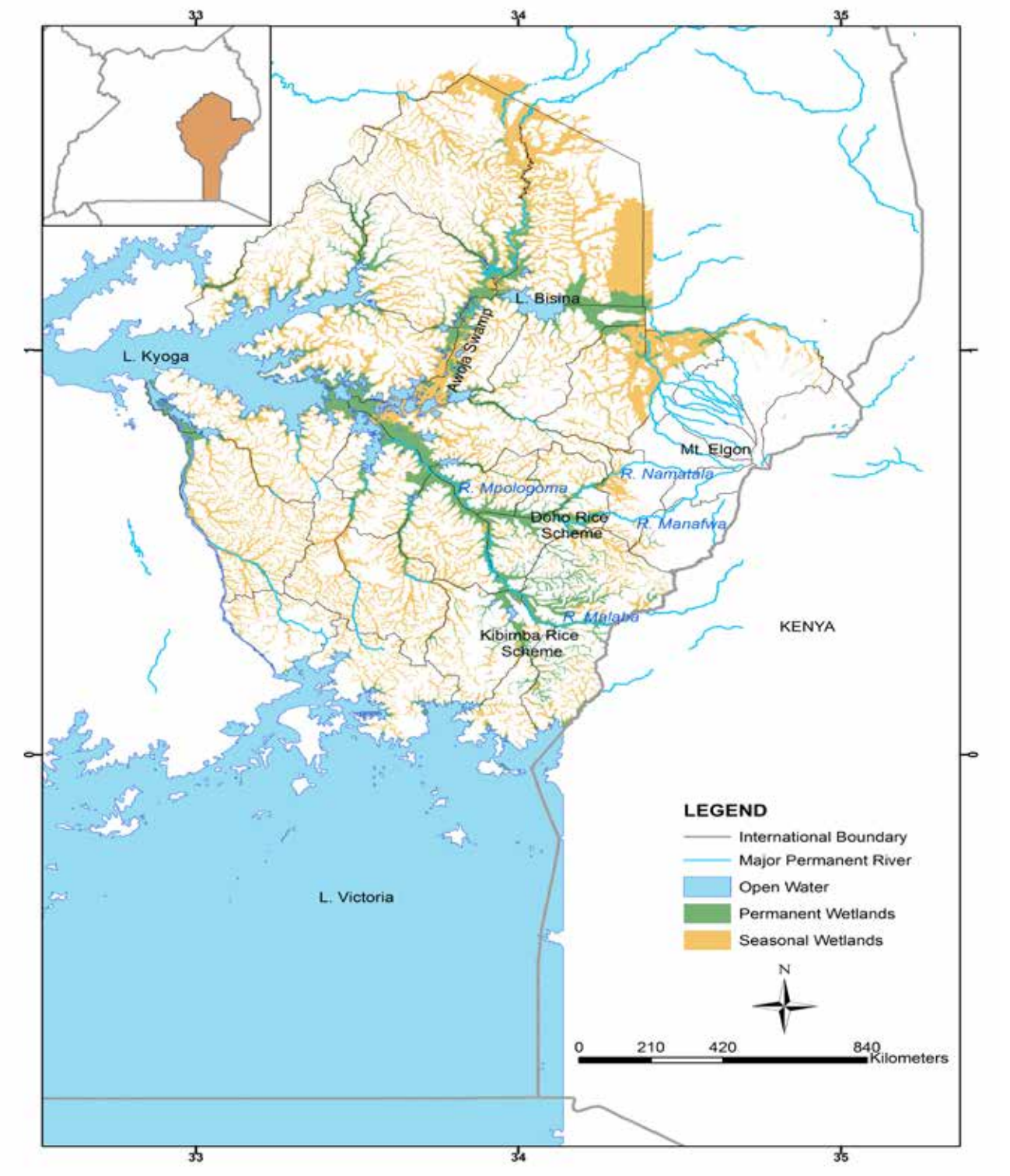

Figure 1: Map of eastern Uganda showing drainage and other features
Source: Prepared for Nature and Livelihoods by the GIS Section of the Wetlands Management Department, Ministry of Water and Environment, Kampala

Parkland farming and livestock keeping are practiced in the drier northern areas of the region, which lie within the Sudano-Sahelian vegetation belt. Parkland farming is a dryland cropping system in which trees are left in gardens when virgin areas are opened up for cropping (Boffa 1999; Lovett & Haq 2000). In Uganda, the main crops grown under this agroecosystem are millet, sorghum, cassava, groundnuts, and peas. It usually includes leaving strips of uncultivated land between fields. Areas reserved for livestock grazing are usually seasonally flooded grass swamps. Upland areas dominated by rocky soils were, until recent years, reserved for livestock grazing. Paddy rice is grown in shallow swamps, usually in the wetter areas to the south of the region, though rice growing also occurs in the drier swamps to the north. Rice is cultivated in pure stands. Rice farming was introduced into Uganda in 1904 (Bigirwa 2005, cited in Odogola 2006). Thereafter, growing was limited until the establishment of the irrigated Kibimba and Doho rice schemes in 1966 and 1976 respectively (Odogola 2006). The wetlands of eastern Uganda are the main rice-producing area of the country (Haneishi et al. 2013). Rice is grown primarily by subsistence farmers as a commercial crop. Shade coffee (*Coffea arabica*) of a commercial variety was first planted in Uganda around 1900 (Brown & Hunter 1913). The main *arabica* coffee farming areas in eastern Uganda around the slopes of Mt. Elgon, where it is cultivated by smallholder farmers.

Cocoa (*Theobroma cacao*) farming is another agricultural practice in this region that has inherent potential to support biodiversity conservation when well managed. Such potential has been demonstrated (Rice & Greenburg 2000; Scroth & Harvey 2007). However, cocoa farming is not further discussed in this paper as it is still a relatively new practice in Uganda even though cocoa was introduced into the country in 1901 (Brown & Hunter 1913).

12.2 Functions and values of existing agricultural SEPLs

12.2.1 Globally demonstrated benefits

The importance of integrating biodiversity conservation into agriculture has been little demonstrated. However, available information points to substantial livelihood benefit. Although farming benefits certain indigenous species, those species also contribute to agricultural production. Pest, weed, and soil fertility control are thought to be some of the most important services of biodiversity in agroecosystems. Agricultural production is reported to be correlated with biodiversity in agroecosystems, within limits: as the biodiversity increases, so does agricultural production (Luo, Fu & Traore 2014). In coffee gardens, it has been shown by Classen et al. (2014) that exclusion of pest predators (birds and bats) reduced fruit set and inclusion of pollinators (bees and butterflies) increased the weight of coffee berries. For mosaic agroecosystems, beekeeping is reported to depend heavily on the biodiversity of uncropped pasturelands (Blair 2015). Even weeds are reported to be useful. Despite their negative competitive effect on crops, arable weeds have been reported to support various species of beneficial insects, especially crop pollinators, and high weed diversity is considered favorable in maintaining and regulating the microbial diversity of the soil as well as in reducing the effects of harmful weeds (Marshall et al. 2003). In parklands, natural trees left in plantings can also serve to improve soil fertility, for example as demonstrated for *Faidherbia albida* parklands. Parklands also supply edible fruit (Boffa 1999). In wet pastures, native fishes and other aquatic organisms account for a large share of residents' intakes of animal protein, micronutrients, and essential fatty acids, especially for poor households (FAO 2004).

Ways in which these farming practices benefit biodiversity can be illustrated with a few of numerous examples. For rice fields, much of the available documentation comes from Asian countries (Kurihara 1989; Bambaradeniya & Amerasinghe 2003; Edirisinghe & Bambaradeniya 2006). The rice field ecosystem is potentially one of the most sustainable forms of agriculture that can contribute to sustaining rich biodiversity. In coffee agroecosystems, the requirement for shading of *arabica* coffee bushes affords an opportunity to elements of native biodiversity to survive in an otherwise degraded landscape. Unlike unshaded coffee, shade coffee has been documented to support, for example, conservation of arthropods, amphibians, resident and migratory birds, and mammals (Tejeda-Cruz et al. 2010). Many of the supported species would normally be dependent upon tropical forest. Pastures sustain native biodiversity by retaining native grasses, herbs, and shrubs, while parklands promote the maintenance of indigenous tree species richness and thereby act as reserves of native biodiversity (Fifanou et al. 2011).

12.2.2 Demonstrated and potential benefits of native biodiversity to local livelihoods

(a) Control of harmful species such as pests and weeds

This is a service that potentially exists in all agricultural types described in this paper. This study is not aware of documented evidence from Uganda that relates to this service.

(b) Pollination service

This service would be important mainly for parklands, pasturelands, and coffee gardens. However, crops dependent on this service and the main pollinators in Uganda need to be identified.

(c) Soil nutrient supply and retention

This service would be cross-cutting for the four agroecosystems. Tree retention in plantations in parklands (**Photo 1**), promoting heterogeneity of rice fields, and low-impact grazing of pastures have potential to facilitate this service. Anecdotal observations suggest that cropping of seasonal wetlands is degrading (**Photo 2**) lands that would normally support livestock. In non-seasonal wetlands, accumulation of rich black soils has promoted emergence of a booming rice industry (**Photo 3**).

Photo 1: Example of parkland cropping. Parkland remnants like this can be bases for revitalization of the parkland farming system. Photo taken in Toroma County in Katakwi district
Photo credit: William Olupot

Photo 2: Wet pastures in the northerly areas (Teso Subregion) of eastern Uganda. Retention of grass swamps for pasture as opposed to cropping benefits biodiversity and is probably the only livelihood practice that is sustainable in the long term for these landscapes. Photo is of a major wetland draining into Lake Bisina.
Photo credit: William Olupot

Photo 3: Paddy rice agroecosystem. Kibimba and Doho Rice Schemes support a stunning array of species, particularly the avifauna. Other rice farmlands have potential to support biodiversity in a similar way if appropriate measures are taken to integrate biodiversity conservation into rice farming
Photo credit: William Olupot

Depending on the species, shade trees in coffee gardens (**Photo 4**) may contribute to maintaining good soil conditions in this system.

Photo 4: Coffee garden agroecosystem with shade trees on the slopes of Mt. Elgon. If managed properly, the practice of including native trees in plantations has potential to sustain a cross-section of native biodiversity, particularly species that promote berry yield.
Photo credit: Paul Okullo

(d) Food provision

Native trees left in parklands and pasturelands provide this service (Olupot 2015). A recent study by Nature and Livelihoods has shown that fruits from parklands and wooded pastures contain certain essential nutrients that occur in limited quantity in certain agricultural fruit (Olupot & Omujal 2015). Wet pastures are a source of fish, and both parklands and wooded pastures are a source of edible mushrooms that contribute to the food security of people in these areas. In Kibimba Rice Scheme, a dam created to support the irrigated paddies has become a source of fish for the local people (Personal Observation).

(e) Forage and water retention value

The wetlands of the northern part of this region are mainly grass swamps. As such, they are an important source of both water and pasture for livestock. Experience gained by Nature and Livelihoods while working in this region points to wetland reservation for this service as opposed to cropping has contributing to the sustenance of the native aquatic and floral diversity in this area.

(f) Amenity value

Irrigated rice paddies and wet pastures have a high amenity value owing to abundance of birds and a beautiful scenery. However, these esthetic values have not been promoted for recreation to the level that they might be.

12.3 Challenges and responses

12.3.1 Challenges

(a) General

Increasing human populations and changing societal values and practices in Uganda are leading to loss of traditional practices that sustained biodiversity in parklands and pasturelands, while rice and coffee farming are new practices that have high potential but have no built-in mechanisms to conserve biodiversity.

(b) Use of agrochemicals

In many types of agroecosystem around the world, the use of agricultural chemicals including pesticides, herbicides, and fertilizers has been demonstrated to be harmful to biodiversity, and in some cases has resulted in extinction of certain species (USDA 1969; Reid & Miller 1989). In addition to reducing biodiversity, they pollute the water and soil environments (Luo, Fu & Traore 2014). Such pressures and their impacts have largely not been documented in Uganda. For agroecosystems considered in this paper, chemical application has been reported for the irrigated paddies (Namaalwa et al. 2013) but not for other farming systems.

(c) Heavy livestock grazing

Evidence of heavy livestock grazing and its impact has not been documented in the pasturelands of eastern Uganda; yet such evidence is needed to guide local people towards sustainable practices. Anecdotal observations of bare patches in grazed areas however suggest occurrence of this practice. Elsewhere, heavy livestock grazing and trampling have been shown to reduce rare plant species, especially palatable ones (West 1993; Holden 1992). From the viewpoint of livestock production, heavy grazing results in gradual reduction of fresh grass yield, grass species composition, and quality

Photo 5: A cultivated wetland/upland interface along the shore of Lake Bisina. Soil on such interfaces is usually infertile and their cultivation neither benefits biodiversity nor livelihoods. Water is visible near the top right corner of the picture.
Photo credit: William Olupot

of forage (Zhang et al. 2002). Intensive grazing pressure on rangelands has been reported to lead to poor biomass production for both livestock and wildlife over many years (Blench & Sommer 1999).

(d) Burning of pastures

Pasture burning is a common practice in grass swamps and also occurs in papyrus swamps to a lower level during the dry season. Nature and Livelihoods' working experience is that unplanned, uncoordinated burning results in severe shortage of pasture during the dry season, leading to loss of condition and increased mortality of livestock, but this effect remains to be demonstrated through systematic investigation. Effects of burning on biodiversity are also pronounced. Several rare tree and shrub species (such as African ebony, *Diospyros mespiliformis* which furnishes edible fruit, and the knob wood, *Zanthoxylum chalybeum*, which residents value highly as for medicine and spice) have been severely depleted by wildfires occurring during dry seasons.

(e) Farming of marginal areas

Population growth appears to be driving arable farming into marginal areas with low soil fertility and hence not suitable for cropping. Such areas were traditionally reserved for livestock grazing (**Photo 5**). Direct negative impacts of claiming marginal areas for cropping are becoming apparent. For example, in addition to resulting pasture shortage, water scarcity for both people and livestock was reported during Nature and Livelihoods' survey of the status of gray-crowned cranes in the wetlands of this region in 2014 (Olupot 2014). In one case, it forced a community to restore wetland that they had converted to rice fields back to native grass cover. This action resulted in increased availability of water but had by that time not fully restored the lost pastures, as the wetlands were still dominated by sedges and other grasses not palatable to cattle.

(f) General change in societal values and overexploitation of biodiversity

Reduced appreciation of the food provision value of native plants is leading to loss of trees traditionally left in gardens through parkland farming. The trees are being lost to commercial charcoal and timber production. Loss of uncultivated field borders (hedgerows, shelterbelts) is also ongoing. In wooded pastures, there is an increasing trend of woody cover loss and use of destructive methods (such as application of chemicals to mounds) to control termites. In paddy rice fields, the necessity of clearing all trees from paddies that goes with rice growing has led to loss of nesting and roosting grounds for birds. Non-consideration of soil conservation is leading to a progressive loss of soil fertility in rice fields, as evidenced by emergence of infertile soils along wetland edges years after cropping. Killing of birds also occurs in paddies outside the irrigated schemes (Olupot 2014) and in wetlands of the drylands, various pressures include overstocking and cropping leading to undesirable impact on fish, pasture, and water provision services.

(g) Monocultural tendency

Rice growing is the only monocultural practice among the agroecosystems described in this paper and is expanding. Although its effect on biodiversity and livelihoods has yet to be demonstrated in Uganda, studies from elsewhere are informative. According to these studies, widespread clearing of fringing natural habitat and indiscriminate use of broad-spectrum biocides leads to the destruction of natural enemies, causing a resurgence of primary and secondary pests and development of insecticide-resistant pest populations (Bambaradeniya & Amerasinghe 2003; Luo, Fu & Traore 2014).

(h) General non-integration of biodiversity into farming practices

Although there are many opportunities to integrate biodiversity into farming, such efforts are still limited in Uganda. Traditional farming practices such as maintaining uncultivated field borders and leaving native trees in cropped areas are not being retained. New practices that have potential to do so in rice paddies are little encouraged. In rice fields, the only ongoing effort to integrate biodiversity into agriculture, though still limited, is that by the rice schemes (Kibimba and Doho). The proprietors of these schemes discourage hunting of birds and other wildlife. In coffee gardens, the only response is an effort by local CBOs to popularize tree planting. However, this is primarily for stabilization of the landslide-prone soil soil (Kato et al. 2015) rather than for integrating native biodiversity into coffee farming.

12.3.2 Responses to the challenges

Nature and Livelihoods has been documenting challenges and opportunities to determine avenues for integrating biodiversity conservation into farming in these agroecosystems. This has only just started. We are not aware of any other organization engaged in such, or systematically integrating native biodiversity into livelihood effort in these agroecosystems. As a step toward addressing the challenge of loss of traditional values attached to biodiversity, we recently analyzed nutritional values and conducted high-value market product formulation trials for 10 types of native edible fruits collected from the parklands and wooded pastures. The results indicate superior values for some of the essential nutrients compared to fruits commonly grown in the same areas, and a high potential for use of native fruits in producing products such as jam, juice, and wine (Olupot & Omujal 2015). This information is expected to support awareness raising and community education efforts, thereby reinforcing the traditional practice of leaving native trees on farmlands and wooded pasturelands where they grow naturally.

12.4 Recommendations

Parklands and pasturelands are existing SEPLs that should be revitalized. Paddy rice fields and coffee gardens are farmlands that have high potential to be SEPLs if biodiversity considerations are integrated into livelihood effort in these agroecosystems. Priority actions for engagement of the local communities include addressing threats at all scales (e.g., burning in rangeland, demand for charcoal leading to loss of trees in parklands, increased erosive power of water in paddies at landscape and regional scales, and high demand for more arable land, leading to clearing of marginal areas at microscales). Actions also include enlightening farmers with respect to benefits realized at microscales (e.g., food provision, pest control value, and pollination value of biodiversity in gardens) as well as those that occur at the landscape scale (e.g., income from tourism, soil erosion control value of heterogeneous habitat in rice paddies). From the standpoint of existing knowledge of these farming practices, the following are some of the specific actions that should be implemented, arranged in no particular order:

i) Biodiversity inventory and documentation of use values. As for protected areas, documentation of biodiversity in SEPLS is needed to guide actions. Unlike protected areas where assessment of use values of individual species may not be as urgent, such is required for farmland SEPLs, as these form the main basis for motivating landowners to sustain at least a cross section of indigenous plant and animal populations. Such assessments should include determination of non-extractive values that can be realized at local levels; for example, aesthetic values.

ii) An effort to identify organisms that can serve as a focus of action (e.g., pests, pollinators, weeds, keystone or link species, threatened, and endangered species) in each agroecosystem.

iii) Documenting beneficial and of needlessly destructive practices.

iv) Awareness raising and education to counter the perception that all wild species are harmful to agriculture. For example, insects, fungi, and other organisms that are pests of humans and crops make up less than 1% of the species in a given location (Pimentel et al. 1992).

v) Research to reinforce existing good practices and traditional values locally attached to biodiversity; for example, those that promote retention of species of high socioeconomic value such as those that provide food or medicines, improve soil fertility, or serve as sources of nectar and pollen.

vi) Promoting integrated pest management to curb overuse of insecticides, reducing their toxic impact on biodiversity as well as on human health. The philosophy of maintaining a mosaic of habitats within each agroecosystem should also be promoted by demonstrating its effect on soil fertility and the beneficial effect of species such as natural predators and parasitoids of crop pests.

vii) Promoting sound soil management practices such as retaining crop residues, use of cover crops, diversification of crops in gardens, intercropping, use of shelter belts, use of livestock manure, and agroforestry particularly in parklands. These practices would serve as a disincentive for farming of marginal areas that sustain wildlife and remove parkland trees for short-term financial gain.

viii) In pasturelands, promoting pasture management that prevents overgrazing and wildfires, and retain native bushes in balance with grass cover. Farmers need to be educated about the damaging effect of unsustainable practices on forage stocks and consequently livestock production. They also need to be sensitized. Research is needed to generate information that can support this.

ix) Conducting educational activities to counter unsustainable farming and resource exploitation practices that have depleted woody and other natural vegetation buffering wetlands and uplands. In places where they have been lost, these can be restored through revegetation. As soils of wetland edges in this region are typically infertile in this region, this revegetation of such sites would not constitute loss of farmland.

x) Restoring, in manageable densities native trees that naturally occur in wetlands but have been eliminated by rice growing. Such trees would support particularly avian fauna, many species of which appear harmless to rice.

xi) Establishing uncultivated buffers of natural vegetation along courses of rivers such as Namatala, Manafwa, Malaba, and Mpologoma to regulate water speed that in turn reduces erosion and to supports functions such as water retention in the wetland for various livelihood purposes.

xii) Discouraging indiscriminate exclusion of wildlife and its overhunting for food through education of local communities and relevant policies.

xiii) Promoting, through farmer education and provision of seedlings diversification of native trees in shade coffee gardens.

xiv) Conducting research to assess the potential of other agroecosystems to serve as SEPLs; systems such as cocoa fields and sugar-cane plantations. In one area expansion of sugar-cane growing has indirectly promoted restoration of lost populations of species such as guinea fowl for which the crop has provided suitable breeding, foraging, and roosting habitat (Gilbert Isabirye-Basuta, *personal communication*).

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CHAPTER 13: UGANDA

Natural resources management by Rwoho forest edge communities, Uganda

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Summary

Rwoho forest edge communities comprise peasants that depend on rain-fed agriculture. The crops produced include bananas, cassava, sweet potatoes, beans, cowpeas, sorghum, maize, and millet. Coffee is the major cash crop produced. The average land holding is 2 ha. The forest reserve provides unskilled employment during the off season; however, to a large extent, the population is engaged in subsistence farming. The highlands receive an average of 917 mm of rainfall annually, and the area is a major food producer in the western region of Uganda. The Rwoho Central Forest Reserve covers an area of 9,073 ha. Adjacent communities access the resource through collaborative forest management (CFM). Limited access to forest resources has created shortages of trees and tree products for the community. Converting the forest landscape into a monoculture tree plantation has destroyed biological diversity and affects environmental services and goods derived from the forest ecosystem. Across Uganda and particularly in the Rwoho rainforest ecosystem, the number of naturally growing trees has declined because trees are cut at a very fast rate without being replaced. This has led to a loss of biological diversity, frequent landslides, floods, silting of water resources, severe soil erosion, loss of soil fertility, and decline in agricultural productivity.

Keywords: Uganda, Forest communities, Wildlife, Resources

13.1 Physical and natural characteristics of the Rwoho forest

The Rwoho Forest Reserve is located in Rwampara county of Mbarara District, Isingiro County of Isingiro District, and Ruhama County of Ntungamo District, in southern Uganda (**Figure 1**) The Rwoho Central Forest Reserve covers an area of 9,073 ha and is managed by the National Forestry Authority (NFA) on behalf of the Government of Uganda, based on the National Forestry and Tree Planting Act 8/2003.

The forest is located in a series of rounded ridges at an altitude of 1,800 m above sea level (**Photo 1**). The sides of the ridges are very steep, sometimes reaching 45 °. The narrow valleys between the ridges have almost level floors with slopes of <10 °, where drainage is impeded. The underlying rock comprises weathered phyllites, argillites, and arenites of Karagwe-Ankolean age, capped above 1,800 m by a sheet of laterites, which frequently contains clay and is often stained by iron salts. Peat is commonly found underlying the clay in valleys. Soils on the ridges are deep and fertile. On the flanks of the ridges, the soils are 0.5–1.0 m deep, well drained, and dry out only during severely dry seasons. Narrower ridges and steep slopes contain extremely thin, gritty soil or none at all, whereas landslides and erosion in some cases expose the bedrock. The valley bottoms

Photo 1: The Rwoho forest is located on rounded ridges
Photo credit: Environmental Protection Information Centre (EPIC) 2016

contain deep dark soils, which are permanently moist, even during the dry seasons.

All rivers within the Rwoho Forest drain southwards into the Kagera River, and from there into Lake Victoria. The minimum average daily temperatures for Mbarara town for the period 1960–1993 was 17.3 °C, and the maximum average daily temperature for the same area was 26.6 °C. Analysis of the temperature trend showed an increase of approximately 2 °C over the period. The temperature for Rwoho is expected to be slightly variable due to differences in altitude. Monthly rainfall figures show that there are two annual peaks during March/April and September to November, with the driest period occurring from June to August. The mean annual rainfall is 917 mm. The area is occupied by two vegetation communities (c 1964) classified as type D3 (Albizia Markhamia forest, 45 km^2, 50%), and the other is classified as type Q4 (Themeda Chloris grass savanna 45 km^2, 50%). These occur on hill tops, ridges, and hill sides, and are maintained by frequent outbreaks of fire. The forest is partially degraded, mainly because of its proximity to communities and the easy access they have from all sides.

Natural forests occur in the valleys, with abundant species occurring in almost pure stands in some places. For example, in the Rwanduru valley, *Markhamia lutea* (mushambya) is established, whose yellow flowers are a feature of the forest, whereas *Celtis africana* is dominant in Rwabaranda. Swamp forest is found growing around small swamps in the valley bottoms, dominated by *Mitragyna rubrostipulata* and *Syzygium guineense*, whereas papyrus and other *Cyperaceae spp*. grow on the water. The current plantation area of Rwoho Central Forest Reserve consists of 12 compartments, covering approximately 1,580 ha. The plant viable area is comprised of 1,548 ha. The species planted are mostly *Pinus oocarpa, Pinus caribaea* and small areas of *Eucalyptus grandis* and *Cupressus lusitanica*.

13.2 Functions and values of Rwoho central forests reserve

13.2.1 Socio-economic functions

No valuation of the reserve has been conducted and as such, there are several attributes that are underreported. However, the potential total portfolio includes, but is not limited to timber stocks, natural forests and woodland biomass (**Photo 2**), non-timber products such as minerals, water catchments and hydrological services, and provision of habitats for both plants and animals. The area also provides grazing for livestock. Cultivation of cash and food crops is conducted in the forest reserve by forest edge communities. Rwoho forest supplies saw logs to the market. The market for most of the sawn timber is Kampala, the capital of Uganda (300 km away).

Photo 2: Portions of untouched Rwoho natural forest
Photo credit: Environmental Protection Information Centre (EPIC) 2016

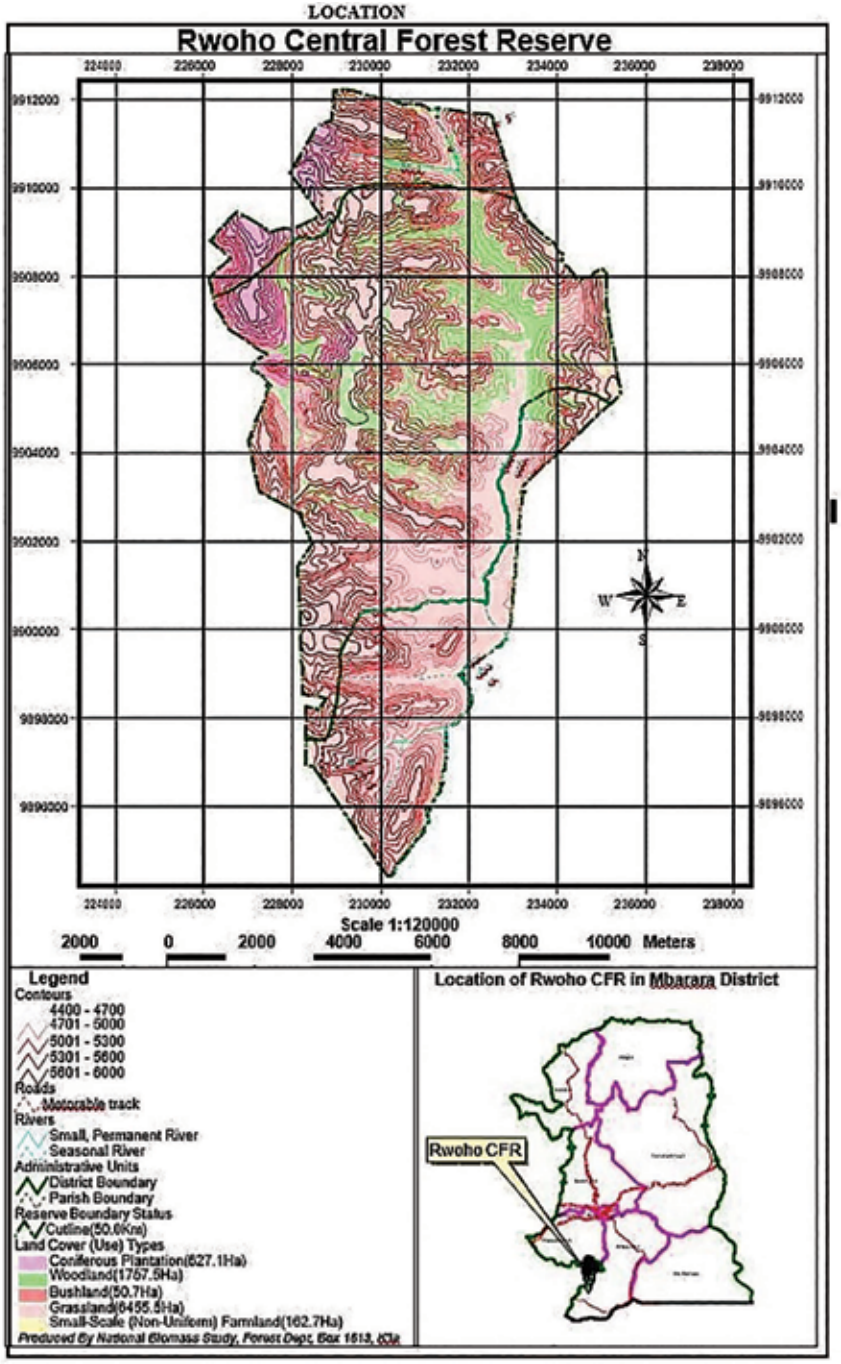

Figure 1: Location of Rwoho Forest Reserve
Source: NFA, Rwoho CFR Management Plan 2016-2026

The local demand for forest products is growing as the urban areas of Mbarara and stability of the neighboring countries (Rwanda and Congo) provide opportunity for supporting a sizeable forest industry. The dependence of the local communities on the reserve is visible from the products they require for livelihood sustenance. The main requirements by different stakeholders include water for people and animals, fuel wood for domestic use, local herbal medicines for people and animals, timber for local and commercial sale, poles for domestic and commercial construction, grass for grazing animals, poles for tool handles, weaving materials, soils and sand for building, mushrooms and vegetables for domestic use, and charcoal for sale in urban areas. The National Forestry and Tree Planting Act 8/2003 requires that NFA manages the reserve in close collaboration and consultation with the different stakeholder categories.

13.2.2 Ecological and ecosystem functions

According to the inventory by the National Forestry Authority, of the 65 forests investigated for biological diversity, Rwoho ranks 41st in overall importance with a score of 12. It ranks third in small mammal richness, with a score of 8.8, but 51st in bird richness with a score of 7.4. In terms of rarity value, it ranks 27th for trees with a score of 7.4, 52nd for moths, and 13th for small mammals with a score of 6.5, 45th for birds, and 18th for butterflies with a score of 5.3. The forest supports one tree species and two butterfly species, which do not appear anywhere else in Uganda's protected areas. It also supports two small mammals and one butterfly which are regional endemics, and five tree/shrubs, one small mammal, and eight butterflies of restricted range (NFA 2006).

Rwoho Central Forest Reserve serves an important watershed role. It is the source of the Mishumba River that flows through the drier south east to meet the Kagera River. Kagera River flows into Lake Victoria, emerging as the River Nile. Land use changes within the watershed can have far reaching repercussions on the fresh waters of Lake Victoria and is one of the sources of nutrients that fertilize Lake Victoria, causing eutrophication and pollution. In particular, phosphorous attached to soil particles is carried by runoff from crop fields and artificial fertilizers from large-scale agricultural estates. Although plantations of exotic species sequester carbon, the indigenous, broad leaved species are more effective species as carbon sinks.

13.3 Threats and challenges

Several factors, ranging from socio-economic to environmental changes, currently threaten the Rwoho Central Forest Reserve in Uganda.

13.3.1 Species documentation

Wildlife resource composition of the forest reserve is not well documented. Historical documentation was mainly concerned with zoological pests. Among the faunal heritage documented to date are small mammals, birds, butterflies, and moths. Large mammals include buffalos, baboons, lions, and occasional elephants. These did considerable damage early during the establishment of plantations in the area. However, human pressure and grazing threatened and eliminated these animals to the extent that the present threat to young crops originates from domestic animals only.

13.3.2 Climate change

The forest reserve is experiencing prolonged dry seasons and increased temperatures. This affects mainly plantation establishment, particularly young plants and seedlings in the nurseries. Crops in fields of adjacent communities fail due to lack of sufficient rain. Decline in crop yields is causing food insecurity and forcing forest edge communities to engage in illegal activities within the forest reserve, such as charcoal burning, in order to earn a living.

13.3.3 Firebreaks

Fire outbreaks are caused by encroachers who carry out illegal activities in the reserve. The main sources of fire are wild honey harvesters, cattle keepers who burn the bush to regenerate grass for grazing, and disgruntled individuals that start fires to damage the forest. The fire destroys both the plantations and the natural forest belts, causing financial loss and loss of biological diversity.

13.3.4 Vulnerable landscapes

The fact that plantations are established on steep slopes of up to 45 in some places makes it ecologically vulnerable to erosion. The outcrops lack the thick undergrowth that control runoff and the impact of rainfall on soils. When the trees are harvested, the slopes are left bare and are prone to soil erosion and landslides. Soil infiltration and water holding capacity of tree plantations are less compared to that of natural forests. Flooding and soil erosion are becoming a phenomenon in the watershed, which defeats the objective of reforesting the Nile Basin. Sedimentation and fertilization of fresh waters in the Nile basin are major threats in the Lake Victoria ecosystem.

13.3.5 Poor local farming practices

Poor farming practices are accelerating soil erosion, which leads to sedimentation and silting of water sources. Monoculture tree systems of exotic species cause loss of biological diversity of species and habitats. Plantation establishment requires clearing of land by use of fire and treatment with herbicides and pesticides. These practices are environmentally unfriendly and are direct causes of pollution in water

Photo 3: Poor farming practices: cultivating on steep slopes in Rwoho
Photo credit: Environmental Protection Information Centre (EPIC) 2016

sources in the watershed, besides being a health hazard to local communities. Tropical forests host a high percentage of global biological diversity. However, monoculture tree systems are not forests, implying that biological diversity is underrepresented in the reforestation activities of the Rwoho Central Forest Reserve.

13.3.6 Restricted access to forest resources

Given the remoteness of their communities in relation to towns and transport infrastructure, this limits livelihood options of communities living adjacent the forest. Cultivating on unprotected marginal land causes loss of soil nutrients through runoff and soil erosion, leading to poor crop yields (**Photo 3**). Forest communities are forced to abandoned these sites and encroach on the forest reserve. The process is unsustainable, in that the cleared land in the forest is also ecologically fragile, and the soils lose nutrients the moment vegetation is removed, forcing farmers to move on to virgin land in the forest.

13.3.7 Population explosion

Population explosion has reduced land available for agriculture, forcing forest edge communities to encroach on the forest reserve to produce food. As more young people obtain employment in the tree plantations, this affects labor available for food production, leading to dependence on food imports, which expose local communities to risks of food price fluctuations, causing food insecurity.

13.4 Responses: existing and proposed interventions

In terms of practical measures to address the many threats facing the Rwoho forests as a socio-ecological production landscape, a number of actions can be highlighted.

Payment for carbon credits is one of the environmental services from which NFA and forest adjacent communities have benefited. According to the Chairman of Rwoho Environmental Conservation and Protection Association (RECPA), Mr. Jerome Byesigwa, their association received carbon credits payment of 11 million Uganda Shillings in 2014. RECPA is a community based organization that is participating in the NFA/World Bank Nile Basin reforestation project that earns carbon credits under the United Nations Clean Development Mechanism (CDM). However, it is imperative to state that timber production to meet the market demand and need for carbon credits revenue generation are overriding the good intentions of reforestation of the Nile Basin. The current project activities overlook the costs of losing biological diversity and the vital role played by riparian natural forest belts in regulating temperatures and halting nutrient loading in rivers and streams through filtration. Therefore, the decision to establish *Pinus* plantations for timber production in the Nile Basin requires urgent review with regard to the magnitude of the biological diversity crisis in the Lake Victoria ecosystem. There are other, more suitable sites for timber production.

A number of proposed interventions are being suggested by EPIC based on its many years of engagements with different stakeholders. They include:

i) Raise public awareness on the status and values of biological diversity and the dangers associated with environmental degradation in Rwoho SEPLs.

ii) Support and replicate the application of the Vetiver grass hedges technology for soil and moisture conservation, for the treatment of all crop fields and marginal lands, to improve crop yields and prevent runoff from carrying sediment and nutrients into rivers.

iii) Support communities to establish riparian natural forest belts along rivers and streams in the watershed to control nutrient loading through filtration.

iv) Train local communities in other income generating activities such as honey production, vegetable growing, aquaculture, and improved methods of farming.

v) Research and documentation of biological diversity in the Rwoho SEPLs.

vi) Promote and market carbon credits derived from conservation of natural forest belts, best practices in agriculture, and from the Vetiver grass hedges technology, to enable the wider community to contribute to carbon sequestration activities and to benefit from carbon credit sales.

vii) Contribute to local, national, and international policy processes aimed at enhancing the status of biodiversity conservation in Rwoho.

viii) Advocate for a co-management system of natural resources that includes all stakeholders.

ix) Support the under-privileged, especially women, in their efforts to overcome shortages of fuel wood and other tree products, through skills development and establishment of small group tree nurseries. In addition, help them to acquire land in the forest reserve under the Collaborative Forest Management arrangement, where they can raise indigenous, multipurpose tree species of their choice.

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SATOYAMA
INITIATIVE

SOCIO-ECOLOGICAL PRODUCTION LANDSCAPES AND SEASCAPES (SEPLS) IN AFRICA

UNU-IAS & IR3S/UTIAS