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Case studies on ecosystem-based approaches for resilient livelihoods in developing countries

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Foreword

Earth's biodiversity and the vital ecosystem services it provides is fundamental to all life on earth – from clean water and productive soils, to a diverse cornucopia of nutritious foods; from carbon sequestration to regulating atmospheric greenhouse gases and our climate.

Around the world, people are an integral, sometimes dominant, part of the environment. This has two implications. First, a key requirement for achieving our 2030 agenda lies in finding ways to meet the dual goals of conserving nature and providing for the well-being and quality of life of billions of people. Second, while conservation and stewardship certainly require acknowledging the pollution, climate change and biodiversity loss driven by human activities, we can also tap into the considerable potential of humans, working with nature, to solve a range of environmental challenges.

In a rapidly growing world, where over 1 billion people already rely on natural resources hand-to-mouth to support their livelihoods, an increasing body of evidence suggests that ecosystem-based approaches – namely the protection, restoration and sustainable management of ecosystems– can not only halt and reverse ecosystem degradation but can provide economic and job opportunities while building climate resilience, particularly for local communities in developing countries. For instance, protecting coastal habitats like mangroves provides natural flood defenses; reforestation can hold back desertification and recharge groundwater supplies in times of drought; and water bodies like rivers and lakes provide natural drainage to reduce flooding.

The need for collective action has never been greater. This report contains many inspiring stories from communities around the world, as they address and, in many cases solve local challenges of environment and livelihoods, through ecosystem-based approaches. It features 10 case studies representing distinct freshwater, mountain and dryland areas at different sites across Asia and Africa. Taking advantage of data and information mainly collected by means of household surveys, the report showcases a sustainable livelihoods framework revealing the impacts of different ecosystem-based approaches on the livelihoods of local communities. Key findings in the report underline the importance of human capital, diversified income activities, and social inclusiveness in linking natural capital to human society to achieve multiple co-benefits.

Susan Gardner
Director, Ecosystems Division
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Each case study brings into sharp focus not only the extraordinary wealth of biodiversity these regions possess, but also its role in generating ecosystem services upon which developing populations and communities rely for their food, water, livelihoods and health. These case studies make a strong argument for greater attention to be paid by local, regional, national and international actors and agencies, both public and private, to collaboratively devise policies and establish knowledge and technology sharing mechanisms to enhance the capacity of local actors to implement ecosystem-based approaches. This, towards the attainment of our 2030 agenda.

This report was produced by UNEP in collaboration with UNEP-IEMP, with partial financial support provided by the Chinese Academy of Sciences. UNEP and the report's authors are grateful to all the technical partners and individuals involved in the preparation of this publication and hope that is further garners multi-level collaboration between scientists, communities, industry, policy makers and other stakeholders to greatly improve the resilience and livelihoods of communities.

CONTENT

Abbreviations

BBP	Biodiversity-based Products
BIC	Biodiversity Information Centre
BPL	Boeung Prek Lapouv Protected Landscape
CAS	Chinese Academy of Sciences
CBWC	Community-based wildlife conservation
CEL	Climate, Ecosystem and Livelihoods
DFID	British Development for International Development
EbA	Ecosystem-based Adaptation
FAO	Food and Agriculture Organization of the United Nations
FSN	Farmers' Seed Network
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
IGSNRR	Institute of Geographic Sciences and Natural Resources Research
IUCN	International Union for Conservation of Nature
JSA	Jaibiksrot Samrakchan Abhiyan
LVWATSAN	Lake Victoria Water Supply and Sanitation Programme
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
MMWCA	Masai Mara Wildlife Conservation Association
masl	Metres above sea level
mm	Millimetres
NbS	Nature-based Solutions
NTFPs	Non-timber forest products
PKNP	Phnom Kulen National Park
RLRFC	Rupa Lake Restoration and Fishery Cooperative
km^2	Square kilometres
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-IEMP	United Nations Environment Programme – International Ecosystem Management Partnership
UNESCO	United Nations Educational, Scientific and Cultural Organization

Summary

Multiple issues go alongside poverty, including climate change, water scarcity, malnutrition, unemployment and the loss of eco-traditional knowledge and culture in the developing world. Through changes in mean conditions and climate variability, climate change is worsening existing ecosystem degradation, exacerbating inequalities and triggering new vulnerabilities, often with negative outcomes for livelihoods, especially for local communities living in ecologically and economically fragile areas. Ecosystem-based approaches have thus become critical for these communities to build resilient livelihoods that can better adapt to stresses and crises, including the coronavirus (COVID-19) pandemic.

This report features 10 case studies across Asia and Africa of ecosystem-based approaches being used to sustain and improve livelihoods for local communities in changing environments and societies. With a focus on three distinct ecosystems – freshwater, mountain and dryland – this collection of cases aims to provide evidence, experience and lessons learned on building resilient livelihoods through the conservation, restoration and sustainable management of ecosystems in a geographically diverse and cross-cultural context.

The case studies are based on a sustainable livelihoods framework developed and applied to analyse the impacts of ecosystem-based approaches on the livelihoods of local communities. In each case, data and information were collected at the study sites by means of household surveys and other methods. A total of 923 households and 39 local communities were interviewed to provide the primary data used in the study. These households, randomly selected at the sites, were divided into two groups according to whether or not they participated in project interventions for conserving and utilizing agrobiodiversity, fisheries and other natural resources. These data were analysed to compare the livelihood capitals and outcomes of the two groups of households, so as to unveil the effects of the interventions on people's livelihoods and well-being.

With this comparative analysis, we have seen that the conservation interventions had positive effects on the livelihood outcomes of households in most cases. The overall key findings in these cases include the following:

1.Natural capital is a determinant and fundamental factor of household livelihoods, and human capital fills gaps in knowledge around enhancing sustainable livelihoods and resilience.

2.Diversified on-farm and off-farm income activities enhance household livelihoods and capacity to adapt to changes.

3.Community participation, inclusiveness and cooperation among stakeholders are key for the success of implementing conservation interventions. Ensuring the involvement of both women and men as well as those from lower socioeconomic backgrounds is crucial.

01 Introduction

Climate change, ecosystems and livelihoods are multifaceted, interdependent and interactive. Healthy ecosystems and biodiversity, including genetic and species diversity, are the natural foundation of economic activity, human well-being and the global carbon cycle. Rural communities in developing countries that depend highly on ecosystems for their food and livelihoods are among the most vulnerable to the impact of climate change. As such, solutions allowing them to transition towards sustainable development depend upon how best they can tackle the intertwined issues of climate change impact, ecosystem degradation and ongoing poverty.

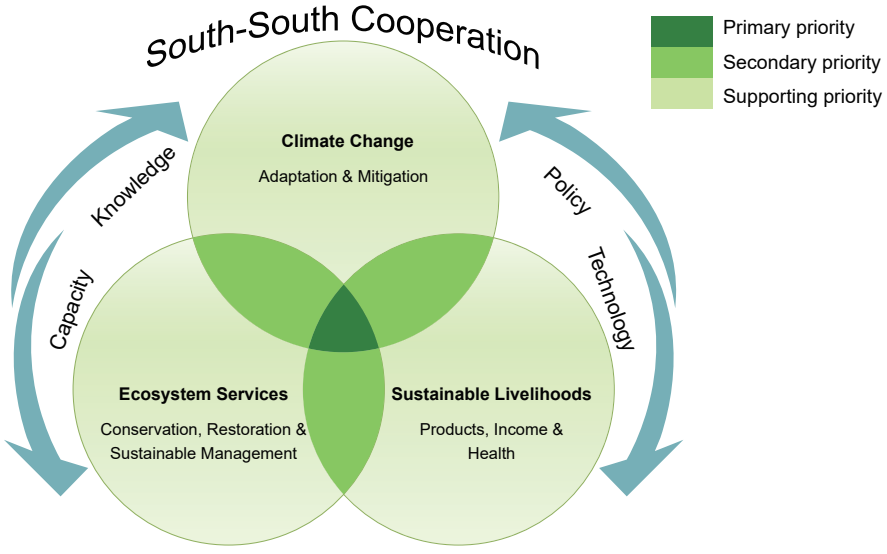
In November 2016, the United Nations Environment Programme (UNEP) launched a decade-long (2016–2025) flagship programme on Climate, Ecosystems and Livelihoods (CEL), supported by China and other developing countries, and designed to assist countries in the Global South with effective delivery of the Sustainable Development Goals and climate targets while improving the livelihoods of their people and protecting ecosystems.

Within a conceptual framework (Figure 1.1), the CEL programme focuses on the nexus of climate change, ecosystem services and sustainable livelihoods. The work encourages cross-sectoral cooperation and brings together natural science, economics and social science to seize the power of integrating the Sustainable Development Goals in vulnerable developing countries (Zhang, Liu and Fu 2018).

The implementation of the CEL programme is led by the UNEP International Ecosystem Management Partnership (UNEP-IEMP). This collaborating centre between UNEP and the Chinese Academy of Sciences promotes long-term South-South cooperation and seeks to employ a wide range of knowledge, expertise and practices in order to have a tangible impact on sustainable development. The programme targets fragile ecosystems like drylands, mountains, river basins and coastal zones, and particularly takes into account the ecological issues and priorities for social and economic development in the targeted regions.

The CEL programme has been implemented through a set of related projects and initiatives with particular emphasis on the nexus approach. For example, the Institute of Geographic Sciences and Natural Resources Research (IGSNRR) of the Chinese Academy of Sciences, with support from UNEP-IEMP, launched a project in 2018

Figure 1.1 CEL conceptual framework.



Source: Zhang, Liu and Fu 2018.

entitled Sustainable Livelihood and Green Development Strategies in Environment-Economic Fragile Areas. Among the major components of the project are case studies, which contribute to scientific assessment and decision-making on green development and help to explore pathways for sustainable development in priority areas in Asia and Africa.

Ecosystem-based approaches, including efforts to manage, conserve or restore the natural environment, may also be referred to as Nature-based Solutions (NbS) (Fifteenth Meeting of Conference of the Parties to the Convention on Biological Diversity 2021; United Nations Environment Assembly 2022). They are widely recognized as a promising way to link climate change and disaster risk reduction with sustainable livelihoods and development (Munang *et al.* 2013). Many examples of good practices already exist on the ground and provide multiple environmental, social and economic benefits to local communities (Doswald *et al.* 2014). Research also shows that approaches that embed gender equality and a rights-based approach drive progress towards achieving environmental sustainability (Bhattarai, Beilin and Ford 2015).

Numerous stories and case studies have been developed to showcase the role of ecosystem management, conservation and restoration in helping people cope with global challenges, such as those carried out by the NbS Initiative based at the University of Oxford. The NbS Initiative (2022) set up an interactive map for a wide selection of best-practice case studies, including projects supported by UNEP with a focus on ecosystem-based approaches for climate change adaptation, or Ecosystem-based Adaptation (EbA).

However, the existing evidence base concentrates on measuring biophysical environmental and ecological conditions for relevant interventions. Although some case studies have qualified the cost-effectiveness and economic benefits of EbA interventions (Reid *et al.* 2019), they are rather lacking in quantitative and consistent measures of livelihood outcomes for local communities. Comparisons between different interventions and options, and distinctions between different social groups who might benefit or suffer from the interventions are key knowledge gaps that need to be addressed in order for ecosystem-based approaches to be fully utilized.

The 10 case studies selected and highlighted in this report demonstrate how changes in climate and ecosystems (with a focus on freshwater, mountain and dryland areas) affect livelihood capitals and outcomes for rural communities, as well as how they adapt to these changes and cope with stresses and crises such as the COVID-19 pandemic. The case studies demonstrate that livelihood outcomes can be enhanced through ecosystem-based approaches, not only with more income, but also increased well-being, reduced climate vulnerability, improved security, advanced sustainable use of natural resources, and more decent jobs. The lessons learned from such practices can be useful for other developing countries and communities who are facing similar challenges dealing with ecosystems in their pursuit of the Sustainable Development Goals and climate change targets.

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02 Methodology

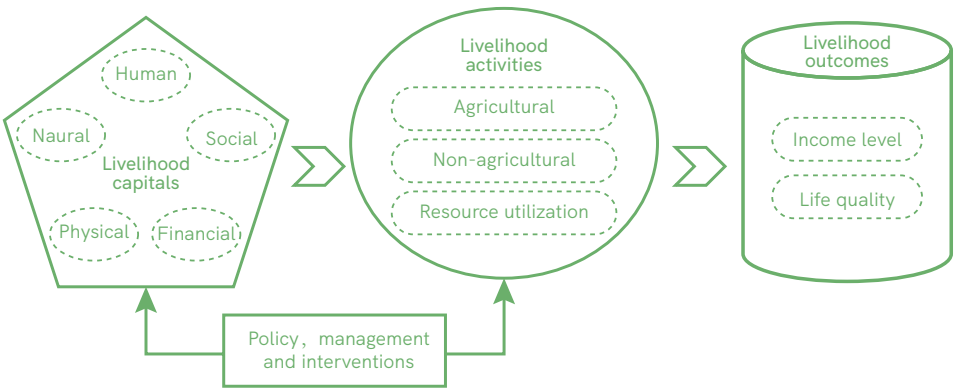
2.1. Sustainable livelihoods framework

The case studies with household evaluations build on the concept of sustainable livelihoods, which was first introduced by Chambers and Conway in the 1980s. A livelihood is sustainable when it can cope with and recover from stresses and shocks, and maintain or enhance the capabilities and assets on which livelihoods depend, while not undermining the natural resource base (Chambers and Conway 1992). People's capabilities, assets (including both material and social resources) and activities that are required for a means of living are what constitutes a livelihood (DFID 1999). These capabilities and assets can be divided into five types of capital:

- Human capital: good health, education, skills and knowledge
- Social capital: networks and connections between individuals with shared interests, forms of social participation and relationships based on trust and reciprocity
- Natural capital: the natural resources useful for livelihoods
- Physical capital: the infrastructure and goods that meet the basic productive needs of the population
- Financial capital: the financial resources that people use to achieve their livelihood aims

The case studies are based on an analytic framework adapted from the Sustainable Livelihoods Framework defined by the British Development for International Development (DFID) in the 1990s (Figure 2.1). Put simply, a relationship is established between livelihood capitals, activities and outcomes. This framework visualizes households in a context of vulnerability in which they access the resources that affect their livelihoods. It can be used when assessing the impact of policy, management and interventions on livelihood outcomes, and when planning new activities to strengthen livelihood capitals and outcomes linked to greater resilience (Ding *et al.* 2018; Pagnani, Gotor and Caracciolo 2020; Su *et al.* 2021). We therefore used this framework as a guide to present key findings and analysis of the causes and underlying mechanisms responsible for the effects that ecosystem-based approaches have on the livelihoods of local communities.

Figure 2.1 Analytic framework for sustainable livelihoods in rural areas, adapted by UNEP-IEMP from the DFID's Sustainable Livelihoods Framework (DFID 1999).



2.2. Data collection

This report covers 10 case studies representing three distinct ecosystems targeted by the CEL programme – freshwater areas, mountains and drylands – at different sites in rural areas across Asia and Africa. As the primary method for collecting data and information at the study sites, household surveys were undertaken mainly in 2019 by local teams and partners under the supervision and with the technical support of UNEP-IEMP. All respondents were informed that participation in the study was voluntary, and permissions to collect the data were granted.

Household questionnaires were used in face-to-face interviews to elicit data from family members for a deep understanding of their living status, perceptions and attitudes. Households were selected carefully but randomly, and divided into two groups consisting of similar numbers of households for comparative analysis. "Participant" households were those who participated in project interventions to conserve water resources, crop and tree species, and so on, and who benefited in some way from their participation; "non-participant" households were those who did not participate in any such interventions, but who lived in a similar social and ecological environment. A semi-structured questionnaire that contained sets of closed- and open-ended questions was developed and used in each case study.

Focus group discussions and key informant interviews were used as two qualitative methods to complement household surveys. Focus groups and key informants were selected to represent various stakeholders ranging from farmers and cooperative members to women's associations. Through informal talks and discussions, our teams were able to gather detailed background information on local socioeconomic challenges, the consequences of climate change, and the major policies, governance actions and interventions implemented, in order to analyse the underlying factors affecting local livelihoods.

Two cases, in Maasai Mara and Qinghai respectively, were exceptional. The study in Maasai Mara mainly used qualitative interviews across five community conservancies, and assessed perceived changes in the livelihood capitals of individuals and households. On the other hand, instead of employing first-hand data, the study in Qinghai used the results of a survey conducted by the local government for a large-scale poverty-reduction project in the study area. In sum across all sites, the primary data of a total of 923 households and 39 local communities and the secondary data of 736 households were collected and used in our case studies, with considerable attention paid to women's participation in the survey (Table 2.1).

Table 2.1 Number of sampled households and communities in the survey at different sites

Case	Country	Study site	Survey year	No. of samples		
				Communities	Household	Female interviewee
1	Cambodia	Takeo Province	2019	4	101	57
2	Nepal	Kaski district	2019	4	240	141
3	Thailand	Southern Kalasin Province	2019	2	100	60
4	Tanzania	Mwanza region	2021	12	121	55
5	Cambodia	Siem Reap Province	2019	3	109	62
6	China	Yunnan Province	2019	5	109	40
7	Nepal	Rasuwa district	2019	2	43	17
8	Thailand	North-eastern Kalasin Province	2019	2	100	65
9	Kenya	Maasai Mara	2018	5	/	/
10	China	Qinghai Province	2020	NA	736	350

Note: "NA" indicates "not available"; "/" indicates "not applicable".

2.3. Data analysis

Descriptive statistics was applied for primary data analysis. After gathering data from sources as stated above, our teams created a data set using Microsoft Excel files for each case. Variables in the data set were classified into different types of data measurement scales, including nominal (e.g. gender, ethnicity and occupation), ordinal (e.g. education status and access to public services), and ratio (e.g. income, expenditure and production) scales. By producing frequency, percentage and other statistics, and transforming them into visual graphs, also using Microsoft Excel, we described the general characteristics of the households sampled. It should be noted that in our survey, the values of household assets, income, expenditure and so on were collected in the local currency, i.e. the national currency of the country where the study site is located. We converted these values into US dollars (US$) using the average exchange rate in the survey year[1] and reported the results in US dollars. Further, we interpreted how and why the data observed were distributed among families by taking into account qualitative information. The comparative results of the participant and non-participant samples were used to demonstrate the effects of interventions on people's livelihoods and well-being.

2.4. Limitations

When conducting surveys, collecting and analysing data, and interpreting key findings, we recognized two major limitations:

Labour migration can affect whether family members are included in the survey results. The survey results tend to reflect the living status of family members who stay at home or work nearby, and ignore that of migrant workers.

The project interventions studied in all cases are not exhaustive. There are other activities and governance that might affect communities' livelihoods.

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[1] The exchange rates are: 1 Cambodian riel = US$ 0.04; 1 Nepalese rupee = US$ 0.009; 1 Thai baht = US$ 0.032; Tanzanian shilling = US$ 0.00043; 1 Chinese yuan = US$ 0.15; and 1 Kenyan shilling = US$ 0.01.

03 Case Studies

3.1. Freshwater

CASE 1

Conservation through community fisheries in the Lower Mekong Delta

A corner of the Boeung Prek Lapouv Protected Landscape © Chhin Sophea

Facts

Location:
Boeung Prek Lapouv Protected Landscape, Takeo Province, Cambodia

Ecosystem:
Freshwater

Communities:
Kampong Krasang commune

Sustainable Development Goals involved:
1 No Poverty; 15 Life on Land; 17 Partnerships for the Goals

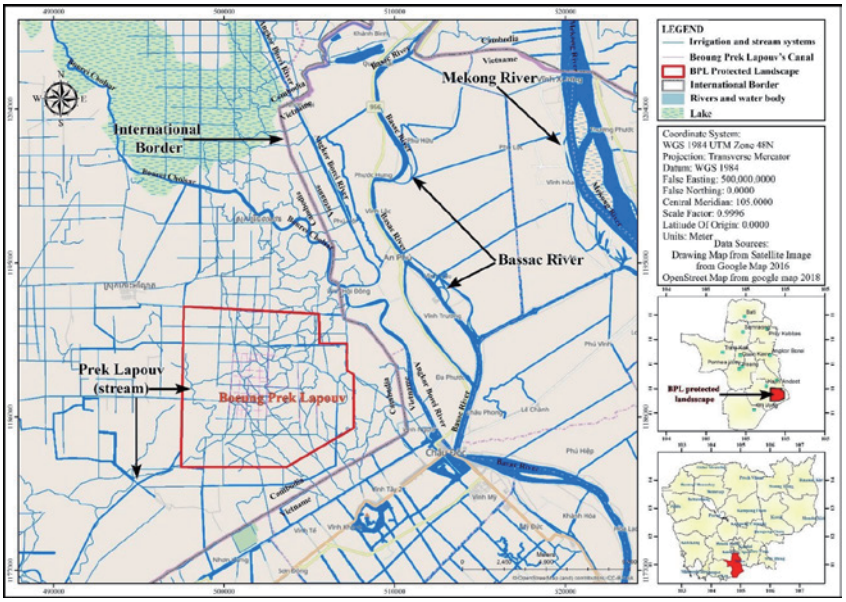
Background

The Boeung Prek Lapouv (BPL) Protected Landscape, which covers an area of over 8,305 ha, is one of the largest remaining areas of seasonally inundated wet grassland in the Lower Mekong Delta region. Located in the floodplain of the Bassac River (a distributary of the Mekong River) along the Cambodia-Vietnam border, BPL forms a natural habitat for a range of plants, birds and other wildlife (Figure 3.1). It is one of 40 Important Bird and Biodiversity Areas identified for conservation in Cambodia and one of three Sarus Crane Conservation Areas.

With a tropical monsoon climate, the Lower Mekong Delta region is characterized by seasonal variation in flows. The water level rises in late May (transforming the large floodplain into muddy water), then peaks in September or October, before receding rapidly and reaching its lowest level in April or May (Quoi and Huu Thien 2013). Following such rhythm, in the rainy season, the whole BPL area is flooded, forming a mat of floating vegetation with about 30 aquatic plant species; in the dry season, water drains to the Bassac River in the east, leaving behind BPL grassland that becomes an ideal feeding ground for a non-breeding population of sarus cranes (BirdLife International 2022).

About 22 villages (5,000 households) live on the BPL, cultivating rice and collecting natural resources, including fish, edible plants, firewood and grass. Almost all households are involved in rice cultivation, their major source of income. As an alternative livelihood, fishing plays an essential role for farmers, especially during the dry season. Recent years, however, have seen a decline in productivity and the diversity of fisheries due to overharvesting, destructive fishing methods and the destruction of floodplain habitats.

Figure 3.1 Location of BPL in relation to major rivers and streams. Source: Sophanna, Pok and Avent 2019.



Source: Sophanna, Pok and Avent 2019.

The BPL has shrunk from 10,787 ha in 2004 to 8,305 ha in 2022, largely because of land being converted for agriculture (Sophanna, Pok and Avent 2019). The protected landscape comprises four habitats: seasonally inundated grasslands, open water with aquatic plants, shrubs and gallery forests, and rice fields. The prior dominant wetland areas (including grasslands and open water) were gradually turned into land for cultivation, with rice fields now taking up 61 per cent of the total area. According to the Royal University of Phnom Penh, an average of 100 ha were converted per year between 2007 and 2018.

With the main purposes of transport and irrigation – especially rice-growing during the dry season – a network of canals began construction in the 1970s and became dense in the 1990s. The canals, which are criss-crossed and feature small natural watercourses, created a rapid drainage system and significantly altered the natural hydrological cycle. This new drainage system increased run-off and water loss in the dry season (Sophanna, Pok and Avent 2019), modified the habitat and feeding conditions for several flagship species, including the sarus crane, painted stork and spot-billed duck, and presented threats for wetland biodiversity and the people who are highly reliant on the natural resources concerned.

Climate change consequences, such as temperature rises, increased rainfall, severe droughts and other extreme events, pose another threat to this fragile ecosystem. Maximum temperatures during both the dry and wet seasons are predicted to increase, while precipitation is predicted to decrease in the dry season and increase in the wet season. Extreme events have been observed and recorded as a result. According to a BPL vulnerability assessment published by the International Union for Conservation of Nature (IUCN) (Sophanna, Pok and Avent 2019), storms were identified annually with significant impacts on rice yields since 2010. Flooding, heat waves and storm surges have been occurring more frequently. Extended droughts in the dry season have been the most devastating extreme event, especially for the most vulnerable habitat of open water with aquatic plants, and the resulting lower water levels and reduced number of ponds and streams have negatively affected the water birds that live and forage in the area, as well as the fisheries that are essential for small farmers. For example, in the severe drought of 2016, grasslands dried up, birds left, fish and aquatic plants were severely affected, about 90 per cent of the rice fields in the upper BPL area were damaged, and human health was also affected.

Governance: Community fisheries as a legal mechanism

In 2000, policy reform in the inland and marine fisheries of Cambodia led to the redistribution of fishing rights from commercial fishing lots to local communities (Kurien 2017). The nationwide fishing concession was cancelled, after which community fishery organizations were constituted with a subdecree[2]. At the same time, numerous non-governmental agencies took steps to assist the communities in their collective efforts to gain control over the fisheries and other natural resources.

Community fisheries serve as a legal mechanism for managing wild fisheries more sustainably and equitably, while ensuring local food and nutrition security. Fisheries are managed under national fisheries legislation, as well as rules and regulations that are formulated in a participatory manner and adopted by local community fishers. In addition to increased patrolling and the reduction of illegal and off-season fishing, this system means that local people can take part directly in planning, managing, using and protecting wetland resources, which are essential for sustainable fishing.

Community fisheries are used alongside conservation to achieve sustainable resource management. In early 2007, the Boeung Prek Lapouv Management and Conservation Area was established at Boeung Prek Lpeou Crane Sanctuary in Takeo by Subdecree no. 149 (Royal Government of Cambodia 2007). A conservation zone of 919 ha was set up, with two community fisheries authorized under the Ministry of Agriculture, Forest and Fisheries. In 2016, the BPL Protected Landscape was redesignated (Royal Government of Cambodia 2016), with objectives to ensure the conservation and protection of natural landscapes, culture and biodiversity, to provide products and natural services for sustainable use, and to encourage local communities and the public to participate in management, protection and conservation.

Livelihood capitals and outcome

Household surveys of two groups in and around the BPL were undertaken in 2019. The participant group consisted of 51 households from three villages in Kampong Krasang commune, Bourei Cholsar district, located on the eastern side of the BPL, namely Kdol Chrum, Bourei Cholsar and Kampong Krasang. These households have participated considerably in community fisheries activities and interventions. The non-participant group was made up of 50 households from Keo Kampleung village in Prey Kla Commune, Kaoh Andaet district, located on the western side of the BPL.

The villages in the two groups shared similar physical and financial conditions but differed in terms of natural, human and social capital. More than 50 per cent of households in both groups had access to paved roads, health care, irrigation facilities, a market, a temple, and a primary and junior high school. Less than half had access to tap water, a nursing home for the elderly, a garbage collection point, and a kindergarten. In terms of natural and human capital, the participant group was in a more vulnerable position than the non-participant group. The rice fields (a key asset for farmers) owned by these households were, on average, over 1 ha smaller than those held by the non-participant group (Figure 3.2). Furthermore, they had a lower level of education: 13 per cent of the population went to junior school, 3 per cent went to high school, and 33 per cent were illiterate (Figure 3.3). However, they were more likely to participate in community organizations that aimed to use natural capital and improve livelihood sustainability (68.6 per cent in participants compared to 0 per cent in non-participants).

Figure 3.2 The average size of the rice paddies owned by participants and non-participants in the sample villages of the BLP

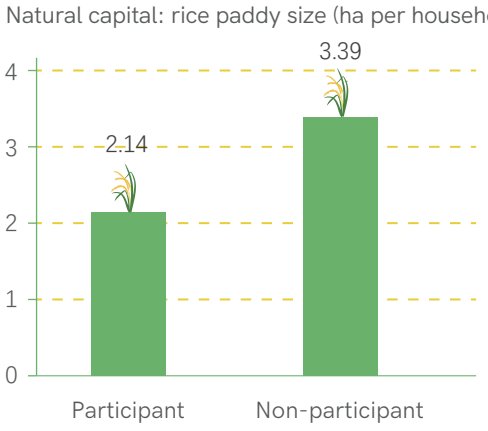
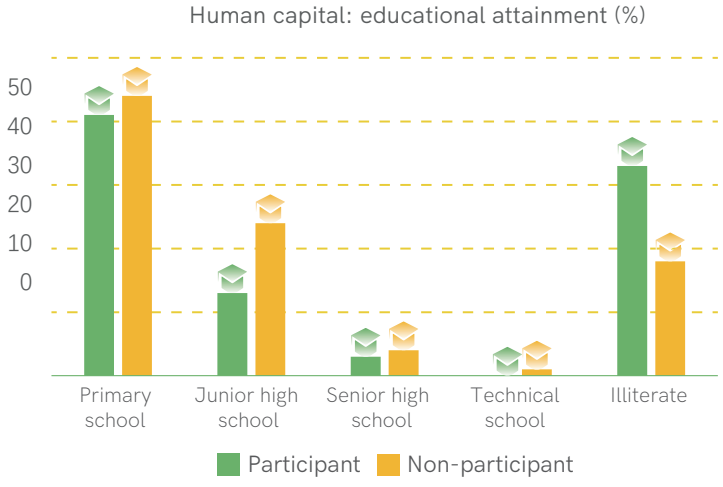


Figure 3.3 Educational attainment of participants and non-participants in the sample villages of the BLP



[2] Sub-decrees are used to clarify provisions within existing laws, set out functions and duties of government bodies or appoint government officials. A subdecree must conform with the Constitution and the law to which it refers.

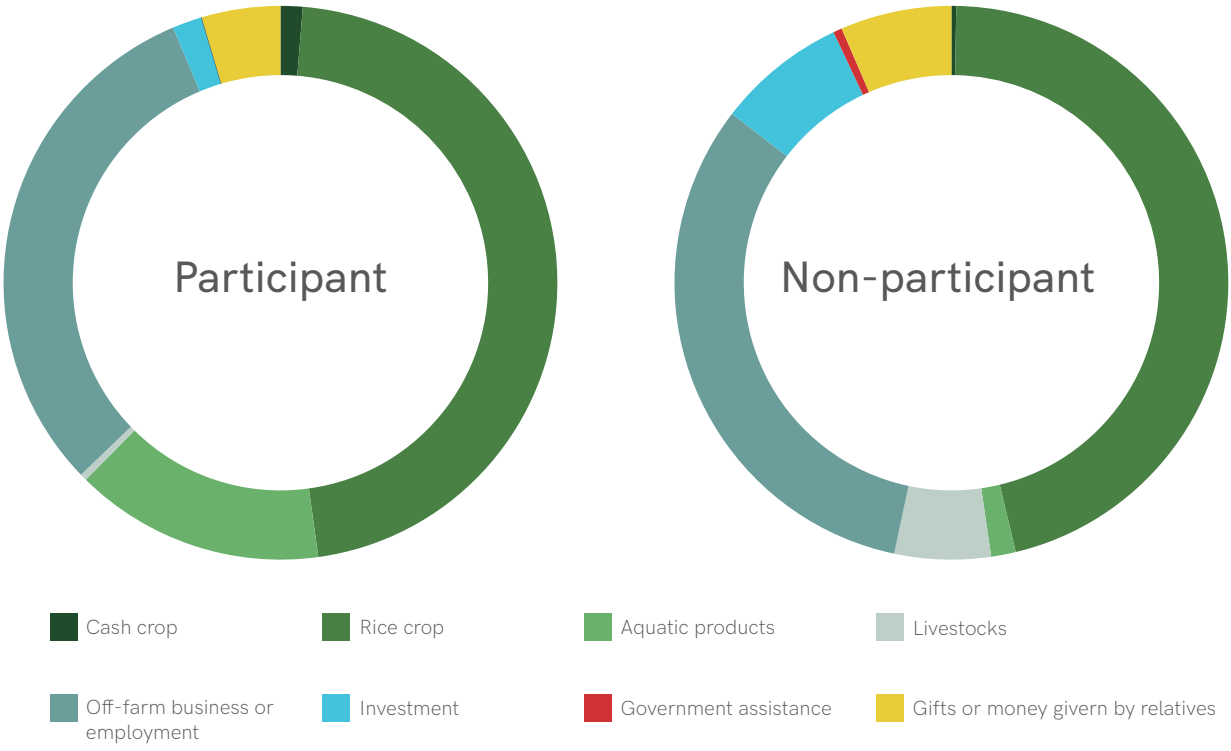
Rice is the dominant economic source of income and most villagers cultivate rice once or twice a year. In 2018, rice farming contributed almost half of the total income in both groups, followed by off-farm business and employment, fishing (aquatic products) and extra income from investment and money given by relatives (Figure 3.4).

People involved in community fisheries are also fishermen, and they carry out seasonal fishing and farming. Fishing represented an important source of income (15 per cent) for their families, along with off-farm employment (31 per cent). Villagers in the non-participant group, however, relied considerably on off-farm business and employment (32 per cent), complemented by investment activities, in particular leasing and land. Fishing was much less important, contributing only 2 per cent to the total.

Interestingly, the participant group had an average household income of US$ 5,466 in 2018, less than the non-participant group income of US$6,482. This might be due to reduced rice production and the lower earnings this group received from off-farm employment, which was associated with their lower human capital. Nevertheless, the cash income earned from fishery-related activities (fishing, processing and marketing) by community fisheries members complemented their income and increased their food and nutrition security, in particular in the non-rice-farming season.

To sustain their daily lives, villagers from both groups spent more than half of their family earnings on agriculture production and food and drinking water, followed by education, health care, restaurants and accommodation, and furniture. Compared with non-participants, members of the participant group invested more in health care but less in education. Although community fisheries can help alleviate poverty, education remains an obstacle to local development.

Figure 3.4 Distribution of average household income by source in 2018 in the sample villages of the BLP



Lessons: local communities' empowerment and inclusiveness

Community Fisheries as a livelihood strategy in this case plays a critical role in securing food and nutrition for local communities, as well as conserving the floodplain, which is essential for sustainable fishing, and diverse plants and species.

In Cambodia, fish accounts for about 70 per cent of animal protein supplies and is vital for the livelihoods of rural poor populations (Food and Agriculture Organization of the United Nations [FAO] 2016). The new form of governance, the fisheries reform that took place in 2000, reached out to these populations to ensure that the country's small-scale communities could access fish for food and livelihoods. Community fisheries can help to alleviate poverty for rural poor populations by giving them rights to fish and empowering small-scale fisheries. These small-scale fisheries are local, context-specific and closely linked to the socioeconomic and cultural ethos of local riparian communities. They are also considered a "community institution for harvesting fish" in which all members of the community – adult men and women as well as young people – are encouraged to take part. They participate directly in planning, managing, using and protecting fishery resources with government institutions and agencies, helping to increase community understanding of the benefits and importance of sustainably managed fisheries.

At the same time, through conservation interventions including the protection of flooded grasslands, the creation of conservation zones and the protection of recession ponds, members became aware of the need for conservation and sustainable management of natural resources. According to the focus group discussions conducted around the country by FAO (Kurien 2017), people showed greater concern and interest in conserving and protecting natural resources than before community fisheries was established (pre-2000).

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CASE 2

Agrobiodiversity conservation and resilience at Rupa Lake watershed, Nepal

Rupa Lake watershed landscape in the mid-1980s (left) and 2020 (right). © LI-BIRD

Facts

Location:
Kaski district, Gandaki Province, Nepal

Ecosystem:
Freshwater

Communities:
17 villages such as Sundaridanda, Jamune Kuna and Kaure

Related Sustainable Development Goals involved:
1 No Poverty; 13 Climate Action; 15 Life on Land

Background

Lying along the southern slopes of the Himalayan mountain ranges, Nepal has beautiful landscapes featuring mountains, cultivated terraces and lakes that attract millions of visitors, trekkers and adventurers every year. However, the country faces lasting challenges of environmental degradation, poverty and rural depopulation, and many areas are highly vulnerable to climate change (Department of Hydrology and Meteorology 2015).

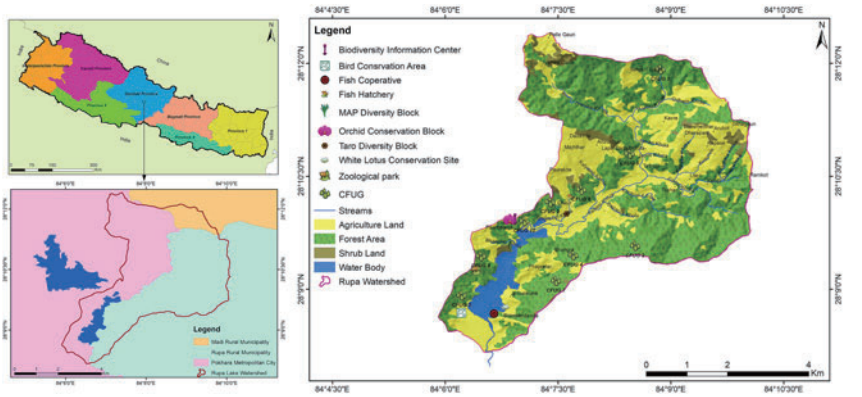
Rupa Lake is a freshwater lake located in Pokhara Valley in Nepal (Figure 3.5). Its watershed area covers 30 km^2 and has steep north-south-facing slopes with an altitude ranging from 580 to 1,420 metres above sea level (masl). The watershed supports a large number of species of flora and fauna. A total of 36 species of water birds have been recorded in the lake, which represents about 19 per cent of all wetland birds found in Nepal (Kafle *et al.* 2008).

The Rupa Lake watershed area comprises three distinct ecosystems: agriculture, forest and wetland. It is critical for sustaining the local livelihoods of a population of 5,332. With a subtropical and humid climate, about 60 per cent of the land is under cultivation, mostly consisting of *bari* (rain-fed) land and *khet* (irrigated) land, which forms a landscape of south-facing terraces. Khet lands are located in low-lying areas around the lake and rivers for convenience of water access. The main crops include rice, maize, millet, wheat and seasonal vegetables.

The water body – comprised of Rupa Lake and numerous streams and ponds – only accounts for 4 per cent of the total area, but it plays a key role in regulating the climate, irrigating and providing drinking water for inhabitants, and serving as a habitat for local aquatic plants (such as the white lotus), birds and fish, which are linked to the livelihoods of locals. However, the loss of forests before the mid-1980s – caused by overexploitation and uncontrolled grazing – increased sedimentation and siltation, accelerated the drying-up of natural streams, and increased the infestation of weeds and invasive species in the lake (Rana *et al.* 2020). The decline of the water environment led to a rapid decline in fish production, thereby affecting the livelihoods of traditional fishing communities who depended on fish from the lake to make a living. The loss of topsoil led to a decline in the productivity of the farmland. The increased use of

chemical fertilizers, insecticides and pesticides along with modern agricultural technologies further damaged the wetland ecosystem (Chaudhary *et al.* 2015). Many local crop varieties disappeared and their genetic resources diminished, with some on the verge of being extinct. The wetland and agriculture ecosystems are also vulnerable to the impact of climate change and natural hazards, including the observed temperature rise, droughts and increased incidence of plant diseases and pests.

Figure 3.5 Location and resources map of Rupa Lake watershed. CFUG, Community Forest User Group.



Source: Rana *et al.* (2020)

Grass-roots governance and interventions

The "Prosperous Nepal, Happy Nepali" motto has been introduced as a long-term national goal to promote people's well-being through high and sustainable production and productivity, equitable national income, a healthy environment and other measures.

In the Rupa Lake watershed area, local social, environmental and community-based groups play a critical – and even leading – role in restoring, conserving and sustainably using the lake's ecosystem and agrobiodiversity to ensure resilient livelihoods. The Rupa Lake Restoration and Fishery Cooperative (RLRFC) and Jaibiksrot Samrakchan Abhiyan (JSA) are two such examples. They have acted as mediators to bring together international knowledge and goals with local communities, by implementing various projects funded by the national government and international organizations such as the United Nations Development Programme (UNDP), IUCN and Netherlands Development Assistance. These projects broadly focus on the rehabilitation and management of watershed resources, agricultural biodiversity, community biodiversity registers (documentation), and community-based wetland management.

JSA, whose name literally translates as Bioresources Conservation Movements, was formed through the Community Biodiversity Register project that ran from 2002 to 2005. This project served as a participatory tool to document local species along with associated knowledge and practices, to strengthen farmers' livelihood strategies with increased access to information and resources, and to create awareness and capacity on sustainable use of biodiversity. Building on the project work, JSA continued to conserve local crop and vegetable varieties and expanded its scope to fundraising and management.

In particular, JSA has secured funding and technical support from multiple partners ranging from government agencies to external institutions. In addition, it established a Biodiversity Information Centre (BIC) in Sundaridanda in 2015 to display seed varieties, native animals and plants, farm tools and traditional handicrafts relating to the local biodiversity for both academic and general public use. This centre soon began to receive visitors engaging in ecotourism. JSA has now developed into an umbrella organization consisting of more than 1,000 household members and involving 17 local groups, 2 cooperatives, 1 community development committee and 1 non-government organization.

The RLRFC was established by locals on their own initiative in 2002, with the main goals of rehabilitating and restoring Rupa Lake and enhancing the livelihoods of its members and shareholders. The on-the-ground interventions carried out include cleaning the lake, constructing fish enclosures and setting up a fish hatchery centre for conserving local fish species. They also set up a savings and credits scheme. The cooperative involves traditional fishers and local labourers as shareholders, and the community-based wetland management plans draw attention to the marginal Dalits population and indigenous communities. Profits are shared and used for public facilities such as building a school.

Both groups have established executive committees that meet on a monthly basis. They also organize general assembly meetings for all members once a year where the annual progress report is presented and challenges and future plans are discussed. Various training events and awareness-raising activities are also undertaken to help to mobilize local communities through participatory processes such as field assessments (Figure 3.6).

Figure 3.6 Fish hatchery by RLRFC (left) and a JSA farmer explaining herbs in his home garden (right). © UNEP-IEMP.

Livelihood capitals and outcome

Interviews and surveys of 240 households across four wards (6, 7, 31 and 32) of the Rupa and Pokhara municipalities in the Rupa Lake watershed area were conducted in 2019. These households were divided into four groups depending on whether they participated in the community-based groups RLRFC and JSA.

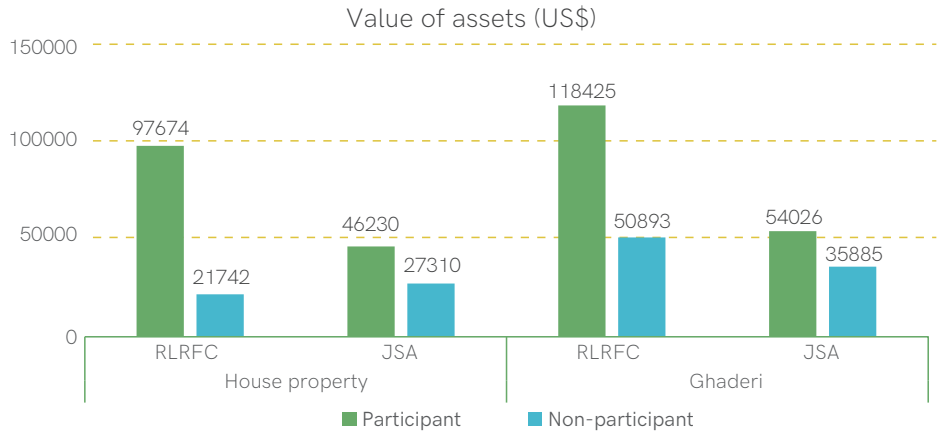
Almost all households had agricultural land. *Khet* land (irrigated for rice and wheat) and *bari* land (rain-fed for dry crops such as maize and millet) were among the most popular for farmers (Tables 3.1). The edges of terraces were also used for growing fodder trees and grasses for household use and to feed animals, named *kharbari* land (Bogati 1996). Forests were managed by community user groups.

Residential properties owned by the participant groups appeared to have a higher value than those of the non-participant groups. Houses owned by people from the RLRFC and JSA had a higher average value than those owned by non-participants – about 4.5 and 1.7 times higher, respectively. Additionally, the average value of *ghaderi* (land plots for construction and business) owned by RLRFC and JSA participants was 2.3 and 1.5 times higher than those owned by non-participants, respectively (Figure 3.7). This difference was partly because: i) participant families were mainly those who had settled beside the lake, downstream and with better access to transport; and ii) participant households had higher economic activity and income.

Table 3.1 Natural capital at study sites

	RLRFC		JSA	
Land size of landowners, ha/household	Participant (n=60)	Non-participant (n=60)	Participant (n=60)	Non-participant (n=60)
Khet (irrigated rice/ wheat paddy)	0.3	0.3	0.3	0.3
Bari (maize/millet farmland)	0.3	0.2	0.2	0.2
Kharbari (marginal land)	0.3	0.3	0.2	0.3
Orchard	0.1	0.1	0.1	0.03
Forestland	0.1	0.2	0.1	0.1

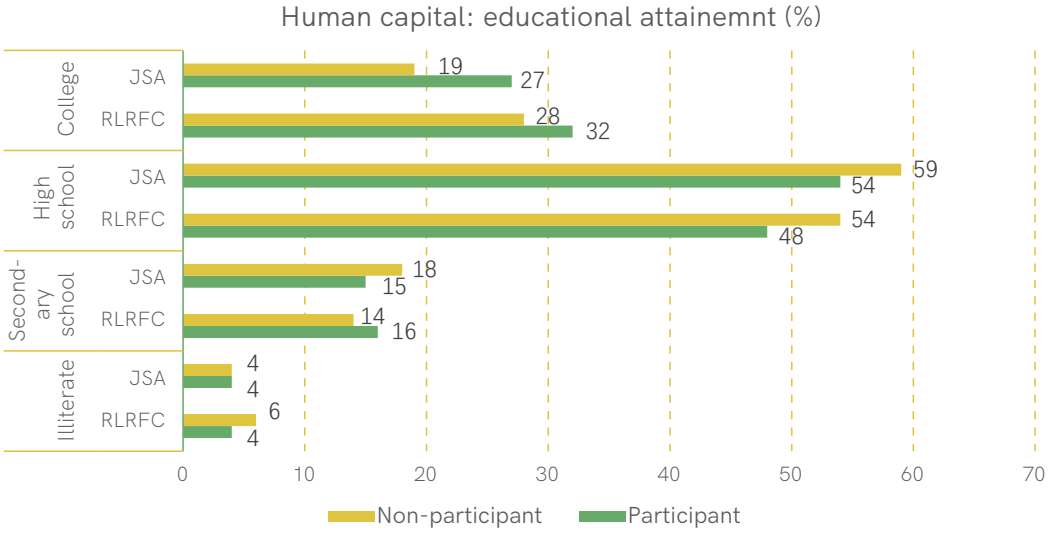
Figure 3.7 The value of assets owned by participants and non-participants at study sites in the Rupa Lake watershed area



Other physical capital, such as accessibility to public infrastructure and services, appeared higher among participants compared to non-participants. For example, more than 50 per cent of RLRFC participants had access to paved roads, health care, irrigation facilities, a market, a temple, and a primary and junior high school. However, less than 50 per cent of RLRFC non-participants had access to tap water, irrigation facilities and markets.

Educational attainment, a key dimension of human capital, was higher among participants than non-participants, mainly due to the higher proportion of labourers with college-level education in participant groups compared to non-participant groups (Figure 3.8).

Figure 3.8 Educational attainment of participants and non-participants at study sites in the Rupa Lake watershed area



All villagers had bank accounts with commendable bank savings. However, access to government assistance and credit cards was slightly better among participants than non-participants (Figure 3.9). About half of villagers in both the participant and non-participant groups had access to loans from banks, cooperatives and other sources in order to invest in their houses, education, businesses etc. Easy access to financing enabled them to secure a more stable and long-term way of generating income.

Genealogy and cooperatives are the primary social networks indicating social capital among rural households. Figure 3.10 shows that social capital was higher among participants than non-participants. Specifically, 43 per cent of RLRFC participants had a family tree, compared to 17 per cent of non-participants. Similarly, 60 per cent of JSA participants had joined cooperatives, compared to just 18 per cent of non-participants.

Figure 3.9 The financial capital of participants and non-participants at study sites in the Rupa Lake watershed area

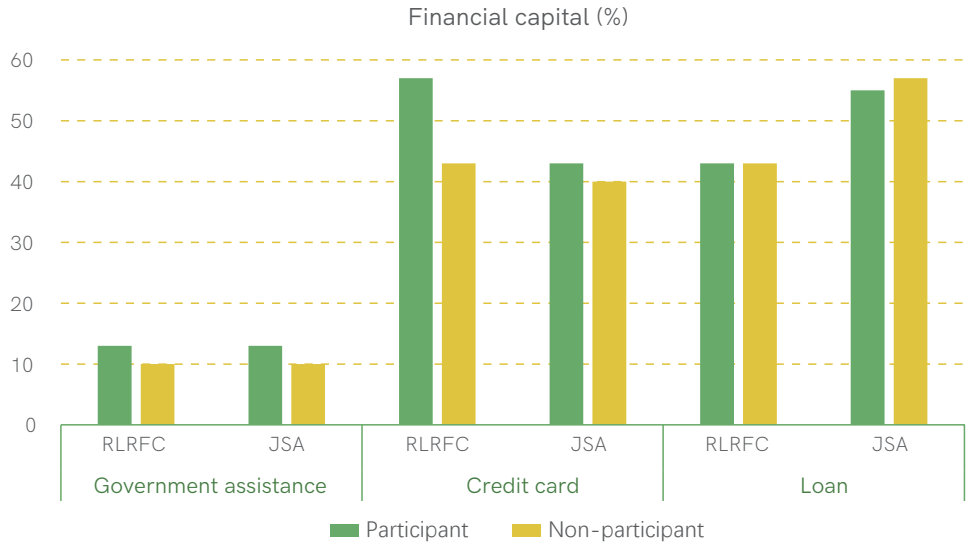
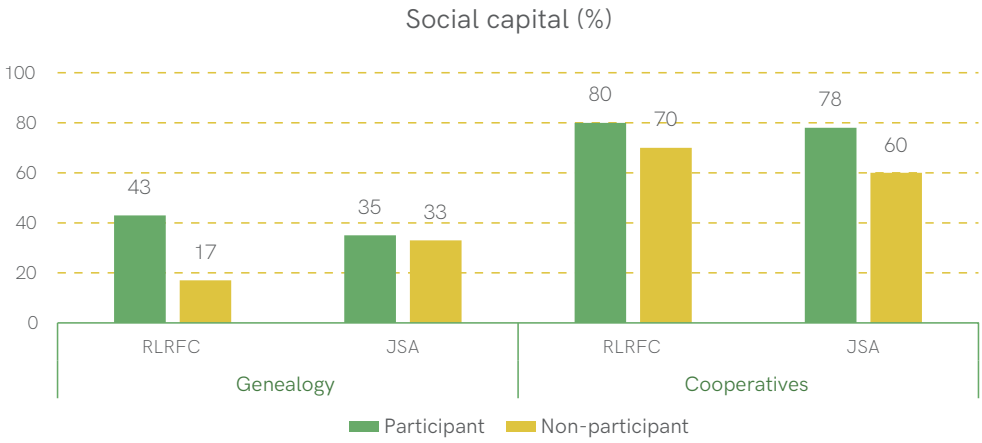


Figure 3.10 The social capital of participants and non-participants at study sites in the Rupa Lake watershed area



The average income of RLRFC-participant households in 2018 was US$ 14,345, about twice that of non-participant families. JSA-participant families had a higher average household income of US$ 20,018, three times that of non-participants. People received large incomes from off-farm businesses, and profits from farming activities, fisheries and livestock became the secondary source of income, together with government assistance. This reflects the trend that farmers had been looking for alternative livelihoods, such as tourism, and increasing numbers of young men and women had migrated to nearby cities like Pokhara and abroad in search of seasonal employment. In general, participant households had explored more diversified livelihood options (both on-farm and off-farm) which enabled them to secure more stable income all year round.

Farming businesses were diversified and farmers grew multiple crops; eight types of vegetable, four types of spice, three types of fruit and three types of rice were observed. There was also increased fish production with higher market value for RLRFC members, which helped to secure food and nutrition for traditional fishers. In addition, JSA established a community-based BIC not only to disseminate local biodiversity knowledge, but also to provide a place to buy and sell local agrobiodiversity products. Smallholder farmers in particular benefited from it by selling indigenous Pokhareli Jethobudho and Anadi rice, millet Kaguno, local beans, taro/Pidhaloo and local honey. The BIC also helped explore a wider and more stable market in Kathmandu and other big cities in Nepal.

Off-farm businesses played an equally important role in enhancing farmers' livelihoods and contributing to

increased income. Among RLRFC-participant households, about half owned businesses – double the number for non-participant households. This was probably partly due to the savings and credit scheme available, which increased investment possibilities for participant households. The average value of a first business was US$ 19,869 and US$ 18,764 for RLRFC- and JSA-participant households respectively, about four and three times more than the businesses owned by non-participant households.

With a stable income, people tended to spend most of their money on education and houses for long-term benefits, in addition to basic necessities such as food and drinking water. Villagers had a good level of education in general. Among the 996 individuals aged 15–64 years old (out of a total of 1,391 people) surveyed, less than 5 per cent could not read and write and 80 per cent went to high school, which was a prerequisite for vocational training and skill-oriented jobs in the market. Some people went to college, especially members or shareholders of RLRFC and JSA. They were more likely to work in professional, managerial and administrative fields with relatively better bonuses and social networks.

The improved ecosystem provided services to all. Local communities, no matter whether they participated in the interventions or not, had positive perceptions of the value of the biodiversity conservation and watershed management investments, especially with regard to the recreational and ecotourism benefits of the lake and agroecosystem.

While the JSA group seemed to rely on firewood as the primary source of energy for cooking, there was an evident switch from firewood to the cleaner energy liquefied petroleum gas among RLRFC members, with 60 per cent of participant households favouring this fuel. Biogas and electricity also started to be used as complementary energy sources.

The community-based groups also provided decent job opportunities. The cooperative RLRFC, for example, now has 24 full-time and several part-time employees.

Lessons: community ownership and knowledge-building

Agrobiodiversity in this case not only conserves genetic resources and promotes the sustaining of wetland and agroecosystems, but also helps to build resilience, with overall positive impacts on people's livelihoods with diversified on-farm and off-farm options.

Communities have gained a strong degree of ownership by taking a leading role in decision-making and executing initiatives and activities, with technical support from international projects. Both JSA and RLRFC are community-based organizations: one was initiated by locals themselves and the other is a community cooperative. JSA established the BIC, where villagers can share biodiversity information and market opportunities. The organizations help to improve the livelihoods of communities by allowing them to diversify their livelihood options with consideration of local knowledge, create more profits by selling products to customers, and build social connections. These benefits are important for making locals less vulnerable to the impacts of climate change. In addition, the active engagement of communities helps people gain ownership, which enables long-term maintenance and benefits beyond projects funded by internal parties.

The establishment of cooperatives is based on experience with previous projects on watershed conservation and agrobiodiversity. People have gained increased understanding and knowledge of local biodiversity, as well as skills around reviving previously disappeared species of local crops, wild plants and even animals. Around 440 crop varieties were well documented, including 111 wild medicinal plants and 92 wild food species, and displayed thanks to the Community Biodiversity Register project and the establishment of the BIC. As well as engaging in training and best practices, local farmers and project experts jointly prioritized certain local species to adapt to the changing market and climate. In addition, the interventions encouraged environmentally friendly agricultural practices, a reduction in the use of chemicals, and the replacement of insecticides with compost or farmyard manure.

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CASE 3

Water conservation for sustainable agriculture in north-east Thailand

Phon Ngam village, Kalasin Province, north-east Thailand © Yanyong Inmuong

Facts

Location:
Kalasin Province, Northeast Thailand

Ecosystem:
Freshwater

Communities:
Phon Ngam Village

Sustainable Development Goals involved:
1 No poverty; 13 Climate Action

Background

Kalasin Province is a rural and mainly agricultural province in north-east Thailand, in the Lower Mekong River Basin. More than 65 per cent of the land area in the province is used for agricultural production (National Statistical Office of Thailand 2022), and paddy fields make up the majority of the cropland area.
The southern area of Kalasin Province is low-lying land, characterized by a large floodplain by the Pao River (Chailangka 2018). A large reservoir called Lum Pao Dam, as well as a number of medium and small-sized reservoirs, were established to provide water for several districts in the centre and south, including Kamalasai district. This represents an advantage for agriculture.

However, this area has faced the challenges of both alleviating poverty and combating climate change, in particular flooding. The province is among the top five poorest provinces in Thailand, with a gross domestic product (GDP) per capita of 61,084 Thai baht in 2017, about one-quarter of the national average (Office of the National Economic and Social Development Council 2019). Livelihoods are highly dependent on rain-fed rice and other cash crops such as sugarcane, which are vulnerable to changes in domestic and international market prices as well as the climate. Flooding occurs frequently in Kalasin Province in August and September, especially in the lowlands in the centre and south, including Kamalasai district (The Nation Thailand 2017; Bangkok Post 2019). An erratic rainfall regime – delayed and intense rainfall in the monsoon months and severe drought in summer – is deemed to contribute to lower rice yields in north-east Thailand (Boonwichai *et al.* 2018).

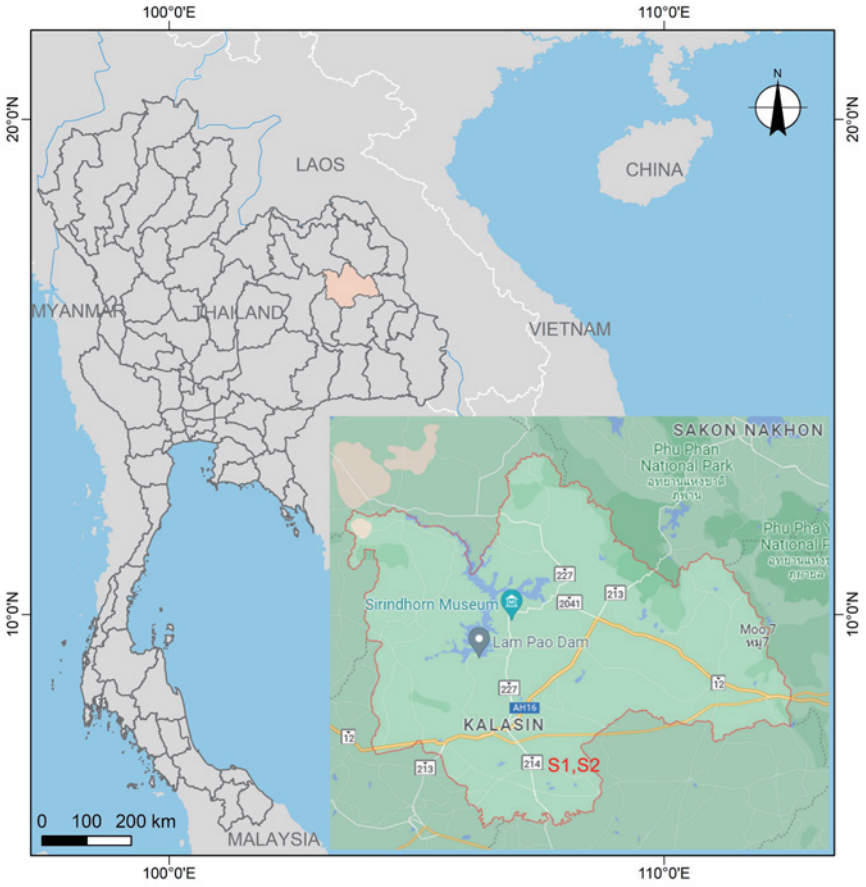


Figure 3.11 Location of the two study sites in the southern part of Kalasin Province: S1 - Phon Ngam Moo 1 village, Phon Ngam subdistrict, Kamalasai district; S2 - Nonsamakkee village, Samakkee subdistrict, Rong Kham district. Adapted based on sources: GMS Research Center for Environment and Sustainability, Faculty of Environment and Resource Studies, Mahasarakham University; Google Earth 2020.

Interventions: water conservation and flood management

A four-year programme (2015–2019) on water conservation and flood management was introduced to the community of Phon Ngam in Kamalasai district in order to restore land and water around the Nong Lueng Ploi reservoir for flood mitigation and sustainable livelihoods. The programme was financed with US$ 160,000 from the Office of the Prime Minister, and implemented by the Subdistrict Administrative Organization and Pid Thong Lang Phra Foundation in collaboration with the Phon Ngam community development group.

Interventions here include: 1) restoring the abandoned shallow reservoir Nong Lueng Ploi with an increased capacity of 6,500,000 m^3; 2) building a network of canals connected to the reservoir; 3) establishing 15 pilot farmlands for sustainable agricultural practices; and 4) promoting off-farm work making clothes and sewing products. The first two create a water system for effective irrigation and flood control: the Nong Lueng Ploi reservoir provides water for farmlands during the dry season and stores run-off water and excess seasonal water flows when prolonged flooding occurs. The last two promote more sustainable farming and alternative livelihoods that are less dependent on natural resources and the climate.

Livelihood capitals and outcome

Household surveys took place in 2019 in two communities in the south of Kalasin Province, in Phon Ngam and nearby Samakkee (Figure 3.11). Both of these villages are located in lowland areas and often encountered severe consequences of seasonal flooding. In each of the two villages, 50 households were selected at random. Among them, 20 households from Phon Ngam have been actively involved in developing water conservation and flood control initiatives, while only 12 households from Samakkee have been involved and interested in planting vegetables that require less water and raising native chickens.

All villagers were rice farmers, owning paddy fields of 2.5 ha per household on average. In general, participants had more physical resources and better access to public services than non-participants. In particular, the average value of the houses owned by the participant group was US$ 16,969, which was 1.5 times that of the non-participants. The participants had more durable assets, such as a separate kitchen, a flushing toilet, tap water and access to the Internet (Figure 3.12), indicating that they had better living conditions than non-participants. They shared a similar level of education: more than half of villagers had attended junior high school and some individuals had undergraduate degrees or higher.

Figure 3.12 Durable assets owned by participants and non-participants

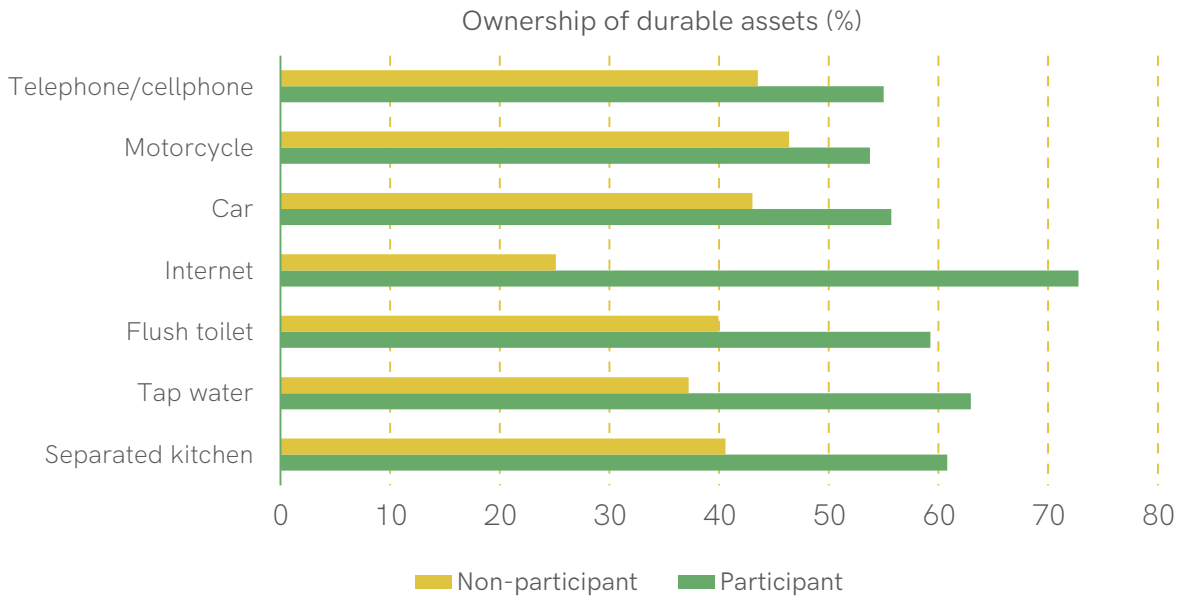


Figure 3.13 Financial capital among participants and non-participants

With regard to household finances, most households had bank accounts and savings accounts, but participant households tended to have fewer loans than non-participant households (Figure 3.13).

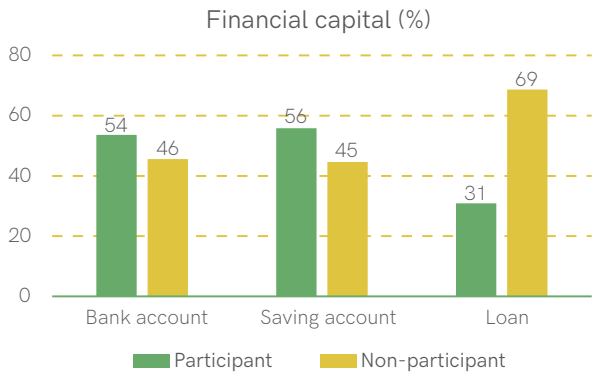
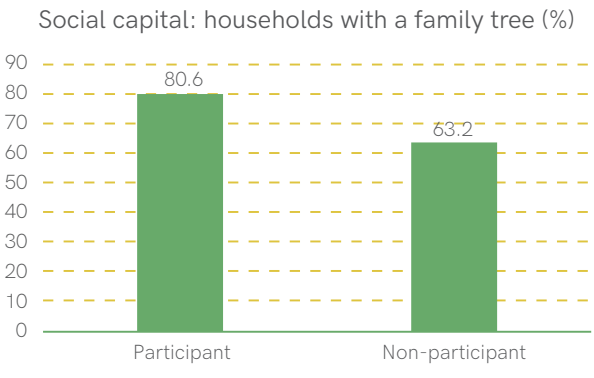


Figure 3.14 Social capital indicated by the percentage of households with a family tree among participants and non-participants

In both villages, more participant households had a family tree compared to non-participant households (Figure 3.14). Most households in the two villages had few relatives working for government agencies, universities or even health centres, and very few households in the villages surveyed belonged to cooperatives or other community organizations.



Participant households in both communities had a higher average annual income in 2018 than non-participant households due to selling mixed crops (Table 3.2). This difference was evident in Phon Ngam, where participants had higher agricultural production and earned more than half of their income from mixed crops and other sources. This result presents a shift from dependence on rice to a more sustainable model with diverse income options. Both rice and mixed crops (largely mixed vegetables) were major sources of income making similar contributions, and off-farm and other activities such as making clothes provided additional income for families. In contrast, Samakkee families still relied on rice production as a major source of income. Mixed crops became the secondary contributor for participant households, while off-farm and other activities contributed more for non-participants, in the form of noodle shops and beauty salons.

Table 3.2 Income by source

	Participant	Non-participant
Average household income (in 2018, US$)	6,837	4,818
Income source (%)		
Rice grain	46.85	56.99
Mixed crops	35.98	11.33
Off-farm & others	17.17	31.68

In Phon Ngam, people spent about two-thirds of their earnings in 2018, on education, food and drinking water, agricultural production, and restaurant and accommodation services or other businesses relating to tourism and hair care. Among the two groups, participants spent more on education, with the highest proportion of annual spending recorded (23 per cent), while non-participants invested more in other businesses and agricultural production.

In Samakkee, people spent about three-quarters of their earnings in 2018, a bigger portion than in Phon Ngam. Both participant and non-participant households invested the most in education, at 30 per cent of total expenditure, followed by food and drinking water at around 20 per cent.

Lessons: achieving co-benefits and stakeholder engagement

Phon Ngam village reduced its vulnerability to the changing climate and increased sustainable agricultural practices for better livelihoods with water conservation and flood control activities. The restored reservoir and canal network water system enabled communities to actively respond to the prolonged dry season and severe or delayed flooding. At the same time, the alternative options to rice-growing and diversified crops – largely mixed vegetables – provided more reliable revenue not linked to fluctuating market prices. This also promoted the paradigm shift from conventional farmlands to sustainable agriculture using fewer chemicals.

Establishing a committee plays an important role in ensuring the effectiveness of implementing such initiatives. The project sponsor – a local government and foundation leader – consulted families impacted by flooding, village leaders and other interested village groups about water issues and potential measures to be put in place. Following this consultation, a project committee was set up by the local government to draft and plan project activities for financial approval. An implementing committee involving farmers was then set up to act as an advisory agent, working closely with families to carry out activities on the ground.

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CASE 4

Use of water resources for sustainable livelihoods in the Mwanza region of Tanzania

Scenery of Lake Victoria near Mwanza City, Tanzania © UNEP-IEMP/Li Li

Facts

Location:
Mwanza region, Tanzania

Ecosystem:
Freshwater

Communities:
10 villages sampled from the region

Sustainable Development Goals involved:
1 No Poverty; 6 Clean Water and Sanitation; 11 Sustainable Cities and Communities

Background

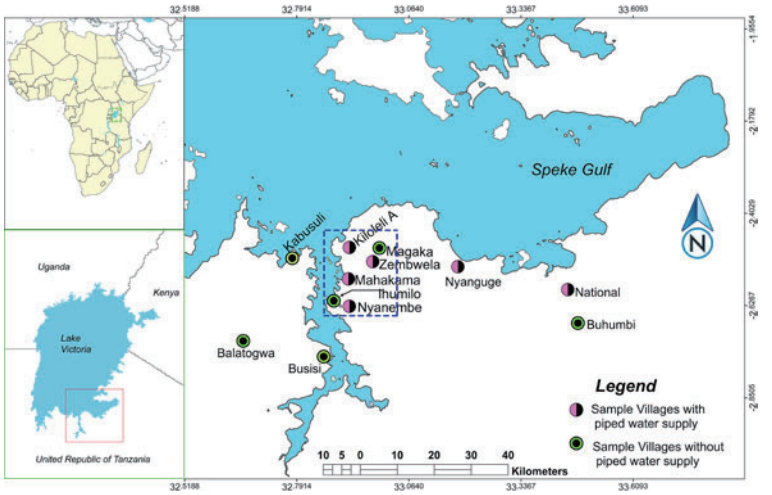
Mwanza is one of the 26 administrative regions of mainland Tanzania, with Mwanza City as its capital. Located to the south of Lake Victoria, the region covers a total area of 25,233 km^2, of which 53.25 per cent (13,437 km^2) consists of lakes and 46.75 per cent (11,796 km^2) is land. The land is mostly flat with altitudes varying from 1,200 to 1,400 masl, on which rainwater drains north into Lake Victoria. Rainfall in the region is bimodal, with a long rainy season between March and May and a short rainy season from October to December. Average annual rainfall is 930 mm, ranging from about 1,200 mm in the Ukerewe islands in Lake Victoria to 700 mm in the southern and south-eastern parts of the region (Tanzania President's Office Regional Administration and Local Government Authorities 2017).

According to the Tanzania Human Development Report 2017, Mwanza had a population of about 3.126 million across Mwanza City and seven districts. Its GDP per capita was around 2 million Tanzanian shillings, ranking it seventh out of the 26 regions of mainland Tanzania. Although considered to have achieved impressive socioeconomic development, the poverty rate (the percentage of people in households with income below the poverty level, as defined by the government) in the Mwanza region was 49.01 per cent, slightly higher than the national average of 47.40 per cent (United Nations Development Programme 2017).

Most of the population in Mwanza depend on natural resources for their income and livelihoods. According to the Tanzanian 2012 Population and Housing Census, about 62.8 per cent of the population were engaged in agriculture, mainly growing maize (130,000 ha), cassava, cotton, rice and vegetables. However, the use of irrigation was very limited in the region, with no more than 3,000 ha of cultivated land being irrigated out of the 10,000 ha with potential for irrigation (United Republic of Tanzania 2016).

Water in the Lake Victoria Basin underpins a number of economic activities, such as transportation, hydropower and fisheries (Lake Victoria Basin Commission 2007; Njiru *et al.* 2018). With the lake basin having already experienced a warming climate and many prolonged droughts interspersed with episodic floods (Mehta *et al.* 2013), climate change is expected to have increasingly negative impacts on these economic activities. The region has therefore been facing the intertwined challenges of poverty alleviation, agricultural production and water resource management in a changing environment (Lake Victoria Basin Commission and GRID-Arendal 2017; Petty *et al.* 2022).

Figure 3.15 Location of study sites in the Mwanza region in relation to Lake Victoria. In the blue dotted box are the six sample villages located in the two municipal districts (Nyamagana and Ilemela) of Mwanza City. Prepared by Joseph Luomba.



Interventions: water development and poverty alleviation

Since 1990s, the countries in the Lake Victoria Basin, such as Kenya, Uganda and Tanzania, have drawn up a series of policies and plans for the sustainable management and development of water resources. In 2001, they also established what is now the Lake Victoria Basin Commission as a specialized institution of the East African Community for coordinating regional cooperation on water resources management (United Nations Economic Commission for Africa 2016). Between 2011 and 2018, Phase II of the Lake Victoria Water Supply and Sanitation Programme (LVWATSAN) was implemented to reduce the pollution flowing into the lake through improvements to the sustainable water supply and sanitation infrastructure in the urban centres within the basin (African Development Bank 2019).

Under the guidance of water policies such as the 2009 Water Resources Management Act, the Government of the United Republic of Tanzania has invested hundreds of millions of US dollars to improve water management and deliver sustainable water supply and sanitation services in the country. In particular, it developed and implemented the LVWATSAN-Mwanza project in partnership with the East African Community and the United Nations Human Settlement Programme to improve on the extension and upgrading of water supply and sanitation in the city and target towns of Mwanza (Tanzania, Ministry of Water and Irrigation 2018). Improved sanitation in informal and low-income areas and communal facilities was taken as a priority.

The Tanzania Development Vision 2025 seeks to eradicate poverty and provide a high quality of life for all by 2025. The LVWATSAN-Mwanza project and other regional initiatives for water resources development and management are expected to contribute to the plan by improving quality, availability and access to water and sanitation services that are geared towards human development and social transformation. According to the 2012 census, 35 per cent of households in Mwanza, ranging from 76 per cent in urban areas to 9 per cent in rural areas, used piped water as their main source of drinking water. A considerable proportion (23 per cent) of the region's population still used unprotected dug wells as their main source of drinking water (United Republic of Tanzania 2016). The effects of access to and the extension of clean and safe water (e.g. piped water) on household livelihoods and community development are yet be explored, so as to provide a reference for improving regional water resources management strategies and plans.

Livelihood capitals and outcome

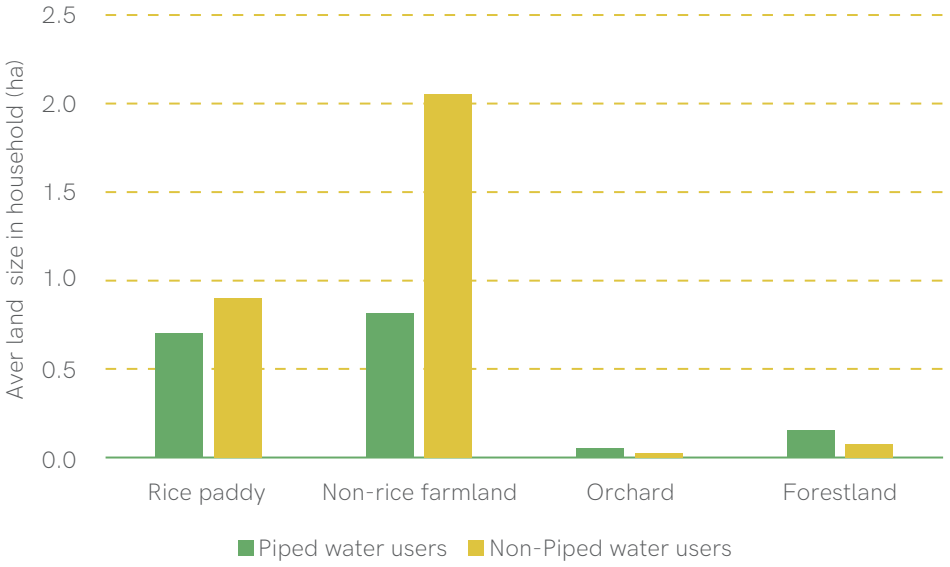
Household surveys were conducted in 2021 in a total of 12 villages in the Mwanza region of Tanzania (Figure 3.15). Two villages with access to a piped water supply and one that does not have access to a piped water supply were selected in the Nyamagana, Ilemela, and Mugu districts, while all three villages selected in the district of Sengerema have no access to a piped water supply. Within each village, a total of 10 households were selected at random for interview. However, one more household was occasionally interviewed in the Nyehunge village in Mugu. It was also found that three households interviewed in the village of Zembwela in Ilemela do not use piped water in their daily life. Both the Nyehunge and Zembwela villages have access to a piped water supply. As a result, a total of 58 households using piped water (piped water users) and 63 households that do not use piped water in their daily life (non-piped water users) were interviewed in this study (Table 3.3).

Table 3.3 Profile of sample households in the Mwanza region

Number of sample households	Piped water users	Non-piped water users	Total
Villages with a piped water supply	58	3	61
Villages without a piped water supply	0	60	60
Total	58	63	121

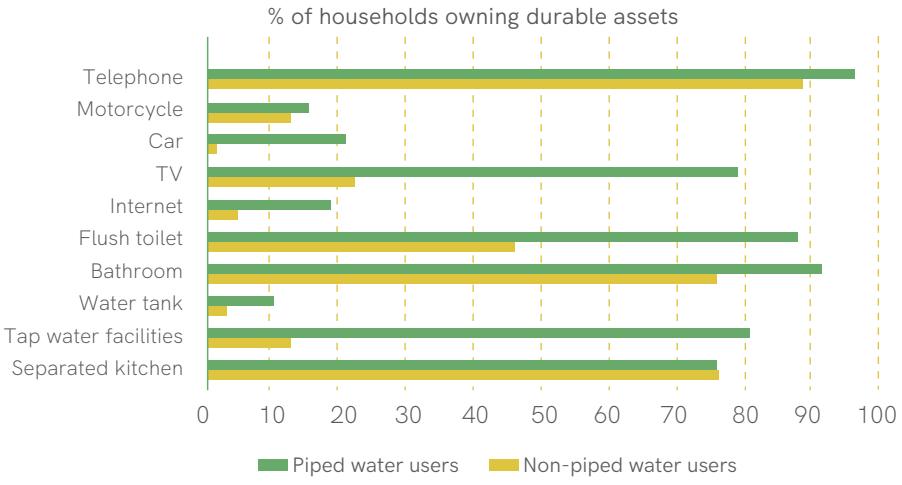
Overall, piped water users had less natural capital but much better physical, human, financial and social capital than non-piped water users. In terms of natural capital, the rice paddies and non-rice farmland owned by households were larger among non-piped water users, while orchard and forestland was larger among piped water users (Figure 3.16).

Figure 3.16 Average land size among piped water and non-piped water users



Piped water users had stronger physical resources than non-piped water users. In particular, the average value of homes among piped water users was US$ 14,231, which is 1.9 times that of non-piped water users. Piped water users had more durable assets, such as tap water, bathrooms, flushing toilets, televisions, cars, and access to the Internet (Figure 3.17), indicating that they had better living conditions than non-piped water users.

Figure 3.17 Durable assets of piped water and non-piped water users

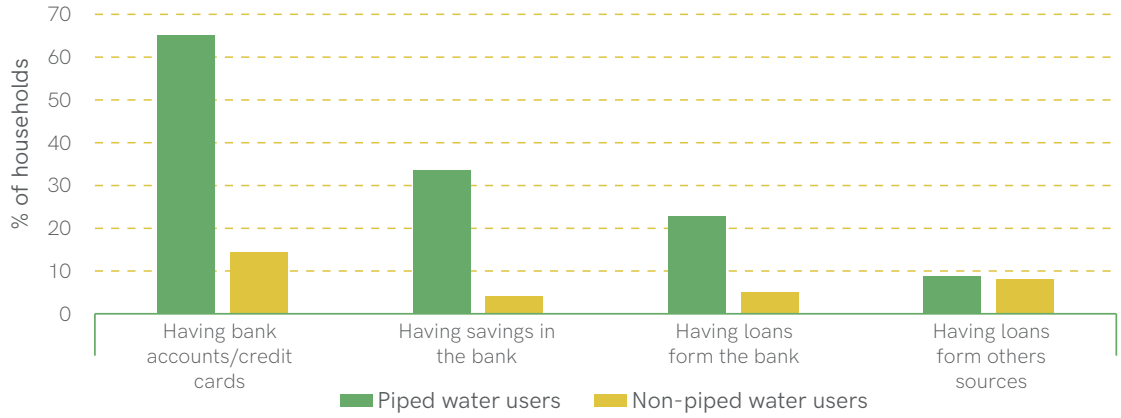


The majority of households in both groups had access to public services such as paved roads, health care, a market, a temple, a kindergarten, a primary school and a junior high school. Few had access to irrigation facilities and nursing homes for the elderly. However, non-piped water users had much lower access to tap water and garbage collection points because of the distance to such services.

Human capital in terms of education differed between the two groups. Piped water users were more educated than non-piped water users. Nearly half of piped water users went to high school and college, while the majority (68 per cent) of non-piped water users had primary-level education or below and less than one-quarter had finished junior high school or achieved a higher level of education.

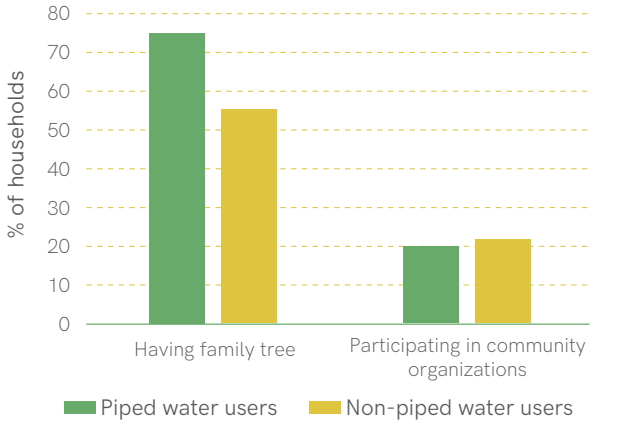
Regarding financial services in 2020, piped water users tended to have more bank accounts and credit cards than non-piped water users (Figure 3.18). They also had more bank savings and loans. Most loans among piped water users were taken from banks (including credit unions) and invested in houses and education to improve quality of life, while non-piped water users took most of their loans from relatives or private lenders and used them to pay for their daily living expenses.

Figure 3.18 Financial capital among piped water users and non-piped water users



There was a significant difference in social capital between piped water users and non-piped water users. Nearly three-quarters of piped water users had a family tree, compared to just over half of non-piped water users (Figure 3.19). Piped water users had many more relatives and friends working for government agencies or as doctors in district hospitals. However, a similar proportion (21 per cent) of households were members of community organizations in both groups.

Figure 3.19 Social capital among piped water users and non-piped water users



Piped water users had an average annual income of US$ 4,470 in 2020, which was much higher than that of non-piped water users (Table 3.4). Family businesses and other investments, like retail shops, house rental businesses, fishing-related businesses, and livestock and poultry sales businesses were the major sources of income for both groups. However, piped water users benefited more from business and investments, which provided them with an average annual income of US$ 2,512, compared to just US$ 795 for non-piped water users. The groups differed in terms of secondary incomes. Non-piped water users still relied on agricultural production (34 per cent) including cattle-raising, cropping, orchard-planting and aquatic products. In contrast, piped water users relied on wages and remittances (14.6 per cent) and pensions (12.1 per cent) in addition to cattle-raising (10.0 per cent) and cropping (4.3 per cent). These results indicate that piped water users have more livelihood options than non-piped water users.

Table 3.4 Income by source

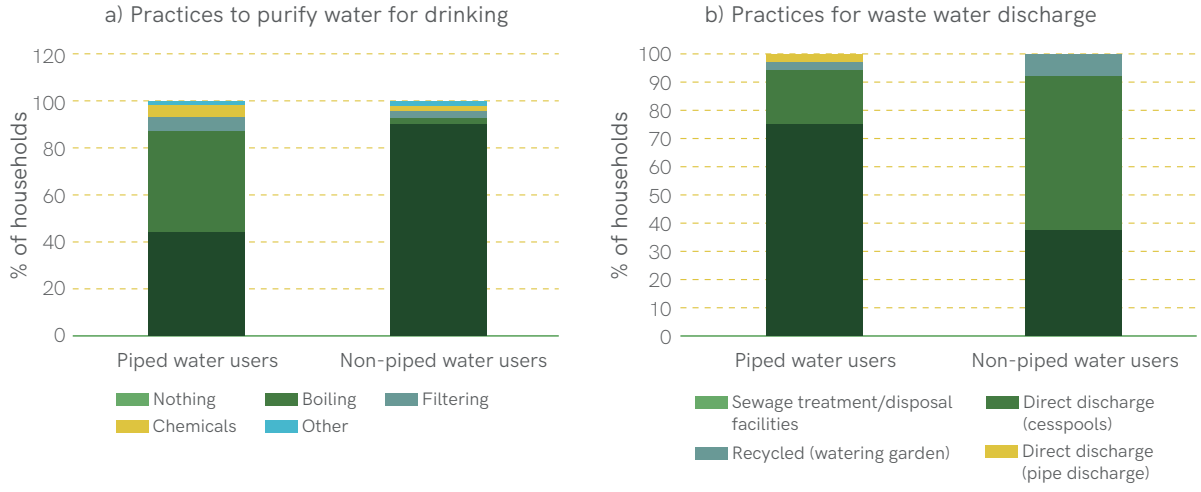
	Piped water users	Non-piped water users
Average income (2020, US$)	4469.7	1308.2
Income source (%)		
Wages and remittances	14.6	3.7
Family businesses	32.8	40.4
Cattle	10.0	11.3
Crops	4.3	16.5
Orchards	0.0	1.2
Aquatic products	0.2	5.0
Gifts	2.6	1.5
Pensions	12.1	0.2
Investments*	23.4	20.3

* Such as land-leasing, house-renting and the stock market.

In 2020, piped water users spent about three-quarters of their annual income, using it to pay for food and drinking water, education, furniture and home maintenance, transportation and other household spending, while non-piped water users spent about 90 per cent of family earnings. Furniture and home maintenance was the third-largest expense (11.9 per cent of annual household expenses) for piped water users, in contrast to health care (14.6 per cent of annual household expenses) for non-piped water users. Both groups had limited investments in agricultural production, which represented 4.7 per cent and 6.9 per cent of annual household expenditure for piped water users and non-piped water users, respectively.

Compared to piped water users, non-piped water users had distinct water uses for household daily purposes. Most of them used bore holes and wells as their primary water source (75 per cent), followed by the lake (19 per cent), streams and rivers (3 per cent) and unprotected springs (3 per cent). On average, households each used about 41,600 l of water in 2020, less than the 46,450 l used by piped water users. They seldom adopted practices to purify water for drinking, and nearly 16 per cent had had diarrhoea over the past seven days (compared to 3 per cent among piped water users). Only 46 per cent of non-piped water users discharged wastewater into sewage disposal and treatment facilities, or recycled it to water their gardens, in contrast to 78 per cent of piped water users (Figure 3.20).

Figure 3.20 Domestic water uses among piped water users and non-piped water users in Mwanza



Lessons: use of water resources and livelihood development

In Mwanza, piped water users had much better livelihood capitals (except for natural capital, measured by the area of rice paddies and non-rice farmland they owned) as well as more livelihood options, higher family income and expenditure, and a better quality of life. It thus remains an urgent priority to enhance the support available to less developed areas and low-income populations in regional water resources development programmes. In addition to water supply and sanitation infrastructure facilities, training and capacity-building programmes need to be enhanced with a focus on both water resource utilization and livelihood diversification in areas without access to piped water.

Off-farm business and employment is always a major livelihood strategy to increase household income and capacity to adapt to changes. However, given that only a quarter of the population in the sample villages were reported to have engaged in off-farm business and employment, while about 30 per cent reported being unemployed or in unspecified employment, alternative methods of income generation need to be introduced to ensure livelihood sustainability in the region.

Farming remains the most important livelihood option for most rural households in Mwanza, but the agricultural yield and the contribution it makes to the family income are unsatisfactory. This may be attributed to the very limited irrigation system that could be observed in the field. The survey results reveal that irrigated land made up around 26.5 per cent of the cultivated area for rice paddies and 9.6 per cent for non-rice farmland in the region. In particular, the irrigated area accounted for just 3 per cent of non-rice farmland among non-piped water users. Therefore, the development of irrigation facilities and networks has the potential to promote agricultural production and livelihood development in the region.

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3.2. Mountain

CASE 5

Biodiversity-based products in north-west Cambodia

Villagers knitting mats with leaves in the village of Tmei in Svay Leu district, Siem Reap Province © Chhin Sophea

Facts

Location:
Siem Reap Province, Northwestern Cambodia

Ecosystem:
Mountain

Communities:
Anlong Thum, Thma Chhrounh, and Tmei village

Sustainable Development Goals involved:
1 No Poverty; 15 Life on Land; 17 Partnerships for the Goals

Background

In north-west Cambodia, Mount Kulen is a very sacred mountain, representing immense cultural heritage and rich natural resources as the origin of the Khmer Empire with a history spanning centuries. It lies about 50 km north of the World Heritage Site of Angkor Wat. In 1993, the Royal Government of Cambodia designated Mount Kulen, or Phnom Kulen as it is known in Khmer (literally mountain of lychees), as a National Park, covering an area of 37,500 ha.

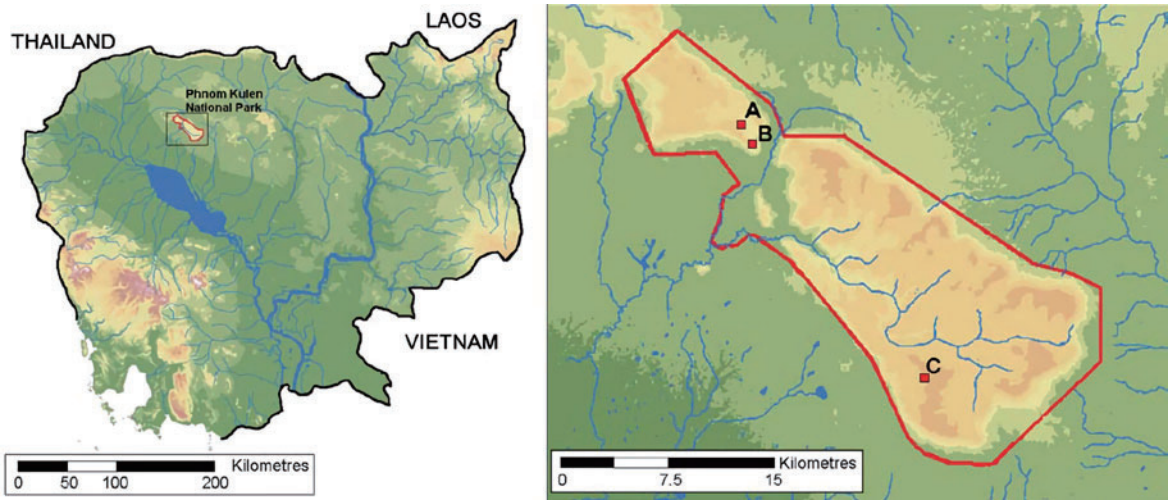
Phnom Kulen National Park (PKNP), with an elevation of up to 500 masl, features a unique plateau above the largely flat lowland landscape of northern Cambodia (Figure 3.21). Major evergreen and semi-evergreen forests intertwine with small patches of deciduous dipterocarp forest, forming a diverse and complex mosaic of landscapes. The main river, Siem Reap, joined by numerous streams, runs from Mount Kulen and flows through reservoirs, moats around Angkor Wat temples and Siem Reap town before reaching the great Tonlé Sap Lake – the largest freshwater lake in south-east Asia (Peou *et al.* 2016). PKNP plays a vital role in providing water to the entire Siem Reap watershed and recharging the regional aquifer all year round.

People mostly live on the eastern plateau, the Khang Phnom Commune, which has a population of 4,565 people, comprised of 990 families. The Ministry of Planning reports that 13 per cent and 20 per cent of these households belong to Poor Level 1[3] and Poor Level 2, respectively (Tola 2015).

For centuries, the people of Mount Kulen have relied mainly on forest resources, using traditional agricultural practices such as shifting cultivation (known as *Chamkar*). These groups traditionally clear forested areas and cultivate crops in plots for years, then move on to new areas before eventually returning to the original areas once forests have regenerated and soil fertility has naturally been restored. Being subsistence farmers, most villagers grow rain-fed upland rice mixed with cassava, taro and other cash crops. The non-timber forest products business is an alternative livelihood option, and includes medicinal plants, bamboo and wild mushroom. These practices are an example of land being managed sustainably with minimal negative impacts on forest cover.

[3] IDPoor is Cambodia's national poverty identification programme. Households are classified into two categories, Poor Level 1 and Poor Level 2. Poor Level 1 is the poorest section of the population. See https://www.idpoor.gov.kh/about/process for more information.

Figure 3.21 Phnom Kulen National Park, Siem Reap Province, The Kingdom of Cambodia.



Source: Hartmann *et al.* 2013

This traditional agricultural system changed in the early 2000s when the cash crop cashew was introduced to Mount Kulen. Driven by high yields up to seven times that of rice, villagers started converting shifting plots into locations to plant cashew trees permanently. Cashew farms soon replaced rice fields and became the dominant crop, representing families' largest source of income. However, planting cashew trees gives forests and natural vegetation little chance to regenerate, and this, alongside illegal logging, has contributed to forest loss. The Ministry of Environment (2017) reported that forest cover at the park has reduced by about one-third, from 87 per cent in 2006 (32,463 ha) to 55 per cent in 2016 (20,747 ha).

The forests of Mount Kulen play an essential role in balancing the ecosystem on the mountain. The loss of forests not only has a negative impact on local biodiversity and livelihood options, but also results in water shortages during the dry season. Seven amphibian and reptile species found in the area are now included on the IUCN Red List of Threatened Species, including the Mekong snail-eating turtle *(Malayemys subtrijuga)* (Hayes *et al.* 2013). Collecting non-timber forest products (NTFPs) for home consumption and trade has become more and more challenging each year as the diversity of the natural resources available declines.

Interventions: biodiversity-based products in forest lands

Various development partners and non-governmental organizations have been working on the sustainable planning and management of natural resources at PKNP. For instance, UNDP and the German Agency for International Cooperation have focused on climate change and resilience, promoting NTFPs, good agricultural practices and the value chain, and planting trees inside protected areas. The Biodiversity-based Products (BBP) project, which aimed for these goods to become an economic source for the improvement of livelihoods and biodiversity protection, piloted from 2015 to 2019. It works directly with local communities – targeting mostly rural populations – to enhance the socioeconomic development using rich natural resources.

With funding from the German Agency for International Cooperation and support from the Association of Southeast Asian Nations Centre for Biodiversity, the BBP project explored the value chain development of NTFPs in close cooperation and collaboration with the Ministry of Environment.

A gap analysis was conducted to obtain a baseline assessment of potential indigenous biodiversity-based products in the forest lands (Tola 2015). Thai black ginger (*Kaempferia parviflora*, known as *prateal thleum chhke* in Khmer) and vine handicrafts were identified as items that could give households in community protected areas an alternative to improve their livelihoods while also protecting biodiversity in the PKNP area (Figure 3.22). Black ginger is an important traditional medicinal plant and has been used as a vitalizing and stimulating herb in south-east Asia for centuries. Group members cultivate black ging¬er in their gardens between cashew trees, coconut trees, mango trees, lychee trees etc. Vines or climbing ferns, which mostly grow in the low-lying areas along the banks of the streams, can be weaved to make handbags, hats and many types of souvenirs.

Figure 3.22 Black ginger cultivated and harvested in home gardens (left); Vine ferns for designing handicrafts and weaving products (right).

Source: BBP project, https://bbp.aseanbiodiversity.org, accessed 9 September 2021.

Rather than selling raw products at a low price, the project supported farmers in developing the value chain, from cultivating and harvesting to processing, packaging and marketing. Black ginger rhizomes, for example, can be processed as tea if sold to a professional tea producer; in this case, market linkage is explored. Villagers were also organized into a producer group involved in planning, including the development and approval of relevant by-laws, and trained in advanced cultivating, crop maintenance, harvesting and storage techniques (Pantastico and Schlegel 2019). The process of developing the value chain also attracted other interested partners. For example, the Angkor Handicraft Association joined as a business partner to support the handicraft products. In addition to conducting a series of training sessions and weaving activities for villagers on different products and designs, including baskets, trays and bracelets, the association has also connected with other wholesalers and retailers to further deliver these handicraft products to end consumers such as restaurants and shops. These market connections continue beyond the end of the project.

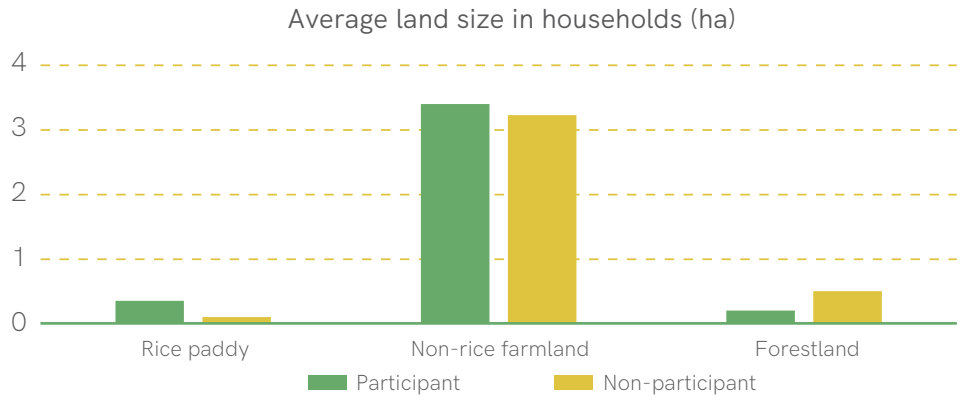
Livelihood capitals and outcome

Household surveys were conducted in Khnorng Phnum Commune in November 2019. The participant group consisted of 58 households that were members of the BBP project, including 24 that had participated in vine handicrafts and 34 that had taken part in black ginger activities. They came from the villages of Thmei, Anlong Thom and Thma Chhrounh. The non-participant group was made up of 51 households selected at random from the villages of Anlong Thom and Tmei.

The villages in the two groups shared some similar socioeconomic conditions. There were limited rice paddies but abundant non-rice farmland, measuring an average of 3 ha per household, which was mainly used to grow cashew trees. Rice paddies were larger among the participant group, while forests were larger among the non-participant group (Figure 3.23). People had a poor level of education: only a small portion of people (4 per cent) had finished high school, obtaining fundamental learning skills, and about one-fifth of people were not able to read and write.

Households in the participant and non-participant groups had a similar level of access to public infrastructure and services, with 50 per cent enjoying access to paved roads, health care, tap water, irrigation facilities, a market, a temple, a primary school and a junior high school. Few had access to a nursing home, garbage collection point and kindergarten.

Figure 3.23 Average land size among participants and non-participants



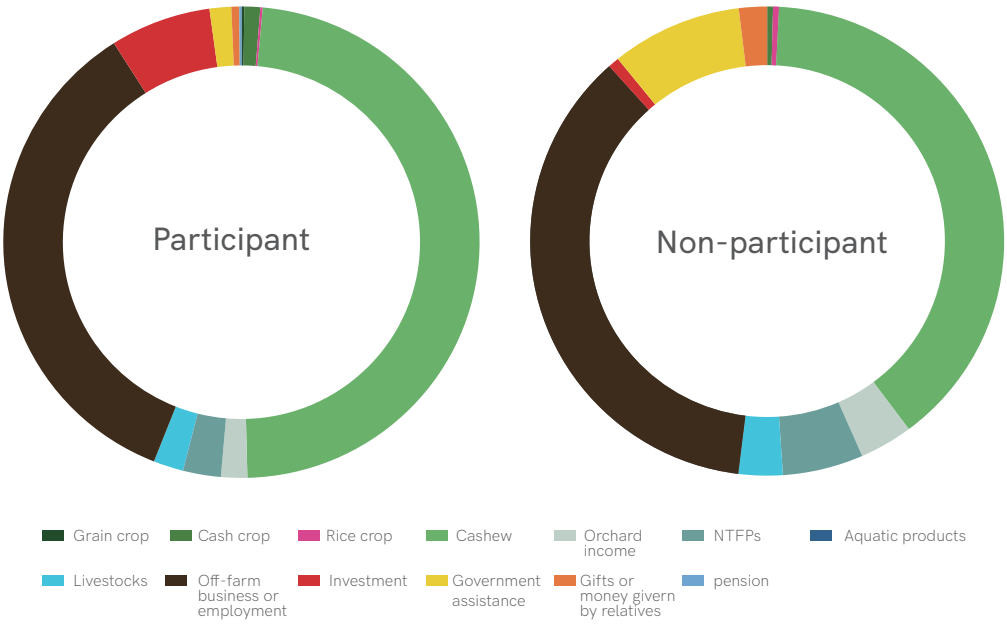
There was a significant difference in social capital between participants and non-participants. Nearly all participants had a family tree, compared to three-quarters of non-participants. In the participant group, 70 per cent of households were members of community organizations; this figure was just 13 per cent among non-participants.

Cultivating cashew nuts was the primary source of income for all villagers, but the participant group benefited more from this crop, which accounted for nearly half of their total income. The two groups differed in terms of their secondary incomes (Figure 3.24). Villagers who were members of the BBP project relied on off-farm business (35 per cent) and investment (7 per cent) like leasing and selling land, while villagers from the control group relied on off-farm business (36 per cent) and government assistance (9 per cent).

The average annual income per household of the treatment group was US$ 4,613, higher than the control group's income of US$ 3,931. This difference was mainly due to the planting of cashew trees. The income generated by biodiversity-based products, including NTFPs, vine handicrafts and black ginger, only accounted for about 7 per cent of income.

The participant group spent money mostly on food and drinking water to meet their daily needs, followed by agricultural production, health care, education, restaurants and accommodation, and social activities (such as gifts for weddings). The non-participant group, which had a lower income, spent more money on food and drinking water. Spending in this category represented more than one-third of family earnings, and limited investment in education to 6 per cent, less than half that spent in this area by the participant group.

Figure 3.24 Average annual income of the two groups in 2018



Lessons: capacity-building and partnerships

The BBP project was designed to help increase income generation and village employment opportunities (Pilarca and Schlegel 2019). As the survey was conducted immediately after the end of the project interventions, it was too soon to see their impacts, and there had not yet been any evidence showing that the approach of trying to draw economic value from biodiversity in a sustainable way had improved local livelihoods while sustaining natural resources. The cashew nut, a short-term economic product, remained a major source of income, securing local communities' quality of life. As such, it promoted the alleviation of poverty in the short term but at the expense of biodiversity. It takes time to effect transformative change from economically dominant agriculture towards biodiversity-based production.

Biodiversity-based products for livelihoods have faced several obstacles in PKNP: the market potential of biodiversity-based products for the local indigenous population is unknown (Schlegel, Lopez and Simorangkir 2019), and it takes times to develop stable trading relations and a value chain for the public, private and civil sectors, as well as making it operational.

Training sessions on skills and knowledge related to the value chain and associations that build stable partnerships could help to increase human and social capital, and promote the generation of economic value from biodiversity. In addition, the booming ecotourism at play at the Angkor site could go hand in hand with the development and operation of the value chain, providing a platform for eco-products.

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CASE 6

Agrobiodiversity conservation and cultural protection in Naxi communities

The landscape at Stone Village © FSN/Yiqing Song

Facts

Location:
Three Parallel Rivers Protected Areas, Yunnan Province, China

Ecosystem:
Mountain

Communities:
Stone Village and Wumu Village, Lijiang City

Sustainable Development Goals involved:
5 Gender Equity; 15 Life on Land; 17 Partnerships for the Goals

Background

In Yunnan Province, south-west China, soaring mountain ridges and deep river gorges span across the terrain. The high snow-covered mountains rise well above 5,000 m. Between ridges, the upper reaches of three of Asia's major rivers, Jinsha (Yangtze), Lancang (Mekong) and Nujiang (Salween), run north to south through steep gorges (Figure 3.25). These comprise part of the Three Parallel Rivers Protected Areas, a world biodiversity hotspot and a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site known for its rich biodiversity, stunning landscapes, and diverse ethnic groups (Sun 2010; UNESCO World Heritage Convention 2022).

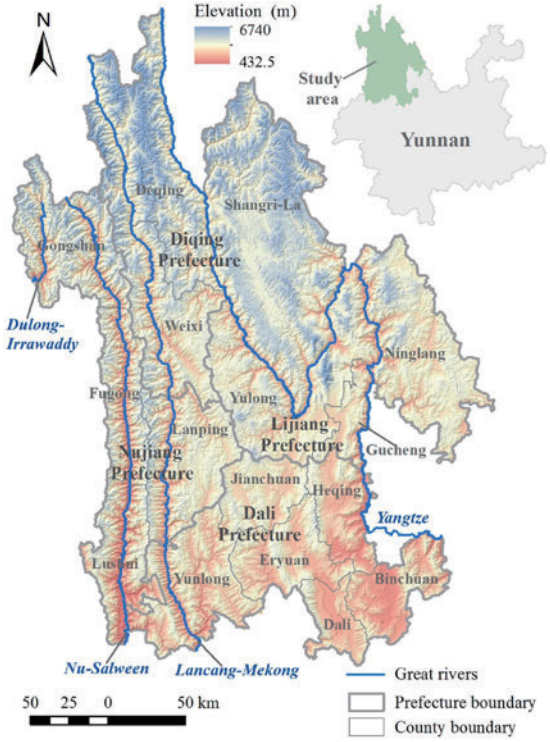
The region is home to 16 indigenous groups, including the Naxi (纳西 in Chinese) people, who are one of the main dynamic cultural groups settled near the area of Lijiang along Jinsha River. For centuries, the Naxi people have cultivated and managed mountain landscapes by responding to the changing seasons. Terraced farming and an irrigation system featuring channels and culverts are the common traditional practices employed along the hot and dry banks of the river (Song *et al.* 2016).

Among the villages inhabited by the Naxi people, Stone village in the north-east of Lijiang city, is located in the Jinsha River Valley near a giant, mushroom-like stone. It has rich biological, cultural and linguistic diversity. With over 1,300 years of mountain farming history, the Naxi people have developed a traditional system of crop diversification, terraced farming and water management in a harsh environment where there are dispersed usable patches at different altitudes, varying climates, and limited road access and use for mechanization (Song *et al.* 2021). The area is mostly made up of dry farmland; terraced fields have become the dominant landscape, where the

main crops are wheat, barley, corn, soybeans, broad beans, pumpkins and sweet potatoes. The village can access water from the nearby Baoshan River, using a thousand-year-old irrigation system consisting of open ditches and underdrains.

Like many other mountain communities, the village has been facing development dilemmas in the face of rapid socioeconomic and climatic changes (Song *et al.* 2021). With the move from traditional farming to commercial agricultural practices, hybrid seeds have been promoted and chemicals used widely. As a result, ecosystem degradation such as soil erosion has increased, traditional crop varieties have decreased, and traditional farming knowledge and associated cultural aspects, such as food, has declined. In addition, the village is challenged by the climate change consequences of more intense spring droughts, increased rainstorms in summer, and a delayed rainy season, which can cause pest outbreaks and crop failure. In September 2014, continuous rainfall damaged a large area of nearly mature maize, devastating the harvest. There is an urgent need for communities to find new ways to sustain and improve their capacity to adapt to all these contemporary changes.

Figure 3.25 The Three Parallel Rivers Protected Areas in south-west China. Source: Lin *et al.* 2016.



Participatory approach for community-based interventions

To conserve agrobiodiversity and raise local farmers' awareness of environmental and climate variability, since 2013, Stone village has explored a cooperative model through participatory plant breeding and the construction of a community seed bank (Song *et al.* 2021).

The community seed bank as a platform for participation, cooperation and knowledge-building

The community seed bank is a way for agrobiodiversity and traditional food sources, as well as related knowledge and practices, to be conserved and used sustainably in situ in order to help farmers adapt to extreme climate events such as droughts and other natural disasters. The bank documents and stores villagers' own seeds in a public community space to help revitalize traditional Naxi culture and knowledge, while also serving as a networking platform for local farmers to connect and exchange seeds with each other, as well as with external agencies.

Initially, participatory varietal selection and participatory plant breeding activities were carried out jointly by researchers and communities, allowing them to understand, protect and improve their own crops and varieties. Farmers received a wide range of expertise and technical support from the Chinese Academy of Sciences Kunming Institute of Botany, the Guangxi Academy of Agricultural Sciences Maize Research Institute, Yunnan Agricultural University, and Farmers' Seed Network (FSN); they were guided to conduct trials on selecting and breeding maize, legumes, peanuts and vegetables based on yield, taste, use and key agronomic indicators like the weather. This can help to identify crop varieties that are adaptive to local circumstances and culture, and more resistant to natural disasters such as droughts and pests. Villagers were also encouraged to resume the planting and exchange of farmers' own varieties and help them build their awareness and self-confidence in producing and planting the old seeds.

Figure 3.26 Community seed bank in Stone village. The seven display cabinets exhibit a total of 108 crop varieties, including 69 varieties indigenous to Stone village, such as rice, corn, sorghum, vegetables and medicinal plants, as well as 39 experimental varieties obtained through participatory varietal selection and participatory plant breeding, such as soybean. © FSN/Milin Tian

Samples of these tested varieties were later brought to be stored in the community seed bank. In order to keep the stored seeds alive, the management team developed two operation mechanisms: seed resource registration and seed field school for selection and breeding experiments (Figure 3.26). At the time of writing, the community seed bank had collected 113 local varieties. The farmers' school also provides regular training workshops within the community (sometimes with guest experts) on different topics including video documentation, integrated pest management and post-harvest management. The seed bank displays the seeds not only to attract farmers to exchange them but, more importantly, to let people recognize the live protection of germplasm resources and increase their awareness of protecting native species.

Linking with external agencies to exchange knowledge

A series of exchange activities have been organized. In 2016, community representatives from Stone village visited the Potato Park in Cusco, Peru to exchange mountain farming knowledge and ecological culture with native Peruvian farmers. A group of female representatives also participated in the United Nations Biodiversity Conference in Mexico, where they presented not only their conservation practices and crop variety knowledge, but also their ethnic culture, with performances of Naxi music. The village has also received visits from other communities, including those from the Potato Park, to promote mutual learning. During these visits, farmers shared their knowledge and lessons learned on traditional farming practices, how to protect traditional food, seed conservation and water systems.

By engaging in exchange visits at home and abroad, supported by the FSN and other partners, farmers have been able to gain understanding and experience of diverse cultures, in particular the vibrant and essential site-specific ecological culture. They have also become more confident in their own traditional culture and more aware of ecological culture, crop varieties, and the conservation and utilization of seeds for adaptation. Such benefits being shared and communicated between farmers helps to further promote biodiversity protection and the passing-on of traditional cultural practices.

Women's empowerment

Women are the main force of agricultural production in mountain communities. By actively participating in various community activities, women in Stone village have not only significantly strengthened their knowledge and skills, but also built their leadership (Figure 3.27). They have learned parental line and seed production techniques by proactively working with experts and researchers and engaging in exchanges with other breeders. They have also led a seed conservation group to carry out field experiments for breeding plants and selecting varieties. In terms of community seed bank management, the group is also in charge of renewing and making use of these seeds. In addition, many women have enjoyed innovative achievements conducting different field trials on seed improvement: two women, for example, managed to improve and develop new hybrid varieties by using maize germplasm from Peru and the Maize Research Institute.

From Stone village to the Naxi community network

The progress and achievements of the participatory seed variety conservation work in Stone village have been extended to other villages along the Jinsha River Valley: Wumu, Lakaxi and Youmi. These four villages formed a mountainous Naxi community network in 2017.

The farm variety conservation action in Stone village has had increasingly social influence in the local area and attracted the attention of surrounding communities and the local government. In 2018, four Naxi villages formed a network, aiming to explore an innovative path to demonstrate rural revitalization and to cope with the social and climate crisis and changes. The network organizes exchange visits at least once a year, during which they exchange seeds, share their experience and knowledge of breeding varieties, protecting traditional culture and coping with community demands, climate change and the difficulties they have faced, and discuss community plans and joint actions. Eco-cultural tourism is considered a future plan to ensure better income for the community while conserving ecological and diverse culture.

Livelihood capitals and outcome

Household surveys were conducted in 2019. A group of 49 households from Stone village and Wumu village in Yulong county in Lijiang City were involved in community seed banks. The non-participant group was made up of 60 households from Guole village in the same county, and two other villages – Labo and Gewa – in Ninglang county.

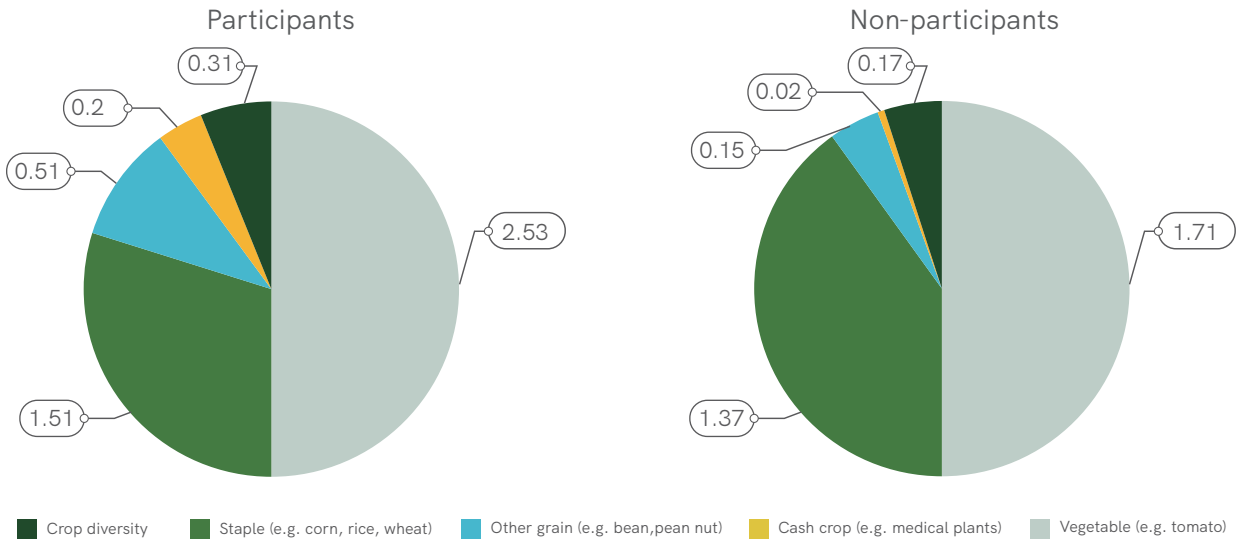
Access to public services appeared less satisfactory, in particular access to paved roads and a primary school. Human capital (in terms of education) was similar across the two groups: for both, less than one-third of people had finished high school, only one-tenth had received college-level education or above, and one-fifth was illiterate. Regarding financial opportunities, villagers in both groups were in favour of having a bank account (which is an important indicator of inclusive finance). In addition, about half of the population had access to financial services such as loans from banks within the township.

However, the participant households owned more farmland (0.22 ha compared to 0.13 ha) but almost no forest. The value of the homes owned by the participant group was double that of non-participants. There were significant differences in social capital between the two groups: the number of relatives working for a government agency, university or hospital, or as the head of a company or a private entrepreneur among participants was much less than that of non-participants (1.7 and 2.3 respectively).

Figure 3.27 Female Naxi farmer breeders in Stone village © FSN/Qiubi

Crop variety at the household level was examined (Figure 3.28). Participant families grew more diverse crops, ranging from staple crops and grain to cash crops and vegetables. On average, each participant household planted three crops, compared to two for each non-participant household. Among participant families, about 31 per cent grew more than three different varieties. When comparing varieties by species, it was noted that the participatory plant breeding and seed bank interventions had helped to expand the food system from just staple foods to one that includes herbs and vegetables, which provide rich nutrition to maintain people's health, especially for those living in rural and remote mountain areas.

Figure 3.28 Number and structure of crop species planted among participants and non-participants



The participant group had an average household income of US$ 9,210 in 2018, more than the non-participant group's income of US$ 8,492 (Table 3.5). Off-farm earnings, including self-employment, contributed significantly to total income for both groups, accounting for almost 90 per cent for the participant group and 60 per cent for the non-participant group. Farming became the secondary source of income for participant families. On the other hand, non-participant families received relatively high subsidies from governments and relatives, which far exceeded their farming income and accounted for nearly one-quarter of their total earnings.

It is interesting to note that although the participant households diversified their farming more, the income they received directly from agriculture was less than for the other group. The lack of financial incentives for conserving agrobiodiversity and the distorted market value of food and traditional crop varieties may have contributed to this result.

Table 3.5 Average income distribution per household at study sites

	Participant (n=49)	Non-participant (n=60)
Average household income (US$)	9,210.13	8,492.83
Off-farm employment: family businesses, labour in cities etc.	8,014.47	5,076.62
Farming	632.77	730.57
Staple and other grains	117.79	125.92
Cash crops	149.36	256.24
Other (e.g. livestock, honey)	365.62	348.41
Government subsidies	320.15	1,034.18
Income from property	7.25	3.93
Transfers from children and relatives	235.49	1,647.53

As part of their livelihood outcomes and in terms of culture, more and more participant households have started to rethink and revitalize their traditional ethnic culture that is associated with agriculture. In September 2015, alcohol and ham from Stone village were added to the Slow Food Chinese Ark of Taste list. Public activities like dancing and singing have also been brought back, contributing to lively village life while helping traditional culture to be passed down.

Lessons: collaboration, inclusiveness and women's empowerment

Stone village is a living laboratory for exploring and exchanging knowledge and experience on agrobiodiversity conservation. It is also a trial on combining traditional and modern practices to tackle the challenges of climate change and economic development. The main achievements enjoyed have been in enhancing the community seed system and documenting traditional knowledge. Extending Stone village's practices to the Naxi community network of four villages in the upper reaches of the Yangtze River prove that restoring local ecological diversity and protecting local seeds and traditional knowledge are now factors considered by communities when looking at sustainable development.

The participatory approaches to plant breeding and variety selection and the management of farmers' seed banks have motivated communities to engage multiple stakeholders from both the public and private spheres for cooperation. Researchers have provided knowledge and techniques for advanced breeding and seed system development, while social enterprises have helped to supply these agricultural products to urban consumers. The FSN and other partners have supported exchange visits for the building and sharing of knowledge. Furthermore, building a network made up of four Naxi villages is not only a mechanism for innovation, but has also demonstrated the potential for uniting regional mountain communities so they can help each other and cope with climate change together.

Women play an increasingly active role in farm variety conservation and community management. Their organizational leadership and agricultural techniques have been strengthened, and they have become a leading group when it comes to conserving farmers' seeds, diversifying local farming and crop varieties, and protecting and using seeds within the community.

It remains a challenge for local communities to reap the economic benefits of this increased agrobiodiversity. An appropriate market needs to be explored under the current circumstances in which cash crops are prevalent. Research and development of market linkages for bioproducts and services are needed to better support the conservation of biological and cultural diversity.

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CASE 7

Mountain Ecosystem-based Adaptation in Rasuwa district, Nepal

Mountain landscape in Rasuwa district. © Thapa, I.
Source: Instituto de Montaña 2020.

Facts

Location:
Rasuwa district, Bagmati Province, Nepal

Ecosystem:
Mountain

Communities:
Aamachongdingmo rural municipality (wards 3 & 4)

Sustainable Development Goals involved:
1 No Poverty; 10 Reduced Inequalities; 13 Climate Action;15 Life on Land

Background

People living in mountain regions are always among the poorest and the most vulnerable to climate change. The rural communities living high in the mountains of Nepal, especially those in remote and ecologically fragile areas, are particularly at risk and face huge development challenges due to their limited access to information and basic services and limited capacity to deal with disasters associated with unpredictable changes in the ecosystem and climate (Nepal, Ministry of Environment 2010; Regmi *et al.* 2016).

Rasuwa district is located in central Nepal, bordering the Tibet Autonomous Region of China to the north (Figure 3.29). Its elevation ranges from 614 to 7,227 masl. The hugely varied territory and rich natural resources – such as the alpine lake Gosaikunda (4,380 masl), Langtang Valley and a number of hot springs –make Rasuwa a famous tourist destination in Nepal.

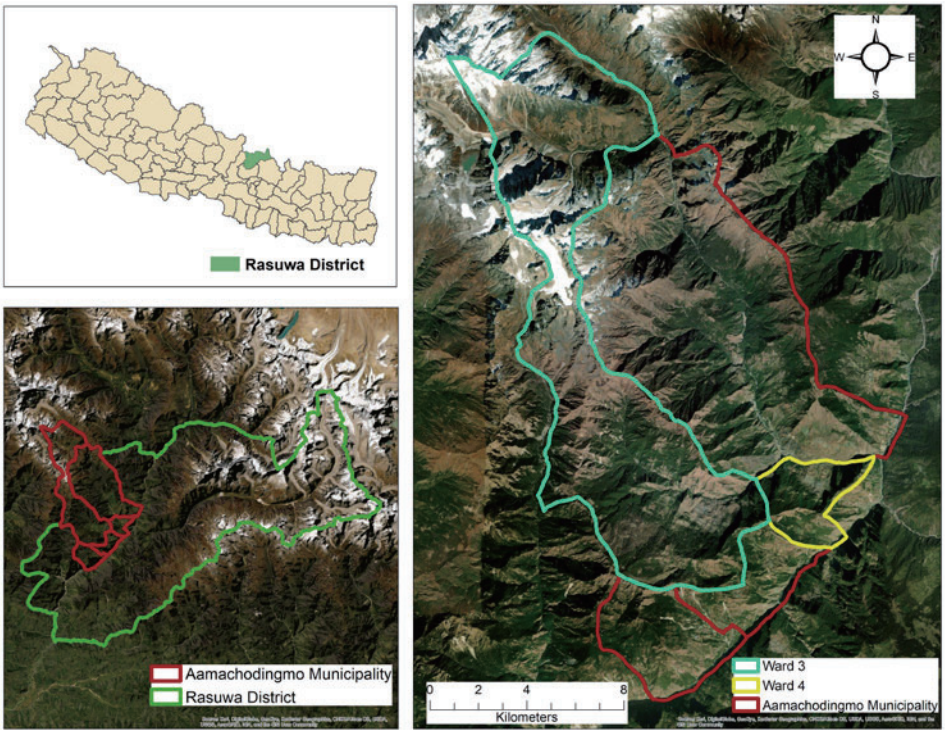
There are various agroclimatic zones in the area, ranging from subtropical to alpine and tundra. Forest covers over 31 per cent of the total area; agriculture and grassland – the main basis of local livelihoods – account for 6 per cent. Due to the high altitude, about 17 per cent of the total area is always covered in snow, which is also the perennial source of water that feeds Trishuli and other rivers.

Rasuwa district has five rural municipalities with a total population of 43,300. One-third of its population lives in poverty. They are mostly small landholders, practising agriculture and farming livestock such as cows, yaks and goats. In addition to steep slopes making cultivation challenging, poor infrastructure (including means of transport) and climate change challenges in Rasuwa have

also hindered its social and economic development. As an example, only half of the villages in the district are connected to roads, and most of them are gravel or earthen roads.

Thanks to the high mountains in the area, Rasuwa district is prone to natural disasters – including landslides – that cause damage, financial losses and even fatalities. In April 2015, an earthquake took place and, together with its aftershocks, triggered around 25,000 landslides in the region (Pokharel and Thapa 2019). More than 1,000 households were severely affected in Rasuwa (Shrestha *et al.* 2016). Other extreme events exacerbated by climate change, such as excess rainfall, longer periods of drought, and flooding are also experienced by the site, and these can cause glacial lake outburst floods that damage irrigation systems, roads and many other facilities (Regmi and Hanaoka 2011). People have experienced increased temperatures, more intense windstorms and landslides, and a rise in plant diseases in recent years, with some also suffering from crop production losses as a result of extreme weather events.

Figure 3.29 Rasuwa district and Aamachhodingmo Rural Municipality sitting in the mountain range. Prepared by Sheila Ghimire



Ecosystem-based Adaptation strategies and interventions

Nepal has established a set of forward-thinking climate policies and plans and adequate institutional architecture to ensure adaptation planning, in line with the United Nations Framework Convention on Climate Change and the Kyoto Protocol. For example, Nepal has drafted a National Adaptation Programme of Action and Local Adaptation Plans for Action, recognizing the causes of the country's high vulnerability to climate change: namely fragile topography, deforestation and eroded soils (Mishra *et al.* 2019).

Along with the existing overarching governance structure, different programmes and projects have been launched to strengthen climate change adaptation capacity in Nepal by focusing on site-specific vulnerability. Strategic Nature-based Solutions for Ecosystem-based Adaptation (EbA) have been widely piloted at different sites. These EbA projects, such as the Ecosystem-based Adaptation through South-South Cooperation (EbA South) funded by the Global Environment Facility and executed by UNEP and IGSNRR (see www.ebasouth.org), and the Mountain EbA Flagship Programme led by the Instituto de Montaña and IUCN (see https://mountain.org/where-we-work/mountain-eba/), provide a set of lessons on interventions such as planting mixed-use trees for ecosystem restoration and land rehabilitation, conserving water sources and diversifying livelihood options (Mills *et al.* 2020; Fu *et al.* 2021). Building on the above, a Mountain EbA project was implemented in Rasuwa district between 2017 and 2020 as a scaling-up initiative.

The project disseminated the EbA approach to strengthen resilience, reduce disaster risks and improve adaptive capacity in these mountain regions, aiming to help build support for EbA approaches in mountain areas, both on the ground and in national and international policy. It attempted to increase local capacity to replicate successful approaches, build evidence and share knowledge on EbA, and inform local, national and international adaptation plans and policies.

Figure 3.30
Farmers preparing nursey beds during the training course.
© Rai, A.

Source: Instituto de Montaña 2020

Training events on various topics including disaster risk management, ecological agricultural technology and tourism were provided in remote mountain villages. For each pilot village, training focused on specific activities that were designed and planned by means of a participatory process. In Tatopami, for instance, villagers sought sustainable ways to make a living while conserving their ecosystems. To cope with the impacts of the earthquake in 2015, the alternative livelihoods of cultivating, conserving and selling valuable medicinal plants were identified as a high priority for a possible profitable income. Paris polyphylla (known locally as satuwa), used for pain relief, as an antispasmodic drug or for treating poisonous snake and insect bites, had the most interest and was subsequently chosen. An expert from MANEKOR Society Nepal provided a two-day training session on medicinal and aromatic plants to local farmers via both theoretical and practical sessions. Key topics covered the importance of medicinal and aromatic plants, the different types, cultivation and conservation, and sustainable methods for planting, harvesting, storage and seed collection. With technical support and expertise, farmers built a demonstration nursery with five nursery beds on a terrace using locally available tools and materials such as forest soil, sand and wooden planks (Figure 3.30). About 1,500 satuwa rhizomes were transplanted in the five nursery beds. From these practices, a medicinal plant's farmers group was established and will serve as a monitoring and support team in the village.

Livelihood Capitals and Outcome

The case study site was Aamachongdingmo Rural Municipality (wards 3 and 4) in Rusuwa district (Figure 3.29). A total of 43 households were selected and interviewed in October 2019, 25 of which participated in the Mountain EbA project and other development projects (e.g. livestock raising). The case targeted the poorest and most marginalized group at the site – the Tamang Janajati indigenous group. They were tightly linked to local natural resources and were key to conserving mountain forests and watersheds.

The overall education level in the municipality was low, with about half the population being illiterate according to key informant interviews. The situation was only slightly better among those surveyed, with 20 per cent of villagers not being able to read and write. Only 25 per cent went to high school, receiving fundamental education and learning skills. Accessibility to public infrastructure and services was similar between participants and non-participants, with 60 per cent enjoying access to paved roads, health care, tap water, a market, a temple, a primary school, a junior high school and a kindergarten. Access to irrigation facilities, nursing homes for the elderly and garbage collection points was poor.

Natural, financial, and social capital differed quite significantly between the participant and non-participant groups (Table 3.6). In general, natural capital, as reflected by land size, was much higher among participants than non-participants. Many more participants than non-participants had a bank account, an indicator of inclusive finance. The proportion of households that had joined cooperatives and community organizations was much higher among participants than non-participants.

Table 3.6 Natural capital, financial capital and social capital at study sites

	Participant (N=25)	Non-participant (N=18)
Natural Capital (ha per household)		
Paddy field	0.46	0.72
Other farmland	0.42	0.5
Forestland	0	1.12
Financial Capital (%)		
Bank account	50	25
Credit card	0	4
Loan	10	5
Social Capital (%)		
Genealogy	4	0
Cooperative	48	30
Community organizations	70	50

Most villagers actively engaged in both on-farm and off-farm business; participant households showed stronger interest in the latter, with about 80 per cent involved in off-farm business, double the figure for non-participants. Off-farm business – mainly tourism and other investments – had the highest economic value. However, agriculture still played an important role in securing food and a stable income for the majority; 90 per cent of products like green vegetables and fruits were consumed at home. In particular, people grew diversified crops, including corn, rice, wheat, barley, potato, soybean, beans, millet, vegetables and flax, and more households went to market to sell agriproducts. The participant families' agricultural income excluding grains and cash crops based on natural resources was one-third more than that of non-participants.

The average income per household in 2018 for the participant group was US$ 1,310, slightly higher than the amount for the non-participant group (US$ 1,115). However, their earnings were far from sufficient in the current context. Expenses were more than four times higher than income, with money spent on education (the biggest cost) and other necessary investments, such as health care, food and drinking water, social events and house equipment. People had to take out loans from banks, cooperatives or relatives to balance their household expenses. This led to an opportunity to improve the availability of education and other public services to reduce their social costs and therefore improve quality of life.

Meat, eggs, green vegetables, fruit and dairy products were the main foods consumed by both groups. In addition to the fruit and vegetables villagers grew themselves, other high-protein foods were purchased from the market and consumed less than twice a week.

Hydropower was the main source of energy in Rasuwa district, providing electricity to 70 per cent of households, but firewood and liquefied petroleum gas remained the primary sources of energy for cooking. Participants showed more interest in replacing firewood with cleaner energy than non-participants, with an increased number of households using liquefied petroleum gas. A small number of participant households had also started to use biogas.

Lessons: joint initiatives for capacity-building

This case study engaged the poorest sectors of society and showed that ecosystem-based development interventions can help improve people's livelihoods by diversifying their options and engaging marginalized groups. This suggests that Rasuwa could be a potential site to scale up the EbA interventions to help communities living in mountainous areas to become more resilient.

The training provided on ecosystem-related knowledge and plant conservation as an alternative livelihood did not generate any direct economic benefits at the study sites. Other socioeconomic and environmental factors making the communities vulnerable should be improved, including human and physical capital and in particular access to education, health care and water. Future actions could involve providing training and knowledge on how to protect the ecosystem to better adapt to climate change and unpredictable disasters such as landslides.

Given the high rate of poverty, the EbA approach alone cannot address the entire issue. It should therefore be used alongside other livelihood improvement initiatives to directly tackle the underlying obstacles hindering access to social benefits such as education. There is also a need to emphasize information and knowledge management to allow poor and vulnerable households to access information and technology in order to adapt. Local, national, regional and international actors and agencies need to perform collaboratively to devise policies and establish knowledge- and technology-sharing mechanisms to enhance capacity.

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CASE 8

Organic farming for sustainable agriculture in north-east Thailand

Farm fields in north-east Thailand © Yanyong Inmuong

Facts

Location:
Na Khu district, Kalasin Province, north-east Thailand

Ecosystem:
Mountain

Communities:
Sai Na Wang community

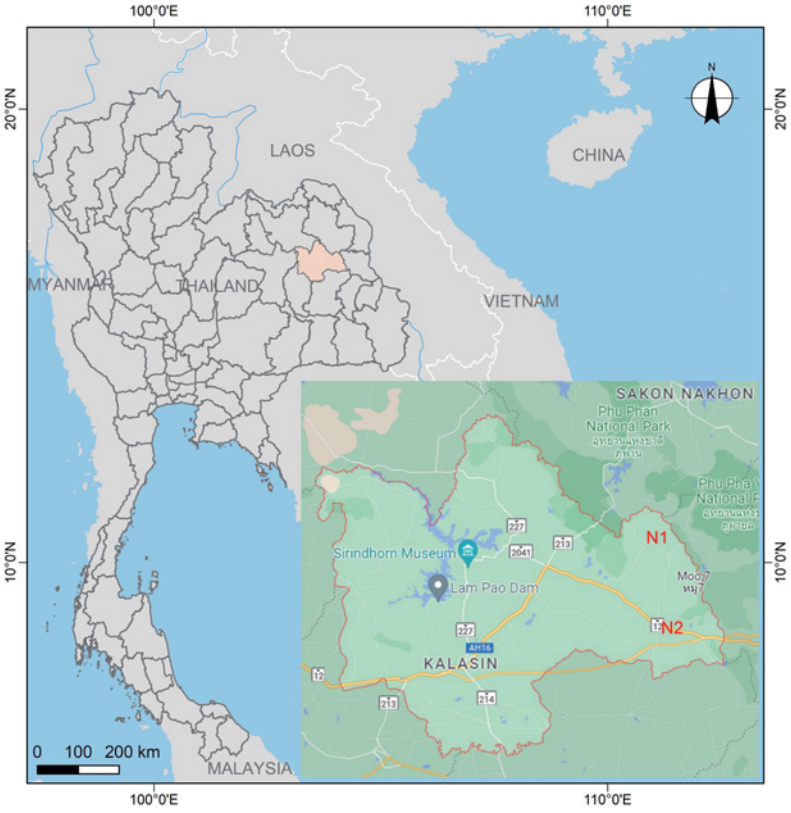
Sustainable Development Goals involved:
1 No poverty; 5 Gender Equality; 13 Climate Action

Background

Rice is a key food crop in Thailand, involving 3.55 million households of rice farmers (Flammini *et al.* 2014). It makes up a significant share of the global market, with more than 50 per cent produced for export (Ngammuangtueng *et al.* 2019). Kalasin Province in north-east Thailand is a typical rural and agricultural province sitting in the Lower Mekong River Basin. More than 70 per cent of the area is agricultural land dominated by paddy fields (Chailangka 2018; National Statistical Office of Thailand 2022). However, Kalasin Province is among the poorest in Thailand. One major challenge in the area is that households are highly dependent on selling rice and other cash crops including cassava, para rubber and sugarcane, which are linked to fluctuating market prices and erratic weather conditions. They also face ecological degradation and climate change consequences.

The north-eastern part of the province is characterized by forest-covered highlands adjacent to the Phu Phan mountain range (Figure 3.31). Since the 1960s, much of the forestland has been converted to cropland, in particular for sugarcane, para rubber and cassava. For example, Pa Dong Moo – a deciduous vegetation community of an area of 48 ha – exploited the land until 2010, when the government established a conservation programme to restrict its use to nature conservation only under the administration of the Royal Forest Department. Deforestation and commercialized cropland farming lead to soil degradation and water shortages, which further affect rice productivity. As a response, some farmers in hilly areas started to intercrop the upland rice with more cassava and sugarcane, and some started to transform their farmlands into integrated farming, growing mixed crops and raising animals.

Figure 3.31 Location of the two study sites in the north-eastern part of Kalasin Province: N1 - Kud Ta Klai Pattana village, Sai Na Wang subdistrict, Na Khu district; N2 - Nako Moo 2 village, Nako subdistrict, Kuchinarai district. Adapted based on sources: GMS Research Center for Environment and Sustainability, Faculty of Environment and Resource Studies, Mahasarakham University; Google Earth 2020.



Affected by regional and local climate change in recent years, many farmers have lost their agricultural products. The area has experienced temperature rises, more intense rainfall, prolonged droughts and other climate change consequences (Artlert, Chaleeraktrakoon and Nguyen 2013; Sritongtae *et al.* 2021). The Mekong River Commission documented that the temperature of the Mekong Basin was projected to rise, with an increase of between 0.3°C and 3.3°C each year by 2060 (Mekong River Commission 2017). The area will remain vulnerable to shocks, particularly droughts and floods in the near future (Artlert, Chaleeraktrakoon and Nguyen 2013; Mekong River Commission 2018). Heavier rainfall in the monsoon months and severe droughts in summer would reduce rice yields by 28 per cent by 2050 (Babel *et al.* 2011). Local farmers also noticed climate change in their rain-fed farming practices, as the cultivation regime was interrupted by delayed and erratic seasonal flooding.

Interventions: ecosystem-based organic farming

The Government of Thailand sets priorities to improve rice production practices and alternative options, including changing from rice to other crops or exploring other land use options to reduce the pressure on natural resources and improve farmers' quality of life (Ngammuangtueng *et al.* 2019). In other words, more efficient resource management in rice production is encouraged and alternative options are suggested for sustainable agriculture and to increase benefits for farmers.

Two development initiatives on nature conservation and organic farming (2011–2017) were introduced by government agencies and development partners and implemented by the Sai Na Wang Subdistrict Administration Organization and Community Sustainable Agriculture Group.

The first initiative, financed by the Ministry of Agriculture and Cooperatives, focused on integrated water management and ecosystem-based organic farming. Interventions included: 1) ponds for conserving and storing water for irrigation and raising fish and ducks; 2) integrated farming through the cultivation of mixed crops, vegetables, fruit trees, native chickens and pigs; and 3) no chemical use. About 22 pilot farmlands were established in the community of Sai Na Wang.

The second initiative, financed by the Ministry of Natural Resources and Environment and the Mekong River Commission, can be seen as a continuous intervention with more focus on capacity-building for farming practices to adapt to climate change. Interventions include the provision of training workshops on ensuring on-farm management of various water sources, composting animal manure, raising native animals, conserving and establishing native seed (genetic) banks, marketing organic products and more.

Livelihood capitals and outcome

Household surveys took place in 2019 in the Sai Na Wang community and the nearby Na Ko community (Figure 3.31). Fifty households were randomly selected in each village. About half of the households surveyed in Sai Na Wang were interested and involved in nature conservation and organic vegetable farming activities, while the majority of those from the Na Ko community had receiving training on household finances and management. For all groups, women were more active in terms of participation in the development initiatives (Table 3.7).

Table 3.7 Gender distribution between participating and non-participating households in two villages.

	Sai Na Wang community		Na Ko community	
	Participant	Non-participant	Participant	Non-participant
Female	53%	47%	54%	46%
Male	45%	55%	48%	52%

Participants owned rice paddies of a similar size to those of non-participants, but they owned much larger non-rice paddies than non-participants (Figure 3.32). Although all households shared similar physical capital with good access to public services, their durable assets indicated that their living conditions were different. Many more participants than non-participants had access to a cell phone, a motorcycle, a car, the Internet and a flushing toilet (Figure 3.33). Similarly, the average value of the house assets of participants was about 1.5 times that of non-participants in both communities.

Human capital, as measured by education, differed between the two groups. Compared to non-participants, the participants were more educated. This was particularly evident in Sai Na Wang, where many people (41 per cent) had graduated from junior high school and only 2 per cent were illiterate (Figure 3.34).

Participants were more likely to have a bank account and savings account than non-participants. However, the percentage of people who had taken out a loan was much higher among non-participants (Figure 3.35). Social capital, indicated by whether those surveyed had a family tree, was much higher among participants in both Sai Na Wang and Na Ko.

Figure 3.32 Land size between participants and non-participants

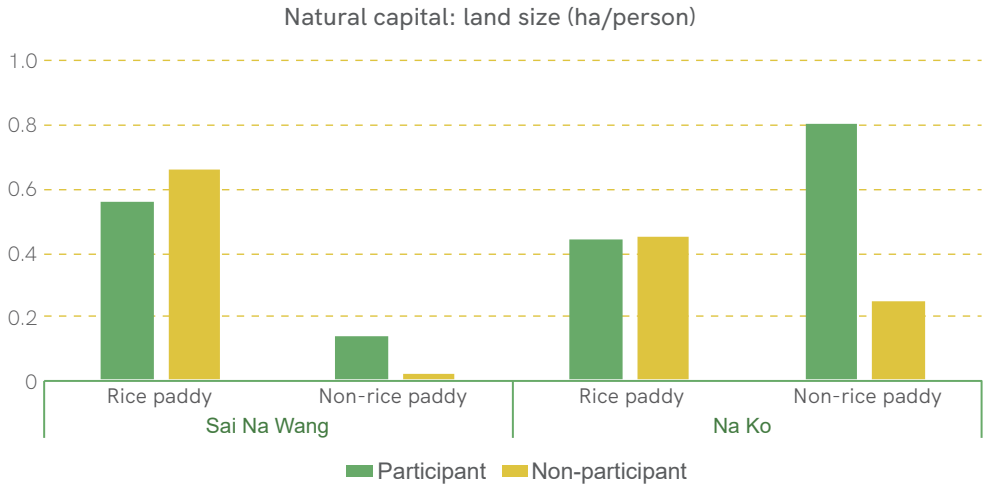


Figure 3.33 Living condition between participants and non-participants

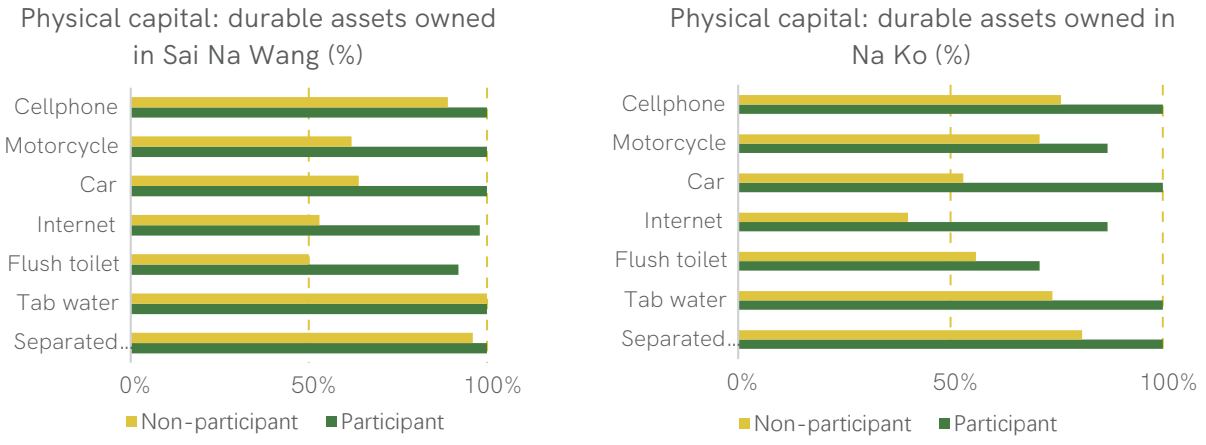


Figure 3.34 Educational attainment between participants and non-participants

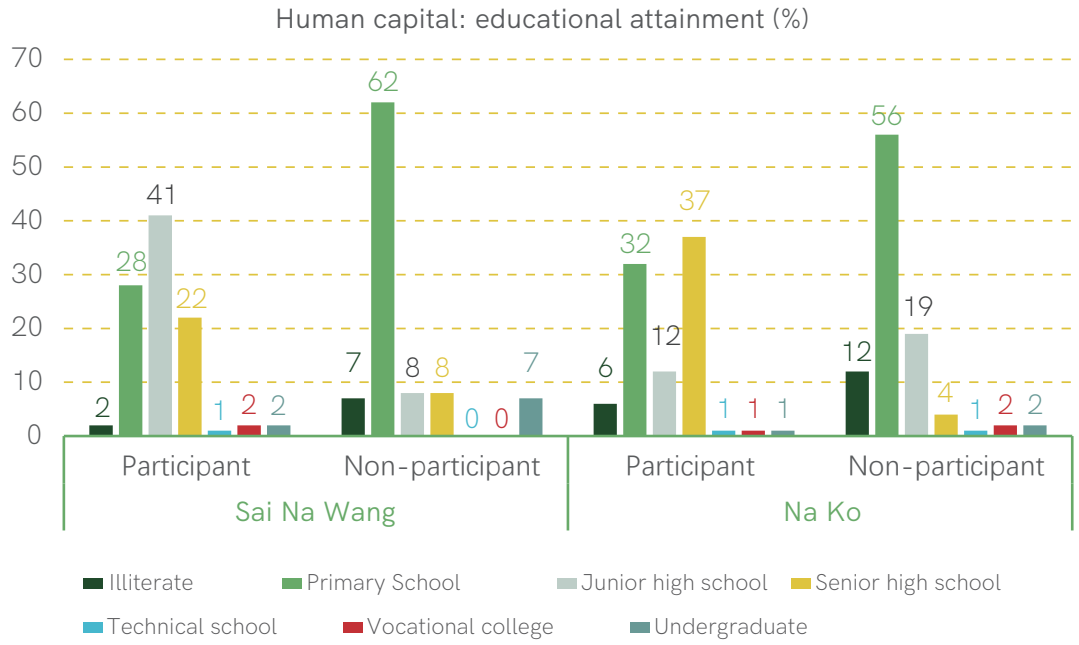
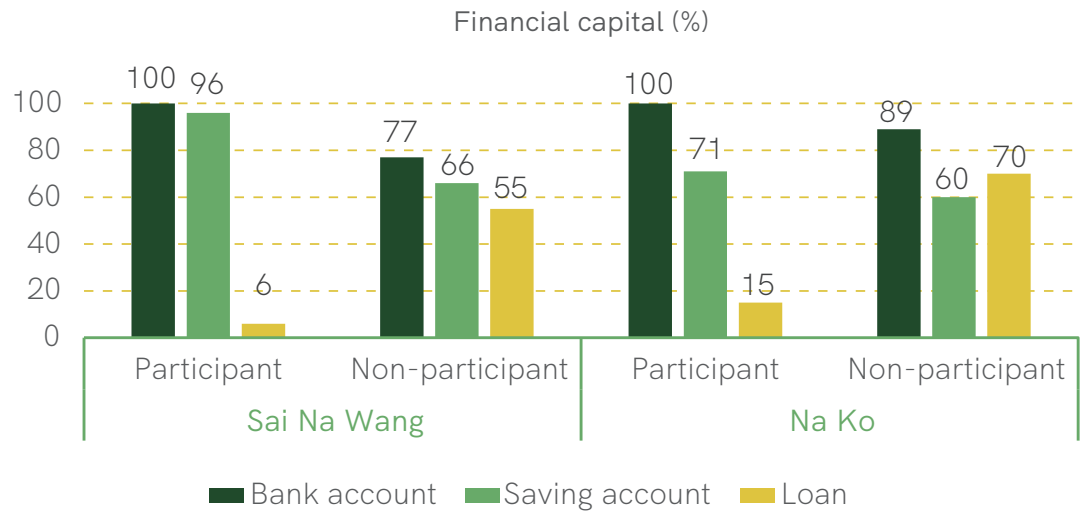


Figure 3.35 Financial capital of participants and non-participants



When measuring average family income, it was noticeable that the households that actively participated in the development activities earned about double the income of the non-participant households (Table 3.8). This large difference may be attributed to the increase in alternative options, the larger variety of crops and the sale of organic products. In Sai Na Wang, rice shifted from the dominant source of income to the secondary source, accounting for one-third of total income, and growing mixed organic crops and vegetables (such as corn, peanuts and beans) became the major contributor as selling these products to big city supermarkets generated higher economic returns. In Na Ko, rice remained the main source of income, but was less important for participants, for whom mixed crops and off-farm activity both provided more income than for non-participants. Families in Na Ko relied more on sugarcane and rubber than organic farming. Species variety also contributed to this difference in income, ensuring that Sai Na Wang gained wider market access and could then build resilience to changing market prices.

Table 3.8 Household income sources of the participant and non-participant groups in the two villages

	Sai Na Wang Participant	Non-participant	Na Ko Participant	Non-participant
Income (in 2018, US$)	5,185	3,205	8,333	3,475
Income sources				
Rice grain	32.25%	65.82%	43.63%	75.21%
Mixed crops	61.34%	32.02%	32.73%	14.27%
Off-farm and others	6.41%	2.16%	23.64%	10.51%

Both villages spent at least one-quarter of their income on agricultural production, but participant families in Na Ko spent more than double the amount spent by those in Sai Na Wang. This might be because cash crops of sugarcane and rubber require extra fertilizer compared to organic farming. Participants in both communities invested more in education, while non-participants spent the most on food and drinking water.

Most households used firewood and petroleum gas as their primary energy sources. From 2013 to 2018, participants from Sai Na Wang experienced a major shift from using firewood to gas, which then accounted for 71 per cent of their total energy use. Non-participants in Sai Na Wang and all Na Ko households surveyed remain the same, with firewood and gas being equally important energy sources.

This case in Sai Na Wang has demonstrated the success of the water-food-energy nexus, using integrated organic farming to reduce water use, enhance food security and promote clean energy.

Lessons: community participation and capacity-building

The implementing agencies have been largely working with community groups, village heads and local government leaders. Firstly, discussions and consultations were undertaken with community leaders to explore their needs and identify appropriate ways of implementing development activities. Secondly, different groups worked together on drafting projects and planning activities, which were widely shared with villagers for their comments and cooperation. Thirdly, as part of outreach activities, training events were provided to farmers on the topics of soil and water conservation, ecosystem-based farming practices, organic farming practices, organic product marketing, and financial and risk management of organic farming businesses. Involving villagers in the process in this way not only helps to increase motivation for participation, but builds villagers' capacity for sustainable agriculture in the long term too. It also results in increased human capital, as natural capital is used efficiently to achieve a better quality of life.

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3.3. Dryland

CASE 9

Community-based wildlife conservation in Maasai Mara, Kenya

Maasai people herding cattle. © Maasai Mara Wildlife Conservancies Association (MMWCA)

Facts

Location:
Maasai Mara, Narok County, Kenya, East Africa

Ecosystem:
Dryland

Communities:
Mara North, Olare Motorogi, Lemek, Naboisho, and Olderkesi

Sustainable Development Goals involved:
3 Good Health and Well-being; 5 Gender Equality; 15 Life on Land

Background

The Maasai Mara ecosystem is home to a wide range of mammal, bird and reptile species. It is the location of the greatest and most spectacular large mammal migration on earth and is the most highly visited tourist area in the East African region. It covers a land area of approximately 6,400 km^2, of which 25 per cent is the Maasai Mara National Reserve (a statutory protected area) (Figure 3.36). The remaining 75 per cent is either communal land or privately owned, mostly by Maasai pastoralists (Ottichilo 2000). Due to its arid and semi-arid ecosystems, crop cultivation is not feasible in a large part of the region, and the availability of high-quality pasture is highly variable across time and space. As a result, local people mainly earn their livelihoods from livestock and livestock products, complemented by the establishment of strong economic and social support networks, trade and wage/labour migration.

The coexistence of people and wildlife is a complex issue compounded by the changing lifestyles of local Maasai pastoralists (Green *et al.* 2019). Conflicts between humans and wildlife are widely recorded, with many cases of livestock depredation and property (e.g. fences and houses) being destroyed by wildlife. Occasionally, wildlife has also caused human injuries and deaths. There have also been feelings that human population

density had increased across the study area, which some people feared would lead to more cases of conflict between humans and animals, and even a resurgence in intracommunity competition for vital resources such as pasture and water. In addition, pastoralists have become sedentary in recent decades (Ogutu *et al.* 2009), and have invested in agriculture and livestock production, meaning the increased likelihood of interactions with predatory wildlife.

"The already high and still increasing human population puts more pressure on the conservancy land. There is a high human birth rate here. More permanent and semi-permanent houses are being built in the human settlement zone of the conservancy. This will lead to more contact between people and wildlife" (Key informant 12, male, Lemek. Source: Oduor 2020).

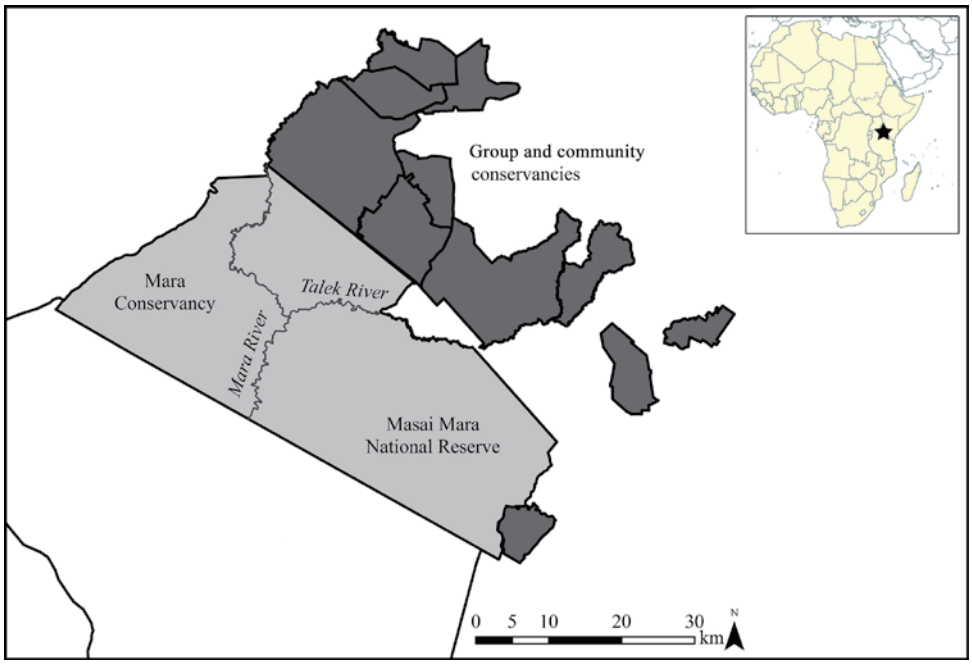
The projected trends in climate and environmental changes are expected to cause a reduction in the amount and quality of the pasture and water available to livestock. From 1965 to 2015, the frequency of severe droughts increased and floods intensified in the Mara. When droughts and floods persist over several years, outbreaks of infectious animal diseases and reduced vegetation quality can be expected (Bartzke *et al.* 2018). These impacts add another threat to human-wildlife conflict.

Governance and interventions: community wildlife conservancies

Community-based wildlife conservation (CBWC) programmes have set a new paradigm for protected areas with strong involvement of local communities by giving them ownership rights or custodianship and management responsibilities over wildlife, and promoting the social and economic benefits of resource conservation.

In Kenya, CBWC programmes exist in the form of group or community wildlife conservancies that cover approximately 10 per cent of the country's land surface area (Kenya Wildlife Conservancies Association 2016). A group conservancy is established by multiple individuals who own contiguous parcels of land. These individuals lease out parcels of land voluntarily (typically for 15 years) to a registered company that then manages wildlife on the land and generate revenue from ecotourism (such as wildlife viewing, camping and balloon safaris). The revenues are used to fund conservancy operations and compensate landowners. In contrast, a community conservancy is established on communal land where local inhabitants have a right to use the land but no exclusive individual rights of ownership (Kenya Wildlife Conservancies Association 2016). Presently, there are 26 groups and 76 community conservancies in Kenya, most of which were established on lands adjacent to statutory protected areas (Kenya Wildlife Conservancies Association 2016). Such wildlife co-management is welcomed by many local households as a strategy for coping with poverty.

Figure3.36 Community conservancy and national reserve in the Maasai Mara ecosystem. Adapted from Green *et al.* 2019.



In the Maasai Mara ecosystem, the conservancies were established on lands that previously served as cattle ranches (Kenya Wildlife Conservancies Association 2016). The common livelihood activities permitted within a conservancy include the collection of firewood, medicinal plants and honey for subsistence use. These rules are enforced by conservancy leaders, who are accountable to conservancy landowners. The leadership of the conservancies comprises a management board made up of elected representatives of landowners and directors of tour operator companies that run tourist facilities within the conservancies.

Several measures were implemented to minimize the costs associated with living alongside predators by providing direct or indirect benefits. These include: 1) financial management schemes such as compensation, insurance, and economic development incentives; and 2) the fortification of livestock management practices such as livestock guarding and the use of deterrents. The Mara North conservancy, for instance, has adopted a scheme to compensate conservancy landowners for livestock lost to wildlife and, according to an informant, has built an electric fence around a local primary school to protect pupils against potential wildlife attacks.

Livelihood capitals and outcome

Surveys were conducted in a random subset of five wildlife conservancies out of the 16 within the Maasai Mara ecosystem in Narok county, Rift Valley Province, Kenya, to assess perceived changes in the livelihood capacities and assets possessed by individuals and households, and to analyse the impacts of CBWC programmes on the well-being of the local people. These conservancies were Mara North, Olare Motorogi, Lemek, Naboisho (all group conservancies) and Olderkesi (a community conservancy). Numerous aspects were perceived positively in relation to participation in wildlife co-management; the most significant covered financial, social and natural capital (Oduor 2020).

Financially, the generation of income increased thanks to gainful employment and new business opportunities. Members of all four group conservancies (Lemek, Mara North, Naboisho and Olare Motorogi) earned extra income by leasing out parts of their landholdings for wildlife conservation. Some landowners from Mara North and Naboisho revealed that they used land lease agreements as collateral to secure bank loans of up to 800,000 Kenyan shillings (around US$ 8,000) which allowed them to pay school fees and medical bills, and supported them during emergencies. It is also noted that people earned tourism-related income by selling art and craft items and providing cultural services to tourists. The conservancies also created new work opportunities. Lemek employed 19 people, Olare Motorogi 25, Mara North 35, and Olderkesi 26, with locals working as administrators, clerks, rangers, community liaison officers and land mapping officers with stable monthly salaries (Figure 3.37).

Socially, improved social relations and reduced gender inequity became evident. Local communities had historically practised patriarchal land inheritance, so women were banned from owning land. Some conservancies endeavoured to address this form of elite capture of resources by starting women's empowerment enterprises and involving women in conservancy leadership and benefit-sharing schemes. For example, women representing over 100 households in the Naboisho conservancy started a microfinance scheme, while in the Olare Motorogi conservancy, women from over 430 households began the Maa Trust women's beadwork project.

"Mara North has a 15-member board of management with five women. Four of the women sit on the landowners' grazing committee that allocates grazing rights to conservancy landowners" (Key informant 13, male, Mara North. Source: Oduor 2020).

The saving of cash in cooperative societies, as opposed to traditional savings in the form of livestock, helped households to cope with uncertainties brought about by periodic droughts, which often damage livestock populations.

Furthermore, the Lemek conservancy issued a policy that entitled women to be conservancy landowners under certain conditions, allowing women to receive some land-leasing compensation.

Naturally, regulating livestock grazing in conservancies was the first step in allowing this magnificent landscape and its wildlife to recover; it helped to enhance access to pasture and conserve soil by minimizing the occurrence of bare ground. In Lemek, Mara North and Olderkesi, people have observed a significant increase in forest and wood coverage in recent years, which has increased the availability of wooden poles used for construction. Regular patrols by conservancy rangers have also helped to control deforestation.

Nevertheless, human-wildlife conflict has remained an issue for local communities, who reported that the cost of conflicts has increased in some areas in recent years due to the increase in population density and lifestyle changes. Pastoralist settlements and tourism infrastructure might have a negative effect on the ecosystem. Other concerns include the capturing of resources by the local elite and the inequitable distribution of conservancy-related benefits.

Lessons: inclusiveness and integration for co-management

The CBWC programmes operate in complex socioecological systems with diverse stakeholder groups living alongside predators. By sharing the rights and responsibilities of managing and conserving natural resources, local communities can benefit socially and economically. This case in the Maasai Mara suggests that participation in wildlife co-management has great potential to improve local livelihoods.

The principles (Lockwood *et al.* 2010) of legitimacy, inclusiveness and integration are shown to be important for good governance in wildlife co-management in the Mara North, Lemek, Naboisho and Olare Motorogi conservancies. The selection of office representatives to conservancy management boards was considered largely free, open and transparent. Landowners also elected committees to represent them in negotiations with conservancy leaderships. Management boards held annual general meetings with landowners to discuss matters concerning the conservancies. Landowners are involved in decision-making as the main stakeholders along with the leaders of the conservancies. One of the most significant changes was improved gender equity when women started to engage in businesses and hold positions on committees.

However, the institutional mechanisms for sharing resources within the conservancies lacked transparency, accountability and fairness, and tended to favour those who were politically connected to conservancy leaders. This is likely to affect social solidarity.

Figure 3.37 Local residents working as rangers in the Maasai Mara. © MMWCA/William Sankau

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CASE 10

Women farmers' income security and resilience in Qinghai, China

Collective action to improve livelihoods in Qiaotou village, Minhe county, Qinghai © FSN

Facts

Location:
Haidong City and Xining City, Qinghai Province, China

Ecosystem:
Dryland

Communities:
Seven counties including Huangzhong and Ledu

Sustainable Development Goals involved:
1 No Poverty; 5 Gender Equality; 8 Decent Work and Economic Growth; 17 Partnership for the Goals

Background

The Yellow River-Huangshui River Valley is located on the north-eastern edge of the Qinghai-Tibet Plateau (Figure 3.38). With an arid and semi-arid climate, the region has transitional features, such as wet and dry seasons, low mountains and high plateaus, and a pastoral farming system (Wu *et al.* 2016). The social and cultural experiences are diverse, with the Han, Hui, Tu, Salar, Tibetan and Mongolian ethnic groups living in the region, where minorities account for almost half of the total population.

The region has a very fragile ecological environment, characterized by a shortage of water and degraded soil resources. Many local communities are vulnerable to climate change and frequent natural disasters such as droughts (Chen *et al.* 2021). Living off traditional agriculture and animal husbandry, people are now facing problems with environment degradation and a decrease in farmlands and grasslands, resulting in low crop yields and poor living conditions for farmers. Women, young people, people with disabilities and ethnic minorities are among the most vulnerable due to limited job opportunities and income sources.

Women in particular are indeed the main force in managing agriculture and natural resources, protecting agricultural biodiversity, and strengthening the resilience of the food system. However, they often face the challenge of not being able to equitably own, use and control production resources and having limited support in playing multiple roles in different organizations.

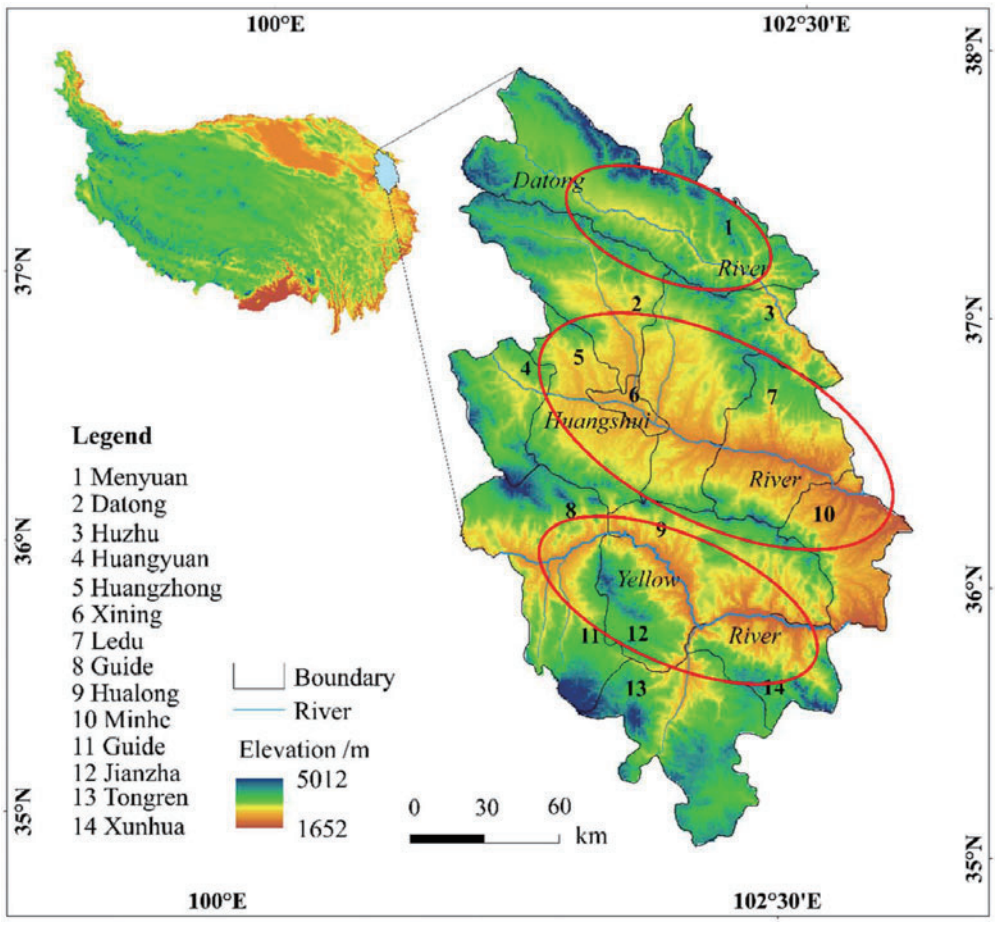
Interventions: strengthening women farmers' income security and resilience

The Strengthening Qinghai Women Farmers' Income Security and Resilience in a Changing Climate project (hereinafter the "Women Project"), funded by the Chanel Foundation and the United Nations Entity for Gender Equality and the Empowerment of Women, was implemented by UNEP-IEMP and FSN from 2018 to 2021 with support from the Qinghai Poverty Alleviation and Development Bureau and the Qinghai Women's Federation. The three-year project built on and complemented the Qinghai Liupan Mountain Area Poverty Reduction Project, which was funded by the International Fund for Agricultural Development (IFAD) and implemented by the Qinghai Provincial Government between 2015 and 2020, by further exploring the role of women in off-farm livelihood support and sustainable development.

Specifically, the Women Project was designed to promote poverty reduction among women farmers by helping them become more economically resilient in a changing climate. Measures and actions focused on improving their access to climate-resilient and productive assets, finance, tools, technologies, capacities and opportunities for moving up the value chain. It targeted the same area as the Liupan project, i.e. the most socioeconomically vulnerable communities in seven counties in the north-eastern part of Qinghai Province: Huzhu, Huangyuan, Huangzhong, Ledu, Hualong, Minhe, and Xunhua (numbers 3, 4, 5, 7, 9, 10 and 14 in Figure 3.38).

Throughout the Women Project, action was taken on three themes: gender awareness mainstreaming, financial knowledge for production and operation, and female leadership and cooperation.

Figure 3.38 Location and terrain of the Yellow River-Huangshui River Valley on the Qinghai-Tibet Plateau.



Source: Chen *et al.* 2021.

Firstly, Training of Trainers workshops were organized on gender awareness alongside ecological agriculture and market linkage, which covered more than 360 government officials and service providers including agricultural technicians mainly from the province and country levels. About 60 per cent of participants in this training were women. Farmers' field schools and other practical exchange events between farmers and villages were also organized.

Secondly, a series of training workshops on financial credit knowledge, e-commerce technology and other digital tools, and production and operation skills, were organized for income generation and off-farm employment, which were extended to a total of 2,358 female farmers and benefited their families (Figure 3.39). A field trip was also organized to conduct a market feasibility study and determine the entry points, opportunities and challenges for women farmers entering the market.

Third, capacity-building support for female leadership and cooperation was provided to help set up women's entrepreneurship funds and run women-led agricultural cooperatives. With expertise support, villagers demonstrated handicrafts and other products at domestic and international conferences and other occasions.

Figure 3.39 Experts teaching greenhouse agricultural skills in an agricultural cooperative in May 2019. © FSN

Livelihood capitals and outcome

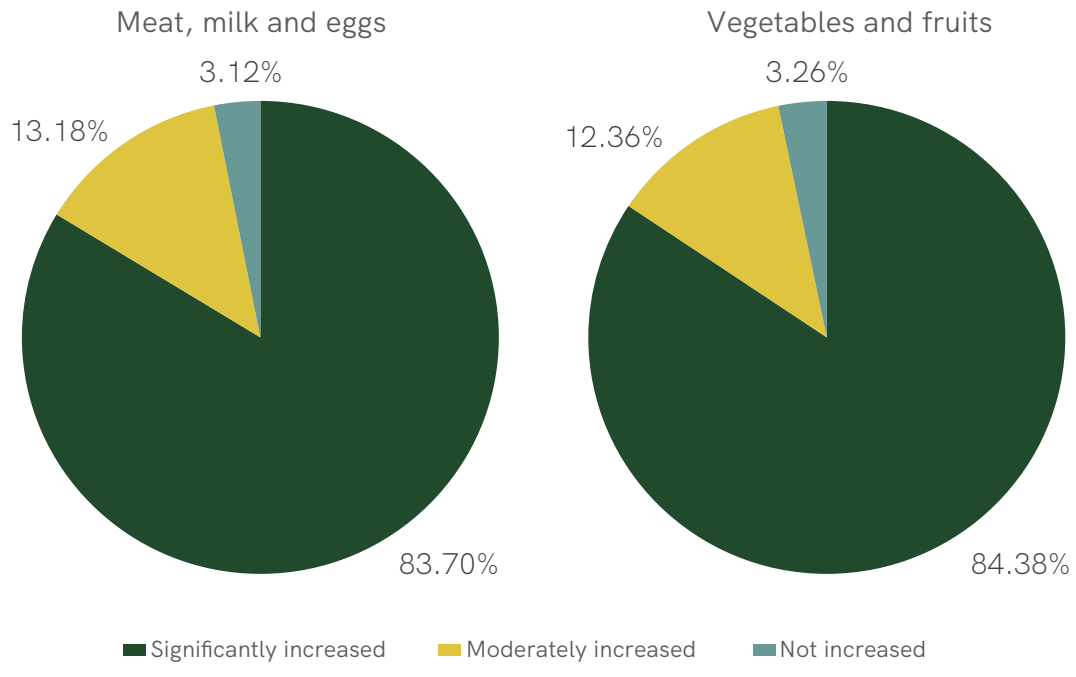
A survey with interviews was undertaken for the completion review of the IFAD-funded project in 2020. The survey included key informants at the provincial, county and village levels and 736 households across the project area. The survey indicated that 85 per cent of the households surveyed reported an average annual increase of 10,171 Chinese yuan in their household income since 2014 (IFAD 2021). Remarkably, the survey's off-farm livelihood component covered 90 households that received skill training and capacity-building support and confirmed the improved status of women's socioeconomic empowerment among project beneficiaries. Most women farmers had increased income security and adaptive capacity in facing climate and socioeconomic changes – including pandemics – after receiving the training and support. Gender equity and average household quality of life were also improved.

Income secured through diversified livelihoods

Women have been encouraged and motivated to participate in planting, farming and off-farm income generation activities. For farming activities, they were provided with training on advanced techniques such as the use of nurseries and breeding, and market information and linkage. The project helped women move up the value chain and develop local businesses with higher-value products. Among the respondents in the survey, women accounted for up to 58 per cent of the beneficiaries of income generation activities (IFAD 2021). Of those who participated in off-farm employment skills training, 74 per cent started wage-earning jobs such as housekeeping. Of the people who received business start-up training, about 84 per cent created their own business. Off-farm activities not only contributed significantly to their family income, but also reduced farmers' reliance on the ecosystems.

The quality of life of families has also been improved. In terms of food consumption, more than 80 per cent of farmers indicated that their monthly intake of vegetables, fruit, meat, eggs and milk has increased considerably (Figure 3.40). People also spent more money on renovating their homes, maintaining agricultural equipment and starting businesses.

Figure 3.40 Changes in food consumption.



Source: IFAD 2021

Gender equity

Through capacity-building activities, women's social capital and social status have improved. As well as women contributing more to family income, their voices were increasingly heard in decision-making activities. For almost all households surveyed, women were able to decide together with their husbands whether to apply for a loan and what to use it on.

Women's leadership and cooperation have been also strengthened. The Women Project tailored capacity-building to seven communities in three counties (Huzhu, Huangyuan and Minhe). Each of these seven villages that received capacity-building support has set up a women's association, mutual aid group or cooperative, with the number of members ranging from 25 to 100 people. These organizations provide a platform for women to share information and knowledge they have gained from training and advocate for gender awareness in the community. In addition, seven women-led enterprises were established with support from local government and external experts. Of them, four were agricultural enterprises including organic farming and animal husbandry, and three were non-agricultural enterprises, including housekeeping services and embroidery (Figure 3.41).

Increased access to financial services

The established and advanced agricultural cooperatives explored wider social networks and marketing opportunities for higher incomes for members. Training events on digital financing and e-commerce further promoted them to consumers and other partners. Zelin village in Huzhu county, for example, mobilized resources to develop an e-commerce industry. The village actively organized women to start local small businesses and open online stores, which effectively helped them out of poverty.

Increased adaptive capacity to climate and socioeconomic changes

The development of off-farm activities could help ease farmers' dependence on agricultural production and its impact on ecosystems. Together with the advanced production of agriculture and animal husbandry, they have improved farmers' abilities to withstand the changing climate and natural disasters.

During the COVID-19 pandemic, the implementing agency adapted quickly, establishing a remote communication and coordination system, including regular online meetings and thematic training through WeChat. Communities in pilot counties also adjusted their sale channels to online platforms by applying the e-commerce skills gained through the project to ensure stable income.

Figure 3.41 Embroidery business led by women farmers. © FSN

Lessons: women's empowerment and capacity-building

The interventions in counties affected by poverty in Qinghai not only brought financial benefits to families, but also promoted sustainable development with a strong focus on gender equity when facing contemporary challenges such as climate change and social crises.

Given more opportunities and access to training, information and organizations, women showed that them having an active role in agriculture and other businesses could help to secure and improve their families' income. At the same time, they gained equal rights in decision-making within the family and beyond. Women's associations and women-led enterprises cooperate and provide networks to help farmers become more resilient, learn new skills and participate more in public affairs.

The involvement of government and coordination among different departments and associations (including women's associations, agriculture and animal husbandry departments, and poverty alleviation offices) is required for effective implementation of initiatives. In this case, a cooperative mechanism was built by setting up a provincial project office, county-level project office and community-level implementation team.

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04

Key Findings

Comparison analysis was used to reveal the differences in livelihood capitals and outcome between participant and non-participant groups. However, it did not establish the causal-relationship between project interventions or governance and livelihood outcome. In other words, it did not explicitly explain project interventions or governance as the underlying causes for discernable differential livelihood outcome between the two groups. What's more, the analysis in each case did not measure the impacts of a particular intervention or governance implemented at the site. Rather, it reflects the change in status of villages under a bundle of interventions over a certain period. We thus tried to qualitatively analyse the impacts of major interventions at the site and, more importantly, how their livelihoods are affected. Generally speaking, we have seen the differences in livelihoods among the participant and non-participant groups, which indicate the positive effects of conservation interventions on the livelihood outcome of households in most cases.

The key findings from case studies are summarised as below:

1. Natural capital is a determinant and fundamental factor of household livelihoods, and human capital fills the knowledge gaps in enhancing sustainable livelihoods

Natural resources provide the base to support people's daily life. Vulnerability is greater in ecologically fragile areas such as high mountains. And the contemporary challenges such as climate change and environmental degradation caused by intensive human activities worsened the situation.

The increased knowledge and understanding of their living environment and adaptation strategies help improve communities' capacity to cope with these challenges. In other words, people with higher level of human capital can have more opportunities to access the market and be more innovative in using their natural capital efficiently and sustainably to achieve a better quality of life. Such human capital can be increased by securing education (at least high-school level) and informal learning methods such as training and exchange visits.

2. Diversified on-farm and off-farm income activities enhance household livelihoods and adaptative capacity to changes

Economic development accelerates a shrift from agricultural production to more diversified off-farm works. The off-farm income activities help families' dependence on natural resources. Also, better human capital in the studied cases often leads to better paid off-farm employment.

But food security needs to be paid equal attention when facilitating this drift. Reinvest off-farm income in diversifying farm work such as agrobiodiversity activity is also necessary. Diversifying livelihood options provide more reliable revenue, being independent of the fluctuating market price.

3. Community participation, inclusiveness, and cooperation among stakeholders are key for the success of implementing conservation interventions

The strong involvement of local communities through giving a leading role in decision making and executing activities encourages them to take ownership of the projects and therefore secures a long-term operation and sustainability. Youth, gender, and marginal groups should be all taken into account. Ensuring the involvement of both women and men as well as those from lower socio-economic backgrounds is crucial.

Social, environmental and community-based groups such as conservancies and cooperatives play critical roles in restoring, conserving and sustainably using lake ecosystems and agrobiodiversity for resilient livelihoods. They serviced as a mediator to bridge the international knowledge and goals with local communities.

Local, national, regional and international actors and agencies, both public and private, need to collaboratively devise policies and establish knowledge and technology sharing mechanisms to enhance the capacity.

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