Cluster Profile

Climate-Smart, Tree-Based, Co-investment in Adaptation and Mitigation in Asia (SMART TREE-INVEST) Project

Editors: Sacha Amaruzaman, Beria Leimona, Sonya Dewi, Betha Lusiana, Delia C. Catacutan, Rodel D. Lasco

World Agroforestry Centre (ICRAF)
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Cover images

- The landscape of Upstream Watershed in Buol District, Indonesia.
- Smallholder farmers working on their farm in Indonesia, Viet Nam, and the Philippines.

Photo: Arif Prasetyo, Beria Leimona, and Marita Biceno.

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PREFACE

Climate-smart, Tree-based, Co-investment in Adaptation and Mitigation in Asia (Smart Tree-Invest) is an action-research project conducted by the World Agroforestry Centre in Indonesia, Viet Nam and the Philippines from 2014 to 2017. Smart Tree-Invest aims to improve smallholders' resilience to climate and socio-political shocks using ecosystem services schemes through co-investment with others, particularly government and the private sector. This report is a synthesis of the preliminary research activities undertaken in Indonesia, Viet Nam and the Philippines in the first year of the project.

A deep understanding of landscapes is necessary for the development of such schemes in order to design programs that properly address the needs of smallholders, reduce their vulnerability and improve their livelihoods while at the same time contributing to the provision of ecosystem services.

In an effort to better understand the characteristics of clusters of villages and the smallholders within them, and to provide a basis for the development of co-investment schemes, the first year of activity of Smart Tree-Invest was focused on conducting baseline research in the three countries.

This report provides an overview of the clusters' characteristics in each country to improve understanding of the landscape conditions that have an impact on smallholders' vulnerability. Prior to discussion at the cluster level, brief overviews of the project sites in Indonesia, Viet Nam and the Philippines are presented.

During its first year, Smart Tree-Invest has produced information on general socio-economic conditions, drivers of land-use changes, hydrological conditions, biodiversity use, farmers' selection criteria and preferences for trees and annual crops, a shocks-exposures-responses-impact assessment, and a strengths-weaknesses-opportunities-threats analysis of the five types of livelihood capital.

Through a detailed understanding of the environmental, social and economic conditions that shape the resilience of the local communities in the clusters, we will develop recommendations to reduce smallholders' vulnerability and, in parallel, improve their livelihoods and environmental quality.

Last but not least, this cluster profile is a compilation of a series of reports that will serve as a basis for multiple stakeholders to further negotiate their responses to transform their livelihoods and landscapes that are more resilient to climate and socio-economic-political hazards. The documents are available in local languages and have been through a review process, as part of the dissemination and capacity strengthening process.

Smart Tree-Invest Team

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INTRODUCTION

Capacity Strengthening and Vulnerability Assessment for Smallholders' Tree-based Farming Systems in Asia

Sacha Amaruzaman, Beria Leimona, Sonya Dewi

Smallholders in tropical countries are vulnerable to shocks, such as changes in climate and the socio-economic-political situation that strongly influence their livelihood. Their vulnerability is mainly induced by their limited capacity to adapt to changes, by poor access to the different types of livelihood capital (financial, physical, social, human, and natural) that can improve their resilience, and by gender inequity that often adds to the vulnerability of women and children. Lack of buffering capacity at the household, community, and landscape levels is the main limiting factor to being resilient.

Vulnerability can be seen as context dependent, as the risks, shocks, and the ability to cope through the buffering and filtering of shocks varies between space, time, and even social groups (van Noordwijk et al 2011). The vulnerability scale varies from individual, household, community, landscape or region or system, and the characteristics of vulnerability are continuously changing over time.

In reducing vulnerability, improved local capacities to increase buffers should be a key priority. Climate-smart, tree-based agriculture can provide multiple functions to support smallholders' livelihood through agriculture production and therefore improve the buffering capacity at the household level at times of shocks. The tree-based agricultural landscape can improve the landscape buffering capacity through the maintenance of ecosystem services. Watershed function in particular can buffer the landscape during extreme rainfall events that can cause flooding and erosion. Agro-biodiversity and natural biodiversity can provide diverse sources of income and food in hard times during harvest or market failure.

Improvement of landscape capacity, including the capacity of local community that live in the landscape, to strengthen the buffer system is a crucial need to increase resilience. A framework and bundled tools have been developed to addresss the local capacity needs through the compilation of the knowledge from the scientific and participatory assessment, dissemination, discussion, and negotiation among multiple stakeholders. World Agroforestry Centre (ICRAF) have developed, tested, and applied CaSAVA (Capacity Strengthening Approach to Vulnerability Assessment) in Sulawesi, which has resulted in a series of conservation-livelihoods strategies and agreements among multiple stakeholders in the broad region of Sulawesi (Dewi et al 2012).

In the tropical, developing countries, smallholders cultivate tree-based agricultural practices as part of a landscape that provides various ecosystem services (ES). Since 2002, ICRAF has coordinated efforts to test and develop payment for ecosystem services (PES) schemes for incentivising smallholders to provide ES through their farming practices in Asia and Africa (Leimona et al 2015, Namirembe et al 2014). The lessons from the field show that smallholder involvement in providing ES—while simultaneously reducing their vulnerability by increasing their access to livelihood capital sources and co-benefitting from the ES provision—looks promising to achieve the dual goals of poverty alleviation and conservation. Based on such lessons, we frame payment for ES as co-investment mechanisms between smallholders (as ES providers) and external stakeholders (as ES beneficiaries). The schemes are shown to reduce vulnerability to climate change and provide an efficient and fair way of investing private and public rural development funds. Rather, co-investment by communities, governments, and businesses builds trust and shared responsibility for accomplishing the dual goals of improving livelihoods and maintaining environmental services. This is beyond the prescriptive understanding of payment for ES, which is commonly understood as a commoditising of ES, that is, a financial transaction for ES. For example, co-investment in the provision of ES could be in the form of private-public partnerships, where the private sector provides most of the income-generating and job-creating opportunities as rewards, which align to their adaptation strategies, facilitated by the government.

Smart Tree-Invest Programme

In 2014, ICRAF initiated an action research project called **Climate-smart, Tree-based, Co-investment in Adaptation and Mitigation in Asia (Smart Tree-Invest)** in Indonesia, Viet Nam, and the Philippines. The project runs from 2014 to 2017, with support from the International Fund for Agricultural Development and CGIAR Research Program on Forest, Tree, and Agroforestry. Smart Tree-Invest aims to improve smallholders' resilience to climate and socio-political shocks through co-investment in an ES scheme with the stakeholders, particularly with the government, private sector, and the NGOs. Gender perspective becomes a special focus in its framework as the project actively works with both female and male farmers. One of the ultimate outcomes of the project is policy transformations in the three targeted countries on how to mainstream tree-based agriculture in their policy-making process as these agricultural practices are often neglected within both the agricultural and forestry domains. Furthermore, it provides good case studies on how adaptation and mitigation to climate changes and shocks can be implemented on the ground by connecting relevant actors in a landscape contextually to the real conditions.

The action research site as a learning landscape

A deeper understanding of the landscape is essential to ensure integrated solutions in addressing the needs of smallholders, reducing their vulnerability, and improving their livelihood, while at the same time contributing to the provision of ES. Smart Tree-Invest applies a landscape approach, where the project sites are defined as clusters. Each cluster shares similar biophysical (i.e. farming systems, ES potential), anthropogenic (e.g. ethnicity, migratory status), and social characteristics, and can be beyond administrative boundaries. These clusters and their information are the media for action research and policy interventions resulting in lessons on best practices.

Table 0.1. Smart Tree-Invest Target, Activities, Objectives and Outcome

Outcome	Gender-specific knowledge for smallholders to cope with shocks and vulnerability	Livelihood benefit flows from community adaptation and mitigation actions to shocks and extreme events	Mainstream smallholders tree-based agriculture in adaptation and mitigation
Objectives	To assess female and male smallholders vulnerability and synthesise local knowledge that reduce vulnerability	To enable smallholders to apply climate-smart, tree-based adaptation and mitigation practices in collaboration with stakeholders as part of co-investment of ecosystem services	To integrate gender-responsive adaptation and mitigation and livelihood strategies into mainstream policies and programme
Activities	**Year 1: 2014-2015** **Baseline Research:** Capacity Strengthening For Vulnerability Assessment (CaSAVA)	**Year 2: 2015-2016** **Action Research:** Development of ecosystem services co-investment with the Government Working Group and other stakeholders	**Year 3: 2016 - 2017** **Policy Advocacy:** Mainstreaming the results of action research into policy: Workshops and meetings with the policy makers at the national and global levels to mainstream climate-smart, tree-based agriculture
Beneficiaries	Smallholder farmers	Local policy makers in Indonesia, Viet Nam, and the Philippines	National and global decision makers

As an effort to better understand the characteristics of a cluster and of the smallholders within it, and to provide the basis for the development of co-investment of an ES scheme, the first-year activities of Smart Tree-Invest were focused on conducting baseline research across the three countries (fig 0.1). By learning from other learning and by networking sites coordinated by ICRAF, the programme coordinates responsibility for providing technical assistance for climate-change adaptation and mitigation and building the capacity of stakeholders in linking local experience to policy dialogues at the provincial and national levels in each country. For example, at the Canadian International Development Agency (CIDA)-funded project in Southeast Sulawesi, a series of field tests in measuring vulnerability is already underway and coordination at the provincial and national level with Smart Tree-Invest has been made possible.

In particular for Smart Tree-Invest, close collaboration with IFAD project beneficiaries through intensive discussion and interaction is nurtured to ensure win-win solutions in designing and implementing the proposed programme. In Indonesia, partners include the Ministry of Agriculture through Rural Empowerment for Agricultural Development (READ) Programme in Central Sulawesi, Indonesia (2008–2014). In the Philippines, the partners have already engaged with the IFAD project of the Environment Management Project (INREMP) including the Provincial Government of Bukidnon, specifically, the Bukidnon Environment and Natural Resources Office, which facilitates the Bukidnon Watershed Protection and Development Council, a multi-sectoral body that recommends policy direction on matters related to watershed management in the province; Mt Kitanglad Department of Environment and Natural Resources Integrated Protected Area System and the Provincial Environment and Natural Resources Office, which facilitates the Protected Area Management Board of the Mt Kitanglad Range Natural Park; the Local

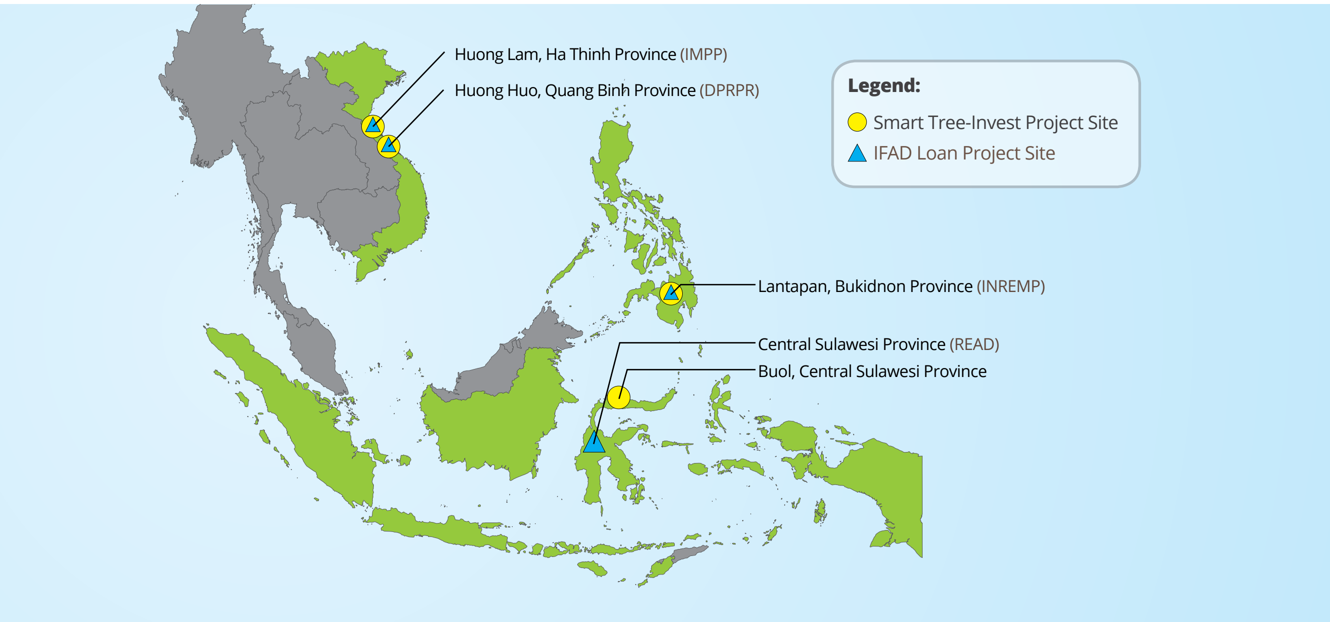

Figure 0.1. Location of Smart Tree-Invest in Indonesia, Viet Nam, and the Philippines

Government of Lantapan, which is currently implementing its Incentive-Based Policy Program, providing various incentives to smallholders and farmers' organizations who adopt sustainable farming systems; the National Power Corporation that generates hydroelectricity and supports 60% of Mindanao's power requirement; and the National Economic and Development Authority, which evaluates economic and development projects, including those related to the environment.

In Viet Nam, ICRAF have established partnerships and collaboration with two IFAD loan programmes; Improving Market Participation of the Poor (IMPP) in Ha Tinh Province (2008–2012) and the Decentralized Programme for Rural Poverty Reduction (DPRPR) in Quang Binh Province. The partnerships include the Ha Thinh Provincial Department of Agriculture and Rural Development that is responsible to manage and monitor forest, supervise agricultural and forestry extension, and implement the provincial climate-change response program; the Ha Thinh Provincial Department of Natural Resources and Management that is responsible to manage land administration and develop a five-year provincial land-use plan; the Provincial Payments for Environmental Services Steering Committee that coordinate the Payments for Forest Environmental Services (PFES) program; the Provincial Forest Protection and Development Fund (currently being established) that is designed to plan, monitor, and evaluate implementation of PFES in Ha Thinh; and the Ha Thinh Provincial Farmers Union, a civil society organization that operates from the central down to the village level.

In the first year, the project has carried out assessments on the vulnerability, local resilience, and landscape characteristics of the landscape at the project sites in the three countries. The project sites are summarised below.

Table 0.2. Overview of the Smart Tree-Invest Sites

Country, District - Province	Cluster site(s)	Landscape typology	Farming System
Indonesia, Buol - Central Sulawesi	1. Mangrove coastal 2. Buol Watershed (upstream and midstream)	1. Watershed 2. Coastal ecosystem	**Seasonal Crops** paddy, corn, vegetables **Tree-based** cacao, cloves, nutmeg, coconuts
Philippines, Lantapan- Bukidnon	1. Tugasan 2. Alanib 3. Kulasihan	Watershed	**Seasonal Crops** maize, sugarcane, bananas, pineapples, vegetables **Tree-based** coffee, eucalyptus
Viet Nam, Huong Khe – Ha Tinh and Huong Hoa - , Quang Binh	Ho Ho Watershed: 1. Huong Lam (upstream) 2. Huong Hoa (downstream)	Watershed	**Seasonal Crops** paddy, maize, green tea **Tree-based** acacia

Conceptual framework

Smart Tree-Invest applies the Capacity Strengthening Approach to Vulnerability Assessment (CaSAVA) research framework, developed by ICRAF (Dewi et al 2014). CaSAVA has been developed, tested, and applied by ICRAF in the earlier Agroforestry and Forestry Knowledge to Action (AgFor) project in Sulawesi, Indonesia. CaSAVA is not only applied for assessing the vulnerability and resilience of male and female smallholders, but also acts as a capacity strengthening tool that allows smallholders to reflect on their own local conditions. CaSAVA compiles multiple perspectives on the drivers, causes, and effects of ES problems. These perspectives come from local communities (female and male farmers), public (government, ES beneficiaries), and scientific communities (fig 0.2).

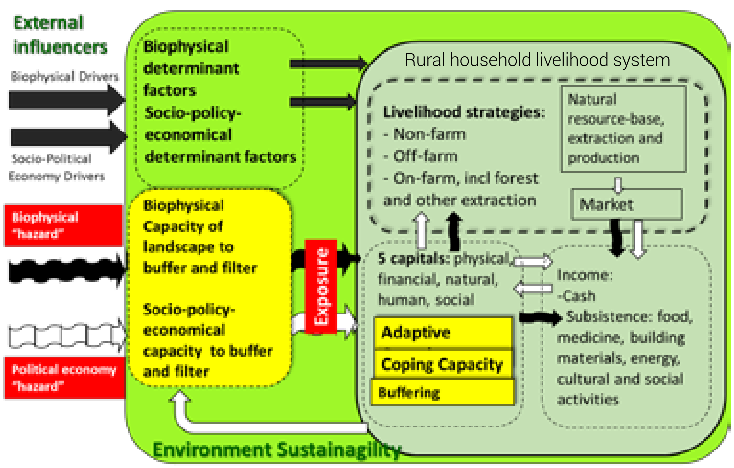

Figure 0.2. CaSAVA as a Vulnerability Assessment Framework

CaSAVA begins with assessing the role of landscapes at the targeted clusters with multiple functions providing ecological, social, and economic buffers against climate shocks. This includes analyses of climatic variability and trends over time that relate to climatic-shock hazards, as well as deepening the understanding

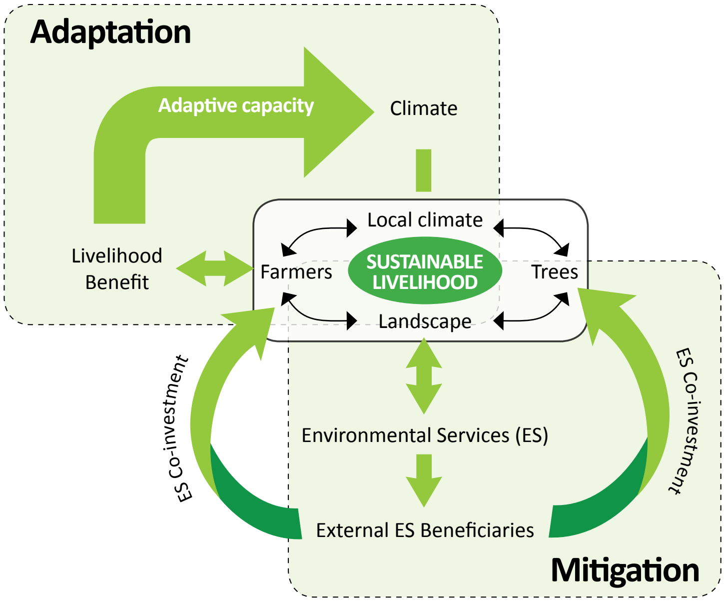

Figure 0.3. Climate-smart, tree-based agriculture contributing to adaptation and mitigation

of farming systems and their changes over time, particularly during years of harsh conditions, and the relationship to the provision of ES. Once vulnerable areas are identified, the team of researchers assesses local communities' vulnerability to climate risks (i.e. exposure, sensitivity, adaptive capacity). In doing this, it is important that the communities themselves identify the climate risks, which may include impacts on human health, livelihoods, and water resources. This also includes the assessment of social conditions and root causes of the communities' vulnerability and options for resiliency. These resiliency options are investigated by incorporating gender-based, local knowledge to reduce vulnerability and adapt to climate change, analysed as planned (long term) or reactive (short term), and at the landscape (community, externally driven) and individual (private, more autonomous) levels. Based on the results of the vulnerability and impact assessment, appropriate adaptation strategies (through a participatory approach to ensure broad-based 'buy- in') are developed as the basis for pro-poor, gender-equitable, ES business cases (fig 0.3).

The co-investment in landscape stewardship paradigm is focused on multiple livelihoods' assets and enshrines local resource management as the basis for contractual agreements between communities as environmental services' providers and their beneficiaries. Analysis of payments for environmental services' schemes in developing countries showed that the co-investment concept was an entry point for developing outcome-based schemes. The underlying reason is that co-investment involves flexibility of contract, broad sanctions, and general monitoring requirements. Operating with collectively or state-owned natural resources, it can include 1) negotiated tenure, conditional on maintenance of environmental services; 2) reduction of land-use conflicts and their collateral damage to environmental services; 3) investment in improved public services, such as feeder roads under community control; and 4) land-use and development planning which creates employment that does not damage environmental services. Finally, in close coordination with national policy shapers, policy-makers, and project/program developers, mitigation and adaptation strategies for local and national public and private sectors are supported.

Structure of the book

This book is a synthesis of Smart Tree-Invest baseline research on vulnerability assessment conducted in the first year of the project in Indonesia, Viet Nam, and the Philippines. Through a detailed understanding of the environmental, social, and economic conditions that influence the vulnerability of smallholders in the clusters, we can develop the proper co-investment schemes to improve their resilience and livelihoods, and, at the same time, enhance the provision of environmental services.

This book presents the information gathered from group discussions with female and male smallholders in eight clusters. More than 90 group discussions were carried out from June to September 2014, with approximately 1 000 female and male smallholder participants. The results then were enriched with the information taken from observation and the key informant interviews prior to the group discussion. The discussions were disaggregated between male and female smallholders to capture the specific perspectives of each gender.

The following chapters present detailed information in each landscape in the three countries. Each chapter mainly describes general socio-economic conditions, drivers of land-use change, hydrological conditions, biodiversity utilisation, tree-crops criteria selection and preferences, shocks-exposure-response-impact, and strengths-weakness-opportunity-threats analysis for the five livelihood capital types. The context of issues at each landscape shapes the extent of information presented in each chapter; thus, the focus and proportion of information may vary for each country.

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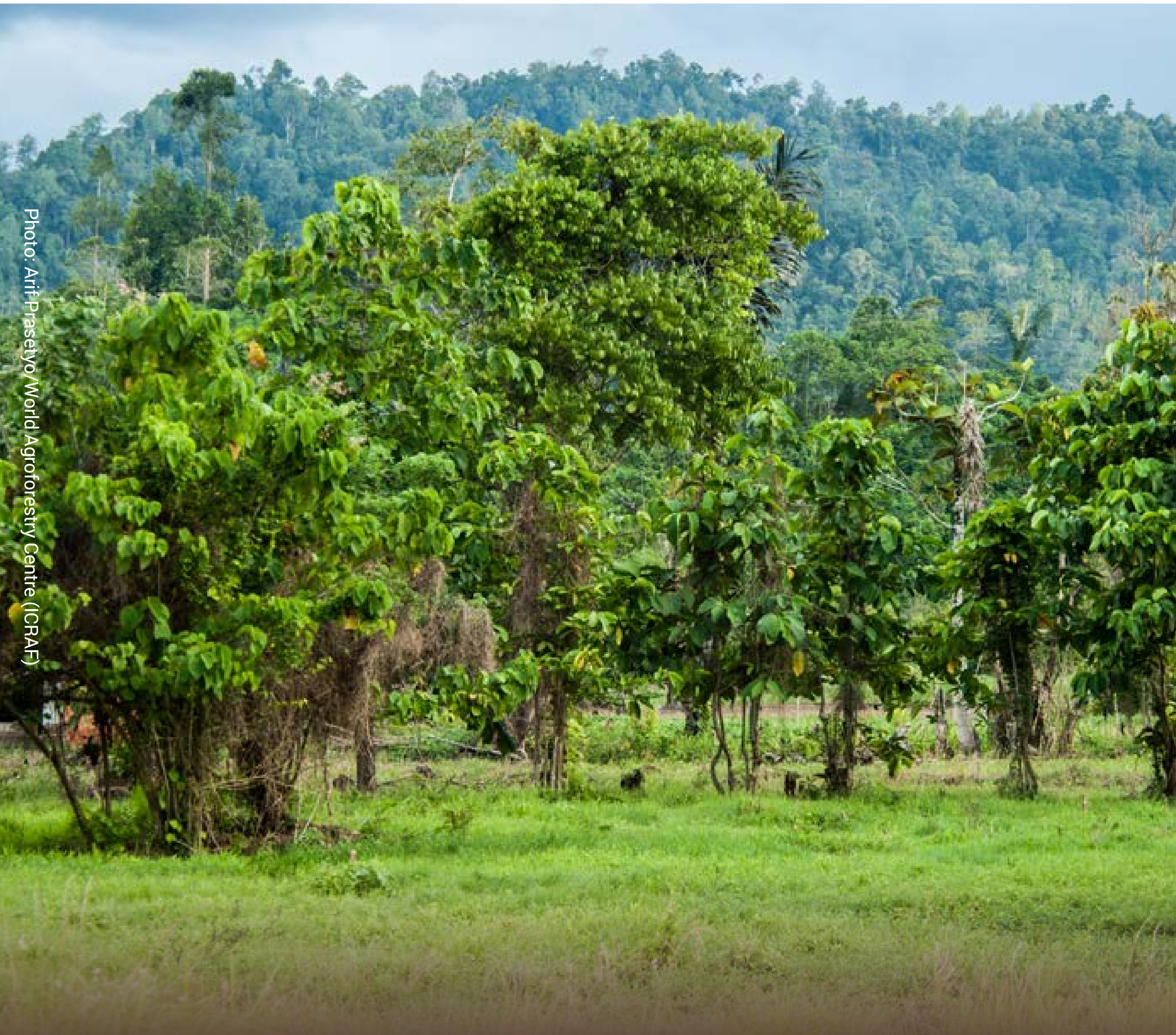
Photo: Arif Prasetyo/World Agroforestry Centre (ICRAF)

INDONESIA
CLUSTER PROFILE

1. BUOL

Lisa Tanika, Sacha Amaruzaman, Betha Lusiana, Chandra Wijaya, Elissa Dwiyanti, Rahayu Subekti

1.1 Buol District

Figure 1.1. Buol District location

Buol District in Central Sulawesi Province is located in the northern part of Sulawesi Island, with a total area of 4,043.6 km^2. Buol District consists of 11 sub-Districts (*kecamatan*) and is located between 0.35° and 1.20°N and between 120.12° and 122.09°E. In the north, Buol District is bounded by the Celebes Sea. Toli-toli District borders the western region while to the east and south lies the Pohuwatu District of Gorantolo Province. Parigi Moutong District also borders the southern region of Buol. (fig 1.1).

With a total population of 137,300, Buol has a population density of 34 persons per km^{-2}. The ratio of the non-productive population (0-14 years and above 65 years) to the productive population (15-64 years) is 69.84, which means that every 100 people within the productive age bracket will support approximately 70 non-productive people.

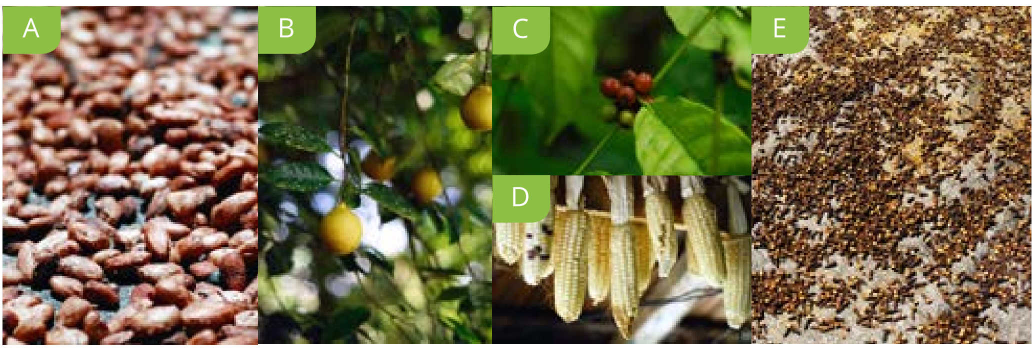

Figure 1.2. Main commodities in Buol District; (A) Chocolate, (B) Nutmeg, (C) Coffee, (D) Corn and (E) Cloves

Agriculture provides the predominant source of livelihood for the local community in Buol District, with the main commodities including coconut, chocolate, cloves, coffee, chili, paddy and seasonal crops. Alternative livelihood options available include public government officers, traders, plantation labour, agriculture day-labour, as well as fishing for the coastal residents. Many households have several livelihood options, such as working in mines and fisheries, to complement their farming activities.

Land-use land-cover change

Based on the spatial analysis of the total area of Buol District, 385,700 ha is dominated by secondary forest (70 percent of the total area), with the remainder complex agroforestry (12 percent) and palm oil plantations (8.6 percent). The secondary forest area is largely found in the mountainous areas at high elevations. Complex agroforestry can be found mostly at lower elevations, while villages and cultivated land are located in the northern part of Buol District on flat ground.

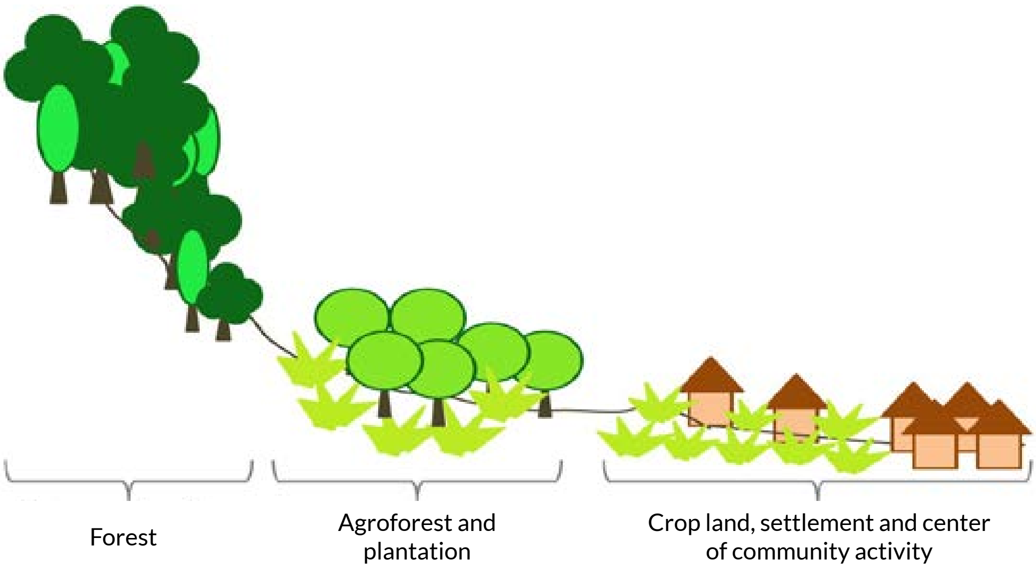

Figure 1.3. Characteristics of land-use land-cover in Buol District

Between 1996 and 2014, the most significant land-cover change in Buol District was a 14.5-percent decrease in high-density secondary forest and an 8.6-percent increase in oil-palm plantation area (fig 1.5). The high density secondary forest was mostly converted into low density secondary forest (3 percent), complex agroforestry (3 percent) and oil-palm plantation (6 percent in total) (fig 1.6).

Oil-palm plantation development can be traced to the mid-1990s, and by 1999, oil palm plantations represented 3.9 percent of the total land area in Buol District. In 2014, oil-palm plantation development has increased to 8.6 percent of the total area of Buol, mostly converted from secondary forest and complex agroforestry areas.

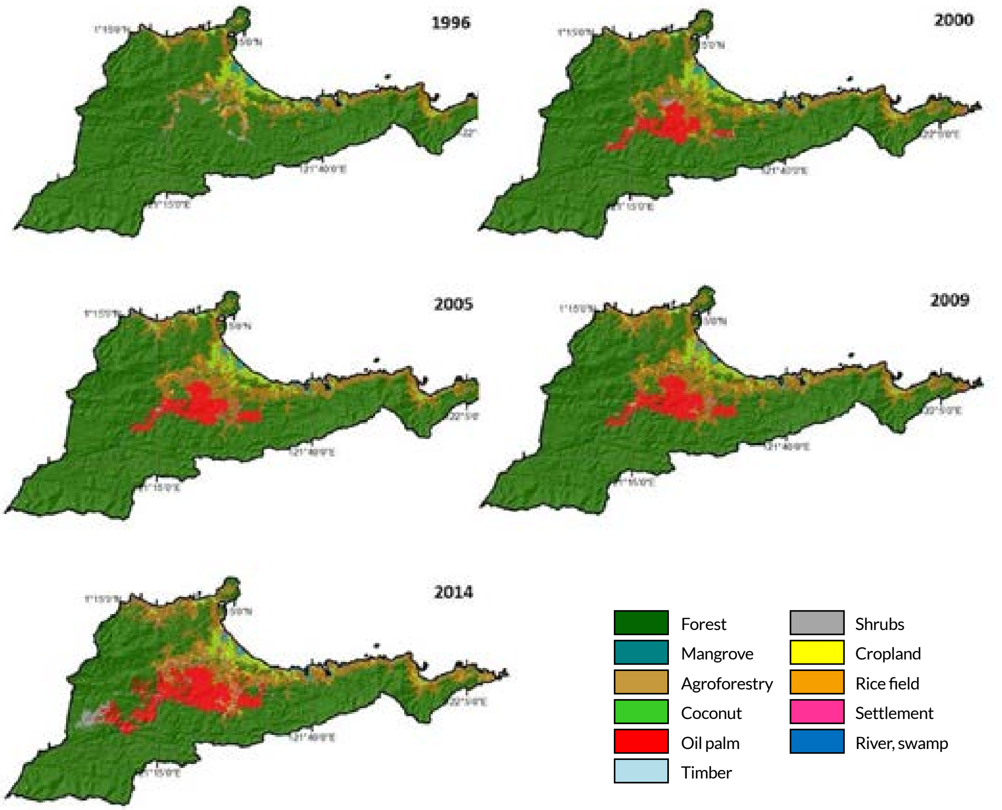

Figure 1.4. Land-use land-cover change in Buol District

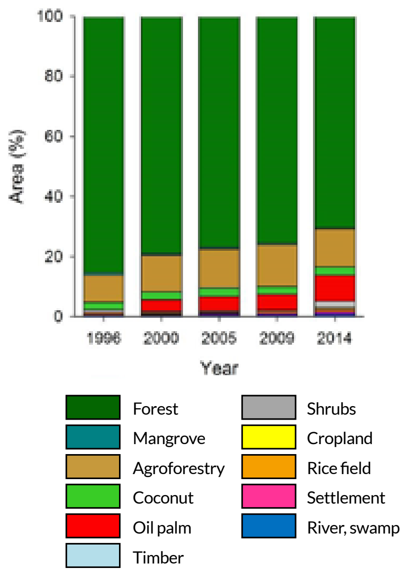

Figure 1.5. Buol District land-use land-cover change

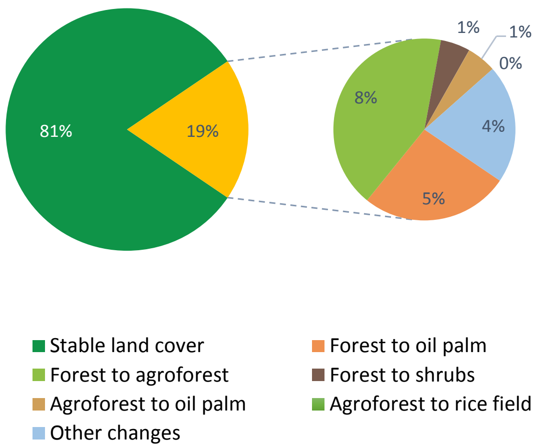

Figure 1.6. Buol District land-use land-cover change 1996-2014

Biodiversity and carbon stocks

The transmigration program supported by the government in the 1980s and 1990s was the starting point for the conversion of the natural ecosystem in Indonesia, particularly in Buol District. Natural forest exploitation, forest conversion into agriculture, clearing land for settlement, and mid- to large-scale private plantation development, contributed not only to economic growth, but also to the changes in the ecosystem and to the ecosystem services provided within each land-use.

Natural forests not only provide habitat for flora and fauna, but also provide a range of ecosystem services, including being a source of food, income and building materials, while also providing climate and water regulation services. The conversion of natural forest to other land-use systems, particularly monoculture, will have long term impacts on the levels of biodiversity and ecosystem services.

Tree diversity in the different land-cover systems in Buol District is between 50 and 100 percent lower than in natural forest. For example, the shift from natural forest to complex agroforestry decreases the tree diversity by 50 percent, the shift to simple agroforestry decreases the tree diversity by 60-75 percent and the shift to monoculture systems decreases tree diversity by almost 100 percent.

Land-use conversion from natural forest directly impacts on the biomass level of land-cover. The carbon stock reduces by 75 percent in a tree-based, land-use system and by 90 percent in a non-tree-based, land-use system.

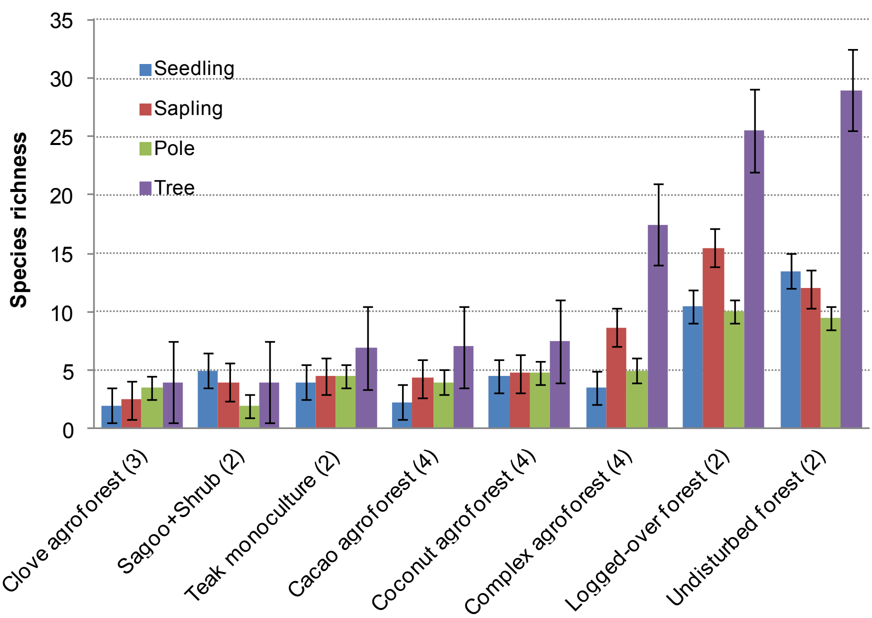

Figure 1.7. Average species richness in various land-use systems in Buol District (error bars represent the standard deviation)

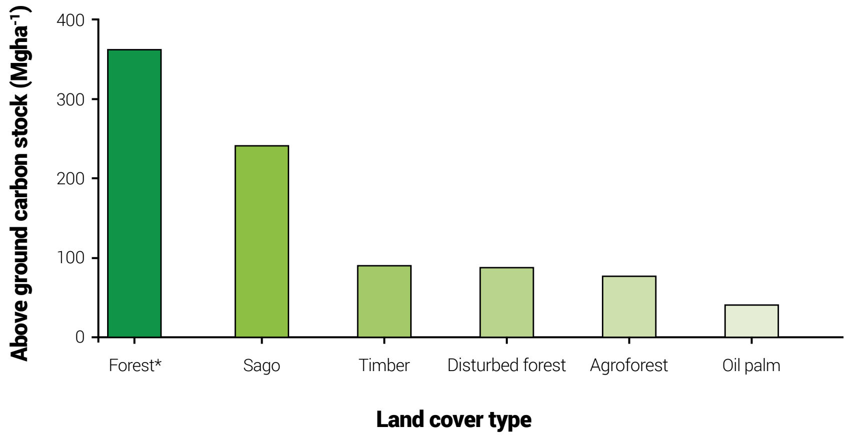

Figure 1.8. Above-ground carbon stock of different land-use land-cover in Buol District

Landscape carbon stock and net emissions

The estimation of landscape carbon was based on above-ground carbon stocks only, excluding litter and soil carbon. The net carbon emission was calculated based on the change in the above-ground carbon, with the assumption that the change in carbon was emitted as CO_2.

The Buol landscape in 2014 stored 43.3 Mt carbon per ha or 113 ton C per ha. This is a reduction by 10.5 percent from the amount stored in 1996 (48.3 Mt C per ha). Over 17 years (1996-2014), the Buol landscape emitted 20.3 Mt CO_2 equivalent to an average of 1.3 Mt CO_2 per year or 3.3 t ha^{-1} yr^{-1}. This does not seem like a high number. However, in the same period only 0.35 Mt CO_2 was sequestered or 1.7 percent of the amount that was being emitted. Thus, during 1996 to 2014, CO_2 emission in Buol District was almost 50 times greater than CO_2 sequestration activities.

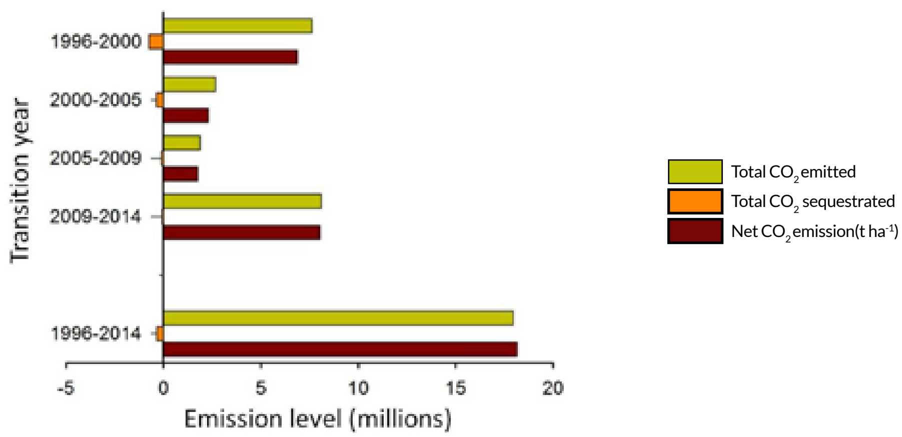

Figure 1.9. Buol District carbon emission and sequestration 1996-2014

1.2 Upstream Cluster (Kokobuka and Lomuli)

The Upstream Cluster is located upstream in the Buol Watershed. The cluster consists of two villages—Kokobuka and Lomuli—which are part of Tiloan sub-District, in the highest area of the watershed. The majority of residents are migrants from Java and Bali, who mostly arrived through the government transmigration program. There is significant potential for further agricultural development; however, due to poor levels of infrastructure development, many areas in this cluster are still too remote to be utilised. This section describes the general condition of the Smart Tree-Invest Upstream Cluster, covering the land-use, water resource management, biodiversity, farming system, shocks and extreme events. This analysis is informed by spatial analysis, key informant interviews, field observations and focus group discussions with female and male groups.

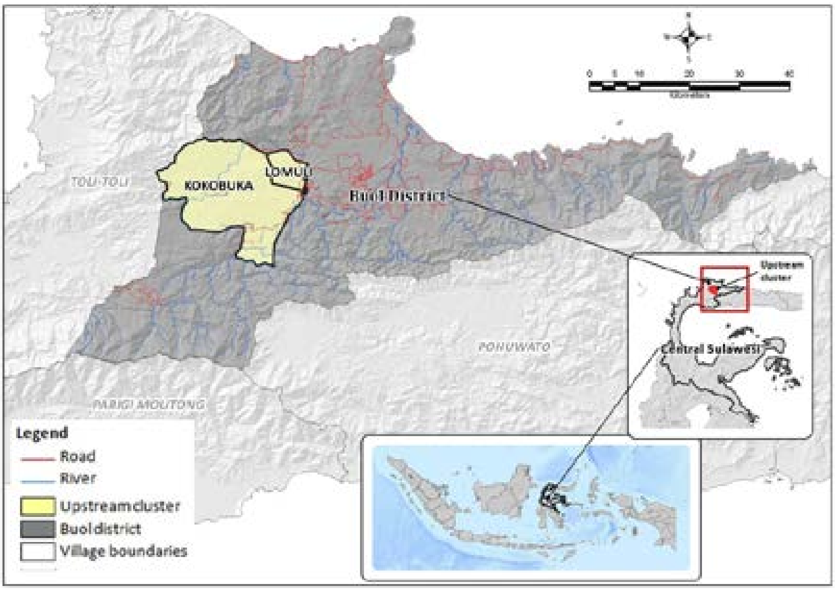

Figure 1.10. Upstream Cluster location in Buol Watershed

Cluster description

The Upstream Cluster consists of two villages (Kokobuka and Lomuli) and is located approximately 400-500 m above sea level (fig 1.10). The area is divided into flatlands (57.5 percent), hills (20 percent) and mountains (22.5 percent). In 2012 the population of the Upstream Cluster was 2,618 persons (Buol Central Statistic Bureau, 2013), comprising around 25 percent of the total population of Tiloan sub-District (table 1.1). Agriculture provides the main livelihoods, namely, paddy, corn, chocolate and patchouli.

Table 1.1. Upstream Cluster population statistics

	Kokobuka		Lomuli		Tiloan sub-district
	Number	%[a]	Number	%[a]	
Population (persons)	1,485	14.1	1,133	10.8	10,536
Number of households	415	15.3	283	10.4	2,721
Population density (persons per km^2)		4.35[b]			7.33
Ratio (male:female)	1.23		1.08		1.08
Number of hamlets	4		3		-

Source: Buol District Central Statistic Bureau, 2013
[a] percentage compared to the total of Tiloan sub-District
[b] Population density of Kokobuka and Lomuli villages

The infrastructure in the Upstream Cluster is underdeveloped, illustrated by the muddy condition of its unpaved main road, no public electricity supply, and no cellular or television services. Education facilities are limited to kindergarten and elementary school level and there is only one health facility unit located in Lomuli, with a health facility sub-unit available in Kokobuka.

Land-use and land-cover change

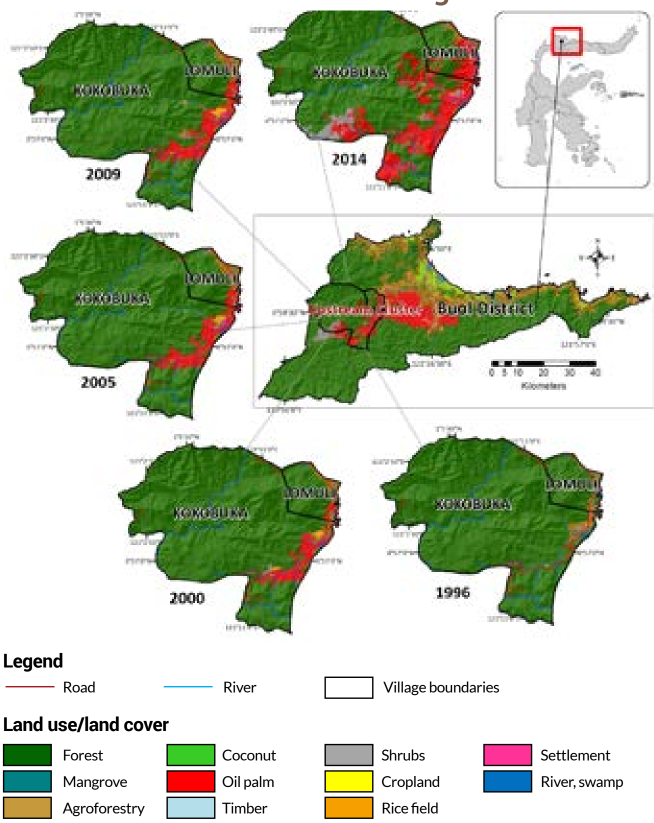

Figure 1.11. Upstream Cluster land-use and land-cover change

In 2014, more than 70 percent of the land cover in the Upstream Cluster was dominated by secondary forest. This represented a 21 percent reduction in land cover from 1994. The other dominant land cover was mixed garden, followed by oil-palm plantation. In 2014, oil-palm plantation covered 17.9 percent of the total cluster area (fig 1.11 and 1.12).

Between 1996-2014, 26 percent of the total cluster area experienced land-use and land-cover change (fig 1.12). The biggest change came from the conversion of secondary forest into oil-palm plantations, which represented 16 percent of the changes in the total cluster area.

According to the local community, the main drivers of land-use and land-cover change in the Upstream Cluster are: (1) population growth, (2) pursuing higher income (3) demand for agricultural land and 4) plantation development by oil-palm companies.

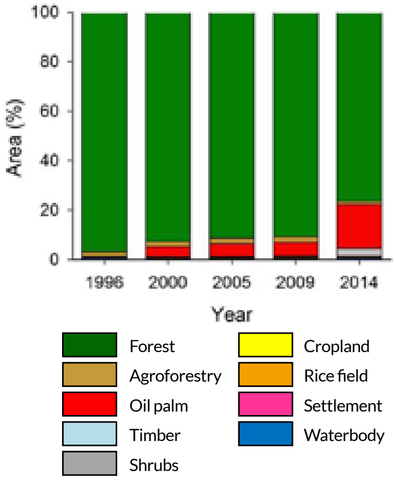

Figure 1.12. Upstream Cluster land-use land-cover, based on Landsat image analysis

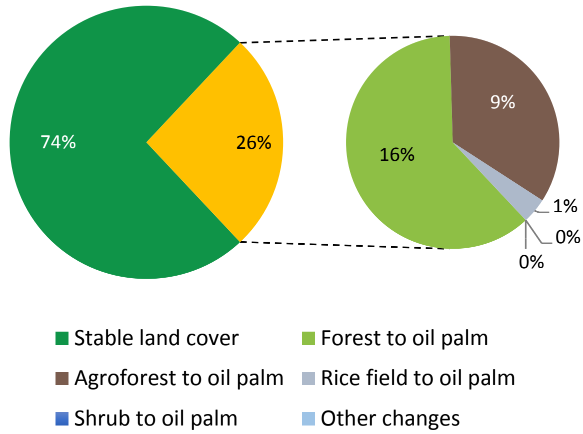

Figure 1.13. Upstream Cluster land-use land-cover change 1996-2014

During the focus group discussions, the community predicted that, based on the current trend, within 10 years land cover in the upstream cluster would be increasingly dominated by paddy fields, mixed garden and oil-palm plantations. Focus group members explained that the demand for rice would increase in line with population growth and due to a strong desire within the community to maintain adequate supplies of the local staple food.

Water resources and management

The main water sources in the local community include wells, springs, rivers and water supply facilities from PAMSIMAS (the community based water sanitation program). During the long drought period, the local community tends to reduce or even cease their agricultural activity. In general, the local community perceived greater problems with water quality than water quantity (table 1.2).

Table 1.2. The ranking of Upstream Cluster water problems, based on male and female perceptions

Water related problems		Rank	
		M	F
Quality	Murky	√	1
	Stinky	√	5
	Garbage pollution	√	-
	Colored	√	2
	Calcium contamination	4	-
	Pesticide contamination	5	4

Water related problems		Rank	
		M	F
Quantity	Droughts	√	√
	Flood	2	3
	Reduced water debit	√	-
	Unpredictable rainfall	1	-
Technical	Erosion	3	-

√ Mentioned in the discussion, but not a priority
M = Male perception, F=Female perception

The community considered that human activities (i.e. illegal logging, land clearing, fertiliser and pesticide use), natural causes (i.e. long periods of rain, long droughts), landscape topography drivers (i.e. soil characteristics, meandering rivers) and poor infrastructure conditions were contributing factors to their water problems. Figure 1.14 shows the perceived causes of water problem based on male and female perceptions.

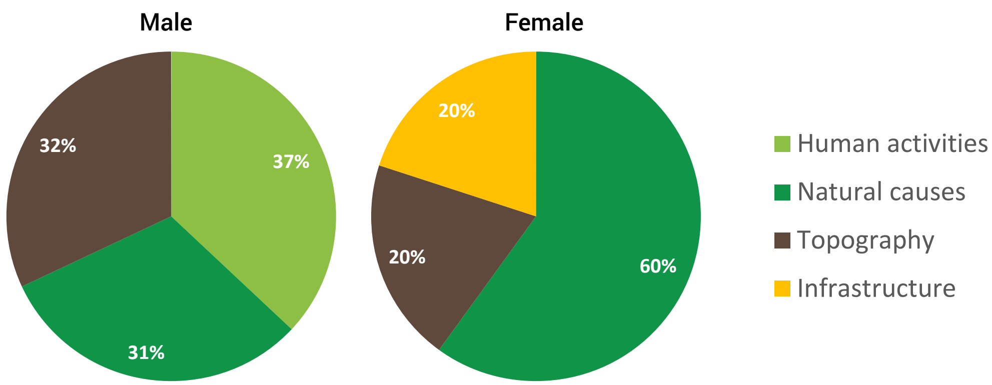

Figure 1.14. Causes of water problem in Upstream Cluster based on male and female perceptions

The community are engaging in a range of activities to cope with their water problems at the domestic level including efforts to find alternative water sources, digging deeper wells, cleaning wells and constructing water filter ponds. However, the local community have not identified effective measures to cope with the sources of the water problems, namely soil erosion and floods.

Biodiversity

Most of the available land cover in the Upstream Cluster provides valuable ecosystem services for the villagers through the provision of food, traditional medicines and sources of income (table 1.3). The women utilise reeds, *ciplukan (Physialis angulata)*, snails, lizards and earthworms as sources of food and traditional medicines, while the men utilise the shrub area to source firewood and construction and fencing materials.

Table 1.3. Upstream Cluster utilisation of biodiversity in different land-cover types, based on male and female perceptions

Land cover	Building Materials	Firewood	Fence	Food	Income	Medicine	Others
Forest	♂ ♀	♀	-	♂ ♀	♂ ♀	♂	♂
Oil-palm plantation	-	-	-	♂	♂	-	-
Cropfield	-	-	-	♀	♂ ♀	♀	-
Rice field	-	-	-	♀	♂ ♀	♀	♀
Cacao agroforest	-	-	-	♂ ♀	♀	♀	-
Swamp	-	-	-	♂	-	-	-
Bush (simple forest)	♂	♂	♂	♂	♂	-	-

Notes: Others: bird food, rattan rug materials; ♂ male's perception ♀ female's perception

Farming practice

The men considered three main factors when selecting which tree and crop varieties to grow—soil suitability, price and providing a source of income (table 1.4). Due to the absence of technical irrigation in the area, low water requirements are important when selecting the tree or crop variety, as the farmers depend largely on rainwater to meet their agricultural water needs.

Table 1.4. Upstream Cluster criteria for tree and crop selection based on male and female perceptions

Rank	Male	Female
1	Land suitability	Farming knowledge
2	High commodity price	Seedling availability
3	Household income	High commodity price
4	Easy maintenance	Easy maintenance
5	Domestic consumption	Land suitability
6	Seedling availability	Domestic consumption

The women considered that farming knowledge, seedling availability and a high commodity price were the three main criteria when selecting which commodity to grow. Seedling availability was the most important criterion as traditionally women only farm around the settlement or village area, so they depend on seedlings that are available in their village. Food security was an additional criterion, which both males and females mentioned, acknowledging the importance of growing crops to meet their household consumption needs.

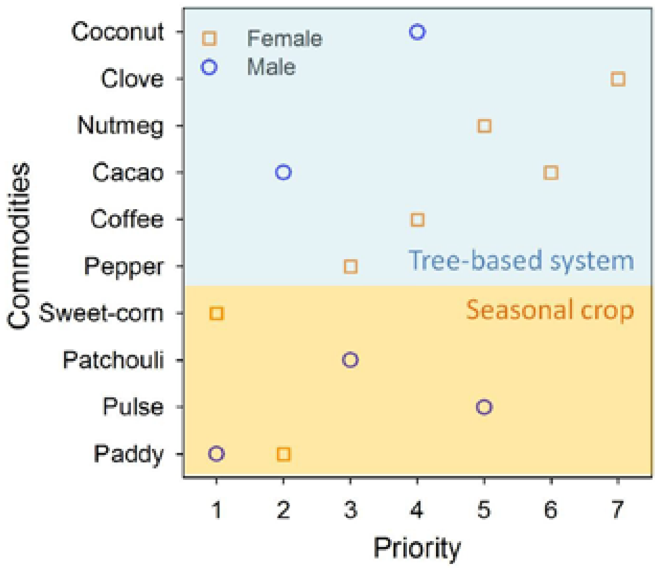

Figure 1.15. Upstream Cluster priority commodities according to male and female perceptions

In the absence of irrigation, the main commodities grown in this cluster are seasonal crops that can survive on rainwater (fig 1.16). Paddy is the number-one commodity choice for males and the second commodity choice for females

Under the transmigration program, the natural forest in the Upstream Cluster was converted to agriculture and village settlements. At the beginning of the program, in addition to developing rice and other annual crops, the first wave of migrants also planted cacao. Most cacao gardens have since been abandoned due to high disease rates and a limited knowledge of how to deal with the diseases. Patchouli has since become the main commodity, however price uncertainty has led many farmers to replace their patchouli garden with other commodities. Most farm households in Buol District plant coconut which they can sell as copra and also utilise for their own consumption.

Shocks and extreme events

The focus group discussions revealed that floods have the greatest negative impact on community livelihoods, farming systems, biodiversity and land-use change (fig 1.16). The floods impact on farming activities and mostly lead to failed harvests while also inflicting material loss on the community through damage to houses and livestock. The community have developed several adaptation strategies, including constructing embankments and trenches at critical points along the river.

Men and women in this cluster had different opinions concerning the extreme events that influence their livelihoods and farming activities (fig 1.17). The men perceived low agricultural prices as having the greatest impact on their livelihoods and agriculture activities, while the women perceived the significant increase in the price of staple goods as having the biggest impact.

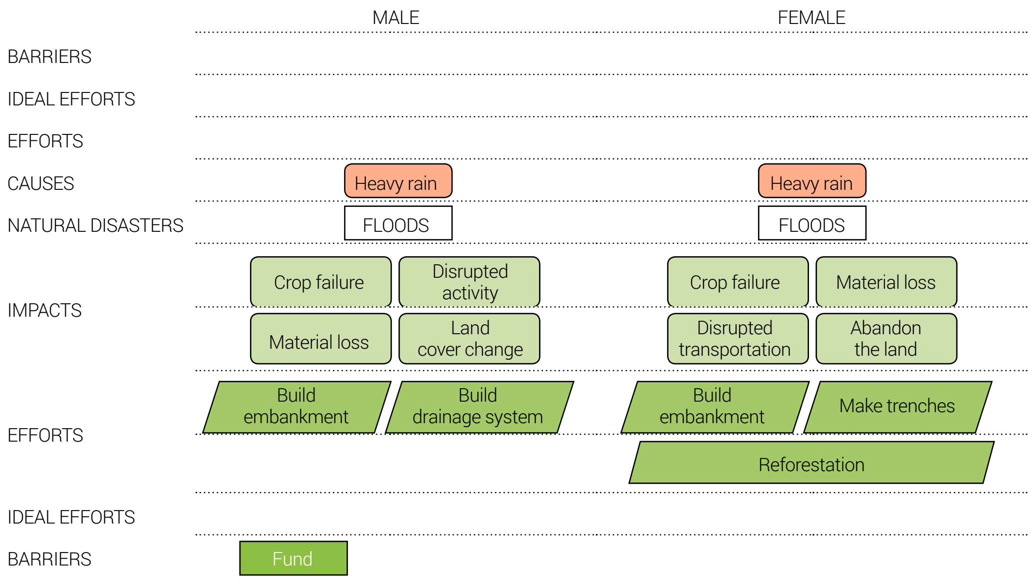

Figure 1.16. Natural disasters with the greatest impact on community livelihoods, farming systems, biodiversity and land-use change in the Upstream Cluster, according to male and female perceptions

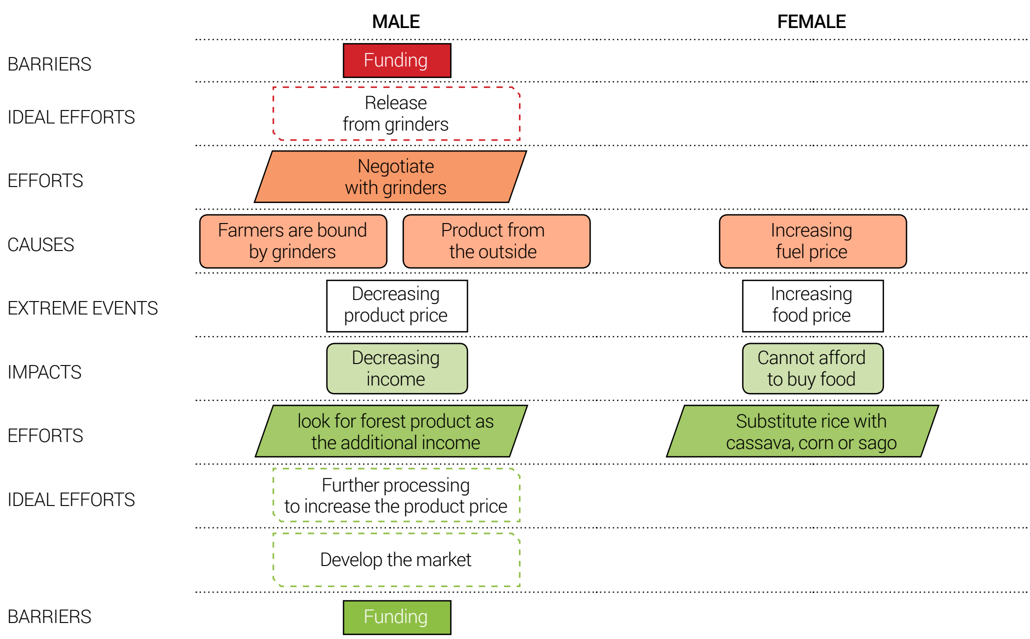

Figure 1.17. Extreme events that impact farming activities in the Upstream Cluster, according to male and female perceptions

Strengths, weaknesses, opportunities, and threats

The Upstream Cluster members viewed their soil fertility and agricultural commodity production to be their biggest strengths (fig 1.18). An additional perceived strength of this cluster was their social capital, largely via religious and farmers groups. The main weaknesses in this cluster were inadequate physical capital or infrastructure including limited electricity connectivity, limited cellular infrastructure and the absence of irrigation.

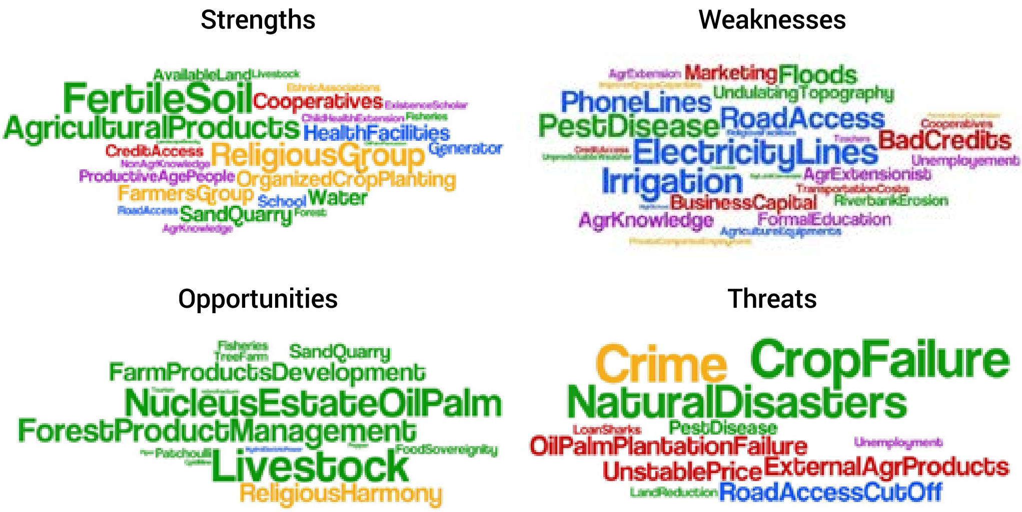

Figure 1.18. Stakeholders' perceptions of strengths, weaknesses, opportunities, and threats in the Upstream Cluster (note: bigger fonts represent stronger perceptions, font colour representation of livelihood capital: green = natural; blue = physical; red = financial; orange = social; purple = human)

Focus group discussions in the Upstream Cluster identified opportunities to further develop livestock farming, mixed garden, palm oil plantations and the utilisation of forest products such as rattan and nypa. The main threats to agricultural production were plant diseases and frequent floods which lead to harvest failure. A high unemployment rate and the associated prevalence of criminal activity also posed a threat.

1.3 Midstream Cluster (Air Terang, Balau, and Boilan)

The Midstream Cluster consists of three villages—Air Terang, Balau and Boilan. Located in Tiloan sub-District, this cluster is in the midstream part of the Buol River. Fertile soil and the widespread availability of irrigation provide this cluster with a range of agricultural livelihood opportunities. However, the remote location of the agricultural land poses challenges to agricultural and plantation commodity marketing. This cluster profile outlines the characteristics of the midstream cluster, covering land-use and land-cover, water resource management, biodiversity, farming systems, shocks and extreme events. To conclude, this cluster profile discusses the strengths, weaknessess, opportunities and threats to the cluster, as perceived by the local community and local government.

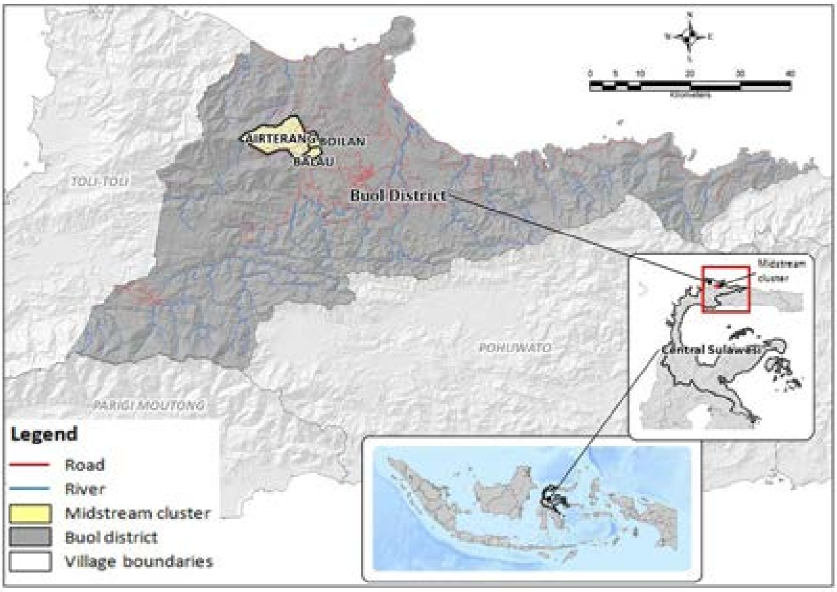

Figure 1.19. Location of Midstream Cluster in Buol Watershed

Cluster description

The midstream cluster consisting of three villages (Air Terang, Boilan and Balau) has a total area of 22.800 ha, and is located between 190 and 200 m above sea level (Buol District Statistic Bureau, 2013) (fig 1.19). The area can be broken down into flatland (55 percent), hills (7.7 percent) and mountains (36.6 percent).

In 2012, the population of this cluster reached 2,592 or about 25 percent of the total population of Tiloan sub-District (table 5). The residents are mostly migrants, particularly in Air Terang and Boilan, while residents native to Buol District reside in Balau Village. The majority of residents are farmers, with the main commodities consisting of paddy, clove, cacao, horticulture and patchouli. A few of the residents, particularly in Balau, work in the oil-palm plantation as labourers.

Table 1.5. Midstream Cluster population data

	Air Terang		Balau		Boilan		Tiloan sub-District
	Number	%[a]	Number	%[a]	Number	%[a]	
Population (persons)	1,130	10.7	565	5.4	897	8.5	10,536
Number of households	306	11.2	152	5.6	257	9.4	2,721
Population density (persons km^{-2})	104.7		103.2		105.2		108.6
Ratio (male:female)			8.07[b]		133.83[c]		7.33
Number of hamlets	2		2		3		

Source: BPS Kabupaten Buol (2013); [a] Percentage of total Tiloan Sub-district; [b] Population density of Air Terang and Balau Villages, for total area of 210 km^2; [c] Population density of Boilan, Maniala and Monggonit villages for total area of 18 km^2

Boilan has relatively better roads, communication and electricity networks and health and education facilities, compared to the other villages. Balau is least developed in terms of roads, communication, electricity and services. The irrigation network covers Boilan and Air Terang; paddy fields are limited to these two villages.

Land-use and land cover change

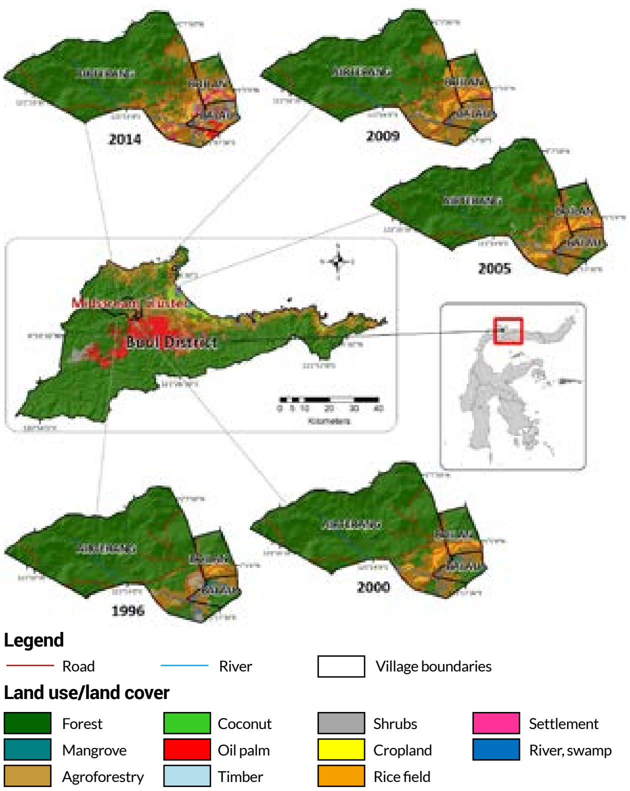

Figure 1.20. Midstream Cluster land-use and land-cover change

The Midstream Cluster is dominated by secondary forest, complex agroforestry and paddy. The settlement area is divided among paddy, agroforestry gardens and oil-palm plantations (fig 1.20).

During 1996-2014, the area of high-density secondary forest decreased by around 23 percent, while complex agroforestry and paddy fields increased significantly. During this period, many migrants came to the area and cleared land for agriculture and settlement. A summary of the land-use land-cover change in the midstream cluster during 1996-2014 can be seen in Figure 1.21.

Between 1996-2014, around 31 percent of the total Midstream Cluster area experienced change in land-use land- cover, while the rest of the area remained stable (fig 1.21). The conversion was predominantly from secondary forest to complex agroforestry (15 percent) and to other land-uses such as settlement (13 percent).

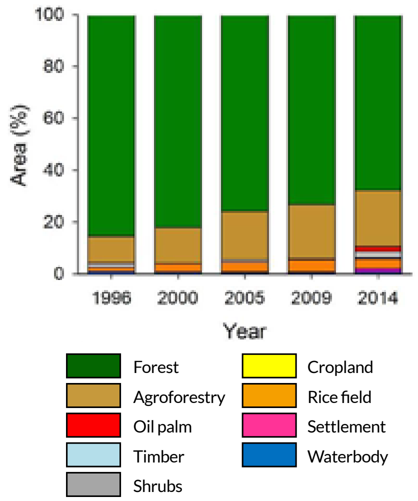

Figure 1.21. Midstream Cluster land-use land-cover, based on Landsat image analysis

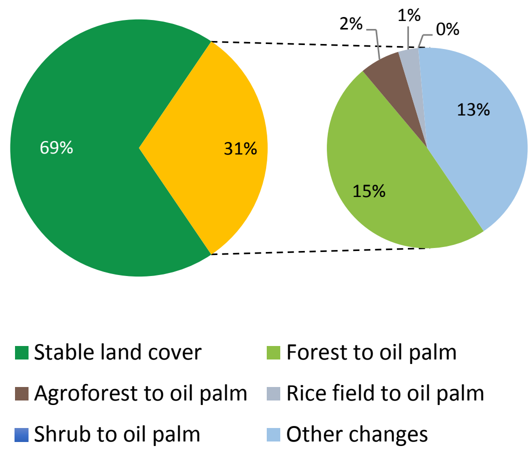

Figure 1.22. Midstream Cluster land-use land-cover change 1996-2014

The community viewed the main drivers of land-use change to be economic: (1) livelihood driven, (2) subsistence needs driven, and (3) pursuing higher profitability. Additional drivers of land-use change included food security, population growth, soil fertility and land-use change in response to the construction of irrigation systems.

Based on the current trend, the community estimates that over the next 10 years, the main form of land-use change will be from natural forest to oil-palm plantation. They also predicted that other dominant land-uses over the same period would include complex agroforestry (mixed garden), and agricultural land (particularly paddy field), because these land-uses have high productivity and profitability.

Water resource and management

The main water sources in the Midstream Cluster are rivers, wells, water supply facilities from PNPM (a government program), rainwater, and bottled drinking water. In the drought period, the water is mostly supplied from rivers, while cooking and drinking water is mainly sourced from wells.

The community expressed concerns over water quality during the dry and rainy seasons (table 1.6). The main driver of this problem is the topographical conditions, namely meandering rivers and soil erosion (fig 1.24), with heavy rains bringing sediment down from upstream.

Table 1.6. The ranking of Midstream Cluster water problems, according to male and female perceptions

Water related problem		Rank	
		M	F
Quality	Murky	3	1
	Stinky	1	5
	Garbage pollution	5	4
	Coloured	4	3
	Rust Corrosion	-	√
Quantity	Droughts	√	√
	Flood	√	2
	Reduced water debit	√	√
Technical	Broken pipe	√	-
	Erosion	2	-

√ Mentioned with no further discussion
M=Male, F=Female

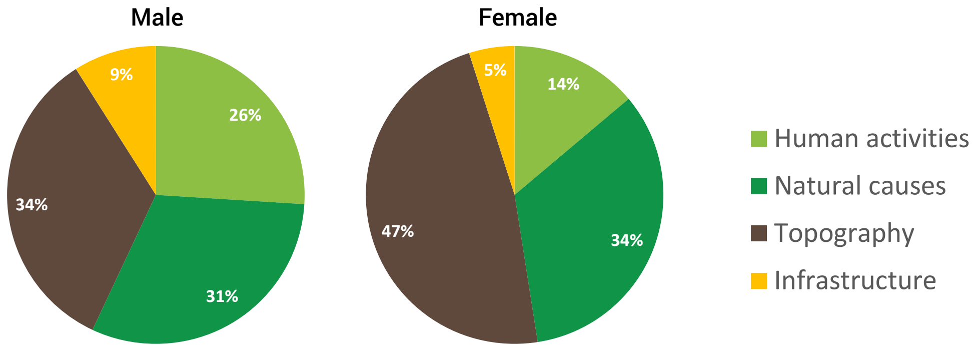

Figure 1.23. Causes of water problems in Midstream Cluster based on male and female perceptions

Due to concerns over poor water quality, the community is purifying their water supply using filters prior to drinking. At the household level, the community has several adaptation strategies to deal with the water supply shortage, including looking for new sources of water in their neighbourhood. At the larger scale, efforts to address water problems include bamboo planting to reduce riparian erosion and reduce flood impact; however, these efforts have not been fully successful.

Biodiversity

The focus group discussions revealed that the forest provides many more benefits to the community than most other types of land cover (table 1.7). The women argued that almost all of the types of land-cover had potential as a food source. The men perceived an array of benefits from different types of land-cover, i.e. oil-palm plantations helped to prevent landslides, and shrubs and thickets were sources of firewood and traditional medicines.

Table 1.7. Midstream Cluster utilisation of biodiversity for different land-cover types, based on based on male and female perceptions

Land cover	Building materials	Firewood	Food	Income	Erosion prevention	Medicine	Others
Forest	♂♀	-	♂♀	♂♀	-	♂♀	♂♀
Shrubs	♂♀	♂	♂♀	♂	-	-	-
Seasonal crops	♂	-	♂♀	♂	-	♂	-
Paddy field	♂♀	-	♂♀	-	-	♂	♀
Oil-palm plantation	-	-	♀	♀	♂	-	-
Swamps	-	-	♀	♀	-	-	-

Notes: Others: bird food, rattan rug materials; ♂ male's perception ♀ female's perception

Farming practice

For men, the three most important criteria determining the commodity grown were marketability, land suitability and household income (table 1.8). Limited opportunities to add value and the relatively remote location of many gardens made marketability the main consideration for many in selecting tree or crop varieties. Limited knowledge of farming systems and production technology means that farmers limited their selection to what was suitable for their soil conditions. Furthermore, access to irrigation meant that the farmers are not limited purely to rain fed agricultural production systems.

For women, the three most important criteria for commodities were price stability, land suitability and a short harvest period (table 1.8). The women also prioritised "domestic consumption" as one of the most important criteria, because they still consumed a large portion of their paddy and seasonal crops, such as peanuts, soybeans and corn. Interestingly, the Midstream Cluster was the only cluster to consider "future saving" as one of their selection criteria for commodities.

Table 1.8. Midstream Cluster criteria for tree and crop selection based on male and female perceptions

Rank	Male	Female
1	Marketability	Price stability
2	Land suitability	Land suitability
3	Household income	Short harvest period
4	Domestic consumption	Saving
5	Saving	Household income
6	-	Domestic consumption

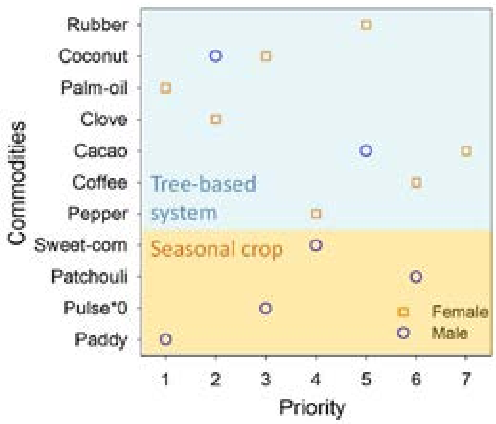

Figure 1.24. Midstream Cluster priority commodities from male and female perceptions

The men tended to prefer seasonal crops, such as paddy, beans, corn and patchouli, while the women select tree-based commodities such as oil-palm, clove, rubber, coffee and cacao (fig 1.24). Similar to the experience in the upstream cluster, in the 1990s and early 2000s, cacao was the main commodity, however pests and diseases had decreased its productivity and encouraged the farmers to convert their cacao gardens to other commodities. Like the Upstream Cluster, most farmers planted coconut for their domestic needs and as a source of income.

Shocks and extreme events

Floods have the greatest negative impact on people's livelihoods, farming systems, biodiversity and land-use change (fig 1.25). Meandering rivers, heavy rains and river siltation from upstream are the main causes of flood in the Midstream Cluster. More

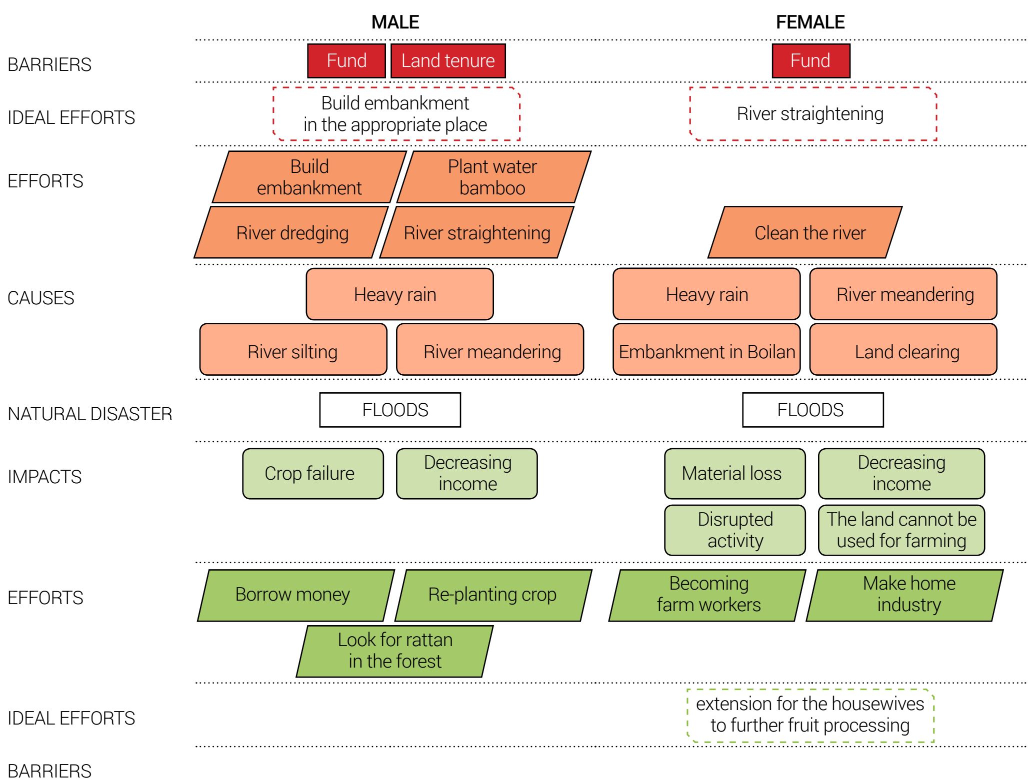

Figure 1.25. Natural disasters that have most impact on community livelihood, farming system, biodiversity and land-use change in the Midstream Cluster, based on male and female perceptions

recently, efforts were being made to address the causes of floods, including dredging and straightening of rivers, planting bamboo and river embankment. The floods directly disturb agricultural activities and contribute to harvesting failure, lowering farmers' income. When the floods occur, the farmers survive by working as farm labourers, undertaking extra jobs and borrowing money from the moneylender to replant.

The community viewed fertiliser scarcity and the increase in staple goods prices as the two extreme events that had the worst impact on their livelihoods (fig 1.26). Both of these reduced their income and led to unexpected expenses. Despite consistently experiencing these two events, the community had yet to find measures to cope besides reducing unnecessary expenses and increasing food self-sufficiency.

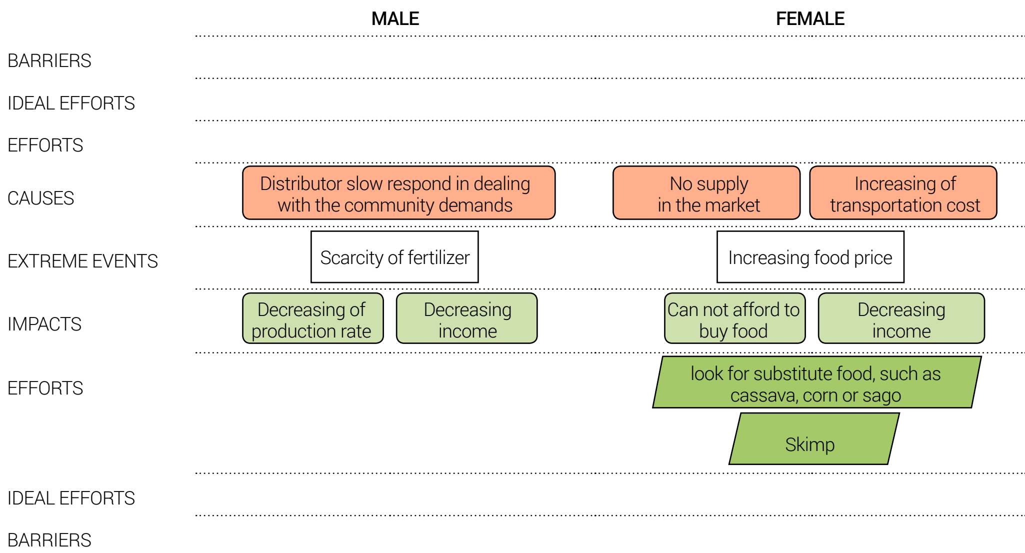

Figure 1.26. Extreme events that impact farming activities in the Midstream Cluster based on male and female perceptions

Strengths, weaknesses, opportunities and threats

The main strength of the Midstream Cluster was the irrigation network (fig 1.27). The other strengths in terms of natural capital were good soil fertility, the availability of forest products and the availability of degraded land that can be cultivated. The combination of good soil fertility and irrigation networks provides the Midstream Cluster with opportunities to cultivate a wide range of agricultural commodities, including oil palm. The main weaknesses of this cluster were related to human resources such as an increasing unemployment rate and a lack of education, skills and knowledge to support livelihoods. These have contributed to the threats of rising criminality, uncompetitive products and a growing number of middlemen who are coming to the cluster and making the smallholders more dependent on them.

Figure 1.27. Stakeholders' perception of the strengths, weaknesses, opportunities and threats in the midstream cluster (note: bigger fonts represent stronger perceptions, font colour representation of livelihood capital: green = natural; blue = physical; red = financial; orange = social; purple = human)

1.4 Coastal Cluster (Taat, Matinan and Lokodidi)

There are three villages in the Coastal Cluster—Taat, Matinan and Lokodidi— all which are part of Gadung sub-District. This cluster is located on the north coast of Buol, next to the Sulawesi Sea. Passed by the Trans-Sulawesi Highway, this cluster has relatively good access and opportunities for agricultural and fisheries development. However, the younger generation faces the threats of dropping out of school and drugs. One of the main problems in this cluster is mangrove deforestation, which contributes to the coastal erosion and degradation. This cluster profile provides an overview of the land-use and land-cover, water resource management, biodiversity, farming system, shocks and extreme events of the coastal cluster. This cluster profile concludes by discussing the perceptions of the local community and local government and their views of the strengths, weaknesses, opportunities and threats in the cluster.

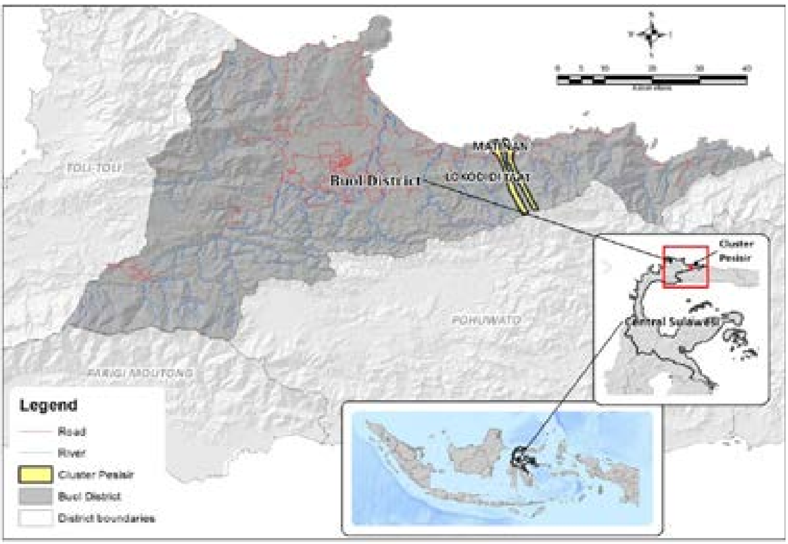

Figure 1.28. Coastal Cluster location

Cluster description

The Coastal Cluste, has a total area of 4,185 ha, which is roughly 26 percent of Gadung sub-District, and is located next to the Sulawesi Sea on the northcoast of Central Sulawesi Province (Buol District Statistic Bureau, 2013) (fig 1.28). The cluster consists of three villages (Taat, Matinan and Lokodidi) and the landscape is dominated by flatlands, with some mountains and hills.

In 2012, the population of this cluster was approximately 3,825 persons, representing 33 percent of the total population in the Gadung sub-District (table 1.9). The majority of residents are natives of Buol, with their livelihood options comprising farming, sea-fisheries and mining. The main farming commodities in this cluster are coconut, clove, cacao and nutmeg.

Table 1.9. Coastal Cluster population statistics

	Taat		Matinan		Lokodidi		Gadung sub-District
	Number	%[a]	Number	%[a]	Number	%[a]	
Population (persons)	840	7.2	1,218	10.5	1,767	15.2	11,639
Number of households	199	7.4	284	10.5	398	14.8	2,692
Population density (persons/km^2)	106.7		87.8		107.1		105.5
Ratio (male:female)	59.2		96.3		117.8		72.6
Number of hamlets	3		3		4		

Source: BPS Kabupaten Buol (2013)
[a] percentage of total of Gadung sub-District

This cluster has good public facilities, such as road, electricity and cellular networks. Almost all villages, excluding Taat, have asphalt roads, with most of the villages located on the Trans Sulawesi Highway. The education facilities available range from kindergarten to high school level. In terms of health services, municipality medical centres are only available in Matinan and Lokodidi.

Land-use and land-cover change

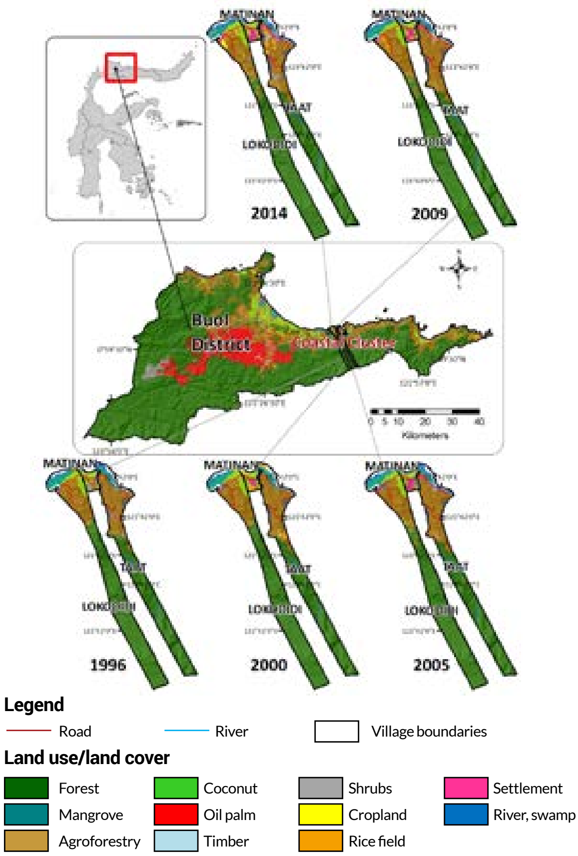

Figure 1.29. Coastal Cluster land-use and land-cover change

Based on the classification of land-use and land-cover change, the cluster is dominated by high density secondary forest and agroforestry. There are also areas of secondary mangrove forest and coconut agroforestry. Settlement spans monoculture coconut, complex agroforestry and the coastal area.

Between 1996-2014, land-use and land-cover in the Coastal Cluster were relatively stable. The secondary forest and area under complex agroforestry were only reduced by 3 percent during this period. Figures 28 and 29 illustrate the changes in land-use and land-cover in the coastal cluster during 1996-2014.

Between 1996 and 2014, only 14 percent of the Coastal Cluster experienced land-use land-cover changes, while the remaining 86 percent remained stable (fig 1.30).

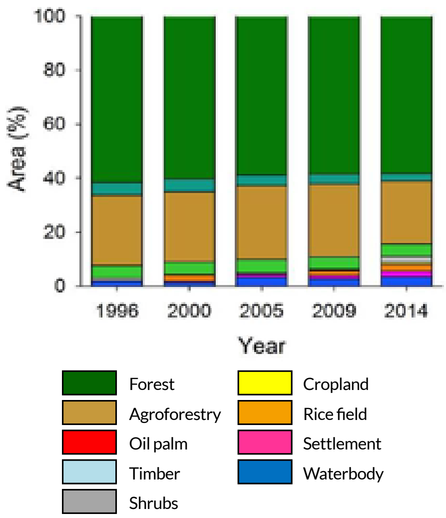

Figure 1.30. Coastal Cluster land-use land-cover, based on Landsat image analysis

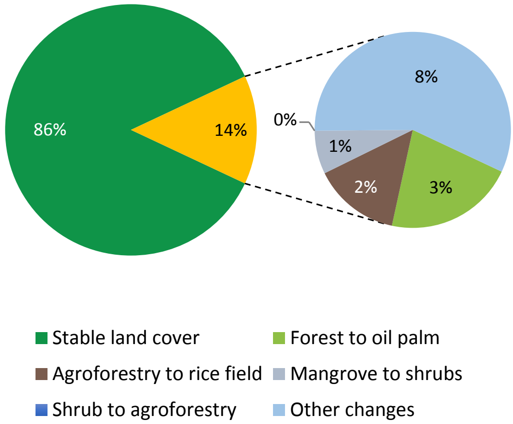

Figure 1.31. Coastal Cluster land-use land-cover change 1996-2014

The land-use land-cover changes mostly surrounded shifts from secondary forest to complex agroforestry, complex agroforestry to paddy field, and secondary mangrove forest to bare land.

There are three main drivers of land-use change in the Coastal Cluster: (1) decreasing productivity of old trees, particularly cacao and coconut, (2) the adoption of new commodities with better market access and price and (3) the adoption of new commodities with lower labour requirements. One example of common land-use change in the cluster is the shift from cocoa to other commodities, as cocoa productivity has continuously decreased due to pests and diseases.

The focus group discussion revealed that land availability and population growth encouraged community members to convert the forest to mixed garden to support their livelihoods. The participants estimated that in the next 10 years, the trend of complex mixed garden would continue to dominate the land-use in the Coastal Cluster, while other land-uses would remain stable. The focus group discussion highlighted a strong preference from the coastal communities for agroforestry (mixed garden complex) above other farming systems.

Water resource and management

The coastal communities used wells and rivers as their main water sources, while also occasionally using small springs and water supply systems built through the PAMSIMAS (government water and sanitation) program. During the dry season, the main water sources are wells and rivers.

The main perceived problem was with water quality, as the water contains calcium and is quite turbid (table 1.10). This problem occurs frequently throughout the year during both the rainy and dry seasons.

Table 1.10. The ranking of Coastal cluster water problems, based on male and female perceptions

Water related problems		Rank M	Rank F
Quality	Murky	2	1
	Stinky	4	
	Garbage pollution	-	3
	Brackish	-	5
	Coloured	-	4
	Calcium contamination	1	-
	Pesticide pollution	3	-
	Mercury contamination	6	-
Quantity	Droughts	√	2
	Flood	√	-
Technical	Broken pipe	5	-

√ Mentioned with no further discussion
M=Male, F=Female

The men felt that the water problems could be mainly attributed to the conditions of the infrastructure (fig 1.32), as the fact that the wells and water reservoirs are located close to their gardens and bad installation of the water pipes makes the wells and reservoirs prone to contamination. The women highlighted coastal conditions, such as the topography, soil characteristics, and the proximity of their wells and reservoirs to the sea, as affecting water resources in the cluster.

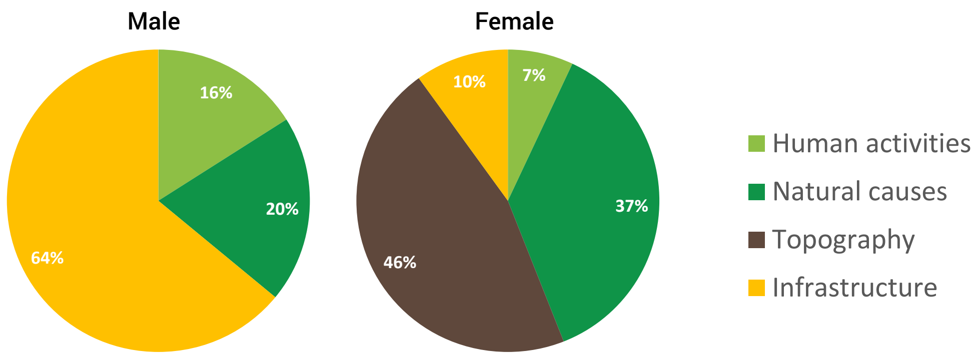

Figure 1.32. Coastal Cluster causes of water problems, based on male and female perceptions

The community described a range of efforts that have been undertaken to address water quality problems such as filtration tubes, boiling the water before consumption and relocating the water reservoirs to better locations. In addition, people were also replacing the broken pipes with metal pipes to reduce spillover and contamination problems. They also anticipate support from experts to assist them to overcome the calcium contamination problem.

Biodiversity

The focus group discussion revealed that the perceived benefits of each type land cover vary between men and women (table 1.11). Women were more likely to mention the benefits of each land cover associated with daily activities, such the benefits of providing a source of food, medicine and household income. The men mentioned the wider benefits of land-use such as the mangroves to protect the coast from erosion, *nibung (Oncosperma tigillarium)* forest plant leaves for handicraft, and *nibung* trunks to make ladders for clove harvesting.

Table 1.11. Utilisation of biodiversity in different coastal cluster land-cover types, based on female and male perceptions

Land cover	Building material	Firewood	Food	Income	Medicine	Coastal protection	Others
Forest	♂ ♀	-	♂ ♀	♂ ♀	-	-	♂
Mangrove	♂	♂	♂ ♀	♀	-	♂	-
Clove	-	-	-	♂	-	-	-
Agroforestry	♀	♀	♀	-	♀	-	-
Coconut	-	♂	-	-	-	-	-
Rice field	-	-	♀	♀	-	-	-

Notes: Others: bird food, rattan rug materials; ♂ male's perception ♀ female's perception

Farming practice

The focus group discussion participants stated that soil suitability, seed availability and low labour requirements are the three most important criteria for commodity selection (table 12). The participants noted short harvest periods and marketability as other important selection criteria. However, those criteria were less important as the coastal area has good infrastructure; hence it is relatively easy to market and distribute most of their commodities.

Table 1.12. Coastal cluster criteria of tree and crop selection based on male and female perceptions

Rank	Male	Female
1	Land suitability	Easy maintenance
2	Seedling availability	Household income
3	Easy maintenance	Seedling availability
4	Household income	Short harvest period
5	Short harvest period	Marketability
6	Marketability	

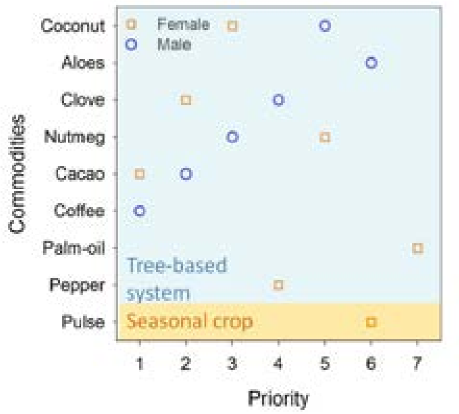

Figure 1.33. Coastal cluster priority commodity based on male and female perceptions

The coastal cluster is dominated by tree-based agriculture, rather than paddy or seasonal crops. Comparisons among the criteria and the commodities using an analytical hierarchical process indicated that coffee is the commodity that best meets the selection criteria (fig 1.33). Although until recently coffee was not the main commodity in the cluster, the males stated coffee as their main preference meeting most criteria. Cacao was the dominant commodity for second preference, followed by other tree-based commodities such as nutmeg, clove, coconut and *gaharu*.

The women mainly preferred crop-based commodities such as beans and pepper. The women indicated their interest in planting oil palm, comparing its relative profitability to the other commodities grown.

Shocks and extreme events

The men and women revealed that plant pests and diseases are having the greatest impact on community livelihoods (fig 1.34). This leads to a decrease in productivity, harvest failures and a reduction in household income. The community suggests that

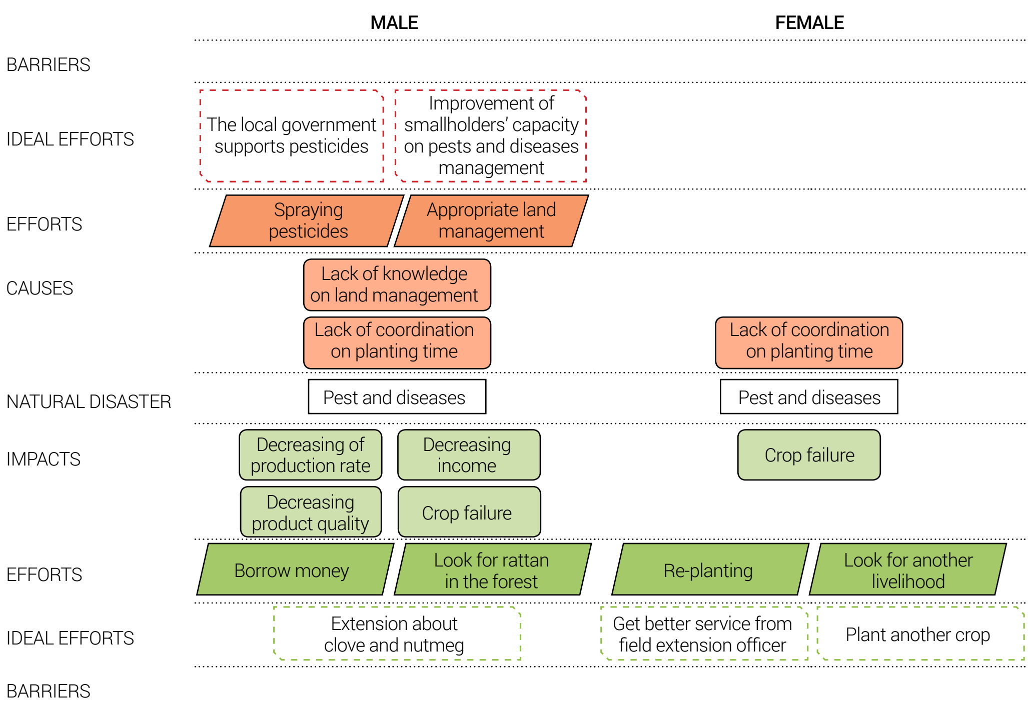

Figure 1.34. Natural disasters having greatest impact on community livelihood, farming systems, biodiversity and land-use change in the Midstream Cluster, based on male and female perceptions

sub-optimal agricultural land management practices and the lack of coordination between farmers regarding planting times are the main causes of this problem. To cope with plant pests and diseases, the community use pesticide regularly and seek to improve their agricultural land management practices.

Figure 1.35 illustrates the perceptions of men and women towards the extreme events that have negative impacts on their agricultural activity and livelihoods. The men perceived that fertiliser scarcity had the biggest impact on their well-being, while the women perceived that the increase in the price of staple goods had the most negative impact on their livelihood.

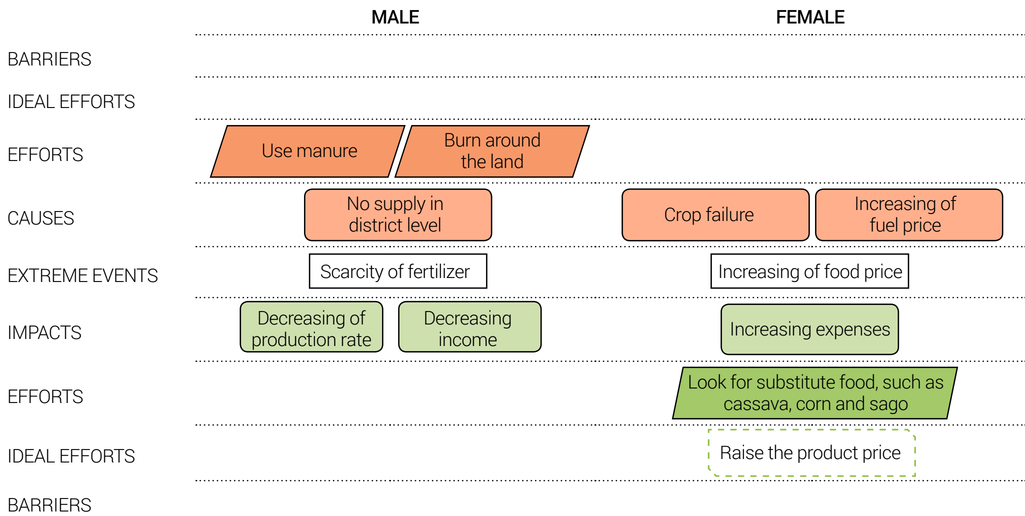

Figure 1.35. Extreme events that impact farming activities in the Coastal Cluster based on male and female perceptions

Strengths, weaknesses, opportunities, and threats

The main strengths of the coastal cluster are its financial capital, represented by the community finance cooperative, and its natural capital, including agriculture, plantations and fisheries products (fig 1.36). The strengths provide the cluster with opportunities in agriculture, plantation and sea-fisheries. The stakeholders viewed the main weaknesses of the coastal cluster as coming from the natural and human capital. The weaknesses related to the emerging threats of coastal erosion and degradation and the increasing number of school drop outs and those with alcohol and drug problems.

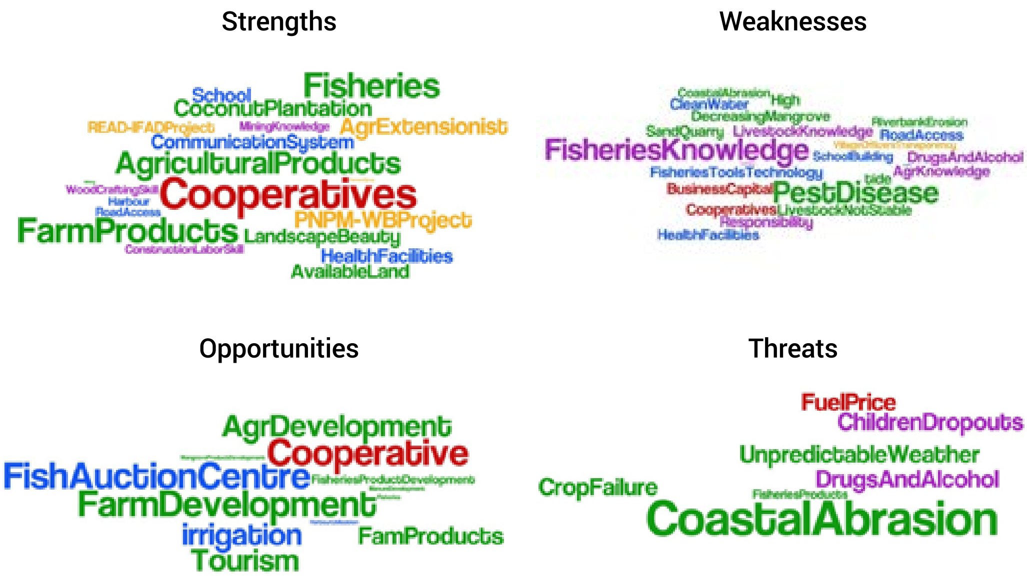

Figure 1.36. Stakeholders' perceptions of strengths, weaknesses, opportunities, and threats in the Coastal Cluster (note: bigger fonts represent stronger perceptions, font colour representation of livelihood capital: green = natural; blue = physical; red = financial; orange = social; purple = human)

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VIET NAM
CLUSTER PROFILE

2. HO-HO SUB-WATERSHED

Dam Viet Bac, Delia C. Catacutan, Rachmat Mulia, Nguyen Maiphuong

2.1 Ho-Ho Sub-Watershed

The Ho Ho sub-watershed is a part of Huong Khe watershed of the Ngan Sau River and is located in Huong Khe, Ha Tinh Province and Tuyen Hoa, Quang Binh Province (105° 50' E, 18° 2' N) (fig 2.1). It consists of five communes, namely Huong Lam, Huong Lien, Huong Hoa and a part of Huong Vinh and Thanh Hoa. With a total population of 3,500 households (equivalent to 10,400 people) according to the 2014 census, the Ho Ho sub-watershed covers an area of 27,600 ha wherein 70 percent is logged over forest (natural forest) while 7.5 percent is under forest (acacia) plantation. Forests occupy the upper section of the sub-watershed while the mid and lower sections are predominantly farmland. The sub-watershed consists of tributaries that all feed into the main river and this drains into the reservoir of the Ho Ho hydro-electric power plant (HEP). The water is also used as source of potable water in the downstream communes of Huong Khe, a township of Ha Tinh Province.

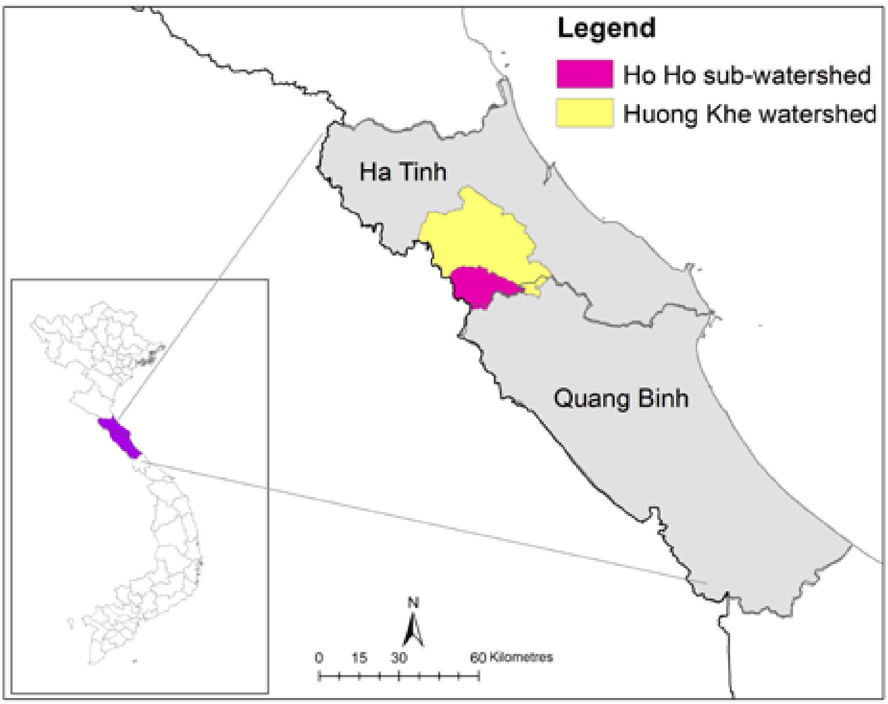

Figure 2.1. Location of Ho Ho sub-watershed in Ha Tinh and Quang Binh Province

The sub-watershed experiences the tropical monsoon in the hot and cold seasons. The hot season lasts from April to August with dry and hot conditions. In particular, Ho Ho is severely affected by the southwest wind in June and July. The cold season starts in November and ends in March with the northeast monsoon and rain. The average annual temperature in the area is 24.5° C. The maximum temperature is about 29.5° C in June and July, and the minimum temperature is 18° C in December and January. The annual rainfall range is 1,590-2,400 mm. The highest average monthly rainfall is about 390 mm in August and September while the lowest is 40 mm in January and February.

The people in Ho Ho depend on agriculture as their main source of livelihood. The dominant crops are peanuts, paddy rice, maize, sweet potatoes, green beans and cassava. Livestock includes pigs, cows, buffaloes and chickens. Farmers usually have fruit trees in home gardens and timber trees such as Acacia spp., *Aquilaria crassna* and *Dalbegia tonkinensis* in small woodlots. Some farmers also earn income from non-farm jobs such as construction labouring and working in industrial plants, as well as from public and private employment.

Land cover change

In 2014, the landscape in the Ho Ho sub-watershed was dominated by logged-over forest (fig 2.2). Areas of undisturbed forest and other forest plantation (cinnamon, eucalyptus and other timber trees) decreased significantly between 2000 and 2014. Undisturbed forest had the largest decrease, due to the conversion of 1,600 ha to logged-over forest

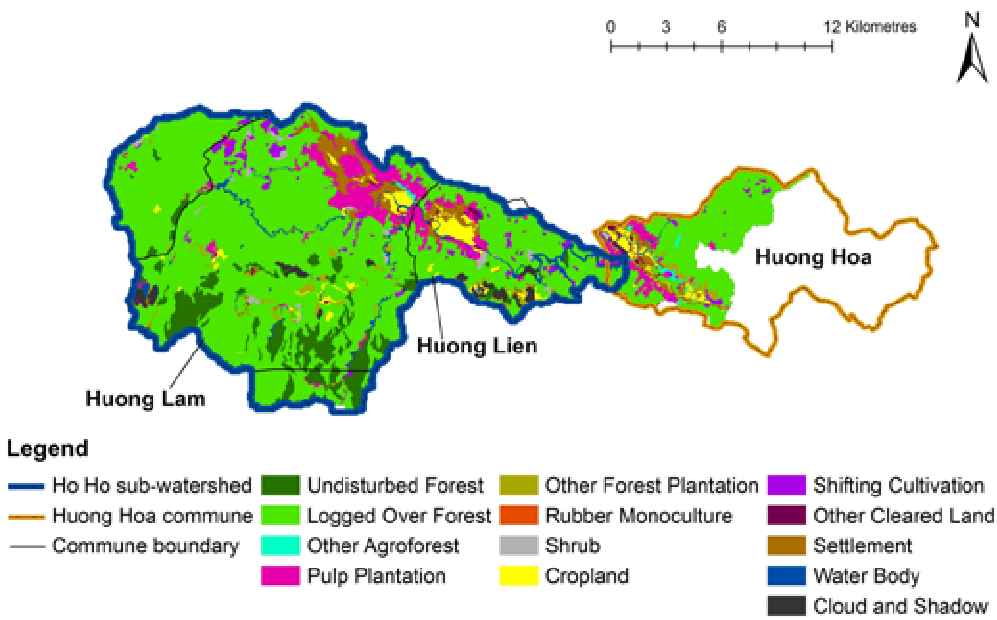

Figure 2.2. Land cover distribution in Ho Ho sub-watershed in 2014.

(41 percent of its area in 2000). Other forest plantation is one type of planted forest and is not used for pulp production. Its area decreased by 1,568 ha from 2000 to 2014, due to the conversion of 978 ha to logged-over forest and 590 ha to pulp plantation. As a consequence, logged-over forest increased by 609 ha and pulp plantation by 1,053 ha from 2000 to 2014.

Water issues

Land-use distribution in the Ho Ho sub-watershed influences water balance and river flow. The water quantity and quality in the Ngan Sau River have been declining over the last decade (2004-2014). The water level has been unusually low in the dry season and extremely high during the rainy season. Since its first operation in 2013, the Ho Ho Dam, which is located on the border between the Huong Lien and Huong Hoa communes, has had to deal with the issues of water scarcity and flooding. Rainfall has also been low in the dry season (May-July) preventing a second crop, and very heavy in the rainy season (August-October) causing flash floods.

Exposure to extreme weather-related events

The sub-watershed is exposed to climate-related hazards such as storms, drought, cold spells, flash floods and landslides. According to the local people, storm occurrences have been more frequent in the last decade (2004-2014). Soil erosion and landslides have occurred in many places, and flooding has significantly affected lives and livelihoods. Upstream, more flooding events have occurred in the past decade, being approximately twice more frequent than downstream. This is probably because there are more tributaries upstream and more human activity (e.g. farming, dwellings). Storms and cold spells were reported to occur more often downstream than upstream. Interestingly, although in the last decade, landslides have been more frequent in the downstream commune, the annual intensity was higher in upstream areas (a more detailed explanation can be found below).

2.2 Huong Lam Upstream Cluster

Biophysical and socio-economic characteristics

Huong Lam is the upstream commune of the Ho Ho sub-watershed. Based on the 2014 census, the commune has a total population of 6,673 people, equivalent to 1,636 households. The average population density is 400 people km^{-2}. The majority ethnic group is Kinh, accounting for 99.9 percent. The other minority groups include Thái and Tho. The commune covers a total area of 17,156 ha, of which forests accounts for 90 percent. The agricultural area is small but it is the main source of livelihood for local people with peanuts, paddy rice, maize, sweet potatoes, green beans and cassava as the dominant crops. Pigs, cattle, buffaloes and chickens are usually raised by farmers for domestic consumption and generate cash in case of urgent financial need, while *Acacia mangium*, *Aquilaria crassna* and some fruit tree species are grown primarily for cash.

The network of small rivers and streams is dense, flowing through the mountain valleys and connecting to the Ngan Sau River that is 10 km long. There are four dams in the commune (Khe Mui, Cây Sung, Moi Roi, Khe Đập) containing 1.6 million m^3 of water for irrigating 33 ha of paddy rice. The paddy fields have 8 km of mud dikes. All households have electricity, although the electrical wires are still bare so transmission losses remains high. About 70 percent of households use mobile phones. In terms of health and education, the commune has a small clinic, one kindergarten, two primary schools and one secondary school.

The Huong Lam commune receives support from the government's New Rural Development Program, from the Sustainable Rural Development Program (SRDP) funded by the International Fund for Agricultural Development (IFAD) as well as from the UN-REDD program. Local residents participate in collective action activities through membership in the Women's Union, Farmers Union, Youth Union and Veterans Union. Both provincial and district governments provide training to farmers and commune staff on various aspects of rural development including income generation, health care, agriculture, forestry and gender issues. Farmers can access finance mostly from the AgriBank and the Bank for Social Policies.

Land-use and land-cover change

In segregated focus group discussions (FGDs) with men and women, we asked farmers to recall the changes in land-use from 2005 to 2014. They identified five dominant land-uses, of which natural forest was the largest, followed by plantation forest, cropland, residential and paddy rice lands. Between 2005 and 2014, both males and females reported a significant reduction in natural forest area, and a significant conversion to plantation forest. Crop land area remained constant while the residential areas expanded.

Drivers of land-use change

Table 1 shows the drivers of land-use change based on local peoples' recall during FGDs. The area under annual crops declined over the period 2005-2014. According to the male groups, this was due to landslides while the female groups raised the issues of landslides caused by flooding, riverbanks erosion and land conversion. The trend was the same for paddy rice, with landslides and water scarcity as the drivers identified by men, and riverbanks erosion, landslides and drought as the drivers identified by the women. At the same time, the settlement area was increasing as a result of population growth as reported by both male and female groups. Both male and female groups agreed that the area of natural forests was declining due to over exploitation of timber and conversion to forest plantation. However, gender-segregated opinions exist about the causes of land-use conversion. While the male group claimed that the afforestation program drove the conversion of natural forest to plantation forest, the female group emphasised the forest land conversions as a result of forest land allocation to households.

Table 2.1. Drivers of historical land-use changes in Huong Lam commune, Ho Ho sub-watershed (2005-2014)

Initial land-use	Drivers of land-use change	
	According to male	According to female
Annual crop	Landslides	Landslides and riverbank erosion
Paddy	Landslides Lack of water for cultivation	Landslides and riverbank erosion Drought in the second season (May-July)
Natural forests (mostly converted to acacia plantation)	Afforestation plan from district and commune Logging	Forest/land allocation to households Logging

Impacts of land-use change

The decrease in cropland and paddy rice area led to loss of income and food for humans and animals. Rice is the staple food, and yet 30-40 percent of households experience rice shortages for some months of the year. Maize is the main source of animal feed, especially for pigs and chickens but production is also declining. Natural forests are also a source of income for local people, especially in terms of NTFPs, but reduced areas limit the harvesting of valuable forest products. Upstream deforestation and degradation were identified by all local stakeholders and representatives of the Ho Ho hydropower company as the main causes of the low water supply in the river and the dam.

Water resources

Water sources

During interviews, the female and male groups identified seven different sources of water, namely dug wells, artesian wells, streams, rivers, dams, ponds/rain and channels. For daily use, people prefer using water from dug wells and rivers than from any other sources. Water from wells is used mainly for domestic purposes such as cooking, drinking, washing clothes and bathing. Water from rivers, streams and dams is occasionally used for human bathing, but more commonly for animals and for irrigating crops such as vegetables. For making wine, water from wells is used. Both male and female groups said water from rivers and dams is not used for domestic purposes.

Water issues

Both the male and female groups mentioned different water quality problems with all existing sources, in particular, streams, rivers and dams. The quality problems related to bad smell, alum, rubbish and being muddy and were found in the Ngan Sau River, dams and drilled wells (table 2.1). The causes of the problems came from household waste, defoliation and branches remaining in the water after forest exploitation (table 2.2). After logging, defoliation and small branches of trees in the forests are transported by surface run-off to rivers and streams and even to the dam.

Table 2.2. Water quality issues and causes of the problems

Rank	Problem	Location of contaminated water sources	Causes of the problem
1	Bad smell	Ngan Sau River, Ma Cho River, Mui Dam, drilled wells	Household waste, defoliation, branches after forest exploitation, coal
2	Alum	Wells, drilled wells	Coal, rubbish buried underground a long time ago
3	Rubbish	Ngan Sau River, Ma Cho River, Mui Dam	Timber exploitation, defoliation, road construction, household waste
4	Muddy	Wells, drilled wells, Mui Dam, Ma Cho River, Ngan Sau River	Coal, flooding, agricultural activities, road construction, timber exploitation, defoliation

Water quality issues have serious consequences on the livelihoods of local people. Except for dug wells, poor water quality in all water sources can cause animal deaths due to water-borne diseases, animal and human skin problems and poor vegetable quality (cited by women). Both men and women claimed that poor water quality in rivers, streams and dams resulted in a reduction in the rice yield.

Actions to overcome water quality issues

Existing solutions to address water quality issues were mentioned by the local people during interviews, though most were reactive rather than preventive measures. Both groups reported the use of vaccines to treat water-borne skin diseases and some men were reported to use bitter tea to treat skin diseases. In addition, domestic wastes are burnt and buried underground and usually, the women treat dirty water with chlorine as a preventative measure.

Biodiversity

The male and female groups reported benefits of biodiversity (i.e. flora and fauna) to the livelihood such as for food provision, income generation, medicine, building materials and for environmental services such as carbon and water services. Homegardens, plantation forest and natural forest can provide all five of these functions since different species can be found in such land-use types including timber, medicinal plants, rattan and some animals, whereas annual croplands, paddy rice and water surfaces mostly are associated with the food provision function and income generation. Building materials include products from tree species such as *Erythrophloum fordii, Vatica odorata, Sindora tonkinensis* and bamboo. Medicinal trees include *Ardisia silvestris, Anoectochilus setaceus, Andenosma caeruleum* and *Eclipta alba.*

Both the male and female groups claimed that extreme weather events like cold spells, flooding, storms, and drought are most destructive with regard to crop yields and animals. Croplands, residential lands and paddy rice were identified as land-use types affected by all types of extreme weather event. A series of impacts such as serious damage to plots of annual crops, deaths of animals, and fallen trees, were mentioned. The events prevent the significant crop production necessary to satisfy local demand.

Planting crops in the areas less affected by the weather events and cultivating more resistant crops are common ways to maintain crop production. Pruning trees in homegardens and preparing protection areas for animals are examples of adaptive solutions on residential lands. With regard to paddy fields, locals cultivate a variety that can be harvested in a shorter period and plant bamboo along the paddy field borders to restrain landslides from inundating plots. Efforts to control timber extraction from nearby forest was also mentioned as a way to reduce the severity of weather events.

Farming practice

Croplands, residential lands, plantation forest and paddy rice are allocated to individual households through the issuance of Land-Use Certificates (LUC), which stipulate the recipients' land-use rights. The land area varies by household, but on average, one household can own 1,500 m^2 of cropland for cultivating peanuts, green beans and maize. The area is the same for paddy rice but paddy rice is cultivated in two seasons annually. In addition, each household is allocated 1,000 m^2 of residential area. Home gardens are a common feature in residential areas wherein farmers usually have a number of fruit trees and vegetables for home consumption. Natural forests are managed by the State Forestry Enterprise (Chuc A Company) and the State Forest Protection and Management Board (Ngan Sau PFMB). The average land holding for planted forest is 30,000 m^2 (or 3 ha) per household. The water surfaces are managed by the commune as a common pool resource.

Rice, sweet potatoes, cassava, taro, maize and green tea are the major products for domestic use, whereas peanuts, fruit trees and timber species are grown for income generation (table 2.3). Male groups considered bananas as an income source but females considered it for domestic use. The timber species of acacia, agarwood and *Dalbegia tonkinensis* were identified as providing income. Acacia can produce a profit after 6-7 years whereas the other two species need a longer time of about 10-15 years.

Table 2.3. Different farming systems and products for domestic consumption and income generation

Farming system	Male Perception		Female Perception	
	For income generation	For domestic use	For income generation	For domestic use
Annual crops (3-5 months)	Peanuts, maize and green beans	Rice, sweet potatoes	Peanuts, green beans	Maize, sweet potatoes, rice
Annual crops (6-12 months)	Bananas	Cassava, taro		Taro, bananas, cassava
Perennial trees	Pomelos, oranges, acacia, agarwood	Green tea, jack fruit	Acacia, agarwood, *Dalbegia tonkinensis*, pomelos	Oranges

Shocks, exposure, response and impact

Exposure to extreme weather events

According to local knowledge, in the last decade (2004-2014), storms have occurred more often in the upstream than in the downstream commune (fig 2.3a). An inverse trend was observed for landslides. Landslides across the years were clearly more frequent downstream than upstream. The location of the Ho Ho Dam in the upstream area most likely induces more landslides to occur in the downstream commune. For other extreme events like drought and cold snaps, no clear difference in occurrence across years was found between the two communes (fig 2.3a). Flash flooding was slightly more frequent in the upstream commune.

On average, four flooding events occurred upstream within the affected years (fig 2.3b). This is almost double the frequency of flooding events in the downstream commune. More river streams upstream and their proximity to locals' residences most likely were responsible for the more frequent flooding occurrence according to the local people. Annual storms and cold snaps were reported to be more frequent downstream than upstream (fig 2.3b). Interestingly, although in the last decade, landslide events were more frequent downstream, the annual frequency was higher upstream (fig 2.3b). This can be related to the steeper slopes being located in the upstream commune.

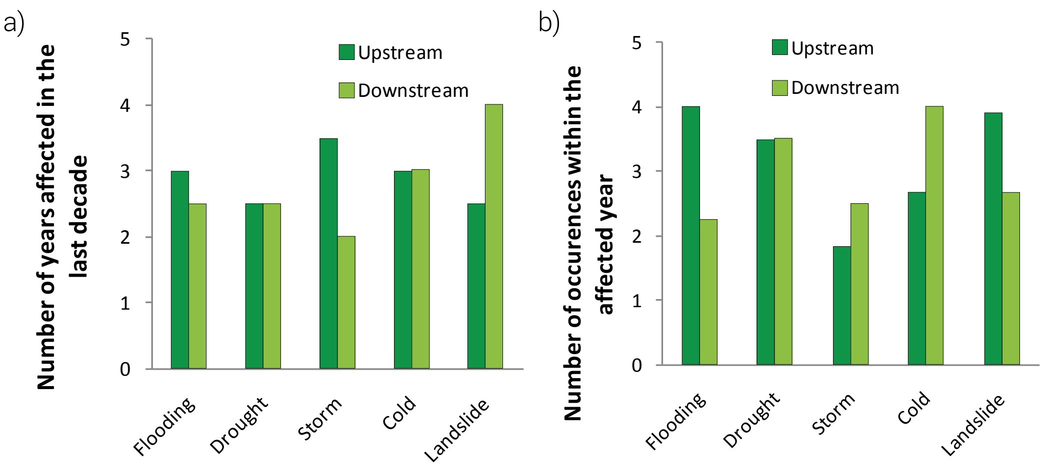

Figure 2.3. Number of extreme event years in the last decade (2004-2014) (a) and average occurrence of those extreme events within the affected years (b) according to local knowledge in Ho Ho sub-watershed, central Viet Nam

Sensitivity to extreme weather events

The effect of flash flooding on households was reported to be more severe in the upstream than the downstream commune (fig 2.4a). This is not surprising since flash flooding was more frequent during the last decade and more frequent annually upstream. Storm and landslide events affected more households downstream than upstream (fig 2.4a). The presence of the Ho Ho Dam on the upper side of the downstream commune can explain the stronger impact of landslides on the local people.

Flash flooding and landslides caused serious damage to plots of annual crops downstream (fig 2.4b). On average, about 82 and 70 percent of the total area of annual crops in the downstream commune were damaged each time by flash flooding and landslides, respectively. This is also related to the location of the Ho Ho Dam on the upper side of the downstream commune.

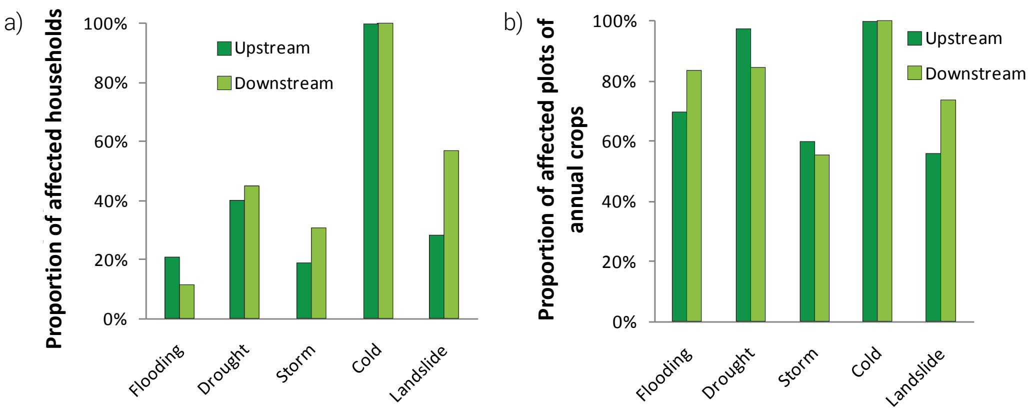

Figure 2.4. Average relative number of households (a) and plots of annual crops (b) affected by extreme events like flooding, drought, storms, cold snaps and landslides in the last decade (2004-2014), according to local knowledge in the Ho Ho sub-watershed, central Viet Nam

Role of trees in livelihood and environmental functions

In the upstream commune, both males and females mentioned two roles for trees with regard to livelihood (fig 2.5a,c) and five for environmental services (fig 2.5b, d). For the food provision function, no differentiation was made between food for humans and livestock. In the female group, these roles were assessed for each of three systems of annual crops (i.e. rice, peanuts and maize), two tree monoculture systems (i.e. acacia and agarwood), and one mixed system (i.e. agroforestry system with agarwood and taro or cassava as understorey) (fig 2.5a, b). With the males, annual crop systems consisting of green beans as well and pomelos, acacia and agarwood as tree monoculture system (fig 2.5c,d) were considered. The male group did not specify any mixed system.

The female group valued acacia as a good source of income but not agarwood (fig 2.5a) because at the time of the interviews, the agarwood trees were still young and not in their productive stage—generally 7 years are required before harvesting acacia timber whereas it is 15 years for agarwood. The group reported a higher appreciation for the agroforestry (AF) system with agarwood most likely due to the good profit made from the understorey (i.e. taro or cassava). The role of trees in food provision was low, as expected.

The female group considered annual crops to be inferior in providing environmental services, except for maize (fig 2.5b). This crop occupied a larger area than the other two crops and its root biomass was returned to the soil as mulch. For trees, acacia was valued more highly than agarwood most likely related to the relative land areas involved. The average land holding area per household (i.e. average for both upstream and downstream) is 0.1 ha for paddy, 0.13 ha for annual crops, 0.15 ha for the homegarden, and 1.3 ha for acacia plantation. Most agarwood was planted in the homegarden. The AF system with agarwood received higher scores than did agarwood monoculture (fig 2.5b). The good perception regarding the environmental service function was likely due to the presence of an understorey.

In contrast to the female group, the male group considered annual crops as a more important source of income than trees (fig 2.5c). This might have been related to the task allocation between males and females in the family—in 82 percent of the 200 sampled households, selling activity was handled by women. Late harvesting resulted in a low appreciation for agarwood as a source of income generation. Surprisingly this was also the case for pomelos. For the environmental service functions, except for soil improvement, the male group clearly identified trees as playing a better role than annual crops (fig 2.5d).

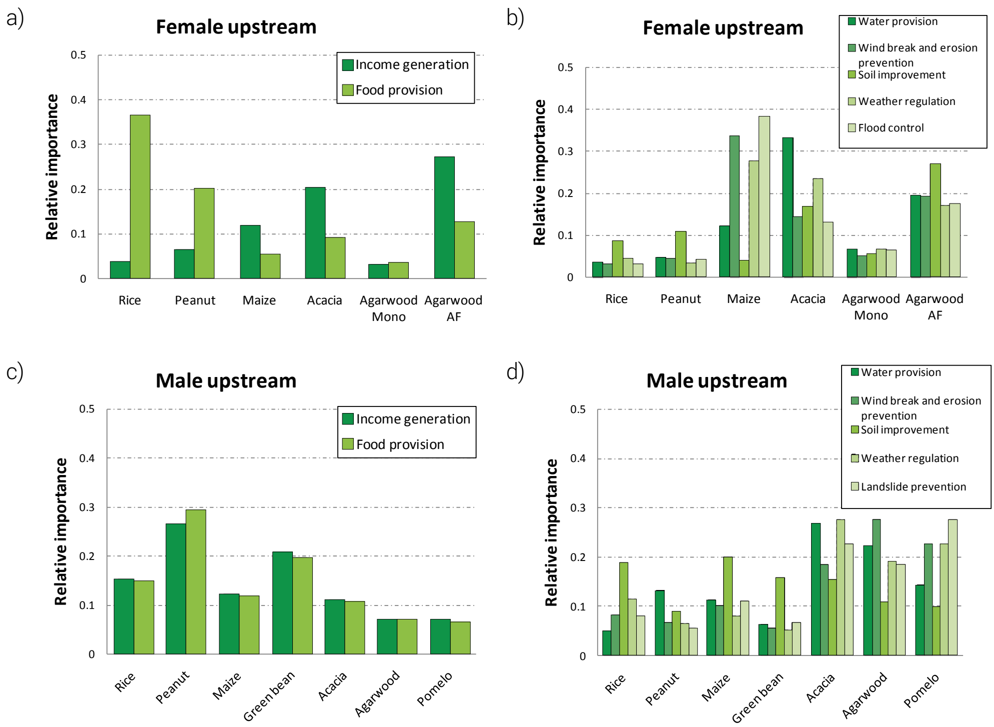

Figure 2.5. Role of trees in livelihood and environmental services based on the local knowledge of female and male groups in Huong Lam (upstream) commune. *The two groups provided a different list of annual crops and tree-based systems in the commune (X-axis). The relative importance was calculated based on the AHP (Analytic Hierarchy Process) method.*

Extreme weather events and impacts

Table 2.4 shows the most common natural hazards (extreme weather events) that had occurred in the area over the last decade (2004-2014) and their impacts on the local people. Both the male and female groups reported problems as the impacts of the natural hazards ranged from external damage such as plot damage, to more serious problems such as disease and even causing some deaths.

Table 2.4. Extreme weather events and impacts on the local people

Climate-related hazard	Impact on local people	
	Male perception	Female perception
Landslides	• Damage cultivation lands • Lose food and furniture	• Damage cultivation lands • Lose products—rice and crops (maize, peanuts, beans)
Flood	• Affect productivity, outputs of cash crops (beans, peanuts) • Reduce income • Land degradation • Disease (human and livestock) • Pollution (rubbish, dirty water) • Affect next crop (fungi and soil becomes more acidic/high alkaline content) • Lack of clean water	• Lose rice and crops in the field • Lose houses • Lose furniture • Lose food at home • Livestock death • Livestock disease (i.e. diarrhoea) • Human disease (skin disease and red eyes) • Lack of water for daily use • Human death
Cold	• Plants and poultry die • Rice and peanuts have to be germinated twice, even three times • Human health (respiratory disease) • Cattle health (swollen feet) and some deaths	• Cattle die • Crops are not well developed and reduced productivity • Re-germination of crops (rice and peanuts) • Human health (coughing)
Storm	• Lose houses • Lose roof • Trees broken • Cattle death (due to lightning)	• Lose houses (roof) • Human injury • Lose roofs • Timber trees broken • No electricity
Drought	• Lack of water for daily use • Lack of water for irrigation • Lose products of trees/crops (trees and crops die) • Cattle die • Cattle don't grow well • Human health (heatstroke)	• Lose products of rice and crops • Disease in cattle (distension) and poultry (flu) • No water for daily use • Lands become uncultivable
Tornado	• Lose house roofs • Trees broken	• Loss cultivation lands • Loss products (especially rice)

Local people used vaccination for humans, cattle and poultry before and after the extreme weather events. They also purified water, dug wells deeper, sourced their water from other houses and from the rivers and streams for daily water needs. They planted bamboo along the rivers to reduce landslides. Related to recovering after the damage, people bought new furniture, restored the house roof, or tried to build a higher house floor. However, the extent of this recovery depended on their financial and labour capital.

Strengths, weaknesses, opportunities and threats

Figure 2.6 shows the identified strengths, weaknesses, opportunities, and threats analysis (SWOT) based on the FGDs with local farmers. The participants were representatives of various stakeholder groups in the cluster including village leaders, key farmers in the villages, Farmers' Union, Women's Group, Youth Union and the Agricultural Extension Unit.

The Upstream Cluster had strengths especially related to social organisation, external work opportunity and electricity. The social organisations contributed to increased people's awareness through training and development activities as well as infrastructure enhancement with the SRDP for instance. External work opportunities included working as labourers for logging companies or trading with a foreign party like the Laotians. The locals also highly valued the provision of electricity in the commune.

The weakness aspect included no nursery, poor sanitation, quality of canals and ditches, no savings, floods and drought. Local people claimed a lot of canals and ditches were not functioning, the commune was exposed to extreme weather events, especially floods and droughts that hampered cultivation between July and October. The poor sanitation was induced by the local habit of still throwing garbage into the river. No savings related to the fact that it was not a habit, partly due to unstable and low income.

Opportunities related to agroforestry and fruit tree planting in homegardens. Farmers were open to ways of improving the quality of their homegarden such as planting different fruit tree species combined with an understorey or annual crops. The local government is also implementing a program for livestock and agriculture via the New Rural Development Program by providing seed or loans. Agroforestry systems were considered as ideal practice to integrate all those components for product diversification and income stability, as well as maintaining environmental functions.

The threats for the commune come from the impact of extreme weather events like flooding and drought that take place annually. Drought occurs between May and July preventing crop cultivation in many areas. Farmers also expect to have more suitable crops to cultivate as adaptive response to climate change and variability.

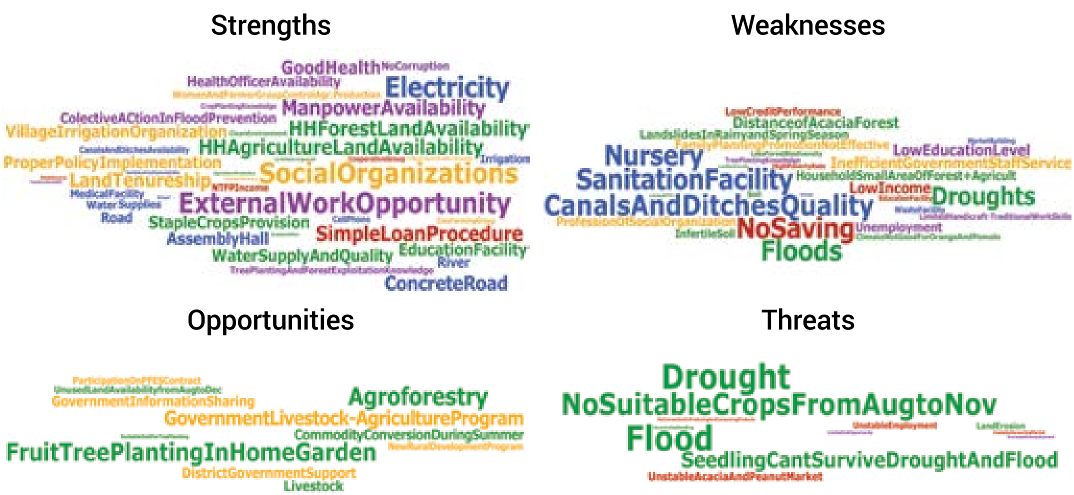

Figure 2.6. Stakeholders' perceptions of strengths, weaknesses, opportunities, and threats in Huong Lam Cluster (note: bigger fonts represent stronger perceptions, font colour representation of livelihood capital: green = natural; blue = physical; red = financial; orange = social; purple = human)

2.3 Huong Hoa Downstream Cluster

Biophysical and socio-economic characteristics

Huong Hoa is a commune located downstream in the Ho Ho sub-watershed. Based on the 2014 census, the commune has a total population of 3,895 people or 815 households. The annual population growth is about 0.9 percent. The average population density is 32 people km^{-2}. The major ethnic group is the Kinh with only one household belonging to the Mường ethnic group. People of a productive age account for 61.7 percent of the total population. Agricultural (e.g. paddy rice, annual crops) and forest (planted forest and natural forest) areas cover 10,506 ha or 93.5 percent of the total area. The main agricultural products consist of peanuts, paddy rice, maize, sweet potatoes, green beans, cassava and fruit trees. Pigs, cattle, buffaloes and chickens are usually raised for domestic use and generate cash in case of urgent financial needs; while *Acacia mangium*, *Aquilaria crassna*, and some fruit tree species are grown primarily for cash.

There are seven small dams in the commune which provide water to the commune, of which, two dams provide clean water for daily use. Household water reticulation is via a 10-km-long pipe. The two big rivers, Ngan Sau and Rao Boi, with a dense distribution of tributaries, flow through the commune. All households have access to electricity with five electrical sub-stations in the commune. About 80 percent of households use mobile phones. The education system comprises a kindergarten, a primary school and a secondary school.

The commune receives support from the government's New Rural Development Program and from the Sustainable Rural Development Program (SRDP) funded by the International Fund for Agricultural Development (IFAD). Local residents participate in collective action activities through membership of the Women's Union, Farmers Union, Youth Union and Veterans Union. Both provincial and district governments provide training to farmers and commune staff on various aspects of rural development including income generation, health care, agriculture, forestry and gender issues. Farmers can access finance mostly from the AgriBank and the Bank for Social Policies.

Land-use and land-cover change

As in Huong Lam, the FGDs revealed five dominant land-uses, of which natural forest was the largest, followed by plantation forest (i.e. mostly acacia plantation for pulp industry), cropland, residential and paddy rice lands.

Drivers of land-use change

Local people identified three major drivers of land-use change, namely landslides, over logging and land allocation (table 2.5). Between 2005 and 2014, large areas of natural forest were converted to plantation forest. The area of cropland reduced over time due to severe landslides or conversion into paddy rice. More settlements were established due to population growth. According to the male group, the area of paddy rice reduced because of landslides, On the other hand, the women group claimed that the area of paddy rice had increased due to conversion from maize and the yield increase had been triggered by the improved irrigation system. The women identified that the reduction in natural forests was initially due to over logging that transformed the forests into poor (or logged-over) forest and bare land and then the State Forest Enterprise allocated the lands to communes and households for plantations.

Table 2.5. Drivers of historical land-use changes in Huong Hoa commune, Ho Ho sub-watershed (2005-2014)

Initial land-use	Drivers of land-use change	
	Male Perception	Female Perception
Annual crop	• Landslides from the hydropower • Lack of water for irrigation	• Flash floods causing landslides and riverbanks erosion and destruction of annual crop plots • Low economic value per land unit
Paddy	Landslides from the hydropower	As contrary to men, women groups claimed increase in paddy areas converted from maize due to better irrigation system in the village)
Natural forests (mostly converted to acacia plantation)	• Afforestation plan from district and commune • Logging	• Forest/land allocation to households • Logging

Impacts of land-use change to livelihood

A change in the paddy area mainly affects local consumption and food security and in the maize area affects food supply for livestock. Both male and female groups reported that the conversion from poor natural forest into plantation forest is an opportunity for them to generate income mainly through establishing acacia plantations. Unlike any other timber tree species, acacia is supported by an established market-value chain. According to both groups, plantation forests and homegardens bring some benefits such as aesthetics and providing function for water regulation, flood prevention and landslide prevention.

Water resources

Water sources

As in Huong Lam, the local people identified seven different sources of water and had the same habits in using water from dug wells and rivers for daily use and water from rivers, streams and dams for human or animal bathing and for irrigation. Differences between the female and male groups existed where women claimed that people still needed water from dams, ponds or rainfall and channels for daily consumption but men did not make that claim.

Water issues

The water quality problems related to alum, a bad smell and dirty and muddy water. In cases of contamination, the local people needed to find water from other places to satisfy domestic demand. Water purification was also undertaken. The use of contaminated and dirty water for irrigation caused a reduction in wine production and also fish production resulting in reduced sales of both products. Contaminated water also induced a decline in vegetable and rice productivity. Shortages of the two products was compensated by buying in the local market to fulfil domestic consumption.

Table 2.6. Water quality issues and causes of the problems

Rank	Problem	Contaminated water sources	Causes of the problem
1	Alum	Streams and dug wells	Mud underground, defoliation, remaining branches/ leaves after logging
2	Stink	Dug wells, Rao Boi River, Ngan Sau River	Leaves under the water for a long time, human waste, mud underground
3	Defoliation	Streams	Defoliation, remaining branches after logging
4	Limestone	Dug wells	Soil formation characteristics
5	Human waste	Rao Boi River, Ngan Sau River	People throw litter or animal corpses into the rivers

Actions to overcome water quality issues

The Local people used vaccinations to cure skin diseases both for humans and animals. Men sometimes used boiled bitter tea as bathing water to cure their skin diseases. They burned waste and rubbish or buried it underground. Interestingly, men could not state any solution to address the shortage of water for irrigation, while women had some solutions like improving the ditches, planting more acacia trees and protecting the remaining forests.

Biodiversity

Both the male and female groups recognised five main functions of land-use, namely food provision, income generation, medicinal provision, material provision and environmental services. Food sources for humans included rice, taro, cassava, fish and prawns; whereas maize and cassava were used for livestock. Income sources from croplands included sales of peanuts and green beans, acacia timber from plantation forest and timber from trees such as *Erythrophloum fordii, Vatica odorata* and *Sindora tonkinensis* and some animals such as weasels and birds from natural forests. Some medicinal plants from natural forest were identified—*Ardisia silvestris, Anoectochilus setaceus, Andenosma caeruleum* and *Eclipta alba*. Environmental services and protection included water regulation, flood prevention, landslide prevention and micro-climate regulation.

Farming practice

Natural forest and water surface areas are managed by the commune or State Forest Enterprise, whereas other land-use types are managed by individual households. As in Huong Lam, croplands, residential lands, plantation forest and paddy rice are allocated to individual households through the issuance of Land-Use Certificates (LUC), which stipulate the recipients' land-use rights. The average land holding area for paddy rice was about 1,500 m^2 and farmers can cultivate paddy for two seasons per year. The average area of cropland was 2,000 m^2 per household and was used to cultivate peanuts, green beans and maize. Residential land was about 1,200 m^2 including homegardens with fruit trees such as jack fruit, chinaberry, oranges, pomelos and bananas, as well as vegetables. The area of plantation forest was about 4 ha per household. Some households with a better labour force, financial capital and experience managed larger forest plantation areas of about 10-15 ha per household. However, these made up only 5-7 percent of total households in the commune.

The dominant crops in the commune were sweet potatoes, rice, maize, cassava and taro for daily consumption or livestock feed, whereas perennial trees and peanuts were grown to generate income. Women reported some other commodities for domestic consumption that included jackfruits, mangos and longans. Although *Aquilaria crassna* and *Dalbegia tonkinensis* were ranked as important commodities, the trees were not at a productive stage. Local people obtained information from other communes indicating these trees can give higher profit.

Table 2.7. Different farming systems and products for domestic consumption and income generation

Tree farming system	Male		Female	
	For income generation	For domestic use	For income generation	For domestic use
Annual crops (3-5 months)	Peanuts, maize, green beans, sesame	Sweet potatoes, rice, vegetables	Peanuts, maize, green beans	Rice, sweet potatoes, maize
Annual crops (6-12 months)	Bananas	Cassava, taro	Taro, bananas	Cassava, taro
Perennial trees	Acacia, *Aquilaria crassna, Dalbegia tonkinensis,* oranges, green tea, pomelos, jack fruit, rubber	Oranges, green tea, pomelos, jackfruit	Pomelos, oranges, acacia, agarwood, chinaberry	Jackfruit, mangoes, longans

Shocks, exposure, response and impact

The role of trees to livelihood and environmental functions based on local knowledge

The female group in the Downstream Commune differentiated the food provision function between humans and livestock (fig. 2.7a). However, they listed fewer environmental service functions than the male group. As with the Upstream Commune, the female and male groups identified slightly different types of annual crops and tree plantations and only the female group identified the presence of mixed systems. Downstream, agarwood is usually combined with peanuts, maize or beans as an understorey. The female group clearly valued tree-based systems more highly than annual crops both for income generation and environmental service functions (fig. 2.7a, b). Interestingly, unlike upstream, a high appreciation for income generation was also given to agroforestry systems with agarwood. Agarwood trees downstream were not planted earlier than upstream, which meant that the female group probably had a better appreciation of this tree species based on “knowledge” rather than “current source of income”. They knew that in the future, agarwood could provide a high income from collected latex and wood.

The female and male groups had different perceptions of the role of trees in income generation. Like upstream, the male group downstream perceived that a better income could be obtained from annual crops than from trees (fig. 2.7c). The female group saw things the other way round. From an environmental aspect, both groups generally considered trees to have better environmental services, with the exception of the soil improvement function (fig. 2.7d).

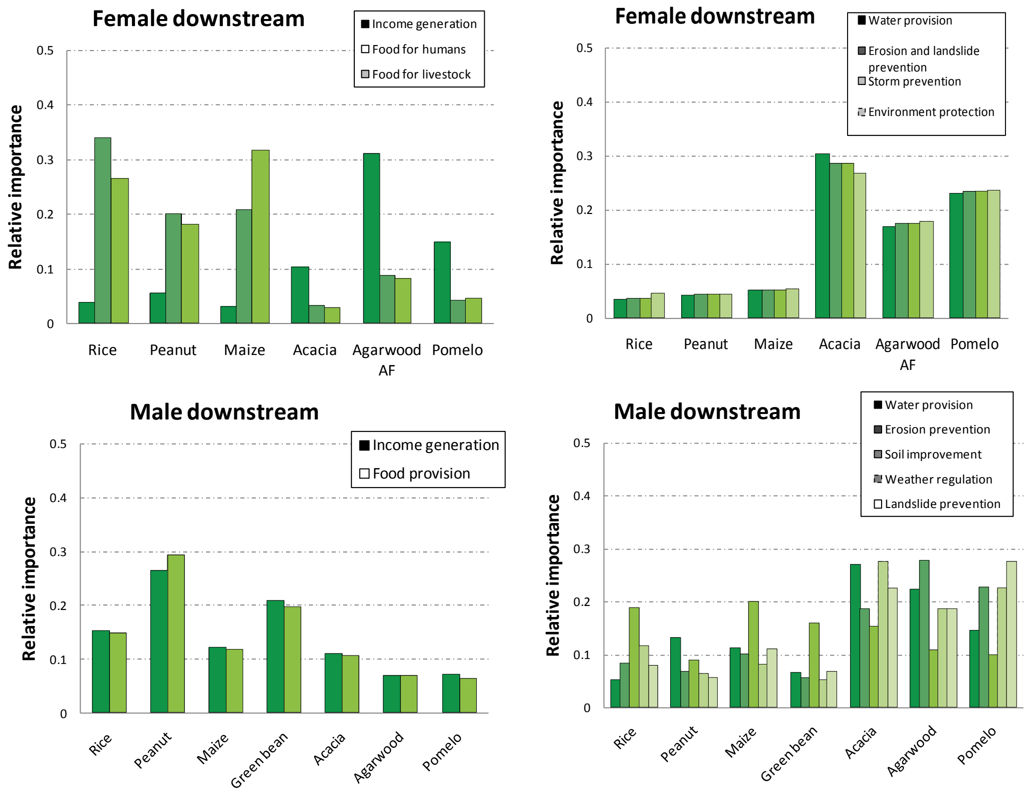

Figure 2.7. Role of trees in livelihood and environmental services based on the local knowledge of female and male groups in Huong Hoa (downstream) commune. The two groups provided a different list of annual crops and tree-based systems in the commune (X-axis). The relative importance was calculated based on the AHP method

Extreme weather events and impacts

Local people identified floods, droughts, cold spells, landslides, tornados and storms as major extreme weather events which resulted in a wide range of impacts. As in the Huong Lam commune, both the male and female groups reported problems from natural hazards that ranged from external damage such as plot damage, to more serious problems like diseases and even some deaths.

Table 2.8. Extreme weather events and impacts on the local people

Hazard	Impact	
	Male	Female
Flood	Houses flooded Agricultural lands lost Crops lost Cattle diseases (haemorrhagic septicaemia) Lack of water for daily use	Lands lost Stone sedimentation Furniture and appliances lost Cattle and crops lost Disease: red eyes, foot-hand-mouth, diarrhoea Pest and disease on crops
Drought	Lack of water for daily uses Lack of water for irrigation Reduction of crop productivity Human health (heatstroke) Livestock diseases	Rice and crops lost Lack of water for daily uses Human health (fever and red eyes) Livestock diseases (mouth and foot) Daily life activity is interrupted

<table>
<tr><th rowspan="2">Hazard</th><th colspan="2">Impact</th></tr>
<tr><th>Male</th><th>Female</th></tr>
<tr><td>Storm</td><td>Roof lost
Acacia trees broken
Reduced maize productivity
Infrastructure damaged
Human injury</td><td>Lose roof
Lose crops and food in the field
Food at home gets wet
Lose cattle and poultry
Big trees broken
People injured
Lack of water for daily use</td></tr>
<tr><td>Cold</td><td>Cattle die
Lose rice seed
Reduce productivity of rice and maize
Human health (children and elderly)
Livestock does not grow well</td><td>Rice dies
Cattle die
Livestock diseases (foot and mouth)
Human health (lung problems in children and rheumatism in elderly)</td></tr>
<tr><td>Landslide</td><td>Cultivation lands
Acacia
Peanuts and rice crops lost</td><td>Lose cultivation land
Lose crops</td></tr>
<tr><td>Tornado</td><td>Destroy annual crops (rice, beans, peanuts, maize)
Reduce productivity (maize)
Damage infrastructure
Lightning</td><td>Lose roof
Lose crops (rice, beans, peanuts, maize)
People injured</td></tr>
</table>

Extreme weather events and local responses to the impacts

To reduce the impact of extreme weather events, the local people used vaccination for humans and livestock, dug wells deeper, adjusted the farming calendar, kept animals in sheds and remained alert regarding the weather or information about it. To recover after events, farmers rebuilt houses, fixed the roof, bought new furniture, and replanted rice or annual crops. However, as with the case in Huong Lam, the extent of this recovery depended on their financial and labour capital.

Strengths, weaknesses, opportunities and threats

Strengths in the Huong Hoa commune related to man power availability, social organisation, the dam and electricity (fig. 2.8a). Every household had 2-3 family members of a productive age who were hard-working. Farmers also showed their understanding of the role of trees in the landscapes to preserve water for irrigation. Well-established social organisations such as the Unions of Farmers, Women, Youth, and Veterans existed in the commune. Through these associations, farmers share ideas and interest and increased their knowledge about farming practice and techniques. The government also allocated land to households for management and production, providing land ownership. Hence, farmers were confident to cultivate long-term species and earn more income from forest plantations. Simple loan procedures, for example from the AgriBank or the Bank for Social Policies, encouraged farmers to develop agricultural systems and production.

Flooding, unstable income and high bank interest were the main weaknesses. Flooding occurs during the rainy season every year (August-October). It destroys large areas of paddy field and annual croplands. The farmers' income mainly depends on agricultural and forestry production, but production is low and there may be no market. Regardless of the simple procedure for a loan, the bank interest rate remains high, preventing farmers from utilising financial aid. As a consequence, they are dependent on government subsidies.

Opportunities in the commune included homegarden enrichment with fruit trees, understorey and short-term crops. Local people believed that fruit trees like pomelos or oranges can be planted in the commune because the soil and weather condition are relatively similar to Phuc Trach, the neighbouring region that produces pomelos. Farmers also can take advantage of the government policy for rural development that includes support for seeds, breeding and financial aid for livelihood improvement. Furthermore, there are also various programs at the district level to support commune development, for example through SRDP programs funded by IFAD. Farmers also listed the Smart Tree-Invest project as an opportunity for them to improve their livelihood and environmental service improvement in the sub-watershed. They expected the project could introduce more suitable practices for tree plantations as well as for crop species.

The biggest threat was extreme weather events, especially the flooding and storms that frequently occur between August and October every year and result in serious damage to annual crops and trees. Drought occurs between June and August preventing crop cultivation during that period. Farmers were aware of the benefits of tree planting but were hampered by the high seedling price and poor quality. Seedlings of desirable tree species such as pomelos, orange, *Aquilaria crassna Pierre*, and *Dalbergia tonkinensis* are not available in the commune, and must be obtained from another commune or district. Another great concern expressed by the farmers is the unstable market for agricultural products. There is not enough demand for local products except for acacia timber. Furthermore, environmental pollution is also a serious problem because of the intensive use of pesticides and herbicides to control plant diseases. A sanitary threat is caused by the habit the local people still have of throwing rubbish into the river.

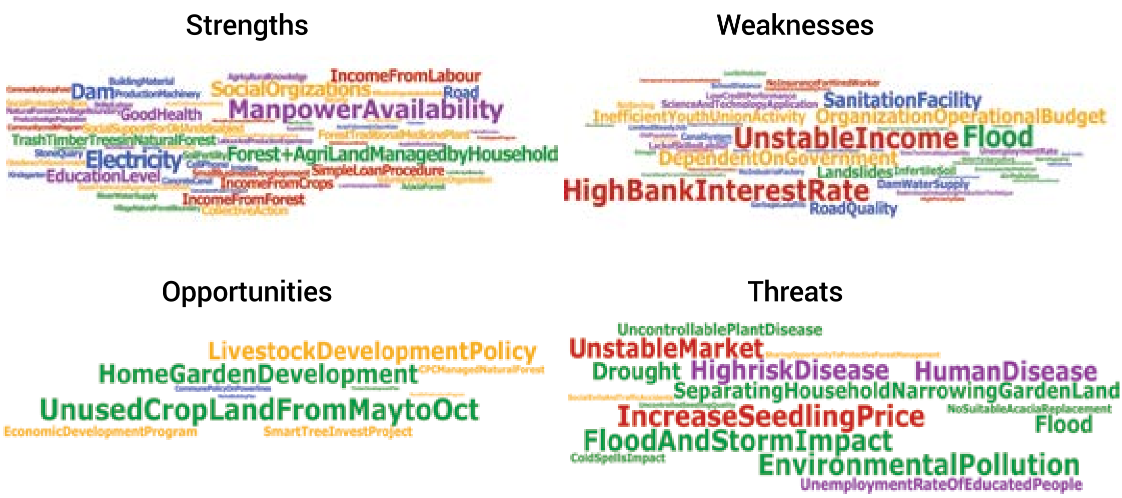

Figure 2.8. Stakeholders' perceptions of strengths, weaknesses, opportunities, and threats in Huong Hoa Cluster (note: bigger fonts represent stronger perceptions, font colour representation of livelihood capital: green = natural; blue = physical; red = financial; orange = social; purple = human)

PHILIPPINES
CLUSTER PROFILE

3. MUNICIPALITY OF LANTAPAN

Kharmina Paola A. Evangelista, Joan U. Ureta, Regine Joy P. Evangelista

3.1 Municipality of Lantapan

Lantapan is a first class municipality in the province of Bukidnon in the Northern Philippines situated within the Mt. Kitanglad mountain range and wholly contained within the Manupali watershed. The whole river system drains into the Pulangui Reservoir which supports the biggest hydropower facility in Mindanao operated by the National Power Corporation. The municipality consists of four urban and 10 rural villages and has a total land area of 35,465 ha. It has an elevation ranging from 320 to 2,938 m above sea level with 70 percent of the area having slopes greater than 10 percent. Its climate is classified as Type IV where the rainfall is evenly distributed during the whole year. The average monthly rainfall is 224 mm. Its topography is generally rugged and steep in the upper areas while gently sloping in the lower portion. Adtuyon clay is the dominant soil type covering 50 percent of the total area. This type of soil is considered best for agricultural crops which is why more than 50 percent of Lantapan is under agriculture. Figure 3.1 shows the location of Lantapan in Bukidnon in the Southern Philippines.

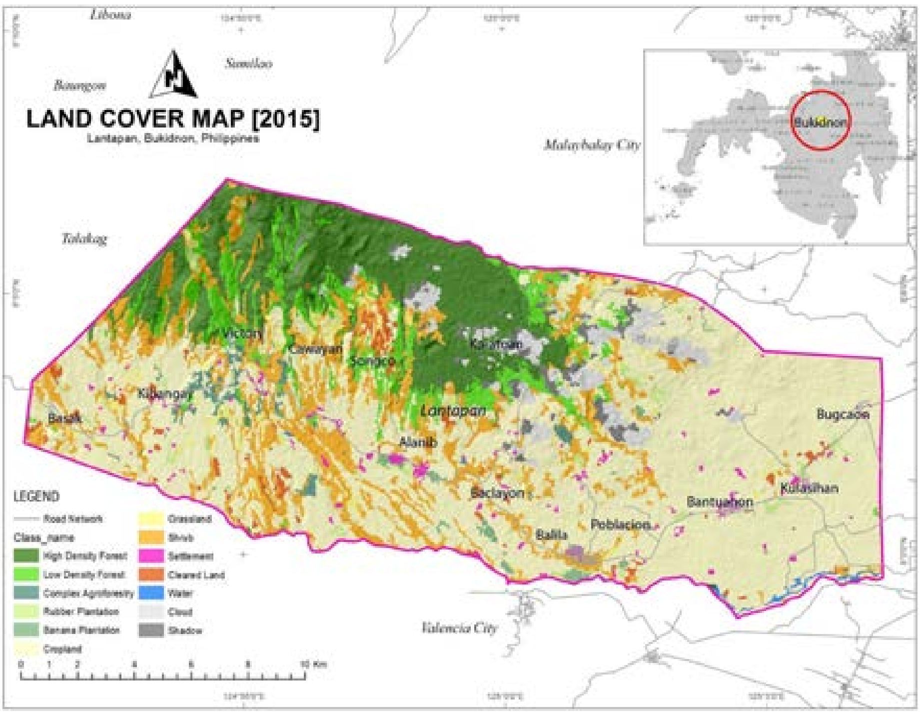

Figure 3.1. Location and land cover map of the municipality of Lantapan in 2015

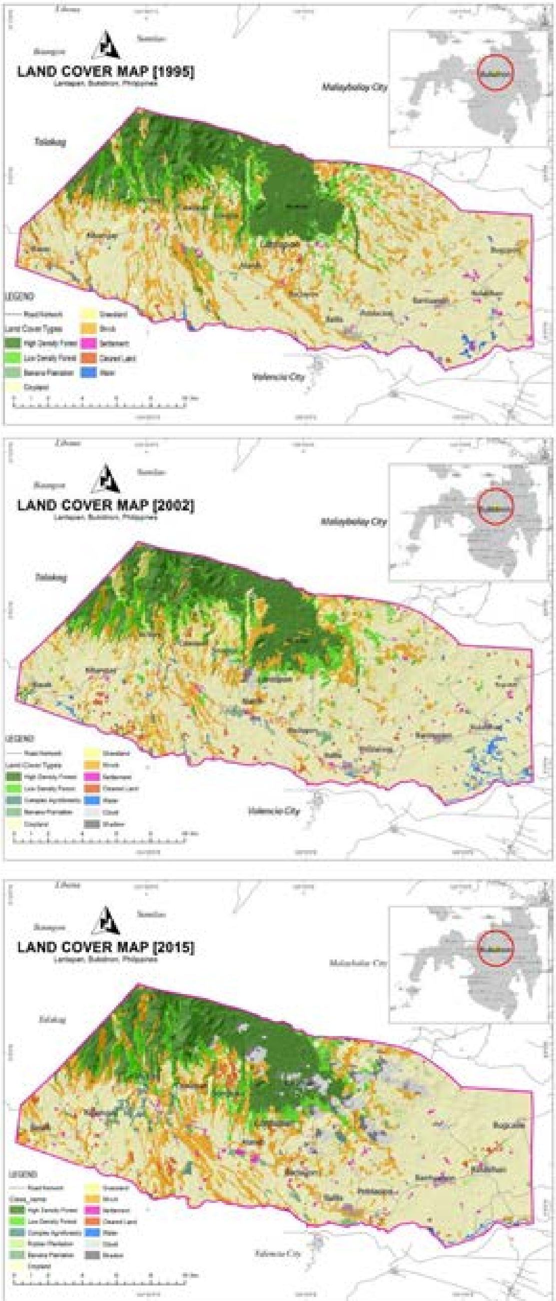

Figure 3.2. Land cover change in Lantapan from 1995 to 2015

In 2012, Lantapan had a total population of 55,934. The natives of Lantapan are the Talaandigs. During the Spanish colonial period and World War II, migrants from the Visayas and Northern Luzon settled in the municipality. Currently, different ethnic groups comprise the population of Lantapan. The productive land of Lantapan has attracted many migrants resulting in an increase in agricultural areas mainly under annual high value crops such as corn, sugarcane and bananas. Figure 3.2 shows the change in land cover in Lantapan from 1995 to 2015.

3.2 Tugasan Sub-Watershed Cluster

Biophysical and socioeconomic characteristics

The Tugasan Cluster covers a total area of 4,879 ha of which 84.5percent is timberland while the remaining 15.5 percent is classified as A&D[1] (Pillerin et al 2010). It is the third largest tributary of the Manupali River in Lantapan. The forestland in its upper portion is within the protected and buffer zones of the Mt. Kitanglad Range Natural Park (MKRNP) and is characterised by rich forest cover. The middle and downstream areas are usually planted with vegetables, corn, coffee and sugarcane (Pillerin et al 2010). This sub-watershed is comprised of two villages, namely Kibangay and Basac and its elevation ranges from 1,000 to 2,700 m above sea level. The population in the cluster is 10,159 based on the 2010 census. Figure 3.3 shows the land cover map of Tugasan Cluster in 2015.

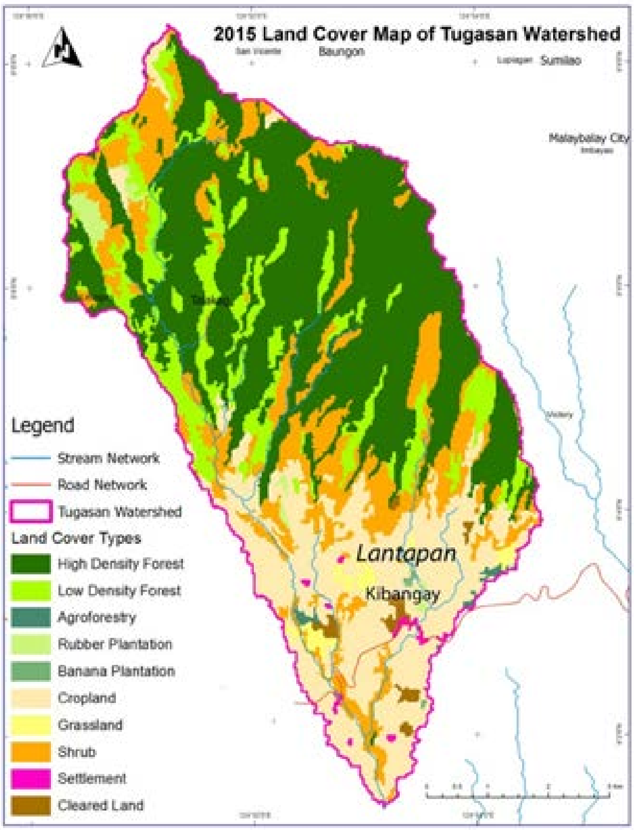

Figure 3.3 Land cover map of Tugasan Cluster in 2015

[1] Alienable and Disposable (A&D) lands refers to those lands of the public domain which have been the subject of the present system of classification and declared as not needed for forest purposes

Land-use and land cover change

Trajectory of land-use and land cover over time

Figure 3.4 presents land cover change in Tugasan for the periods 1995, 2002, and 2015. Based on the results of the object-based image classification in 2015, the majority of the area in the Tugasan Cluster was classified as high density forest accounting for 43 percent of the total area of the sub-watershed. The area decreased by 15 percent from 1995 to 2002 but increased slightly by 4 percent from 2002 to 2015. This can be attributed to the declaration of Mt. Kitanglad Natural Park as a protected area in 2000 and as an ASEAN Heritage Park in 2009. As with the other clusters, farming is the main livelihood in Tugasan.

The total area used for agriculture is 1,212 ha or 24 percent of the total land area of the cluster. The agricultural area includes rubber plantation, banana plantation, agroforestry and cropland. Cropland is the second major land cover type in the cluster accounting for 22 percent of the total land area in 2015. Although the cropland area increased by 9 percent from 1995 to 2002, it had decreased slightly by 15 percent by 2015. Some cropland area was converted into rubber, banana or pineapple plantation from 2002 to 2015; hence the decrease in the area planted with crops. The settlement area increased by 248 percent from 1995 to 2015 mainly due to the increase in the population of native residents as well as due to migrants from nearby cities and municipalities. Employment opportunities from multinational companies have encouraged people from other places to reside in Lantapan.

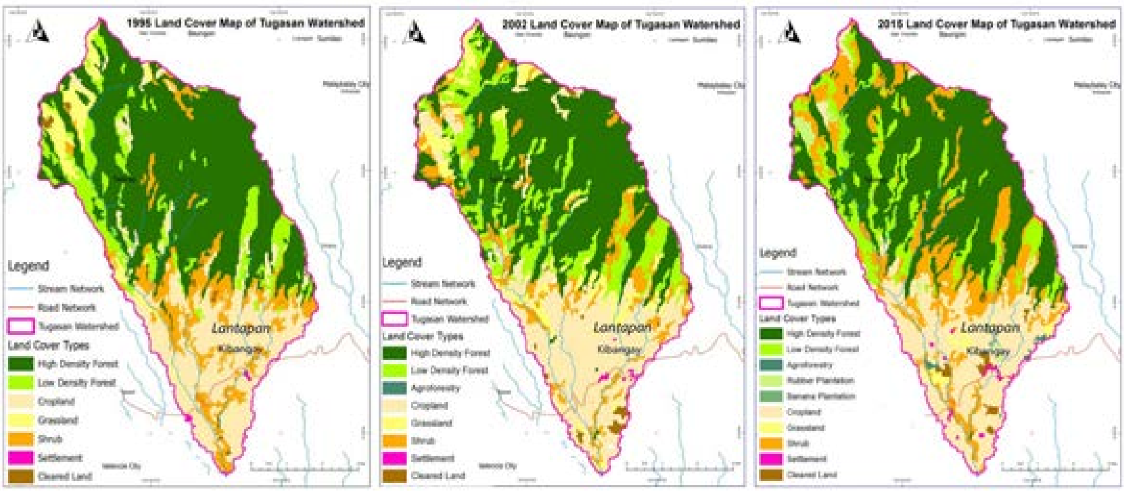

Figure 3.4. Land cover change in Tugasan Cluster

Drivers of land-use change over time

During the focus group discussions, respondents were asked to identify a period in time during which they considered a significant change in land-use had occurred. Comparison of land-use between the 1970s and 2015 guided the discussion. The participants were asked to identify the major drivers of land-use change that they had observed over the last 45 years. For the male respondents, the most influential drivers of land-use change (LUC) were (1) increase in demand for sugarcane, (2) need for a better source of income, (3) shift to crops with shorter cropping season, (4) need for a more sustainable source of food and (5) shift to species that can be used for other purposes such as firewood and building materials.

The female respondents considered the most influential drivers of land-use change were (1) need for a better source of income, (2) increase in price of sugarcane, (3) Increase in demand for a commodity, (4) shift to crops with shorter cropping season and (5) need for a more sustainable source of food. It can be noted that most of these drivers are mainly driven by the desire of the community to improve their lives and well-being and not by natural events.

When asked what land-use changes they would predict in the next 10 years, respondents said that most land-uses will probably stay the same except that 20 percent of the vegetable farms may be converted to settlements if the population continues to increase.

Water resources

Water sources available in the cluster for domestic and other activities

Figure 3.5 shows the sources of water for daily and other uses of male and female respondents per cluster under normal and extreme conditions. A normal condition refers to a state where there is no shock experienced (i.e. extreme rainfall, drought, flooding, etc.) while an extreme condition refers to a state where the community has experienced a shock which affected their source of water thereby affecting their way of living. According to the male group, the community mainly gets water from creeks in Tugasan for daily and farm use during normal conditions while the river is their main source of water during extreme conditions. The creeks are small tributaries of the watershed which supply water to the communities located in the remote areas of Tugasan.

During the prolonged dry season and extreme hot weather, the creeks dry out so the people need to go to the river to fetch water. It is important to note that only the male group mentioned creeks as their source of water while only the female group mentioned mineral/bottled water as the source of water for daily use. The female group said that they no longer got water from the creeks for their daily use because of its quality while the male group said that the water from the creeks was still acceptable even for drinking purposes. For farming needs, the main source of water for both male and female groups under normal conditions was creeks. During extreme conditions, they resorted to getting water from the river instead.

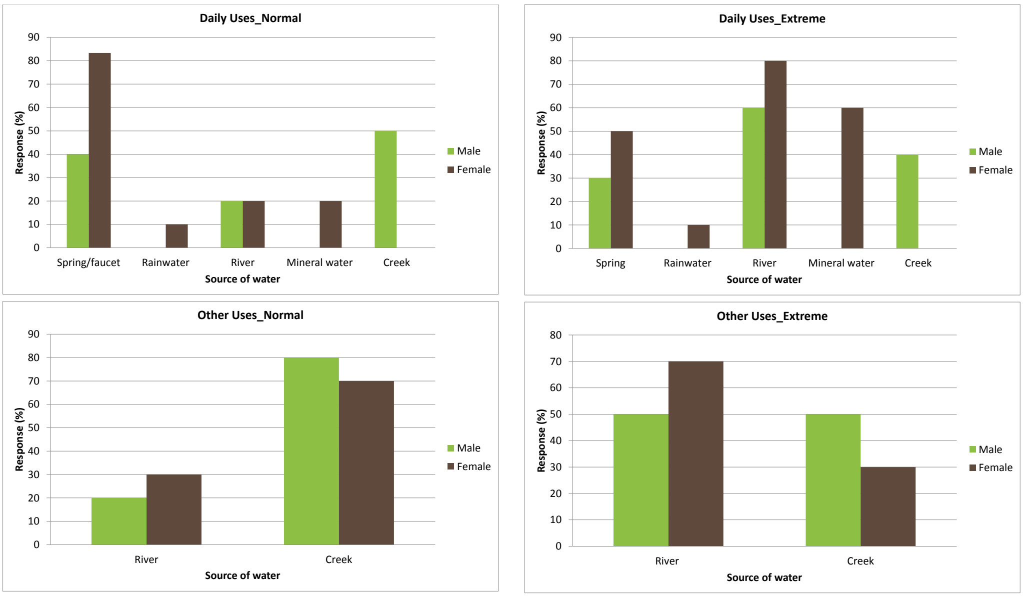

Figure 3.5. Water sources under normal and extreme conditions for Tugasan Cluster

Problems related with water source, domestic and other activities

The respondents were then asked about water-related problems they encountered in their respective sub-watersheds and these were classified into quantity and quality as shown in Figure 3.6. In Tugasan, quantity-related problems were more prevalent than quality-related problems. The male participants reported quantity-related problems in the creeks and springs which were usually dependent on the season. Quality-related problems were observed in the creeks and rivers during the wet season. The main problem identified by the group was flooding along riverbanks, followed by poor quality and then a decrease in quantity.

The female group reported quantity-related problems with all water sources and quality-related problems only with the creeks of Tugasan. The quality problem of water from the creeks meant they did not consider creeks as their source of water in contrast to the male group. The quantity-related problem referred to the decrease in supply during the dry season while quality-related problems pertained to the poor quality of water due to contamination from household wastes and chemical inputs from farming. To date, no water quality assessment has been conducted for the Tugasan River. The residents just assumed that the chemicals from fertilisers and pesticides contaminated the water because many small-scale farms are located along the riverbanks and usually plant corn and vegetables. The main problem identified by the female group in Tugasan was the decrease in the quantity of water attributed to an increase in the temperature in the area and cutting down trees.

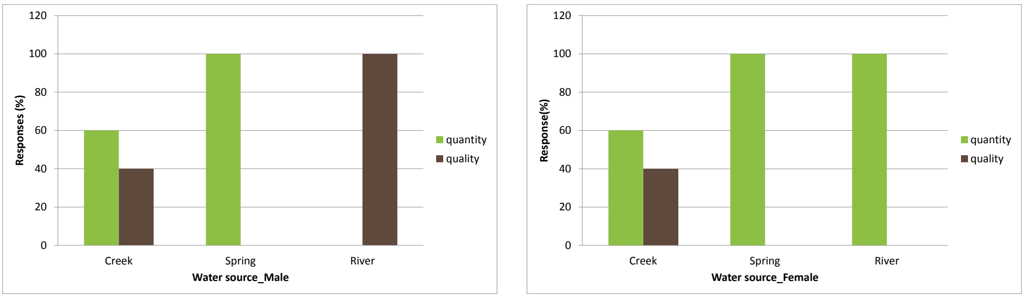

Figure 3.6. Water issues encountered per water source in Tugasan Cluster

Causes of water problems

During the dry season, there was a decrease in the quantity of water flowing in the creeks and rivers of Tugasan. On the other hand, there was regular flooding of the river during the wet season. According to the group, the increased area cultivated for vegetables had resulted in poor water retention capacity by the soil, thus resulting in flooding along the riverbanks. Added to that was the cutting of production trees that had been planted along the riverbanks about 10-20 years ago.

Quality-related problems were attributed to soil erosion and wastes from chemical fertilisers and pesticides. Household wastes were also observed along the creeks and rivers in no particular season. This was mainly attributed to the population increase in the watershed (60 percent), lack of discipline among community members (30 percent), and lack of information, education and communication (IEC) efforts (10 percent). Table 3.1 summarises the causes of water problems as well as the consequences experienced and losses incurred by the community.

Table 3.1. Causes of water issues identified and their corresponding consequences

Problem	FGD Group	Cause of the problem	Consequences	Score*	Non-material losses	Material Losses
Increased incidence of river flooding	Male	• soil erosion due to vegetable farming along creeks • cutting of trees	• loss of top soil (fertile soil) • crop damage • roads access is difficult	5 3 1	• time • joy	- income - crops - animals
Poor water quality	Male, Female	• chemicals used in farming along river • soil erosion from vegetable garden • poor agricultural practices • wastes from domestic activities	• decrease in freshwater species • decrease in supply of drinking water • foul smell • delay in household chores • prone to diseases	5 5 2 3 4	• time • effort	- money - food (freshwater species)
Decrease in quantity	Male, Female	• cutting of trees • farming near the water source • extreme heat	• decrease in water supply for irrigation • have to look for other sources • decrease in water supply for domestic use	5 5 4	• time • effort	- income

*Highest score represents worse consequences of problem to the community

Several adaptation efforts has been applied by the community to cope with the water problems identified. Some of the successful efforts were tree planting, planting of bamboo along riverbanks and coming up with a plan for a dumpsite to minimise wastes. Other efforts which were not completely successful included practising contour farming and organic farming, proper disposal of garbage and chemical waste, raising awareness on waste management and recruiting people to help in community cleaning. The main challenge raised was the lack of discipline among the residents in the cluster in terms of waste disposal and the use of unsustainable farming practices.

Biodiversity

Typology of most common wild species in the cluster

The participants of the FGD on biodiversity identified 40 species of wild plants and 25 species of wild animals that are common in the cluster. As shown in Figure 3.7, most of these species are utilised for various purposes. There are also wildlife species which have been domesticated such as monkeys *(Macaca fascicularis)* and blue-backed parrots (*Tanygnathus sumatranus)*). It was also noted that the participants were able to identify some wild plants which are under conservation (e.g. Hinubayan *(Phyllocladus sp.)*).

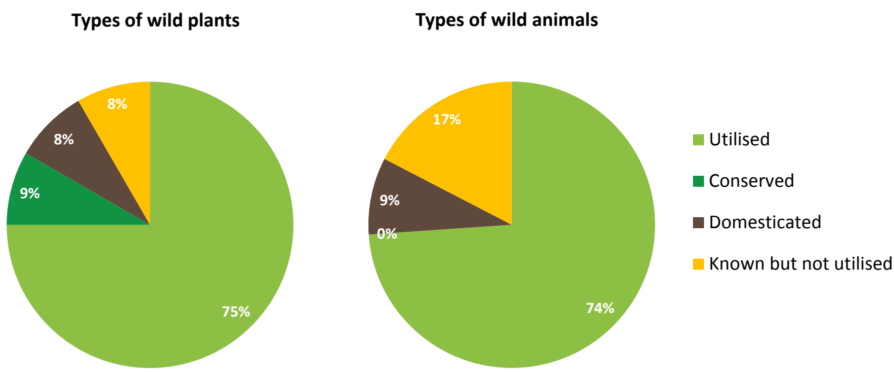

Figure 3.7. Types of wild plants and animals in the Tugasan Cluster

Utilisation of wildlife from different land-uses

As reflected in Table 3.2, male and female farmers identified three types of land-use in the cluster. These serve as habitat for a diverse range of flora and fauna. Wild plants are usually collected for their medicinal values. For instance, *buyo (Cinnamomum mercadoi)* is used for treating coughs and colds. Wild animals, on the other hand, are usually collected for food, for example wild boar *(Sus philippensis)* and the Mindanao fanged frog *(Limnonectes magnus).*

Table 3.2. Number of species utilised by farmers in Tugasan Cluster

Utilisation	Protected area		Agricultural area		Residential area	
	Male	Female	Male	Female	Male	Female
Food	10	13	11	5	1	4
Income source	-	3	-	1	-	-
Medicine	3	4	-	7	-	7
Building materials	-	-	-	1	-	-
Decoration	1	2	-	1	-	-
Domestic use	1	-	-	-	-	-

Utilisation of wild biodiversity was more rampant prior to the declaration of Mt. Kitanglad as a Natural Park in 2000 as the frequency of collection changed when the forest was declared as a protected area. According to the famers, there is currently minimal extraction of wildlife and this is usually intended for personal use. Since destructive activities are not allowed in the protected area where the majority of wild species are thriving, farmers perceived no threats to biodiversity. They even observed an increase in the population of wild animals in 2012-2013 due to the decreased frequency of hunting. Female farmers also highlighted that the population of some wild plants had increased as a result of higher seed dispersal.

Farming practice

Dominant farming systems in the cluster

Crop-based farming is still the most common practice in the cluster with high-value crops as common commodities. The usual annual crops that are being planted in the area are corn, potatoes, squash and tomatoes, among others. Several farmers are also planting perennial crops with the most common being sugarcane. Since the agricultural areas in this cluster are mostly situated at high elevations, the micro-climate is highly suitable for vegetable production. Hence, smallholder farmers usually practise monoculture or multiple cropping of vegetables. They also plant vegetables with corn and bananas. On the other hand, tree-based farms in the cluster are usually planted with timber trees (e.g. species of falcata, gmelina, eucalyptus) or plantation crops (e.g. coffee). They commonly combine these trees with corn. Table 3.3 presents the most dominant farming systems in the cluster based on gender perception.

Table 3.3. Dominant farming systems based on gender perception in Tugasan Cluster

Type of Farming System	Gender perception		
	Male	Female	Both
A. Crop-based			
1. Monoculture			
cabbage, Chinese cabbage, lettuce, white beans	√		
bananas, beans, cassava, sweet potatoes		√	
bell pepper, carrots, corn, potatoes, squash, sugarcane, tomatoes			√
2. Multiple cropping			
bananas- vegetables, corn -squash, lettuce-pechay, sweat peas- corn		√	
broccoli-cauliflowers, cabbages- Chinese cabbages			√
B. Tree-based			
1. Monoculture			
eucalyptus, falcata, gmelina	√		
coffee			√
2. Multiple cropping			
corn-eucalyptus-gmelina-bananas		√	

Benefits of farming systems

All the dominant farming systems in the cluster are sources of cash or livelihood. Based on male farmers, sugarcane and vegetables such as cabbages, Chinese cabbages and squash generate the highest income. Female farmers had the same perception but they included bananas and bell peppers on the list of most profitable commodities. In terms of non-cash benefits, crop-based farms are the usual sources of food. Tree-based farms provide food, building materials and firewood. Table 3.4 shows the benefits that could be derived from farming systems.

Table 3.4 Benefits of the most common farming systems in Tugasan Cluster

Benefit	Crop-based farms (%)	Tree-based farms (%)
Source of cash	100	100
Source of food	100	40
Building materials		60
Energy/Fuel		20
Food for animals	14.27	

**Total number of responses: 19*

Farming system preferences

Figure 3.8 presents the criteria for farming system selection, as well as the most preferred farming systems in the Tugasan Cluster. It is interesting to note that their criteria for farming system selection are all economic-related. ‘High selling price’ and ‘low capital’ are two similar criteria used by female and male farmers in the cluster. However, ‘easy to market’ is still the major consideration of male farmers. According to them, they should be able to sell all their crops to avoid reduced quality due to the absence of post-harvest facilities in the villages. The female farmers favoured planting crops with a shorter growing period to ensure a steady flow of income for the family and a faster return-on-investment.

Monoculture plantation of corn was the most preferred farming system of the male farmers. Considering that corn is the staple food in the area, it was the easiest to sell among the five farming systems identified followed by monoculture plantations of purple yams and cabbages, respectively. Corn plantation also topped other farming systems in terms of low capital or input costs. A combination of cabbages and broccoli yielded the highest selling price. Corn, on the other hand, had the lowest selling price among the farming systems listed. The main considerations of female farmers in deciding which farming systems to adopt were high selling price and low capital. Sweet peas had the highest selling price and the shortest growing period among the commodities identified. They also ranked second in terms of low capital. Monoculture plantation of lettuces, on the other hand, had the lowest capital requirement. It is interesting to note that only two farming systems were commonly preferred by female and male farmers in the cluster—monoculture plantation of corn and intercropping or multiple cropping of cauliflowers and broccoli. This was expected since corn, along with rice, is the staple food of the members of the communities (Rola et al 2007). In addition, the elevation and soil composition of the cluster make it suitable for vegetables like cauliflowers and broccoli to grow abundantly.

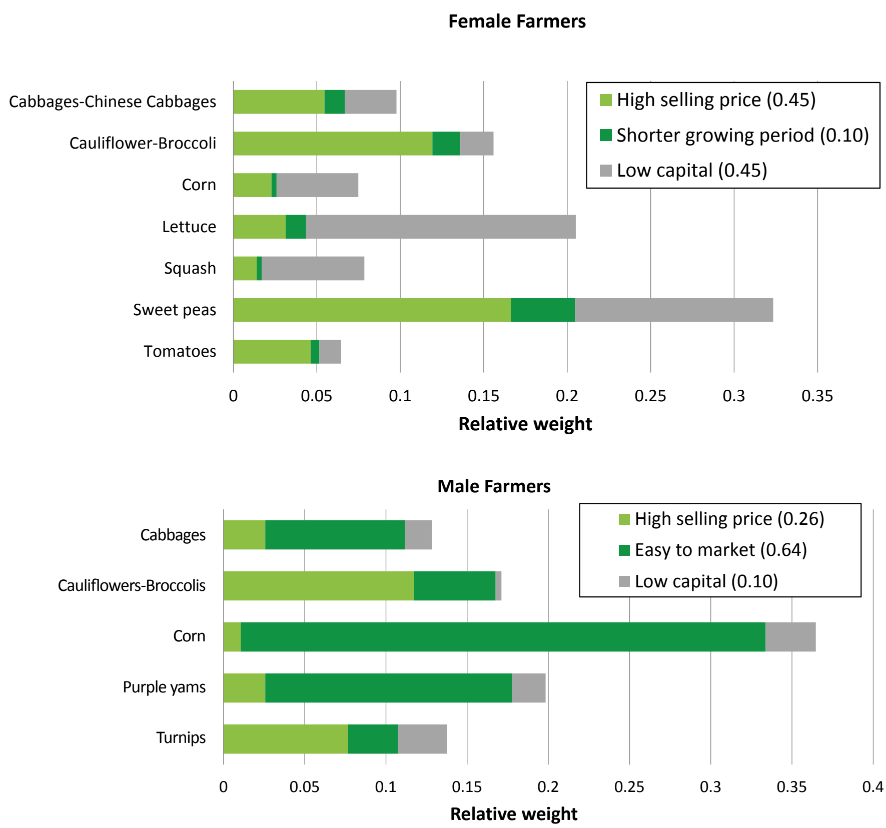

Figure 3.8. Most-preferred farming systems of female and male farmers in the Tugasan Cluster.

Tree species preferences

Most of the selection criteria of the smallholder farmers in the Tugasan Cluster with regard to the major tree species were related to the provisioning services of trees. It is noted though that women considered the regulatory services of trees, specifically soil erosion control, in deciding what trees species to plant. As reflected in Figure 3.9, high income was the main consideration of both female and male farmers. They described this criterion as tree products with a high selling price and low input costs. They argued that timber trees, while having low input costs (i.e. fertilisers, pesticides), have a low selling price which in turn results in a low profit. In addition, both male and female farmers valued the usability of trees as building material. It is also noted that the male farmers greatly preferred trees as a source of food. As the usual provider for the family, men preferred to plant trees that will not just generate income but will also contribute to household food security. Female farmers highly favoured trees which could prevent soil erosion. Considering that most of their farms are located on sloping lands, one of their mitigating measures was to plant trees along farm boundaries to hold the soil and to increase infiltration especially during heavy rains.

The results of AHP showed that lanzones was highly preferred by male farmers in the cluster. Although it was least favoured as a building material, it could generate the highest income and could be used as a food source for the family. They argued that once lanzones becomes productive, it could be harvested annually unlike timber trees which needed to be replanted once harvested. This was also the case for other fruit trees such as rambutan and santol. In terms of timber trees, the most favoured was eucalyptus because of its usefulness as a building material. Falcata, on the other hand, could generate the highest income for farmers among the timber species.

Unlike the male farmers, the females in the Tugasan Cluster highly preferred timber trees over fruit trees. In terms of income generation, species of gmelina and eucalyptus ranked first. It is interesting to note that among the six tree species identified by women, lanzones only ranked fourth in income generation. This was in contrast to the ranking of the male farmers in terms of income. While men tend to look at the income they could derive from multiple harvests, women considered trees as a long-term investment with high gains rather than as a regular source of income. Female farmers also perceived that gmelina is the most appropriate building material followed by eucalyptus and falcata, respectively. Lastly, eucalyptus ranked first in terms of contribution to soil erosion prevention. Among the three criteria used by female farmers in the cluster, fruit trees recorded lower values compared to timber trees.

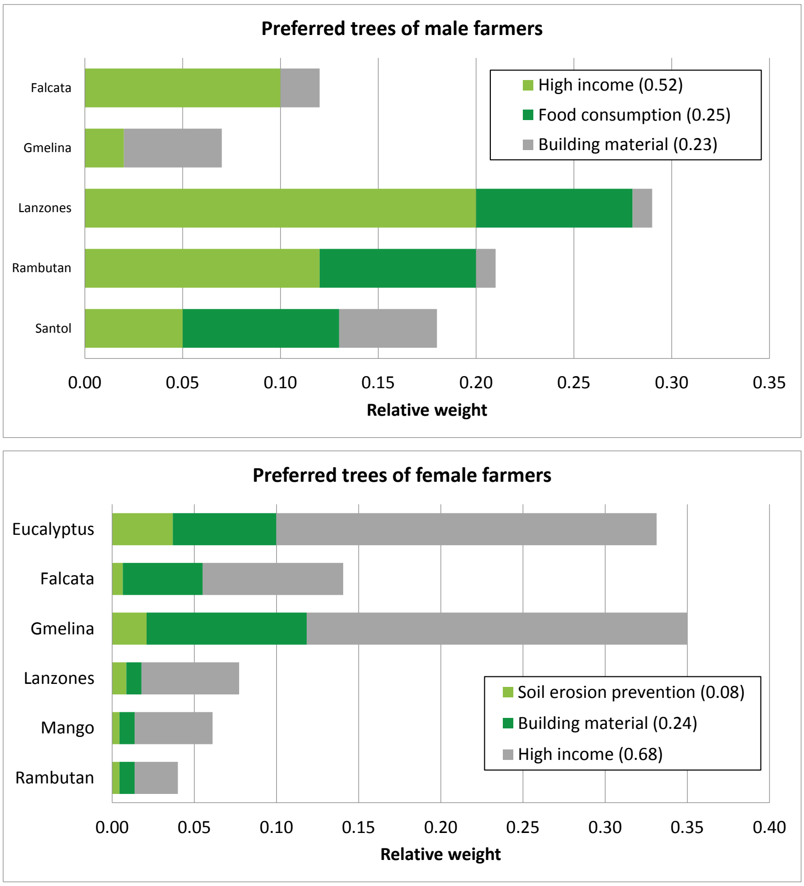

Figure 3.9. Most-preferred tree species in Tugasan Cluster

Most notable shocks on farming systems

According to the male farmers, the most notable shock in the Tugasan Cluster was Typhoon Pablo in 2012. Most of the dominant crop-based farms were damaged by the typhoon. The most affected were the farmers who were planting carrots since they experienced a decline in production by 90 percent Next were the farmers who had planted a combination of broccoli and cauliflower. They recalled that their production dropped by 75 percent. The female farmers considered the outbreak of pests in 2013 as the most notable shock as it affected plantations of broccoli, cabbage and Chinese cabbage. The profile of these shocks is presented in Figure 3.10.

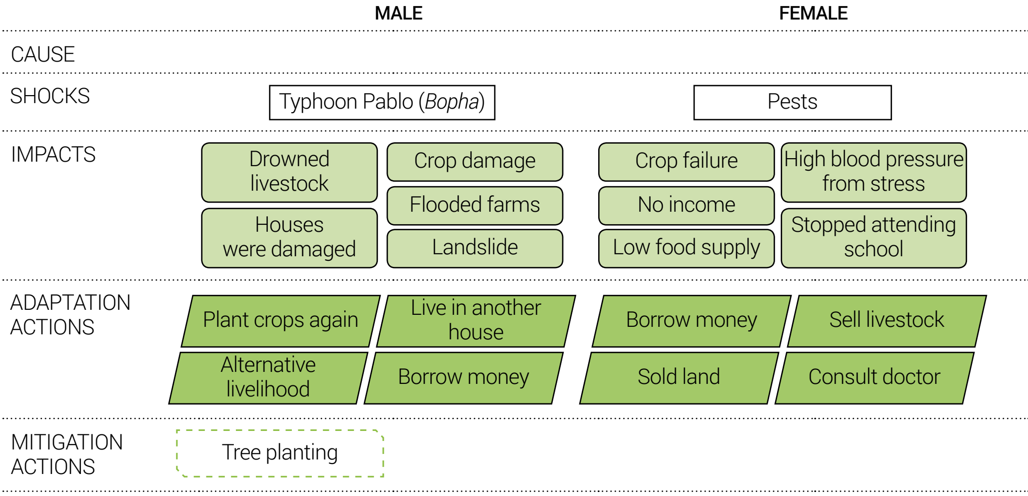

Figure 3.10. Profile of the most notable shocks on farming systems in Tugasan Cluster

Shocks, exposure, response and impact

Natural disaster

The most notable natural disaster for the male farmers was the occurrence of pests and diseases in 2013. Club root disease caused enlargement of the roots in cabbages, broccoli and cauliflowers resulting in a decline in harvest by 30 percent. The female farmers perceived that Typhoon Pablo in 2012 was the most notable natural disaster they had experienced as it resulted in crop failure and disruption of farm activities, particularly fertiliser application. Figure 3.11 presents the details of natural disasters.

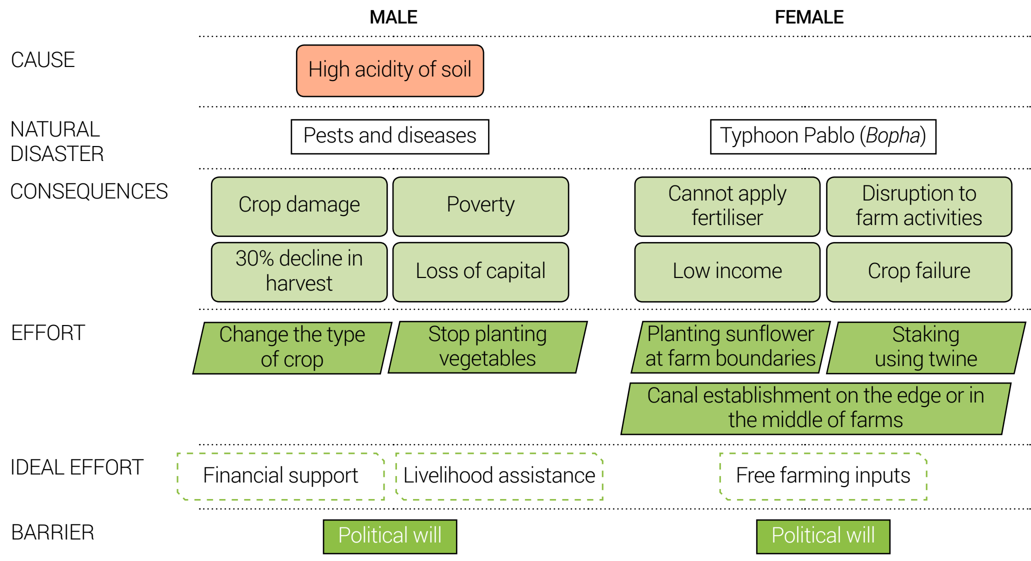

Figure 3.11. Profile of the most notable natural disasters in Tugasan Cluster

Extreme events

A decline in the price of agricultural production was considered by both the male and female groups as the most notable extreme event in the cluster. According to male farmers, the prices of broccoli, cauliflower, Chinese cabbage, and cabbage dropped by 90 percent in 2013. On the other hand, female farmers cited the prices of lettuces, cauliflowers, broccoli and sweet peas which also dropped by 50 percent in 2014. As indicated in Figure 3. 12, male and female groups, despite suffering the same event, responded to the consequences differently. Their perceptions also differed on the ideal efforts that should be undertaken to address the impacts of the event.

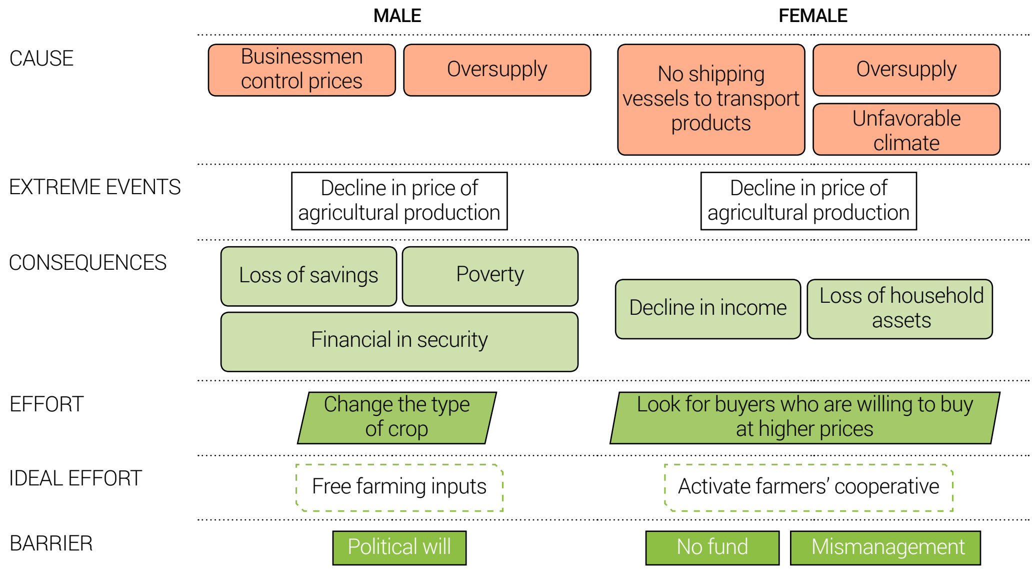

Figure 3.12. Profile of the most notable extreme events in Tugasan Cluster

Strengths, weaknesses, opportunities and threats

Three separate FGDs of two all-male groups and one all-female group were undertaken to collect information on the smallholder farmers' strengths, weaknesses, opportunities and threats (SWOT) in the Tugasan Cluster. The participants were representative of various stakeholder groups in the cluster including the village leaders, farmers' group, women's group, IP group, among others. They were asked to identify SWOT factors existing in their cluster and then to provide a score (1 lowest, 4 highest) for the level of significance of each item. In cases of conflicting scores, the participants were asked to give a single score via consensus.

The figure below shows the identified SWOT factors of all the groups in the Tugasan Cluster illustrated through a word cloud where the font size corresponds to the combined scores. To simplify the analysis, different items with similar themes are combined into the keywords used in the word cloud, with the scores accumulated.

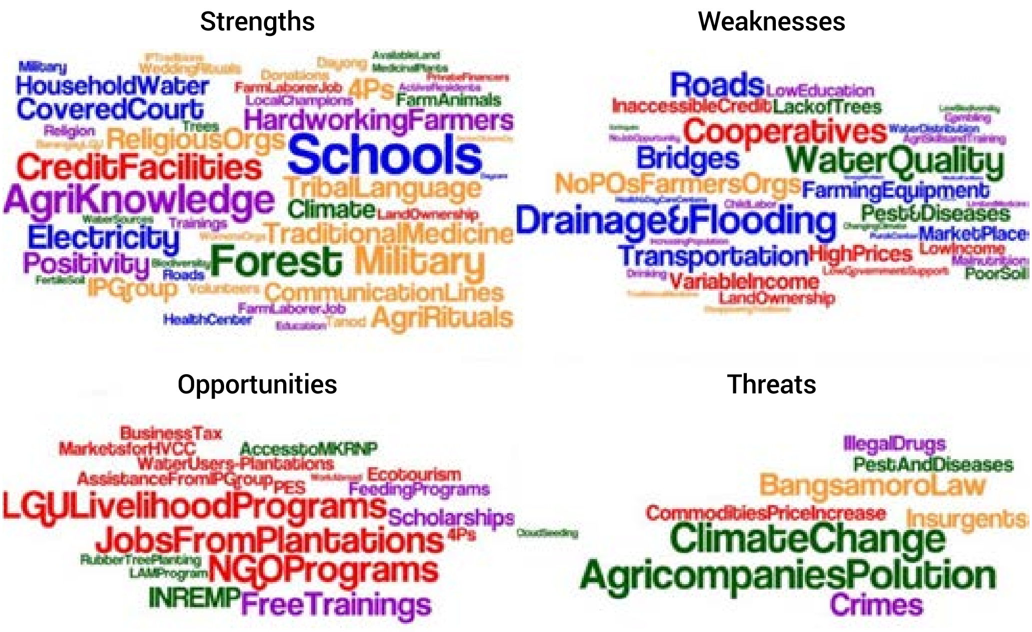

Figure 3.13. Stakeholders' perceptions of strengths, weaknesses, opportunities, and threats in Tugasan Cluster (note: bigger fonts represent stronger perceptions, font colour representation of livelihood capital: green = natural; blue = physical; red = financial; orange = social; purple = human)

The identified strengths and weaknesses were further categorised into the five forms of capital that were intrinsic or internal to the cluster: natural, physical, financial, human, and social or cultural capital. The most significant strength for the Tugasan cluster was adequate infrastructure for schooling, specifically for elementary and high school education, within their villages. A close second was the presence of intact and protected forest in the cluster. Tied in third was the farmers' adequate knowledge on farming and the military presence that keeps the peace in the cluster, from the human and social categories, respectively. The existence of several, easy-access credit or loan facilities ranked fourth in terms of significance. It should be noted that the top five strengths come from each of the five capital categories and that the participants were able to identify more strengths regarding social and cultural capital than for the rest.

On the other hand, the farmers were able to identify the least number of weaknesses for the social and cultural capital category. The most significant weakness was the cluster's problem with infrastructure for drainage and to control the flooding often caused by overflowing rivers and canals. The participants suggested that more canals and spillways were needed, while the existing ones were worn out and needed repair. Another significant weakness was the low or poor water quality for household use, which the farmers attributed to agri-chemical pollution in the rivers as well as household waste pollution.

The most significant opportunities external to the cluster were LGU livelihood programs, NGO programs and jobs from plantations, all of which could provide financial support to the farmers and fell under the financial capital category. The smallholder farmers in the Tugasan Cluster frequently relied on the municipal or provincial LGU and relevant NGOs for livelihood support, including the provision of capital, seedlings and other planting materials, livelihood training and even scholarships. Similarly, the farmers often relied on job opportunities from agri-plantations in Lantapan outside their cluster. Many residents in this cluster worked as farm labourers for the multi-national plantation companies such as DOLE and MKAVI. However, the presence of these big agro-companies in Lantapan was also raised as one of the most significant threats because of their use of chemicals and other pollutants harmful to the environment. New companies also cut down trees to clear land for planting causing further environmental degradation.

Lastly, the threat of climate change was also a top concern among smallholders in the Tugasan Cluster, specifically the increased frequency and intensity of extreme events such as droughts or the El Niño effect and strong typhoons. Farmers in Lantapan have already experienced the devastating effects of these extreme events including damage to their crops, decreased yields, sickness and death of farm animals and increased demand for farm inputs such as fertilisers and water. Climate change impacts that are already being felt in Lantapan were further confirmed in the survey and other FGDs conducted there.

3.3 Alanib Sub-Watershed Cluster

Biophysical and socioeconomic characteristics

The Alanib Cluster covers 6,596 ha of land and is considered as the second largest sub-watershed of the municipality of Lantapan, Bukidnon (Pillerin et al 2010). As shown in Figure 3.14, it is shared by six barangays—Songco, Alanib, Kaatuan, Baclayon, Poblacion and Balila. The cluster lies between the Kulasihan Watershed and Maagnao sub-watersheds. It is bounded in the south by the left bank of the Manupali River and in the north by the Mt. Kitanglad Range Natural Park (MKRNP). It has an elevation ranging from 500 m above sea level to 2,900 m above sea level and includes a main river with an approximate length of 22 km with 14 tributaries.

The majority of its area (52 percent) is devoted to agriculture such as the cultivation of vegetables, maize, bananas and other agricultural crops, while the remaining portion is forestland which is mostly within the Mt. Kitanglad Range Natural Park (MKRNP) (Pillerin et al 2010). Aside from its contribution to the agricultural sector, this landscape also has cultural significance since it hosts a large community of the Talaandig Tribe in Bgy. Songco. In addition, large agro-companies such as DOLE Skyland Philippines, Mt. Kitanglad Agriventures Inc. and Sumifro Corporation are also operating in the cluster. In 2010, the total population in the cluster was 21,556. The figure below shows the land cover map of Alanib Cluster in 2015.

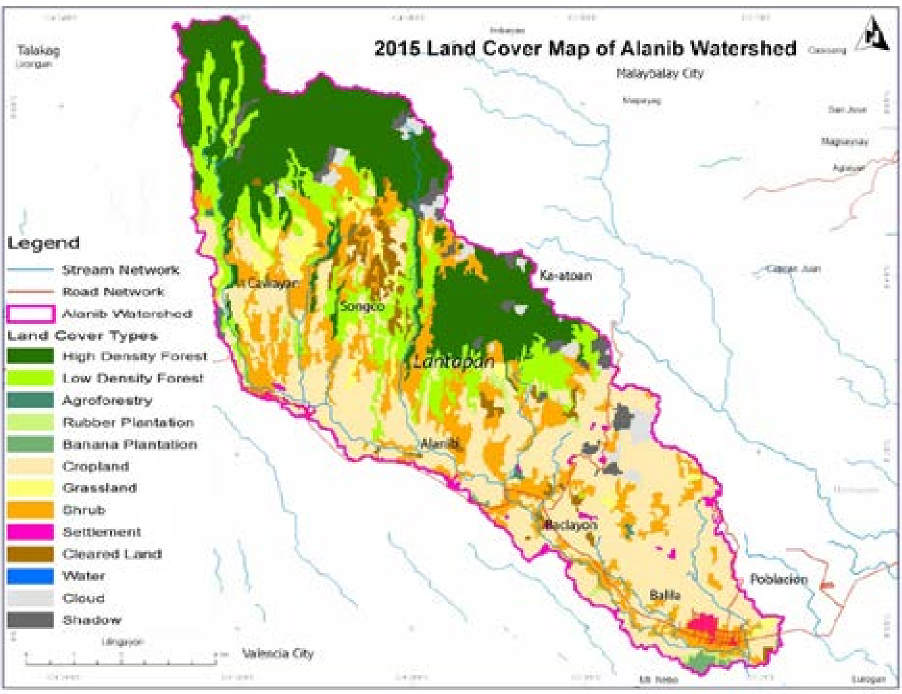

Figure 3.14. Land cover map of Alanib Cluster

Primary facilities in the cluster are moderately adequate in that there are existing public facilities but some families especially in the remote areas have limited access to them due to the poor condition of roads in the barangay. All municipal streets in Lantapan are made of concrete. However, barangay roads are only made of sand and gravel and in some cases, only horses and motorbikes are able to use these roads. This is one of the challenges mentioned by the upland smallholder farmers in transporting their product to the market.

Primary education is more accessible for the residents since each barangay has its own elementary school. At present, no colleges or universities are operating in the cluster. To pursue higher education, students must enrol in Bukidnon State University or other colleges in Malaybalay City and in other municipalities. The majority of households in the cluster are connected with electricity and only a few use gas lamps at night. The communication network in the area is quite erratic with a few areas not receiving any signal. All the villages in the sub-watershed have a health centre with one assigned midwife.

Land-use and land-cover change

Trajectory of land-use and land cover over time

Figure 3.15 shows the land cover change in Alanib Cluster. Of the total area covered by the Alanib sub-watershed, 36 percent is classified as timberland/forestland and 64 percent is considered as alienable and disposable lands. Based on the land cover change analysis, the main land cover in the watershed in 1995 was cropland accounting for almost 38 percent of the total land area and while it increased by 12 percent from 1995 to 2002, it decreased significantly by almost 18 percent from 2002 to 2015. The forest cover in the watershed decreased by 24 percent from 1995 to 2002 and then slightly increased by 9 percent from 2002 to 2015. A significant portion of the sub-watershed, specifically in the villages of Alanib, Songco, and Kaatuan, lies within the Mt. Kitanglad Protected Area which is being managed and protected under the control of a Protected Area Management Board. The declaration of Mt. Kitanglad as a protected area has prevented further loss of forest cover in the protected zone. Shrub lands also make up a significant share of the total area of the Alanib Cluster being 17 percent in 2015 and although it had decreased by 39 percent in 2002, it had significantly increased by 50 percent by 2015. This can be related to the decrease in cropland. The job opportunities provided by the multinational companies have contributed to the shift in the sources of livelihood as some farmers have left some farmland idle. Compared to the Tugasan Cluster, the agroforestry area in Alanib was higher in 2002 with a total of 29.4ha. This was mainly because most of the agroforestry research projects were concentrated in the Alanib Cluster.

Drivers of land-use change over time

In the 45-year period observed (1970-2015), land-use change is widely evident and is generally driven by the desire of the people to improve their lives. Earlier, the majority of the area in Alanib was under forest and agroforestry. However, changes in preferences and market conditions have resulted in a shift to planted crops. During the FGD, the male and female respondents were asked to identify and rank the reasons or the drivers of land-use change in their area.

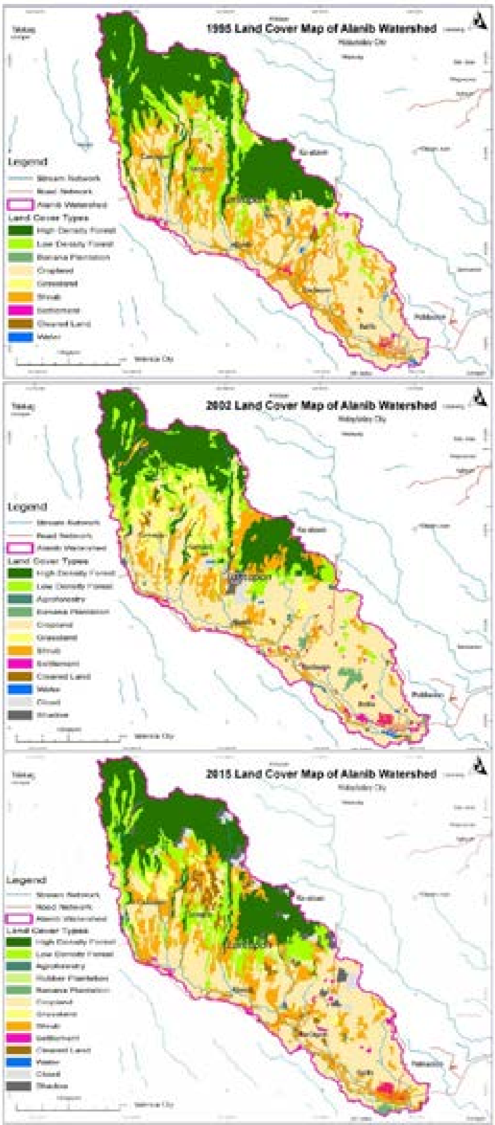

Figure 3.15. Alanib Cluster land cover change in 1995, 2002 and 2015

For male respondents, the top influential drivers of land-use change (LUC) were (1) change in price of a commodity, (2) demand for better sources of income, (3) need for a more sustainable source of food, (4) entry of agro-companies in Lantapan, (5) old age of trees, (6) increase in population and (7) shift to crops with a shorter cropping season such as vegetables.

According to the female respondents, the most influential drivers of land-use change were (1) increase in price of a commodity, (2) shift to crops with lower maintenance requirements, (3) need for a more sustainable source of food, (4) shift to crops with shorter cropping seasons, (5) decrease in demand for a commodity, (6) increase in population and (7) introduction of new technology.

According to the male respondents, the only land-uses that they predicted would change over the next 10 years were corn and sugarcane, with 20 percent of the land planted with corn and sugarcane being converted to rubber. Rubber has gained in popularity in Lantapan especially in the lower areas of the municipality. The female respondents predicted that 10% of the area planted to corn and sugarcane will be converted to bananas because of the predicted increase in the price of bananas. Moreover, they also believed that 10 percent of the area planted to timber trees will be converted to fruit trees to add to source of food and nutrients for the family.

Water resources

Water sources available in the cluster for domestic and other activities

Figure 3.16 shows the sources of water for daily and other uses of the male and female respondents for the Alanib Cluster under normal and extreme conditions. In Alanib, extreme conditions may refer to typhoons or a prolonged dry season and extremely hot temperatures.

The main source of water for daily use for both males and females was springs/faucets under normal conditions. Other sources included the river and mineral/bottled water. In extreme conditions, the female group still considered water from faucets/springs as their main source while the males said they got more water from the river as a prolonged dry season or extreme rainfall or a typhoon affected the quantity and quality of the water from springs. For crop irrigation, the male group mentioned two sources of water under normal and extreme conditions being springs/faucets and the river. The males considered that the community gets more water from springs/faucets during normal conditions and more water from the river under extreme conditions. The females identified the river as their only source of water for their crops under both sets of conditions.

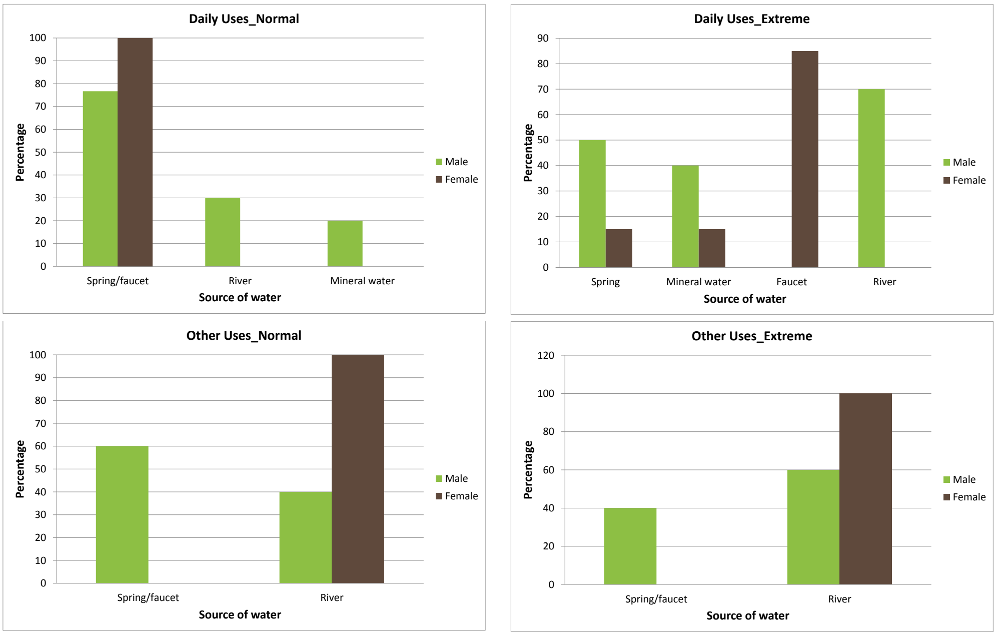

Figure 3.16. Sources of water for male and female respondents under normal and extreme conditions in Alanib Cluster.

Problems related to water source for domestic and other activities

The respondents were then asked about any water-related problems they encountered in their respective sub-watersheds and these were classified into quantity and quality as shown in Figure 3.17. The Alanib sub-watershed experienced more quantity-related problems. The male group identified a decrease in water quantity across all three water sources while quality-related problems such as muddy water and water contamination were only observed in springs and the river. Usually, problems with water quality occurred during the wet season. The group considered a decrease in quantity as the main problem in the cluster.

In the female group, quantity-related problems were experienced with the springs and bottled/purified water while poor quality water was observed in the water supply coming out of the faucets. In terms of quality, this group observed that the water from the faucets became turbid, yellowish and smelly during rainy seasons.

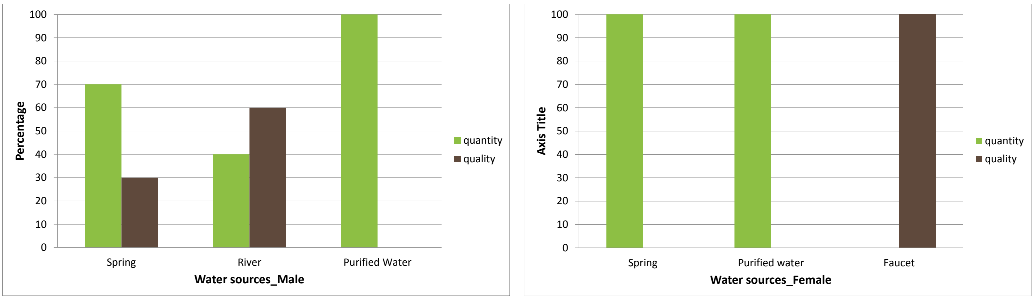

Figure 3.17. Water issues encountered per water source in Alanib Cluster

Causes of water problems

Respondents attributed the problems to several occurrences such as anthropogenic activities (damaged pipes, bathing of animals in the river, etc.) and natural events (typhoon, extreme rainfall, increase in temperature). The decrease in quantity experienced in the springs was attributed to the increase in temperature and happened especially during the dry season. The low supply of drinking water from the bottled water suppliers only happened during power brown-outs and where the changes in the colour of the water and its turbidity were due to the heavy rains and flooding in the watershed. The smell became prominent when the weather was too hot and resulted in the formation of moss. Table 3.5 summarises the identified causes of water issues along with their impacts on the community.

Table 3.5. Causes of water issues identified and their corresponding consequences

Problem	FGD Group	Cause of the problem	Consequences	Score*	Non-material losses	Material Losses
Decreasing quantity	Male	• increase in temperature • lack of filter at the water source • erosion in the headwaters due to typhoon • damaged pipes due to human activities	• delay in household chores • had to spend more time fetching water from other source • had to buy water from far-away places	3 3 2	time	- money - food - crops
Poor quality of water	Male	• extreme rainfall • chemicals from agricultural inputs • animals bathing near the river • throwing of dead animals in the river	• some people got sick • had to look for other sources of water • had to buy purified water	3 2 2	• life • time	money
Poor quality of water (smell, turbid, colour)	Female	• heavy rains • typhoon • flood • moss proliferation due to increase in temperature	• had to buy drinking water • had to fetch water from the river/spring instead of faucet • had to stock water from rainfall • had to buy drinking water	3 4 2 4	effort time	- money - -savings
No supply of drinking water	Female	brown-out	had to buy bottled water	3	effort	- money
Decreasing quantity	Female	dry season	need to borrow money	3	effort	money

*Highest score represents worse consequences of problem to the community

Successful actions by the community to address the problems included repairing the headwater source, planting trees, informing the Bukidnon Second Electric Cooperative Inc. (BUSECO) during brown-outs, sending reports to the barangay on people who damaged pipes, boiling water for drinking and monitoring banned chemicals. However, some problems still remained as a challenge to the community such as the lack of a filter for the pipe, hard-headed individuals bathing their animals along the river and the implementation of an ordinance on sustainable agricultural practices. Efforts to address these have had a poor success rate.

Biodiversity

Typology of most common wild species in the cluster

The participants of the FGD on biodiversity were able to enumerate a total of 23 species of flora and 33 species of fauna available in the cluster. Figure 3.18 shows a breakdown by the typology of wild plants and animals in the area. A large percentage of these species was being utilised by the residents for various purposes such as food sources and medicines, among others. It can be noted that there was a higher percentage of wild animals utilised by residents compared to wild plants. There were also many species from the wild that had already been domesticated by some residents (e.g. orchids, ferns, monkeys).

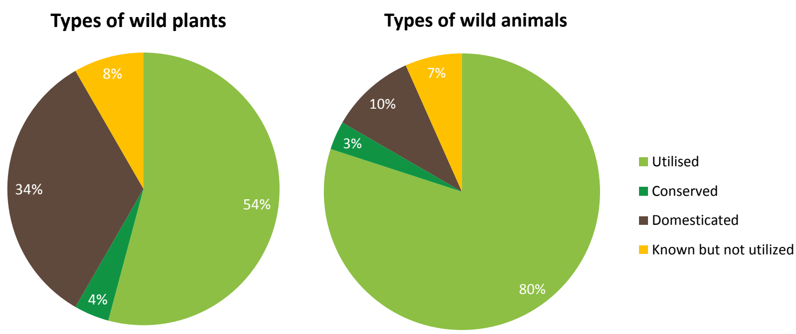

Figure 3.18. Typology of wild plants and animals in the Alanib Cluster

Utilisation of wildlife from different land-uses

The Alanib Cluster possesses rich biodiversity, especially in its northern portion that is part of MKRNP—one of the most important biodiversity reserves in the country and one of the world's 25 hotspots for biodiversity protection. Among the seven barangays of Lantapan that fall within the buffer zone of MKRNP, two are in the Alanib Cluster—barangays Songco and Alanib. However, GIS data from 1990 to 2007 revealed that the forest cover around both villages has decreased substantially (Santos, 2010).

Based on smallholder farmers, four land-use types were available in the cluster—primary and secondary forests, grasslands and agri-residential lands (table3.6). Unlike the male farmers, the women did not differentiate between the primary and secondary forests, categorising them as 'forest' in general. Although they agreed with the output of the male farmers, they were not comfortable in delineating the boundaries of different forest types.

Most of the wild plants were either utilised for medicinal or ornamental purposes. Wild animals, on the other hand, were mostly used as food sources. Table 3.6 presents the number of species utilised by male and female farmers per land-use type.

Table 3.6. Number of species utilised by farmers in Alanib Cluster

Utilisation	Male				Female	
	Primary forest	Secondary forest	Grassland with trees	Agricultural/ residential	Forest	Agricultural/ residential
Food	17	16	11	12	9	9
Medicine	2	3	4	3	7	1
Building materials	1	1	1	0	0	0
Handicrafts	1	1	1	1	1	0
Domestic use	-	-	-	-	1	-
Ornamental	6	6	5	6	3	2
Firewood	1	1	1	-	-	-
Cultural	-	1	-	-	-	-

Farming practice

Dominant farming systems in the cluster

Female and male groups considered corn plantations as one of the most common farming systems in the cluster. They also agreed that multiple cropping of bananas and corn was common in the villages. As presented in Table 3.7, most of the farming systems that were listed were crop-based farms. This type of farm is dominated by annual crops or other non-tree perennial crops. Smallholder farmers preferred crop-based farming because of the easy access to market and the shorter return on investment. Since the municipality is considered as the vegetable basket of the South, there is already a steady market for annuals, particularly vegetables.

Although there were some smallholder farmers who maintained tree-based farms, it was not that common in the cluster. Usually, trees were only planted along the boundaries of the farms and not as a main commodity. They were utilised as windbreaks and boundary marks. Farmers mentioned that the unstable prices of tree products and the lack of access to market discouraged from planting trees.

Table 3.7. Dominant farming systems based on gender perception in Alanib Cluster

Type of Farming System	Gender perception		
	Male	Female	Both
A. Crop-based			
1. Monoculture			
sugarcane	√		
bananas		√	
corn			√
2. Multiple cropping			
cabbages- carrots- tomatoes- broccoli	√		
cabbages- Chinese pechay- broccoli sweet peas- beans- bell peppers		√	
bananas- corn			√
B. Tree-based			
lanzones- durian- mangosteens- coffee	√		
Brazilian fire tree- corn		√	
coffee- abaca- root crops		√	

Benefits of farming systems

All of the most common farming systems in the cluster were sources of cash. According to the male group, sugarcane had the highest profitability among the dominant farming systems in the cluster. Female farmers, on the other hand, perceived that vegetable crops provide the highest income for the smallholder farmers. The difference in their perceptions could be attributed to the dissimilarity in the type of farming systems that they were usually managing as the men were more involved in maintaining sugarcane plantations which were labor-extensive, while the women were more active in planting vegetables in their backyards. Both males and females assigned the lowest ranks to the tree-based farms that they identified. Unlike annual crops, trees did not provide a regular source of income to the residents and had a longer return on investment; hence, they had the lowest contribution to the household income.

Several non-cash benefits were also provided by farming systems. As reflected in Table 3.8, they are sources of food, medicine, building material, and raw materials. Both female and male groups acknowledged corn as having the highest ranking as a food source.

Table 3.8. Benefits of the most common farming systems in Alanib Cluster

Benefits	Crop-based farms	Tree-based farms
Source of cash	7	3
Source of food	6	3
Medicine	4	2
Building material	-	1
Raw material crafts/ accessories	1	-

Farming system preferences

Farmers in the cluster were using different sets of criteria to decide what farming systems to adopt. As presented in Figure 3.19, their criteria are all anchored to the economic benefits of farming systems. It further shows that farmers, especially women, preferred tree-based farms. They combined cacao, coffee and Brazilian fire trees with other crops such as bananas and root crops. The preference of farmers for tree-based farms could somehow be attributed to the presence of successful agroforestry farms in the cluster since ICRAF, together with other organisations such as Landcare, has been promoting agroforestry in the area for more than a decade. The Binahon Agroforestry Farm, a demonstration site for agroforestry practices, is also located in the cluster and there have been several beneficiaries of the NPC's Family Approach to Reforestation and Agroforestry Development Project in the area.

Males considered the growing period of commodities to be important in selecting the farming system to practice. Since they are the usual providers for the family, they wanted to plant crops which could provide a regular source of income and could be harvested within the year. They argued that multiple cropping of vegetables, corn and peanuts had the shortest growing period among the farming systems they preferred. Multiple cropping of coffee and Brazilian fire trees had the longest growing period before they can be harvested. Another major consideration of male farmers was high income and they could generate the highest income from multiple cropping of cacao and bananas. Coffee and Brazilian fire trees, on the other hand, would generate the lowest income considering that a longer period was needed before it could be harvested and sold. Low input costs were the third consideration of male farmers. They perceived that a mixed plantation of coffee and Brazilian fire trees had the lowest input costs while planting vegetables with corn and peanuts required the highest input costs.

The main priorities of female farmers in deciding the farming system to adopt were food consumption, high income and high frequency of harvests. Since the women were usually in charge of preparing food for the family, they preferred farming systems which could also contribute to household food security. The entry of multi-national companies in the area had resulted in greater participation by women in managing farms as their husbands became employees of the companies. Because their husbands had a regular source of monthly income, they preferred to plant crops for subsistence. Mixed plantations of corn and bananas were ranked first in terms of the criteria 'food consumption' and 'high income'. Mixed plantations of coffee, abaca and root crops topped the ranking for high frequency of harvest.

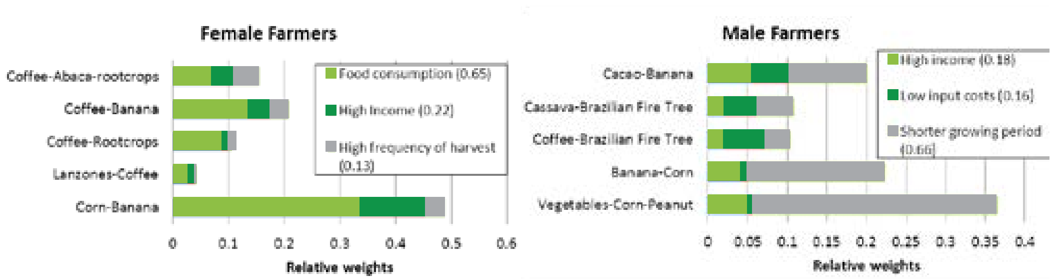

Figure 3.19. Most-referred farming systems in Alanib cluster

Tree species preferences

The tree species selection criteria of smallholder farmers in the cluster can be classified as either provisioning or regulatory services. Male farmers considered primarily the direct benefits that could be derived from trees. While this was also of importance for female farmers, their major criteria for selecting tree species was their capacity to prevent flooding which was the main shock affecting their farms in previous years. To prevent this from happening, they were planting trees on the boundaries of their farms. Figure 3.20 shows that only falcata and Brazilian fire trees were commonly preferred by both female and male farmers in the cluster.

Male farmers had a high preference for hardwood trees which could be used as building material. Since it was usually their task to oversee house construction and repair, they favoured trees which could be used for that purpose. Mahogany ranked first among the five preferred trees of male farmers. Although it had the lowest value in terms of 'easy to market', it ranked first in terms of the criteria 'high selling price' and 'building material'. As argued by the male farmers, even if mahogany had a high selling price, there were no regular buyers in the municipality. Durian, on the other hand, was the easiest to market or sell. However, it ranked least under the criterion 'building material'.

Female farmers considered the capacity of trees to prevent flooding as important. As shown in Figure 3.20, they perceived that coffee had the highest capacity to prevent flooding while Brazilian fire trees had the least. They argued that they could derive the highest income from planting eucalyptus. The least income could be derived from coffee bushes. In terms of usefulness as a building material, they considered Brazilian fire trees to be the most appropriate for the purpose followed by coffee and falcata, respectively.

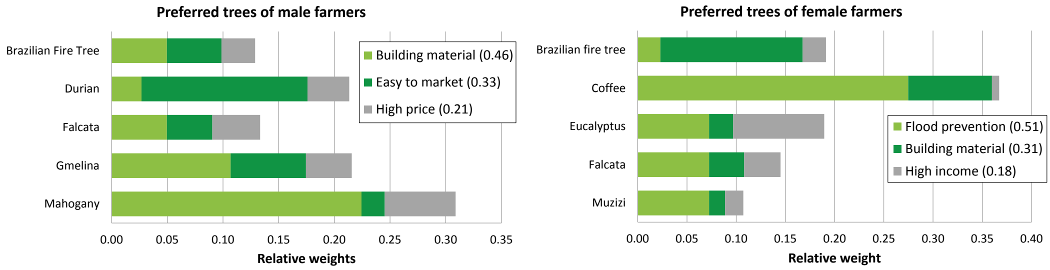

Figure 3.20. Most-preferred tree species in Alanib Cluster

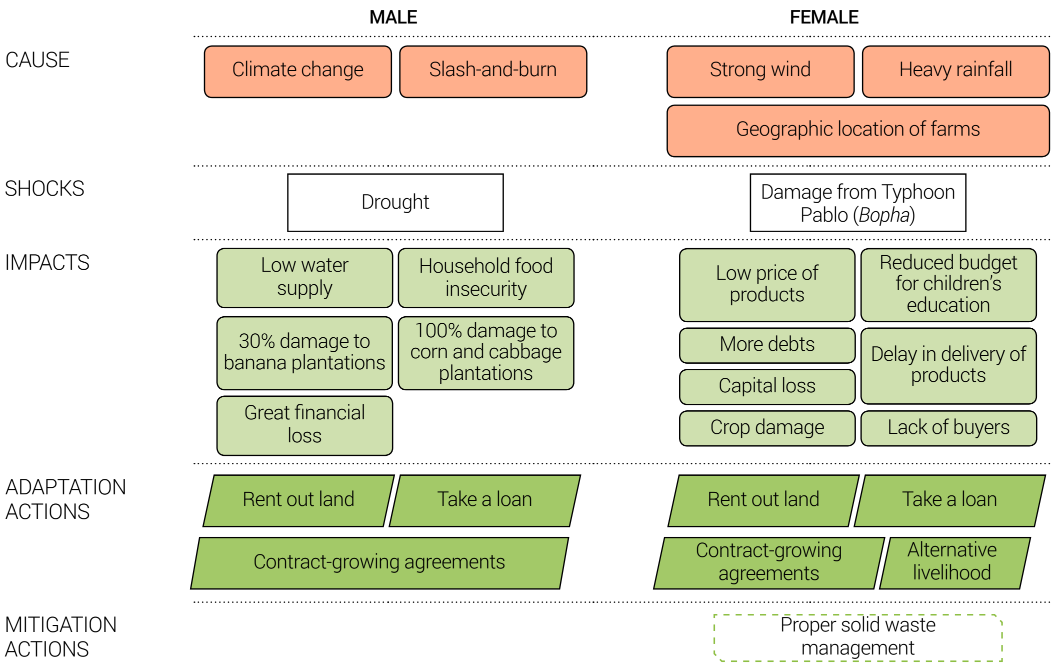

Figure 3.21. Profile of the most remarkable shocks on farming systems in Alanib Cluster.

Most notable shocks on farming systems

According to the male farmers, the drought in 2010 had been the most notable shock that had occurred in the last 10 years. As reflected in Figure 21, it resulted in crop failure for some commodities such as corn, cabbages and bananas. The female farmers identified the flooding resulting from Typhoon Pablo as be one of the most devastating shocks in the cluster. They recalled that it caused a 100 percent decline in banana production and a 50 percent decline in coffee production. It also affected the mixed plantations of cabbage, Chinese pechay and broccoli. Fortunately, they had already harvested most of the vegetables prior to the typhoon in December 2012.

Shocks, exposure, response and impact

Natural disaster

Drought in 2004 and flooding in 2012 were the most notable natural disasters for the male and female farmers, respectively. Male farmers recalled that there had been no rain for four to five months in 2004. On the other hand, the Tugasan River overflowed by 6-10 m on both sides during Typhoon Pablo. It damaged the water facility of the municipality resulting in 3 months with no water services in Songco and Bugcaon. Both disasters resulted in crop damage, hence affecting the income of smallholder farmers. As depicted in Figure 3.22, farmers adopted several strategies to cope with the consequences of these disasters.

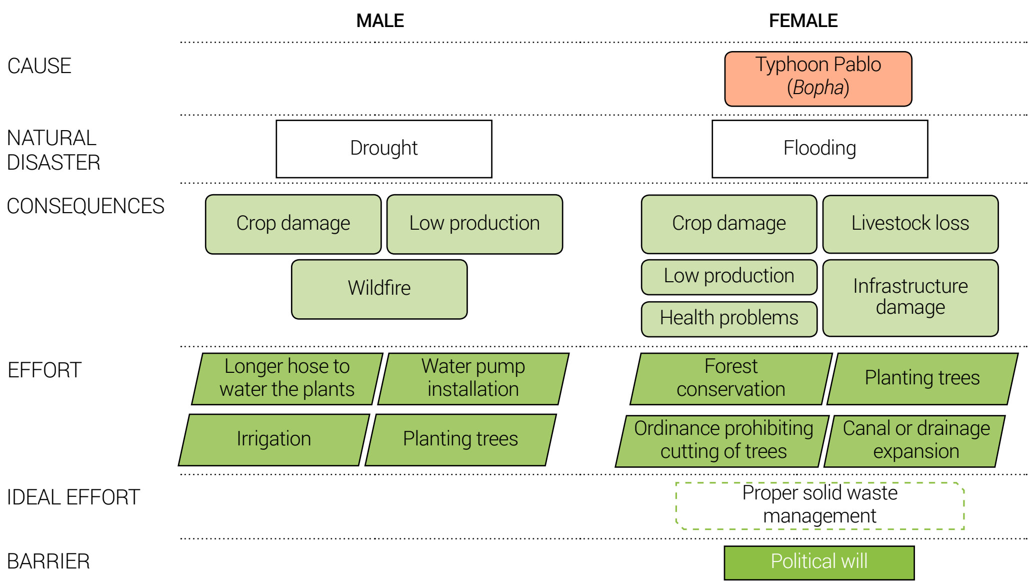

Figure 3.22. Profile of the most notable natural disasters in Alanib Cluster

Extreme events

Male farmers perceived that the rising costs of farm inputs had been the most challenging extreme event that they had experienced in the last 10 years. They argued that the costs had been increasing almost every year. Female farmers, on the other hand, considered the rise in food prices as the most notable event. The difference in their perceptions could be attributed to their distinct roles in their families. Generally, men are more involved in income-generating activities such as farming while women are usually in charge of domestic tasks such as budgeting and purchasing for the needs of the family. The profiles of these two extreme events are presented in Figure 3.23.

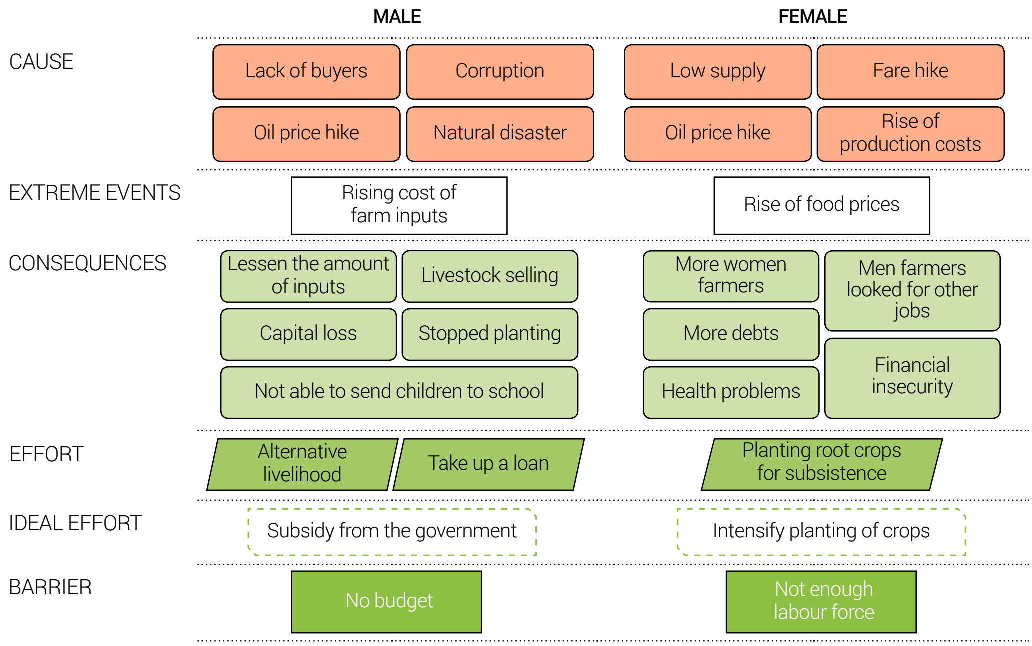

Figure 3.23. Profile of the most notable extreme events in Alanib Cluster

Strengths, weaknesses, opportunities, and threats

Three separate FGDs of the two all-male groups and the one all-female group were undertaken to collect information on the smallholder farmers' strengths, weaknesses, opportunities and threats (SWOT) in the Alanib Cluster. The participants were representatives of various stakeholder groups in the cluster including village leaders, farmers' group, women's group, IP group, among others. They were asked to identify SWOT factors existing in their cluster and then to provide a score (1 lowest, 4 highest) for the level of significance of each item. In any case of conflicting scores, the participants were asked to give a single score via consensus.

The figure 3.24 shows the identified SWOT factors of all the groups in the Alanib Cluster illustrated through a word cloud where the font size corresponds to the combined scores. To simplify the analysis, different items with similar themes were combined into the keywords used in the word cloud, with the scores accumulated.

The identification of the strengths and weaknesses was further categorised into the five capital types that are intrinsic or internal to the cluster: natural, physical, financial, human and social or cultural. The participants identified that having good national roads (physical capital) and active people's organisations (POs) and farmers' organisations (social capital) were their most significant strength. On the other hand, roads were also a significant weakness in Alanib since the village roads or farm-to-market roads were either nonexistent or in need of repair.

Figure 3.24. Stakeholders' perceptions of strengths, weaknesses, opportunities, and threats in Alanib Cluster (note: bigger fonts represent stronger perceptions, font colour representation of livelihood capital: green = natural; blue = physical; red = financial; orange = social; purple = human)

Taken together, the most significant weakness was inaccessible credit or loans from the financial capital category. The respondents said this was a weakness for several reasons, including very high interest rate, too many requirements, as well as no collateral to be able to access loans or credit. Poor soil as a natural capital was also a major weakness, since the farmers mentioned that the soil in their area was either polluted by agri-chemicals or highly acidic. Looking at the big picture, the participants were able to identify more weaknesses and strengths under the social and cultural capital. They were also able to identify more weaknesses than strengths in almost all categories.

In terms of issues or conditions extrinsic or external to the clusters referred to as opportunities and threats, the farmers were able to identify more opportunities than threats. The most significant opportunity that the farmers of Alanib could take advantage of was the presence of job opportunities from agri-plantations in Lantapan outside of the cluster. In fact, they were already taking advantage of this opportunity as many residents in this cluster worked as farm labourers in multi-national plantation companies such as DOLE and MKAVI. But the presence of these big agro-companies in Lantapan also came up as the most significant threat because of their use of harmful chemicals and other pollutants that contaminated the air (through spraying) and water within the cluster. The agro-companies were also a threat because they depleted the natural water sources in Lantapan that the smallholders also used.

Another opportunity that stood out, although slightly less than those mentioned above, was the livelihood programs from the local government units (LGUs) outside of the cluster, including municipal and provincial LGUs. The participants expressed eagerness to benefit from these programs, including the provision of free seedlings and other farm inputs. The farmers also mentioned that they had benefitted from such programs before and continued to rely on them for their livelihood. It should be noted that the majority of the opportunities identified by the farmers were under the financial capital category or opportunities that may increase income or provide financial support, while the threats fell almost completely under the natural capital or threats toward their environment.

3.4 Kulasihan Sub-Watershed Cluster

Biophysical and socio-economic characteristics

The Kulasihan Cluster, the largest among the nine sub-watersheds of the Manupali River in Lantapan, is comprised of 10,076 ha with 27 percent timberland and 73 percent A&D lands (Pillerin et al 2010). As presented in Figure 3.25, the cluster covers portions of seven villages and has an elevation ranging from 300 m above sea level to 2,700 m above sea level. The upper portion of the cluster is mostly covered with mossy forest while the A&D lands are usually planted with corn, rice, coffee, sugarcane and root crops. Some parts of the sub-watershed, especially those near riverbanks, are also planted with fast growing tree species such as yemane, mahogany and eucalyptus, among others (Pillerin et al 2010). There are also other areas devoted to plantings of fruit trees, rubber and cacao. This cluster also hosts the Cinchona Forest Reserve that was established in 1929 and was later declared as an area for "Quinine Reservation and Experimentation" purposes in 1988. In 2000, the whole Cinchona area was included in the Republic Act 8978 which established the Mt. Kitanglad Range Natural Park (Santos et al 2010). The estimated population in the cluster was 14,665 in 2010.

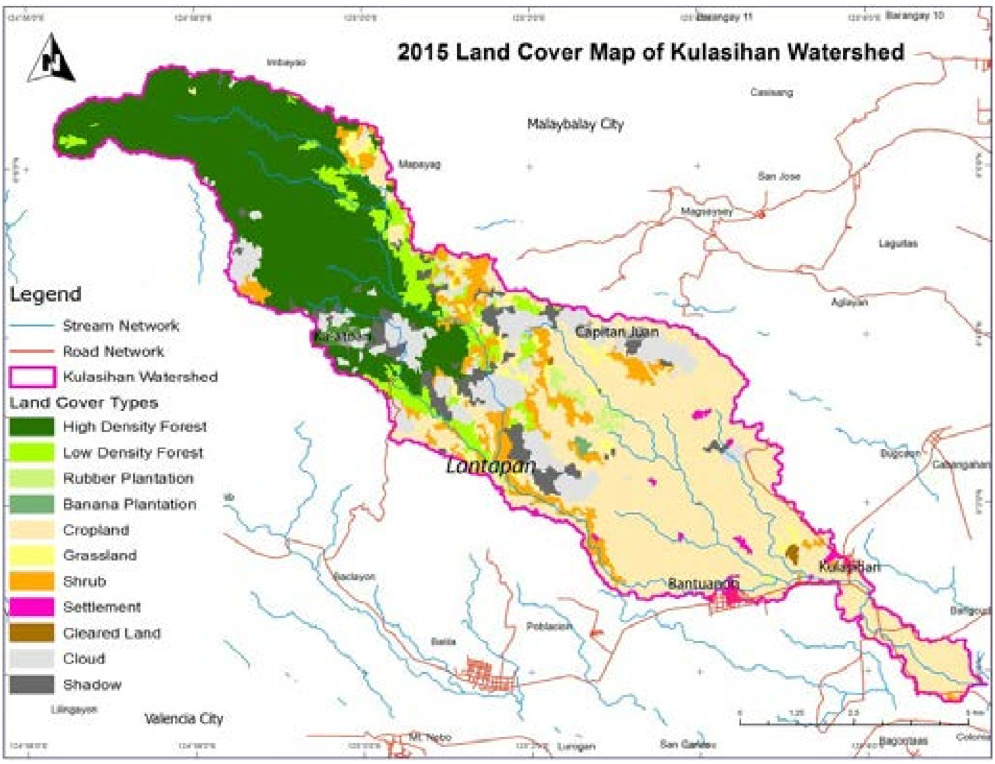

Figure 3.25. Land cover map of Kulasihan Cluster

Land-use and land-cover change

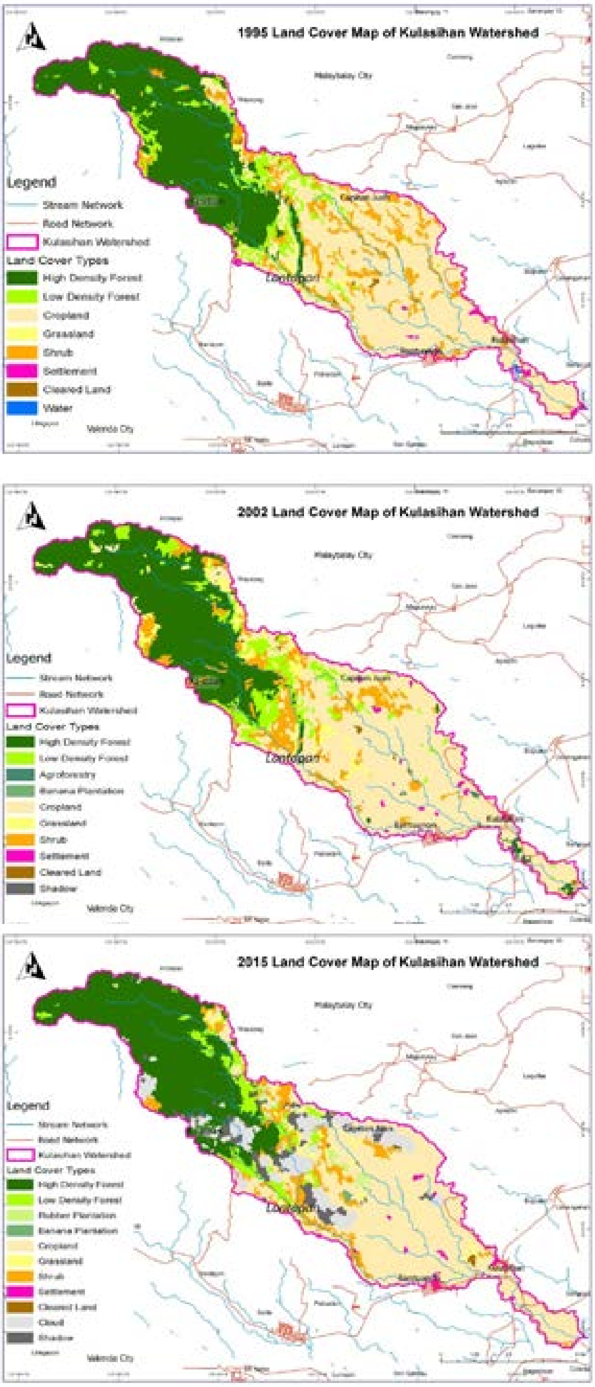

Figure 3.26. Kulasihan Cluster land -use change 1990–2007

Of the 7,194 ha land area of the Kulasihan sub-watershed, only 36 percent is classified as timberland Although forest area contributes only a small percentage to the total land area, it can be observed in Figure 3.26 that only a few changes have occurred to this land-use. This area is where the Cinchona Forest Reserve can be found. The majority of the Kulasihan sub-watershed is situated in the lower part of Lantapan. Cropland has been the major land-use since 1995. It has decreased by 10 percent with a portion of it being replaced by rubber and banana plantations. Rubber plantations are more popular in this cluster compared to the other two. Major crops include vegetables, rice and root crops.

Drivers of land-use change over time

The major drivers of land-use change according to the male group were (1) need for a more sustainable source of food, (2) increase in price of a commodity, (3) high cost of inputs for corn, (4) decrease in price of a commodity and (5) need for a better source of income. For the female group, the major drivers of land -se change were (1) decrease in price of corn, (2) increase in price of sugarcane, (3) high cost of inputs, (4) shift to crops with shorter cropping season and (5) increase in demand for a commodity. It can be observed that market forces play a crucial role in the perceived drivers of land-use change. The price and demand for different commodities mostly dictates the preference of the farmers.

In the next 10 years, the respondents believed that land-use would stay the same except that 10 percent of the vegetables gardens were predicted to be converted to corn which is the staple food in the cluster and even in the whole of Lantapan.

Water resources

Water sources available in the cluster for domestic and other activities

The Kulasihan sub-watershed is the largest sub-watershed in Lantapan and is contained in the Manupali Watershed. It is the only watershed with an irrigation dam providing an additional water source to its beneficiaries. Shown in Figure 3.27 are the sources of water for daily and other uses under normal and extreme conditions in the Kulasihan Cluster. The graphs show that the female group identified only two sources of water for daily use under normal condition—springs/faucets and mineral water—whereas the male group listed five sources of water—springs/faucets, deep wells, rainwater, rivers and mineral water.

The female group said that they mainly sourced their water for daily use such as washing the dishes, washing clothes and bathing, from the springs/faucets under normal condition and resorted to buying mineral/bottled water in extreme conditions. Extreme conditions included typhoons, prolonged dry seasons or extreme temperatures. The male group, on the other hand, considered the Kulasihan River as their main source of water followed by springs/faucets under normal conditions while springs/faucets were the main source of water in extreme conditions.

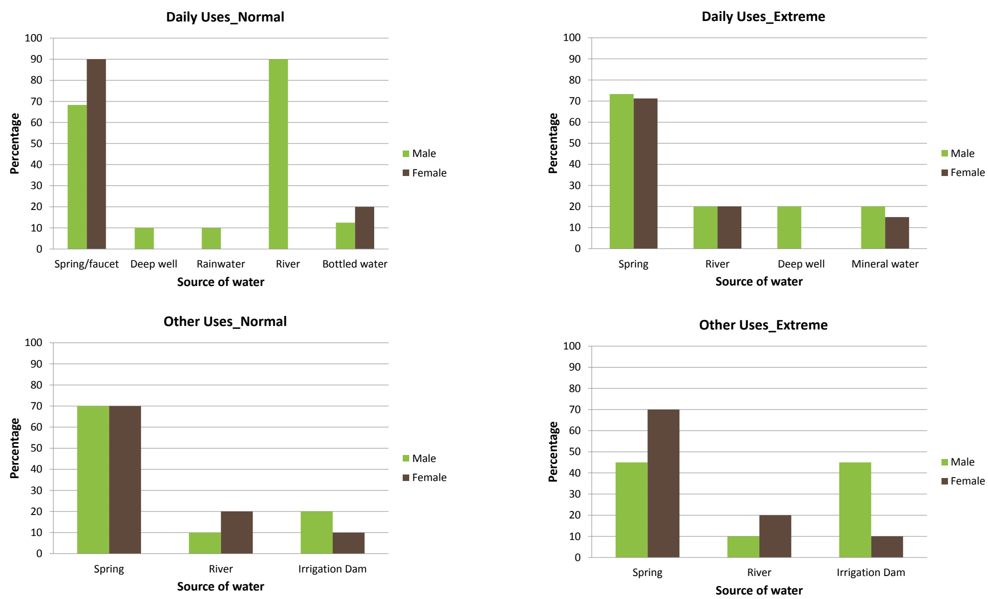

Figure 3.27. Water sources under normal and extreme conditions for Kulasihan Cluster

Problems related to water source for domestic and other activities

Contrary to the situation in the first two clusters, the Kulasihan Cluster has experienced more quality-related problems as shown in Figure 3.28. Compared to the other two clusters, a huge portion of the Kulasihan Cluster is situated in lower Lantapan where most of the population is concentrated including the plantations of agro-companies. This makes the area more exposed to quality-related problems. The male group said that the community experienced such problems with all of its water sources. Quality-related problems included contamination due to household wastes, dead animals, wastes from the agro-industries and changes in the colour of the water during the rainy season.

On the other hand, the female group only identified problems in the spring and river water sources. In both sources, quantity- and quality-related problems were experienced. The participants said that during the rainy season, water became murky. Unstable supply of water was being experienced from their spring water source.

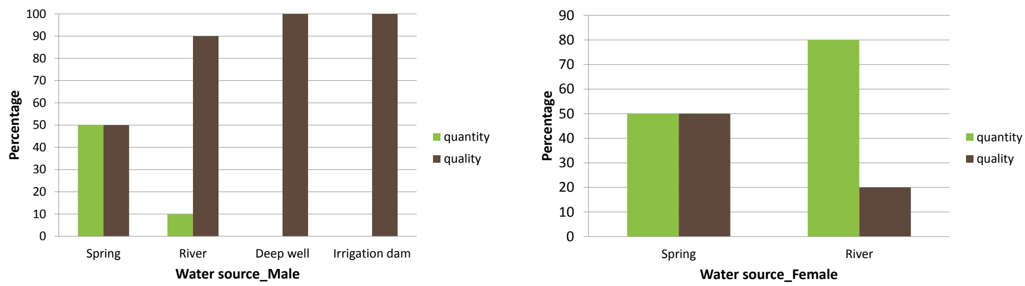

Figure 3.28. Water issues encountered by water source in Kulasihan Cluster

Causes of water problems

There was even a time when a dead body was found at the spring source which raised fears for the health of people drinking the water from that spring. Second to this, the major problem identified was the contamination from the wastes of agro-industries. The most common problem experienced was poor quality of water in the river due to household wastes and dead animals which usually occurred during the rainy season.

Murkiness of water was mainly attributed to extreme rainfall events. Other factors included broken pipes at source and wastes from the piggery farms. The respondents considered the unstable supply of water was caused by unequal water distributor in selected *puroks*[2]. Added to that was the increase in temperature resulting in a decrease in the quantity of water supply. On the other hand, the decrease in water quantity from the river was mainly attributed to the presence of the agro-industries which were drawing out water for their operations. Table 3.9 summarises the identified causes of water problems and the consequences experienced by the residents.

2 *Purok* is a political subdivision of a village in the Philippines.

Table 3.9. Causes of water issues identified and their corresponding consequences in Kulasihan Cluster

Problem	FGD Group	Cause of the problem	Consequences	Score	Non-material losses	Material Losses
Poor water quality	Male, Female	• household wastes due to lack of discipline and increase in population • damaged pipes • strong rainfall • wastes from piggeries • chemical wastes from agro-companies	• people get sick • had to look for other sources • dead fish in the river • delay in household chores • skin disease	2 2 2 1	time	money
Decrease in quantity	Male, Female	• deforestation • extreme heat • competition on water use with agro-companies	• need to buy water • lack of drinking water for animals • decrease in freshwater species	3 5 5	time	money
Unstable water supply	Female	unequal distribution of water districts	need to look for other sources	2	Peace of mind	

Some of the successful efforts to address the causes of the problems included repairing the damaged pipes, informing the owners of the piggery farms, tree planting and the provision of subsidies for water supply from the barangay. Other efforts that were not that successful were the implementation of the municipal ordinance on waste management, construction of a water storage basin and requesting water supply from the companies. Mostly, the lack of funds and political will hindered the success of these efforts.

Biodiversity

Typology of most common wild species in the cluster

A total of 36 species of flora and 37 species of fauna were identified by the participants of the FGD on biodiversity. As presented in Figure 3.29, the majority of these species were being utilised by the residents. There was also a large percentage of wild animals under conservation status (e.g. Philippine Eagle (*Pithecophaga jefferyi*), Pukpuk (*Basilornis miranda*)). On the other hand, a high percentage of wild plants had already been domesticated (e.g. Bird's nest (*Asplenium nidus*), Wild Fern (*Tmesipteris lanceolata*)).

Utilisation of wildlife from different land-uses

The Kulasihan Cluster has three general land-uses—protected, agricultural and residential. Its northern portion is part of the MKRNP and the Cinchona Forest Reserve where most of the wildlife species are thriving. Midlands and lowlands, on the other hand, are devoted to agricultural and residential areas.

As presented in Table 3.10, most of the wildlife species are utilised as food sources. An example is the Mindanao fanged frog (*Limnonectes* magnus) which can be found in all land-uses. Many wildlife species have medicinal values. For instance, the bark of cinchona is known to be a source of quinine, a drug used for treating malaria. Also, *buyo* (*Cinnamomum mercadoi*) is used for curing cough, colds and fever. *Ulayan* (*Lithocarpus* *spp.*), on the other hand, is believed to be useful for deworming. It is also utilised as a building material. The participants highlighted that some of their community members were occasionally collecting and selling hardwood trees, as long as they were harvested outside the protected area. Utilisation of wild biodiversity was restricted in the cluster as early as 1929 when the Cinchona Forest Reserve was established. Most of the forest area in the cluster has been covered by this reserve. In addition, the frequency of collection also became minimal after the declaration of the Mt. Kitanglad Forest Reserve.

Table 3.10. Number of species utilised by farmers in Kulasihan Cluster.

Utilisation	Protected area		Agricultural area		Residential area	
	Male	Female	Male	Female	Male	Female
Food	9	15	4	13	4	9
Income sources	8	-	2	-	2	-
Medicine	7	7	2	5	3	3
Building materials	5	3	-	3	-	-
Ornamental	5	3	2	3	2	1
Handicrafts	-	1	-	1	-	-
Furniture	2	3	-	3	-	1
Fertiliser	1	1	1	1	-	1
Lucky charm	-	-	-	1	1	1

Farming systems

Dominant farming systems in the cluster

Crop-based farming was still the most common farming practice of smallholder farmers in the cluster. As reflected in Table 3.11, the usual annual crops in the area included corn, purple yams, rice and vegetables. Among the three clusters, Kulasihan had the largest area for rice fields. The most commonly planted perennial crops were cassava, papaya and sugarcane. Bananas were usually planted either with corn, purple yams or with other vegetables. In terms of tree-based farming, mixed plantation of coffee and bananas has been the most common farming system.

Table 3.11. Dominant farming systems based on gender perception in Kulasihan Cluster

Type of Farming System	Gender perception		
	Male	Female	Both
A. Crop-based			
1. Monoculture			
Papaya, purple yams, rice, vegetables		√	
Cassava, corn, sugarcane			√
2. Multiple cropping			
Bananas-purple yams, squash-bananas	√		
Bananas-corn, corn- vegetables		√	
B. Tree-based			
Coffee-bananas	√		

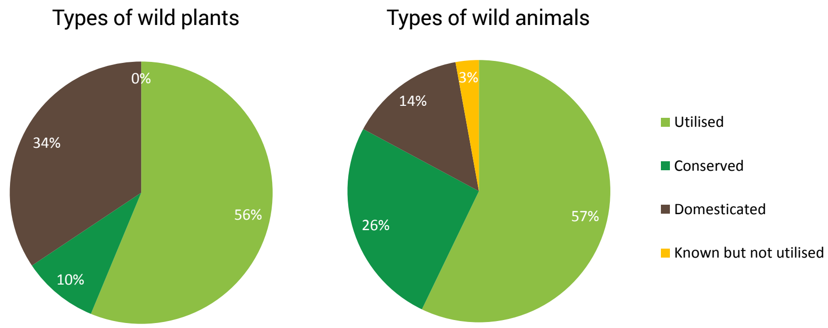

Figure 3.29. Typology of wild plants and animals in the Kulasihan Cluster

Benefits of farming systems

All the most dominant farming systems in the cluster were sources of livelihood. As reflected in Table 3.12, residents usually relied on crop-based farms to earn a living. Male farmers considered multiple cropping of bananas and purple yams as the most profitable farming system. Female farmers, on the other hand, perceived that multiple cropping of bananas and corn generated the highest income. Aside from livelihood, other benefits were also being provided by farming systems including food, medicine and building materials.

Table 3.12. Benefits of the most common farming systems in the cluster.

Benefits	Crop-based farms	Tree-based farms
Source of cash	11	1
Source of food	11	1
Medicine	2	
Building material	2	
Raw material crafts/ accessories	1	
Aesthetics and cultural	3	
Food for the animals	3	

Farming system preferences

Both female and male farmers preferred to adopt farming systems in which the commodities were easy to market and could be sources of food for the family. Referring to Figure 3.30, male farmers also considered the growing period of crops important while female farmers put a high value on the income that could be derived from them. Both genders preferred to have rice fields and corn plantations. Only male farmers wanted to have tree-based farms.

Male farmers value the criterion ‘shorter growing period’ as important in selecting farming systems. They argued that planting annual crops would ensure a regular source of income and a faster return-on-investment. Rice fields topped the three criteria for the farming system selection by male farmers while corn ranked second in all criteria. Intercropping or multiple cropping of coffee and falcata ranked lowest in all criteria. It can be observed from the results that crop-based farms were still the most preferred in the cluster.

As for the male group, rice fields were the most preferred farming system of the female farmers in the cluster, ranking first in terms of 'easy to market' and second for profit generation and usability for food consumption. They argued that the highest income could be derived from planting bananas and corn while vegetables ranked first in terms of the criterion 'food consumption'. Sugarcane plantation had the lowest weight for all the criteria.

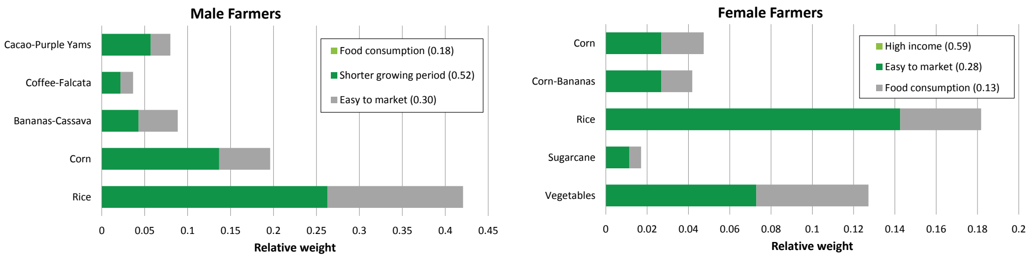

Figure 3.30. Most-preferred farming systems in Kulasihan Cluster

Tree species preferences

The male and female farmers in the Kulasihan Cluster used different sets of criteria in selecting tree species to plant. Both genders considered the income from trees and ease of marketing were important. Male farmers also look into the usability of trees as sources of food. Women considered the usefulness of trees for environmental protection and for long-term investment. Only rambutan, durian and falcata were commonly identified by female and male farmers.

Figure 3.31 shows that the main consideration of the males in tree species selection was the high income that could be derived. This was expected since most of them act as the provider of the family. Among their five preferred tree species, durian and rambutan ranked first in terms of income generation. Unlike timber trees, they provide income annually. They also topped the criterion 'easy to market' since fruit products are easier to market compared to timber trees as there were ready buyers for these commodities unlike for timber trees. In terms of food consumption, rambutan ranked first followed by durian. The results showed that fruit trees were more preferred by male farmers in the cluster.

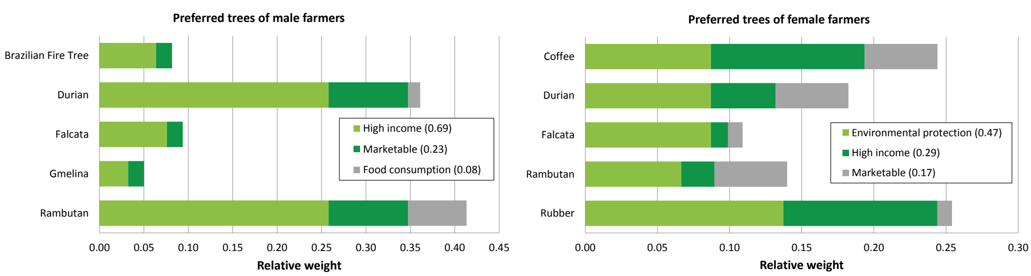

Figure 3.31. Most-preferred tree species in Kulasihan Cluster

Female farmers considered the contribution of trees to environmental protection (e.g. soil erosion prevention, flood control) was important. Among the five trees that female farmers mostly preferred, rubber ranked first in terms of the criterion 'environmental protection'. On the other hand, rubber and coffee topped the ranking for high income. Females found fruit trees easier to market compared to rubber and falcata. Lastly, the group considered plantation crops such as coffee and rubber as good long-term investments.

Most notable shocks on farming systems

Typhoon Pablo in 2012 was considered by both male and female farmers as the most devastating shock that they had experienced in the cluster. Crop-based farms, particularly vegetable gardens and rice fields, were the most affected by this shock. As shown in Figure 3.32, other crops that were damaged included bananas, corn and sugarcane. Most of the responses of farmers to this shock were to avail themselves of loans and assistance from the government.

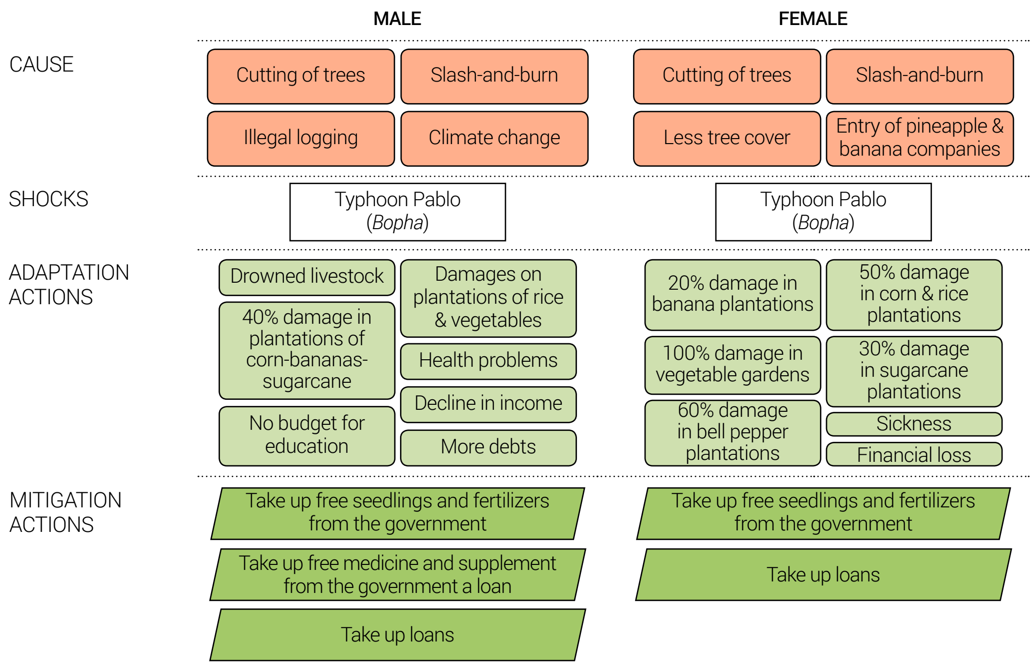

Figure 3.32. Profile of most notable shocks on farming systems in Kulasihan Cluster

Shocks, exposure, response and impact

Natural disaster

Both male and female groups agreed that Typhoon Pablo in 2012 was the most devastating natural disaster that had occurred in the last 10 years. Strong winds and heavy rainfall lasted for two to three days resulting in crop failure and infrastructure damage, among other damage. As presented in Figure 3.33, several efforts were undertaken at the household and community levels to cope with its consequences.

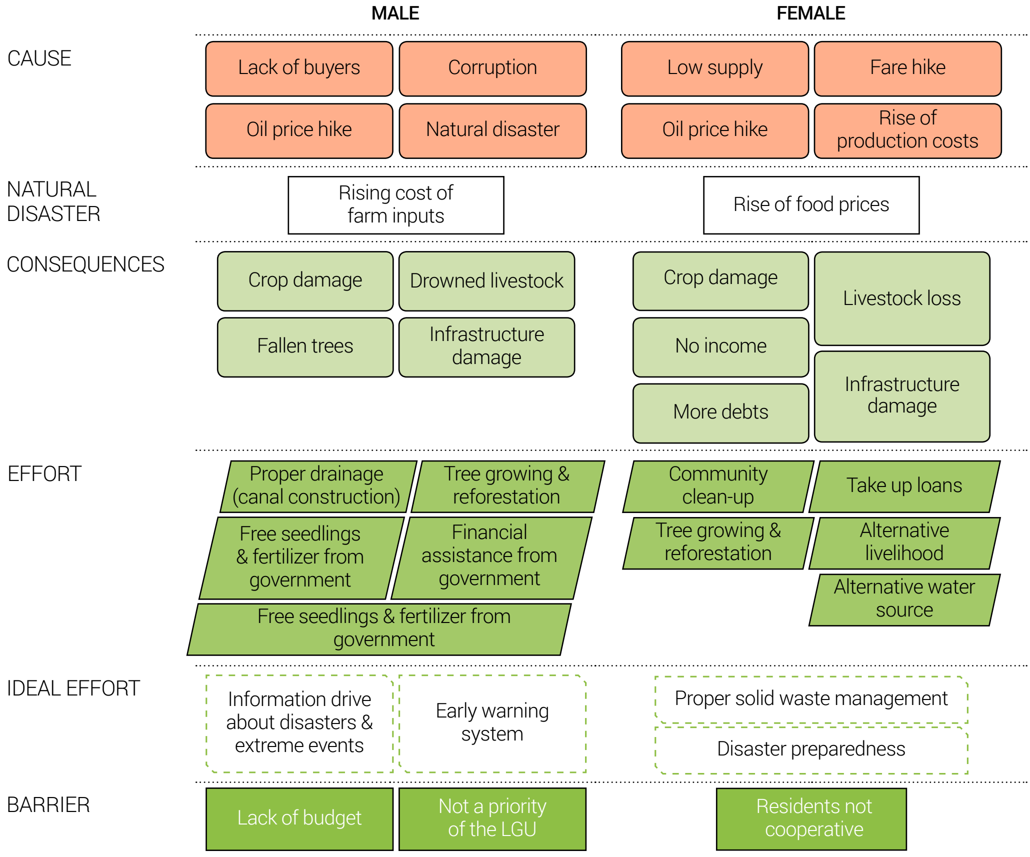

Figure 3.33. Profile of the most notable natural disasters in Kulasihan Cluster

Extreme events

The rise in food prices was considered by both male and female farmers as the most notable extreme event that they had experienced in the last 10 years. Male farmers recalled that the price of rice rose by 50 percent in 2009. It took five months for its price to become stable again. On the other hand, female farmers remembered an increase in the prices of different rice varieties by 40 percent in 2014. Figure 3.34 shows the details of this extreme event.

Strengths, weaknesses, opportunities and threats

Three separate FGDs consisting of two all-male groups and one all-female group were undertaken to collect information on the smallholder farmers' strengths, weaknesses, opportunities and threats (SWOT) in the Kulasihan Cluster. The participants were representative of various stakeholder groups in the cluster including village leaders, farmers' group, women's group, IP group, among others. They were asked to identify SWOT factors existing in their cluster and then to provide a score (1 lowest, 4 highest) for the level of significance of each item. In cases of conflicting scores, the participants were asked to give a single score via consensus.

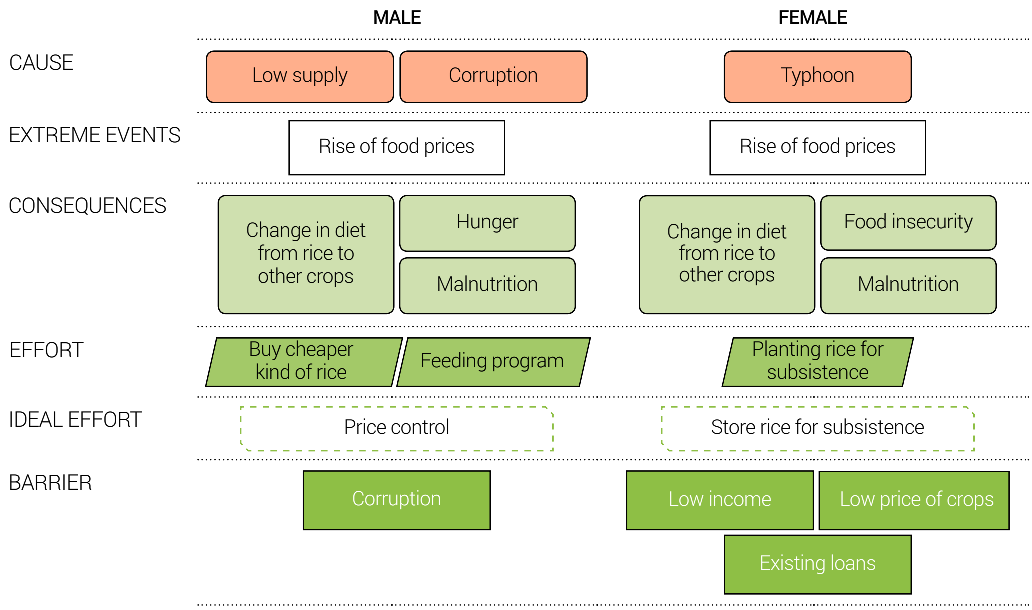

Figure 3.34. Profile of the most notable extreme events in Kulasihan Cluster

The figure 3.35 shows the identified SWOT factors of all the groups in the Kulasihan Cluster illustrated through a word cloud where the font size corresponds to the combined scores. To simplify the analysis, different items with similar themes are combined into the keywords used in the word cloud, with the scores accumulated.

The identification of the strengths and weaknesses were further categorised into the five capital factors that are intrinsic or internal to the cluster: natural, physical, financial, human, and social or cultural. Two of the most significant strengths identified by the participants were both from the social and cultural capital category and both related to the importance of organisations. The farmers in Kulasihan Watershed perceived that having active people's and farmers' organisations as well as an active IP group was their greatest strength. Equally important to them was having an intact and protected forest, especially the Cinchona Forest Reserve that provides many environmental services and is being developed into an eco-tourism spot.

Conversely, smallholder farmers in this cluster considered their low income from farming and the lack of medical facilities in their area as their greatest weaknesses. The farmers reported that the low selling prices of their crops as well as low yields led to very low profit that was often not enough for their family's needs. The lack of medical facilities was evidenced by the fact that the nearest hospital was a few hours away and although there were village health centres, their stock medicines were often in short supply. It should be noted that overall, the farmers considered their financial capital as a weakness rather than as a strength. In fact, while they were able to identify several significant weaknesses in terms of their financial capital, with the top weakness even coming from this category, they were able to identify only three low-scoring (insignificant) financial capital strengths.

Stemming from their low income from farming, the participants considered livelihood programs by the LGU as the most significant opportunity they could take advantage of. In fact, the majority of the opportunities identified by the farmers were those that provide financial support and fell in the financial capital category. Among the most popular was the national government initiative called the Conditional Cash Transfer Program (4Ps) which provides financial, educational and medical assistance. The municipal and provincial LGU also has programs that give farmers free seedlings and other planting materials. The development of the Cinchona Forest Reserve as an ecotourism spot also presented a great opportunity for the Kulasihan Cluster.

On the other hand, a major threat to all residents of this cluster was the entry of large scale agro-companies associated with plantations, piggeries and poultry in Lantapan. The farmers were worried that these companies continually degraded their environment by clearing land, cutting trees, depleting their water supply and releasing chemicals and other harmful wastes into the environment.

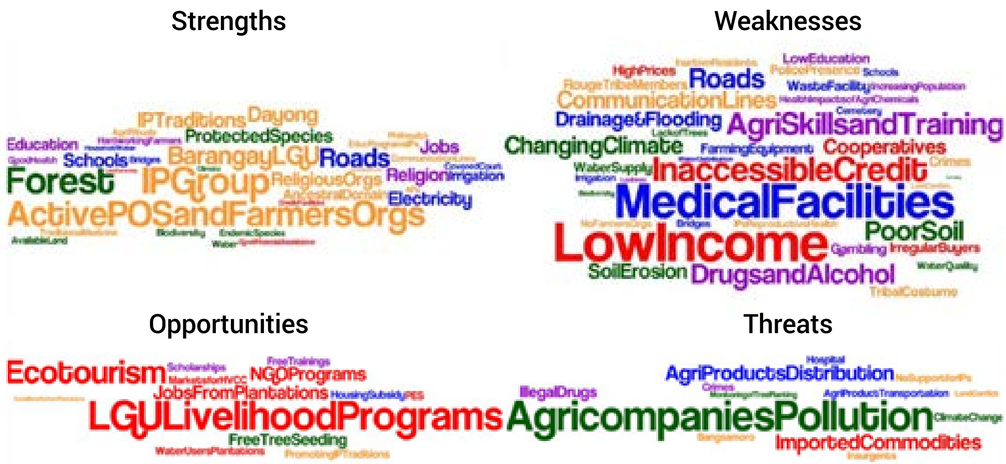

Figure 3.35. Stakeholders' perceptions of strengths, weaknesses, opportunities, and threats in Kulasihan Cluster (note: bigger fonts represent stronger perceptions, font colour representation of livelihood capital: green = natural; blue = physical; red = financial; orange = social; purple = human)

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