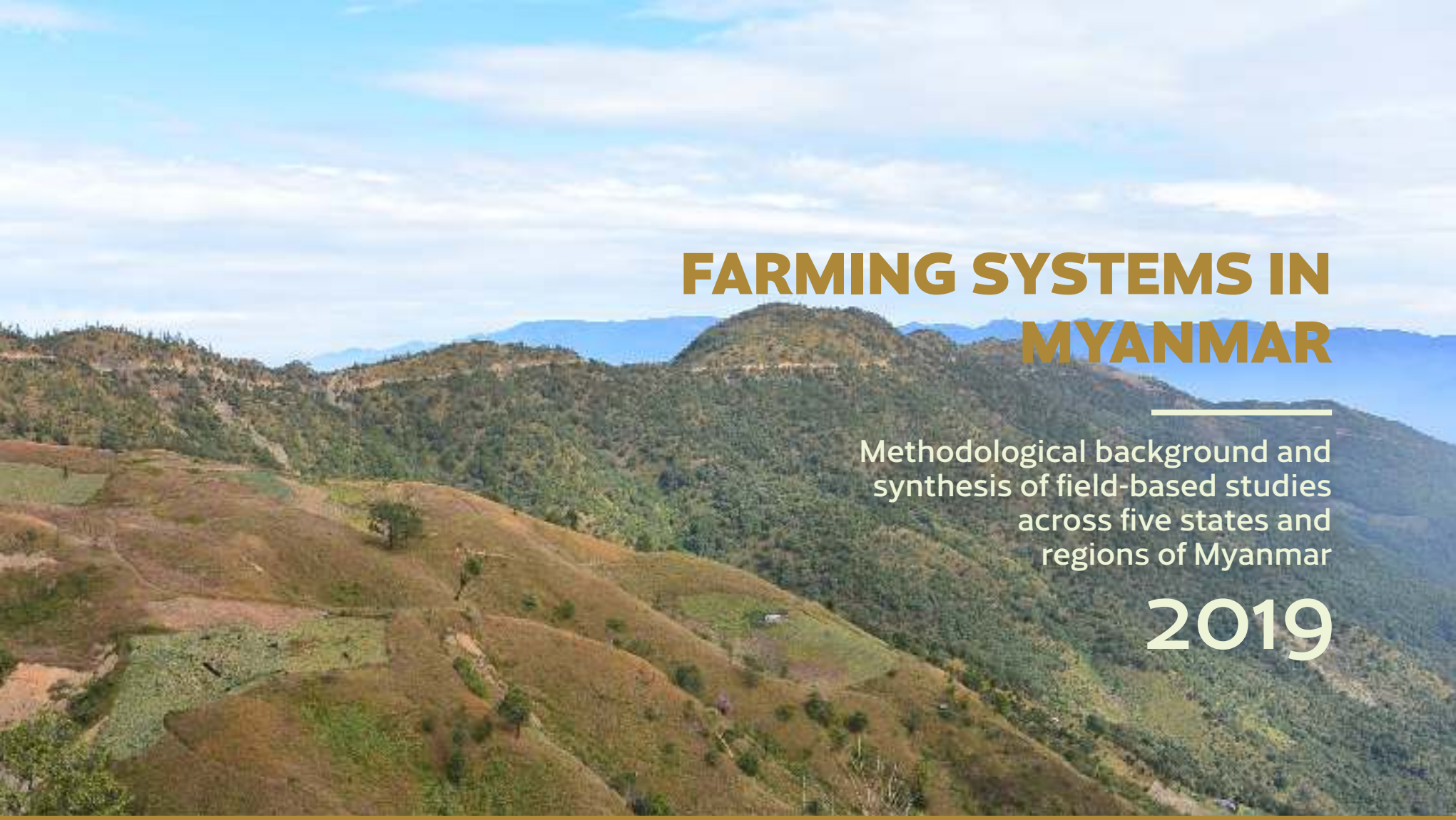

FARMING SYSTEMS IN MYANMAR

Methodological background and synthesis of field-based studies across five states and regions of Myanmar

2019

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Farming systems analysis in Myanmar: Methodological background, selected case studies and synthesis of field-based studies across 5 states and regions of Myanmar

Published by: LIFT, 2019

Coordinated by: Celine Allaverdian

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Cover Page Photo By: GRET

Disclaimer

This document is produced with financial assistance from Australia, Canada, the European Union, Ireland, Switzerland, the United Kingdom and the United States of America. The views expressed herein should not be taken to reflect the official opinion of the LIFT donors.

Acknowledgements to LIFT donors

We thank the governments of Australia, Canada, the European Union, Ireland, Switzerland, the United Kingdom and the United States of America for their kind contributions to improving the livelihoods and food security of rural poor people in Myanmar. Their support to the Livelihoods and Food Security Fund (LIFT) is gratefully acknowledged.

Abstract

The study draws on the farming systems analysis initiative conducted in 2017 and 2018 across 5 States and Regions of Myanmar, by young scholars and junior researchers. It introduces the Farming Systems Analysis approach and its relevance to better understand farmers' decisions and practices. Three selected case studies from Kayin and Chin states and Central Dry zone provide a historic and holistic reflection of the evolution of farming systems in these contrasting agro-ecological zones. A synthesis reflecting on the findings of the 6 farming systems analysis studies sheds light on the key differences and common points of agrarian dynamics and the rapid rural transformations taking place across the 5 States and Regions. In short, although there are much variations within the country in terms of cropping and livestock rearing systems, land holding size and farm incomes, farmers face very similar constraints in terms of labour shortages and they adapt similar off-farm diversification strategies. Conflicts and inappropriate agricultural policies of the last decades have likewise affected rural households throughout the country. China appears to play a major role in shaping agricultural markets and value chains. Finally, Kachin, Kayin and Chin uplands are undergoing agrarian transitions from subsistence based shifting cultivation systems to cash crop based permanent cultivation systems with common impacts on food self-sufficiency, land use and land tenure patterns.

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Units and Measures

Area

Unit	Hectare (ha)
1 Acre (ac)	0.4046

Volumes and Weights: Standardized measurements in Myanmar

Government Basket (GB)	Kilogram (kg)
1 basket of Paddy	20.861

*1 Government Basket (GB) = 16 pyi = 128 condensed milk cans (128 x 11.25 fluid ounces = 9 empirical gallons)

Commodity	Pounds (lbs)	Kilograms (kg)
1 basket Sesame grain	54	24.55
1 basket Maize grain	55	25.00
1 basket Paddy	46	20.91

Units	kg	Vis
1 GB	20.86	
1 kg	1	0.612
1 Vis	1.633	1

(Source: Bernot, 1974)

Acronyms and Abbreviations

CDN	Consortium of Dutch NGOs
CS	Cropping system
DGWR	Department of Ground Water Resource
DOA	Department of Agriculture
FAO	Food and Agriculture Organization of the United Nations
FS	Farming System
FSA	Farming Systems Analysis
GRET	Professionals for Fair Development
GVA	Gross Value Added
Ha	Hectare
IC	Intermediate Cost
IDP	Internally displaced persons
IWMI	International Water Management Institute
KNU	Karen National Union
LIFT	Livelihoods and Food Security Fund
MADB	Myanmar Agricultural Development Bank
MIID	Myanmar Institute for Integrated Development
MMK	Myanmar Kyat currency
NGO	Non-Governmental Organization
PP	Pigeon Pea
PP+G	Pigeon Pea + Groundnut
TMT	Tomato
USD	United States Dollar
VTA	Village Track Administrator
WBG	Winter Black Gram
WC	Winter Chick pea
WD	Working day
WG	Winter Groundnut
WGG	Winter Green Gram
WHH	Welthungerhilfe
WS	Winter Sesame
WW	Winter Wheat

Introduction

1. Background to the publication
2. What is the farming systems analysis (FSA) approach?
3. Details of the farming systems analysis studies conducted
4. Contents of this publication

Introduction

1. Background to this publication

Since 2010, LIFT has supported a variety of implementing partners engaged in the agricultural sector in Myanmar. Initially LIFT's activities were confined to the Ayeyarwaddy delta and with time expanded to include the Dry Zone and the Uplands and represent all the key agro-ecological zones of the country. LIFT partners have developed a range of approaches to support farmers, either directly with extension training or through services along the value chains in the supply or access to finance, seeds, and other inputs along with improving market access. These partners have worked closely with farmers and have gained insights into their practices and the challenges they face. This invaluable knowledge has not been systematically documented, often remaining within small technical teams of experienced field staff, thus limiting its broader use. Furthermore, the technical approaches of projects remain standardized with limited contextual sensitivity. At the same time, it is necessary to acknowledge the dynamic attributes of the agricultural sector in Myanmar as it transforms. This is exemplified by farmers investing in mechanization, the adoption of new crops, varieties and tmodern seed delivery platforms, and the shift to non-farm activities to diversify household incomes. Farmers are engaging and become integral actors in new markets, even in remote areas. These transformations are rarely considered in extension systems due to a lack of analytical tools to understand what it means for different farmers, depending on their land size, access to services, inputs, irrigation, the level of integration with other farm activities and the non-farm sector. The purpose of a farming systems analysis (FSA) is to provide a systematic documentation of farm dynamics and an understanding of the rationale surrounding farmers' choices. This knowledge can be used at a project level to develop more specifically targeted extension strategies that respond to the demands and needs of various categories of farmers.

Studies related to farming systems are limited in Myanmar, as much of the literature focuses on specific value chains, or measuring changes at the national or regional level without sufficient attention being paid to the considerable contextual variations within those boundaries. Conducting a farming systems analysis within a project is a complex endeavour that requires appropriate capacities, time, and resources.

This publication is a culmination of series of studies that were undertaken across key agro-ecosystems in Myanmar by young agricultural researchers under the technical guidance of Gret with the support of a number of implementation partners. Financial support for the initiative was provided by LIFT.

The identification of suitably qualified and experienced researchers with sufficient field work experience and analytical skills was a significant challenge. Consequently, the FSAs that were undertaken are mixed with some providing interesting analyses and insights and others providing mainly general contextual descriptions. We are of the opinion that all FSAs are useful as each contributes to our knowledge base about the diversity of farming systems across Myanmar, their complex ecology, and how farmers are adapting to changing conditions. The full reports of each of the case studies undertaken in this initiative are listed in references and can be requested.Summaries and key findings are presented in the sections below and selected case studies are included in full to provide the reader with insights into FSA and the use of tools.

The initiative supported implementing partners in conducting farming systems analysis in six contrasting areas, across five States and Regions of Myanmar. This was under the guidance and supervision of Gret. Implementing partners contracted international master students from the University of Agriculture SUPAgro Montpellier (studies conducted in Delta and Dry Zone) and young master graduates (studies in Uplands), most having studied agronomy. The young researchers spent between 3 to 6 months undertaking these studies that included field work, analysis and reporting. Celine Allaverdian of Gret was responsible for facilitating the overall process and provided methodological advice and technical support to the implementing partners and researchers in their endeavours. Jean-Christophe Diepart provided technical advice.and insights and others providing mainly generrtners in conducting farming systems analysis in six contrasting areas, across five States and Regions of Myanmar. This was under the guidance and supervision of Gret. Implementing partners contracted international master students from the University of Agriculture SUPAgro Montpellier cess and provided methodological advice and technical support to the implementing partners and researchers in their endeavours. Jean-Christophe Diepart provided technical advice.

2. What is the Farming Systems Analysis (FSA) approach?

The farming systems analysis approach was developed in order to address the complexity of agriculture. Under the banner of "farming systems analysis", various methodologies exist. Although they have distinct differences in their topical focus (e.g. focus on livelihoods' systems or natural resource systems), with different tools used for social, technical and economic analysis, and varying degrees of farmers' involvement and integration on issues such as policy, equity and risk, most FSA approaches share common elements. Specifically, they are multi-disciplinary, systemic and take on a holistic approach to studying the farming system. In addition, they require in-depth qualitative research at the field level, investigating the array of attributes that constitute the farming system matrix. The farming systems analysis approach adopted in these studies is based upon the comparative agriculture approach, developed by agronomists, agricultural economists and geographers as described by Cochet (2015).

Farming systems analysis is a powerful tool for development practitioners that include technicians and agronomists to become familiar with a dialogue approach involving people whom they work with. It can provide an improved understanding of the local context and of farmers' decision–making rationales and assist in identifying the processes of change underway in the region, and the development paths of various farming systems. It can also assist in identifying and prioritizing the problems farmers encounter thereby shedding light on the conditions under which they could modify their practices. As such, agrarian diagnostic analysis is a tool that can be used in project design and impact assessments.

3. Details of the Farming Systems Analysis studies conducted

A number of case studies were conducted across a diverse range of geographic locations and agro-ecological contexts within three of the four agro-ecological zones that are used to describe Myanmar's agricultural sector. The coastal agro-ecological zone was not covered in this study *(Table 1 and Figure 1)*.

In addition, the FSA studies were framed within the context of a particular agricultural development problem that represented a challenge for the local population and development practitioners working in the area. Researchers and implementing partners were encouraged to formulate such entry points to guide the FSA research work *(Table 1)*.

Three studies were undertaken in the Upland areas of Myanmar, more specifically in the hilly and mountainous regions of Chin, Kachin, and Kayin State. The annual precipitation ranges between 1,000 – 2,000 mm. Forested areas are predominant, with agroforestry and shifting cultivation farming systems being the dominant form of agriculture practiced. The region is inhabited by diverse non-Bamar ethnic groups.

A single study was conducted in the Central Dry Zone in Sagaing. It is relatively flat and located within a semi-dry to dry agro-ecological zone with an annual precipitation of between 700 – 1000 mm with frequent dry spells. The dominant agricultural crops are rice, pulses (e.g., pigeon pea, lima bean, chickpea etc.) oil seeds including groundnut and sesame. Livestock plays an important role in these farming systems.

Finally, two studies were conducted in the Ayeyarwaddy Delta. The delta is characterised as flat lowlands dominated by alluvial soils. The annual rainfall ranges between 2,200 – 2,800 mm with frequent flooding and periods of inundation. The main crop is paddy with approximately 60% of Myanmar's rice produced in this agro-ecological zone. Horticulture is practiced on alluvial soils and fishing is an essential livelihood component in the agro-ecological zone.

Zone	Location/State - Township	Area of focus of the FSA study	Responsible organizations, researchers, and advisor(s) within implementing organizations
Upland	Chin State - Hakha Township	Inter-relations between the evolutions in farming systems and diet	Gret and MIID Researchers: Clarisse Frissard (Gret) and Alyssa Pritts (MIID) Advisors: Murielle Morisson (Gret) and Jasper Besemer (MIID)
Upland	Kayin State - Thaundanggyi Township	Transition from shifting cultivation to permanent cultivation and differentiated access to land	CDN Researcher: Simon Ayya Yan Advisor: Jose Garcia (CDN)
Upland	Kachin State - Myitkyina and Waing Maw Townships	Understanding the diversity of farming systems and their specific challenges	METTA Researcher: Mya Darli Thant Advisor: U Khin Maung Latt
Central Dry Zone	Sagaing division - Myinmu Township	Farmers strategies in relation to differentiated access to irrigation water	IWMI Researcher: Fue Yang Advisor: Petra Schmitter and Robyn Johnston
Delta	Ayeyarwady division Laputta and Mawlamyinegyun Townships	Farming systems analysis and rice marketing strategies at local level	METTA Researcher: Adriana Isabel Garcia Martinez Advisor: U Khin Maung Latt
Delta	Ayeyarwady division Bogale and Mawlamyinegyun Townships	Decreased labour supply and transformation of farming systems	WHH (Yi-Jen LU)

Table 1: *List of farming analysis studies conducted under this initiative*

4. Contents of this publication

Introduction provides details on the core principles and concepts that are mobilized in the Farming Systems Analysis approach.

It also explains its methodologicalfoundation, the main steps and provides some detailed explanations of the evaluation and calculation on the most important economic indicators that are used in the technical and economic analysis of farming systems and their sub-components.

Chapters one, two and three are three selected and condensed study cases based on the work undertaken through junior researchers and scholars in 2017 and 2018 with the following organisations: METTA, GRET, CDN, MIID, IWMI and WHH (see Table 1).

1

Chapter one focuses on the evolution of farming systems (notably through the transformation of shifting cultivation systems) and diet in Hakha Township, Chin State, Myanmar.

2

Chapter two is a fascinating example of an upland transition from subsistence-based shifting cultivation systems to permanent cash crop systems in the midst of armed conflict in Thaundanggyi Township, Kayin State.

3

Chapter three explores the question of access to water for family farmers, under various types of irrigation systems of Myinmu Township, Central Dry Zone of Myanmar, and how this affects the diversity of farming systems and their evolution.

4

Finally, chapter four aims to capture the most important findings of each of the six different farming system analyses. It includes an analysis of key cross-cutting issues such as labour shortage, migration, agricultural policies and markets, agrarian transition across the six FSA studies conducted. It sheds light on the common points identified across the region as well as on the diversity of the agrarian dynamics that have been or are currently at play.

Annex 1 proposes a practical reflection - on how the proposed farming systems analysis can be used for development and also explores its limitations and challenges, drawing on the feedback of LIFT, the implementing partners and the researchers who were involved in this project.

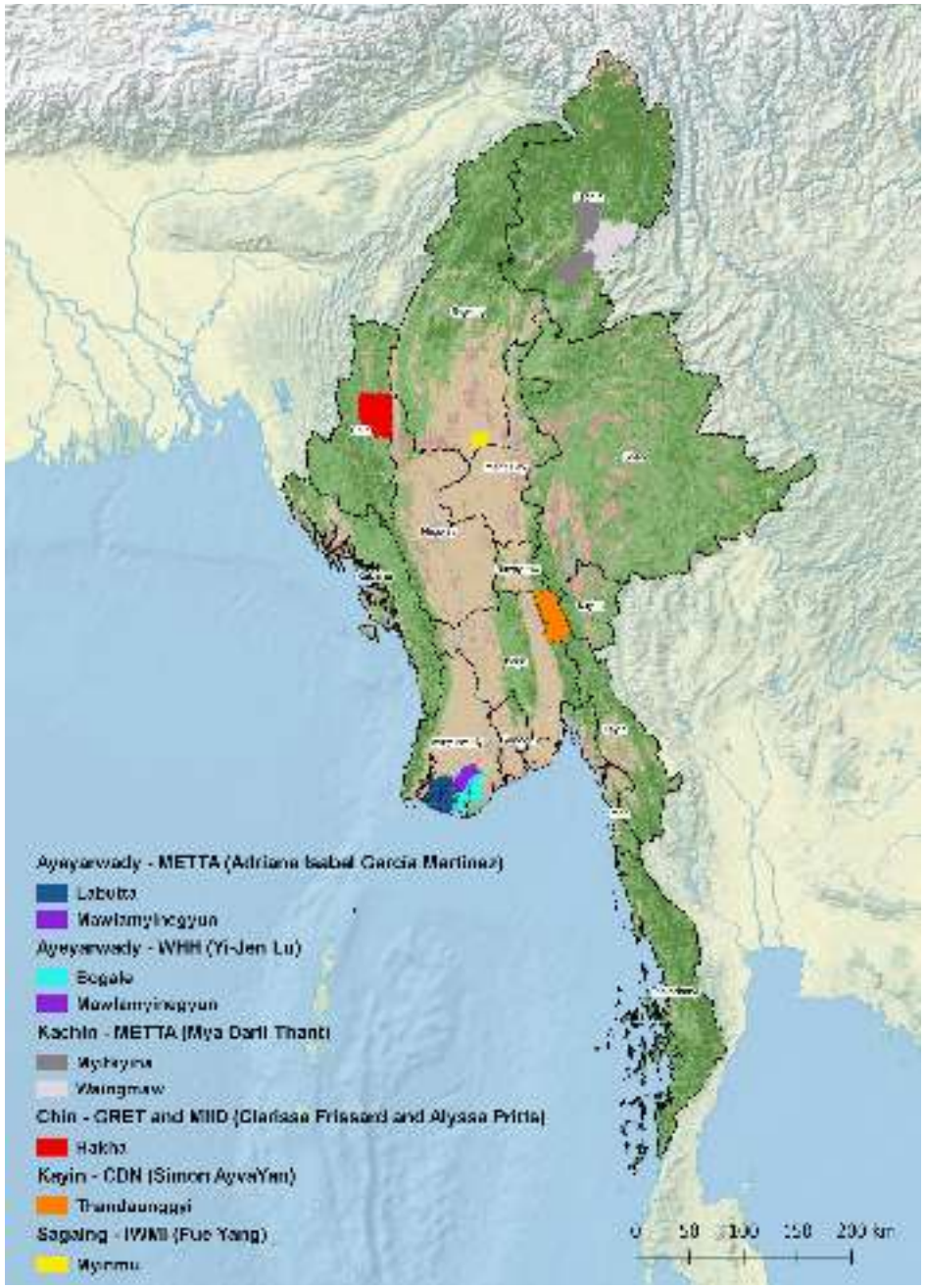


Figure 1: *Location of the six farming systems analysis study sites*

The Farming Systems Analysis Approach

1. Core principles of Farming Systems Analysis
2. Key concepts
3. The approach in a nutshell

The Farming Systems Analysis Approach

1. Core principles of the farming systems analysis

For the sake of brevity, the following section will cover salient elements in undertaking a Farming Systems Analysis. For a comprehensive guide to the approach and concrete examples, the reader is referred to the Farming Systems Analysis: A guidebook for researchers and development practitioners in Myanmar

An approach based on observation and dialogue

The approach requires the building and nurturing of trust between the farmer and researcher. The basist of this is tto observe and listen without pre-conceived ideas or answers formulated to the challenges in order to avoid introducing biases into the analysis. Interviews should be viewed as a period of active listening to capture the farmers' knowledge and skills. This also offers a space for the farmers to step back and think through their own experience.

Besides key concepts, the design and implementation of the farming systems analysis is driven by core working hypotheses that encapsulate the following:

Farmers are rationale; they have "good" reasons to do what they do

In order to conduct farming systems analysis, it is crucial to avoid assuming that farmers' practices are 'backward' or 'inferior', that they lack knowledge or are incapable of appropriate reasoning. Farmers usually take decisions that conform to their interests, within material, human and cognitive means to which they have access.

There is no one uniform category of farmers

Family farmers do not form a uniform category of actors. Even in a small subsistence-based region, it is possible to identify different types of farmers who have different strategies and practices and who react differently to the sets of constraints and opportunities they face.

Farming systems are dynamic

By recognizing recent changes and technical, economic and social transformations, it is possible to shed light on the key factors that lead to the evolution of different types of farms. It also allows one to elucidate the differentiating processes among them in order to understand the major trends and trajectories of different types of farming households over time.

Farming systems analysis: an interface between research and development

It is important to envision farming systems analysis within a wider social context, and to consider its relevance to the rural population. This is particularly important when the analysis is conducted in conjunction with an NGO or a development project working to address a specific development issue. It is recommended that the farming systems analysis be framed with a particular agricultural development problem in mind, a particular question that represents a particular challenge for the local population and their supporters (development professionals, NGOs, etc.). In this way, the farming systems analysis can be seen as a research contribution to a concrete and real-life development issue *(Barral et al. 2012)*. Below are some examples:

- ⇨ Anticipate the interest and ability of family farmers to adopt an agricultural innovation within the agrarian landscape (e.g. agro-ecology farming practices, or the development of a new niche market);
- ⇨ Guide the design and development of an inclusive water management scheme in a small watershed;
- ⇨ Understand the diversity of farming practices and rationale, and evolution pathways in the context of a local level land use planning exercise;
- ⇨ Understand the factors that trigger labour diversification outside agriculture and migration away from the village.

As a result, a key challenge for the person who conducts the farming systems analysis is to reconcile the scientific rigour needed for such an undertaking with the operational concerns co-formulated with the actors on the ground. It is a scientific and methodological challenge. It requires an understanding of the development issues at stake, the formulation of hypotheses as to why they have taken place, and the translation of these hypotheses into research questions to frame the farming systems analysis and to design specific investigation tools accordingly: the agro-ecological zoning, the agrarian history, the farming system typology etc.

2. Key concepts

Farming systems analysis is conducted through the use of a series of systemic concepts developed to study agrarian landscapes. Generally speaking, a system is a set of interacting or interdependent components that form a complex whole and are organized towards one or several objectives *(Crozier and Friedberg 1977)*. The systemic approach consists of delineating the boundaries of this object, its components, the interaction between them and the relationships that integrate each and every component into a more or less organized whole *(Figure 2)*.

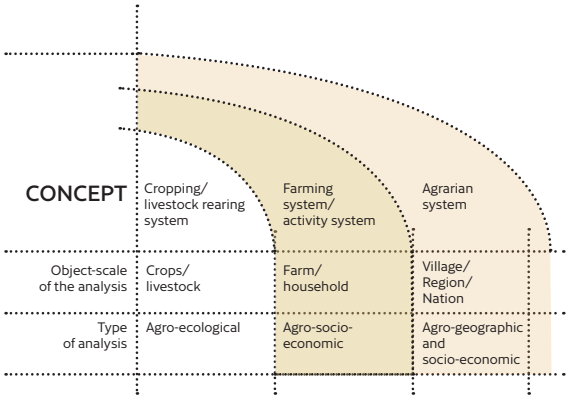


Figure 2: *Hierarchy of systemic concepts used in Farming Systems Analysis*

In comparative agriculture, the concepts of the agrarian system, farming system, cropping and livestock system all deal with the exploitation of an ecosystem by humans *(Figure 2)*. These concepts assist in understanding different agrarian units at different scales: the agrarian system addresses the interactions between an ecosystem and a group of people at the landscape level while the farming system deals with these interactions at farm/family level. The cropping or livestock rearing system refers to interactions at the plot or herd level. These concepts form a nested hierarchy, and a key characteristic of the farming systems analysis is to integrate these different levels of analysis. As presented in Figure 2, the type of analysis and tools used to examine these different "systems" also vary according to the scale, ranging from agro-geographic to detailed agro-ecological analysis at plot or herd level to wider socio-geographic and socio-economic analysis at landscape level.

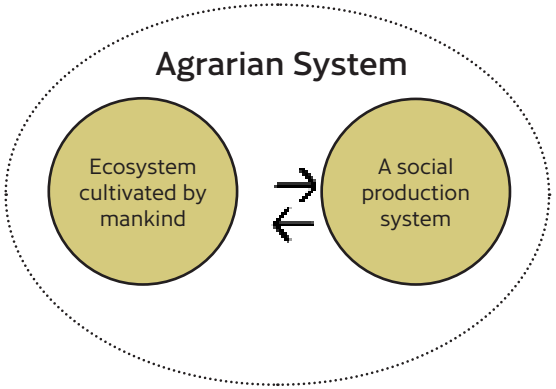


Figure 3: *Representation of an agrarian system*

Agrarian System

The agrarian system is defined as the theoretical expression of a historically constituted and geographically localized type of agriculture, composed of a cultivated ecosystem, and a specific social production system made of people, social relations and institutions *(Mazoyer and Roudart 2002)*. The latter ensure the long-term fertility management of the cultivated ecosystem *(Figure 3)*. The agrarian system includes the following components: the cultivated environment and its historic transformations; the production instruments and the labour force implementing them; the social division of labour among farmers; and the production and commercialization of the agricultural surplus including the trade relations with market actors. The analysis of an agrarian system includes an examination of the social relations of production particularly involving access to all means of production, as well as all the ideas and institutions ensuring social reproduction.

→ **Ensures**
- Long-term fertility management of the cultivated ecosystem

→ **Consists of**
- Cultivated environment
- Production techniques
- Labour force and social division of labour
- Commercialization and trade

Agro-ecological zone

Agro-ecological zone refers to the division of a territory that has similar characteristics defined in terms of climate, landform, soils and land cover, and that has a specific range of potentials and constraints for land use *(FAO 1996)*. An agro-ecological zone is the constitutive element of the agrarian system. It is not limited to an agriculture land use and can also consist of forest, wetlands, grazing areas etc., or a combination of several land uses (e.g., agro-forestry and agro-fishing).

Farming system (also known as production system)

There are numerous definitions of the concept of **"farming system"** here we address it at the level of a typical unit of production: the family.

A [family] farming system is conceptualized as an organized combination of production factors and activities geared towards agricultural production (both cropping and livestock) directed to self-subsistence and to sale *(Figure 4)*. An examination of a family farming system includes the study of relations existing between different elements of the system, notably the organization and distribution of family labour between the different production activities as well as relations between the different crop and livestock systems *(Cochet et al, 2012)*. As such, a farming system is influenced to varying degrees by political, economic, institutional and social forces that operate at many levels.

Cropping and livestock rearing systems

The **cropping system** concept applies to a plot (or a set of plots) cultivated in a certain way by the farmer. As such, it includes the crops planted (potentially as mixed cropping), crop sequences, all the techniques and labour applied to them following a specific organization and under given soil and climatic conditions *(Sébillotte 1976)*.

On an equivalent scale of analysis, the **livestock system** is defined at the level of the herd, and integrates aspects relating to the herd structure (genetic characteristics, population pyramid, sex ratio, etc.), its feeding and the corresponding forage calendar, as well as herd management (movement, reproduction and care among other issues) *(Cochet 2015)*. This also includes aqua-culture, although capture fishery would fall under the activity system.

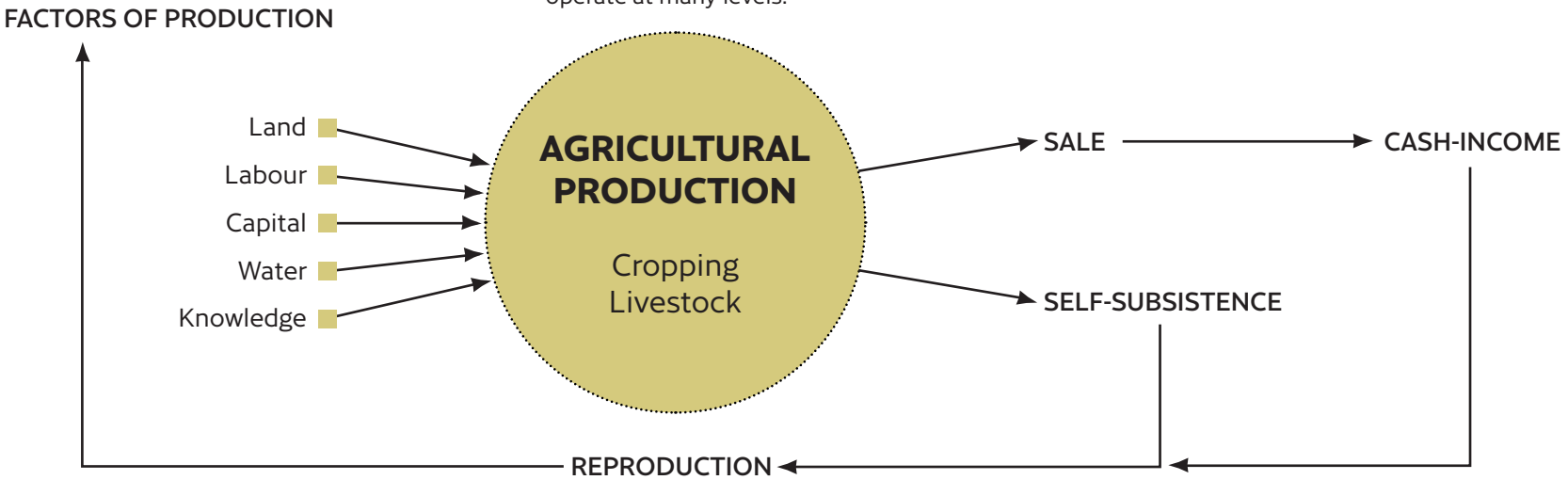


Figure 4: *Representation of a farming system*

Activity system

In most of rural Southeast Asia, the occupations of a household are not limited to cropping and livestock rearing. The activity portfolio of most family farmers also comprises wage-related activities, sometimes involving migration, and self-employed activities in agricultural processing or other services. It further encompasses the activities associated with the harvesting and management of natural resources, such as fisheries or forest related products (timber and non-timber forest products). Similar to cropping and livestock activities, the conduct of these activities is based on factors of production, in particular technology and practices. It is of note that non-agricultural activities are increasingly important to family farmers in Southeast Asia. These non-farm activities usually do not replace farming activities per se but are integrated by families based on their demographic structure, labour capacity, investment capacities, interest and skills, all embedded in a wider ensemble including the security of land tenure, matrimonial strategies, ideological conceptions, the structure and functioning of commodity markets etc. The combination of these income generating activities at the household level is called an **activity system** *(Figure 5)*. It is conceived as a system because the different income generating activities are inter-dependent and managed through a labour management strategy established at the family level.

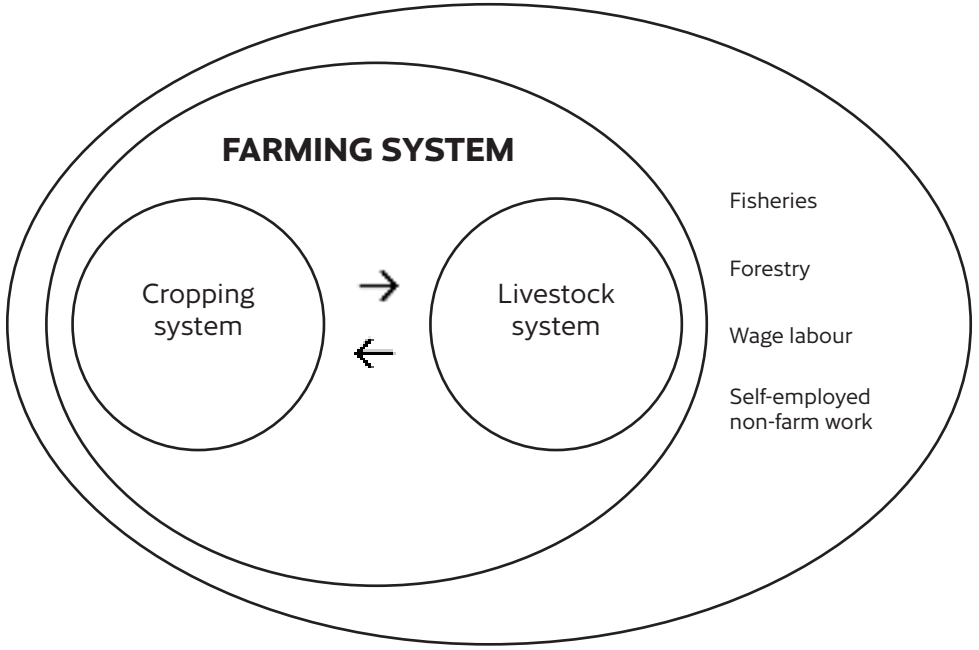


Figure 5: *Representation of an activity system*

3. The approach in a nutshell

Overall, a farming systems analysis is articulated under four main phases as shown in Figure 6:
1) Understand the agrarian landscape;
2) Study the agrarian history and identify farming systems;
3) Analyse the cropping and livestock rearing systems and other income-generating activities; and
4) Assess the economic performance of farming systems.

As such, the analysis relies on an interdisciplinary and holistic approach that necessitates the combination of qualitative as well as quantitative field research methods and tools. It requires researchers to be equipped with sufficient

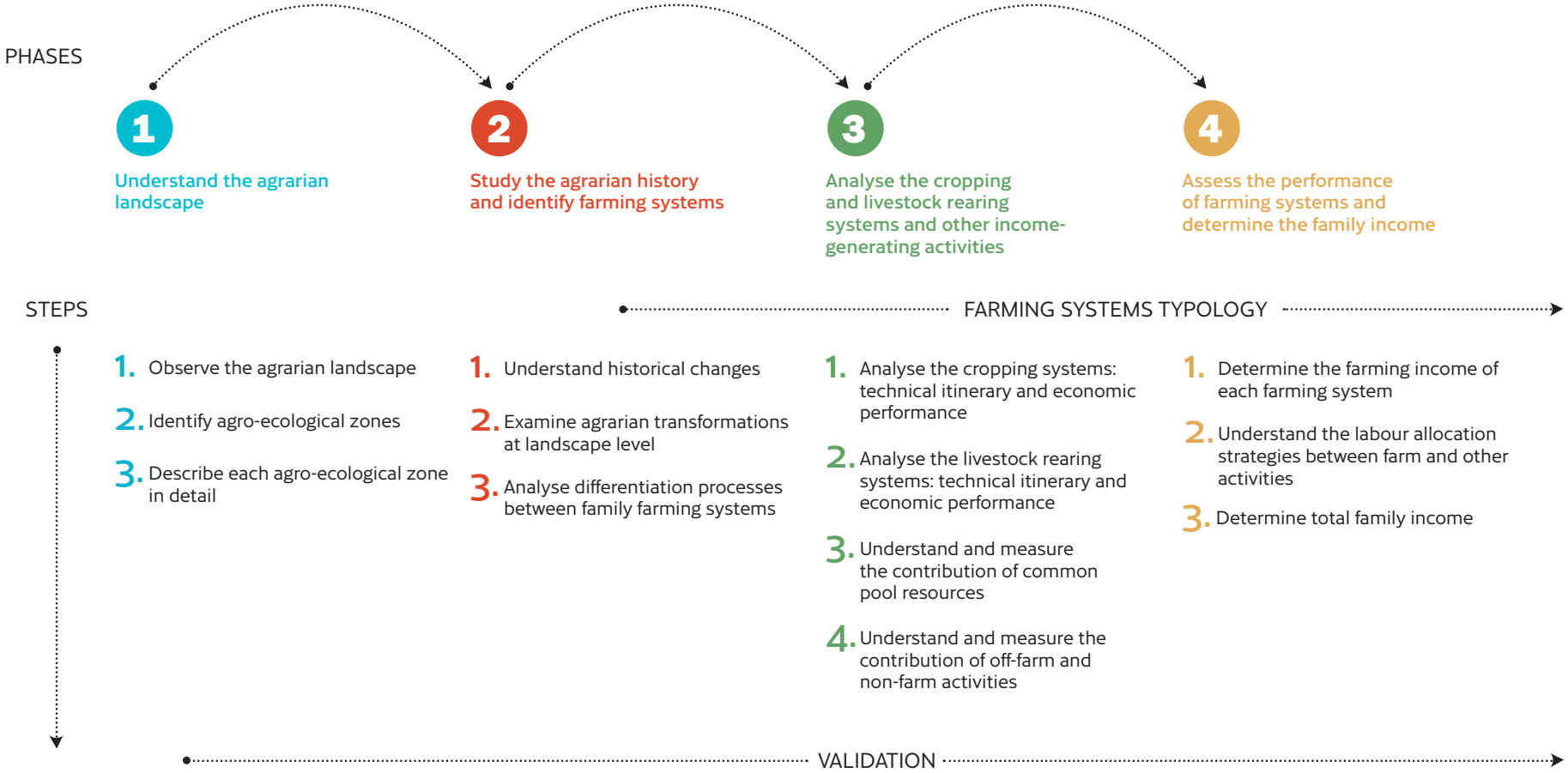


Figure 6: *Phases and steps in the farming system analysis*

skillsets in various disciplines, adequate knowledge in different fields of interest (e.g. history, soil science, socio-anthropology, agricultural economics) as well as a suitable personality and sensitivity to conduct field work in a unassuming manner and engage in a dialogue with farmers. It is not always easy for researchers to mobilise all of these requirements in terms of skills, knowledge and behaviour.

A transversal element across the approach is the need to regularly present and discuss the preliminary findings of the research with local resource persons. It is crucial for them to validate the findings to make sure that the agro-ecological diversity is captured, the agrarian history as reconstructed makes sense from a local perspective, the specificity and knowledge elaborated and transmitted by farmers is well considered, and that agricultural innovation is understood. For this reason, we suggest that seeking validation should be a continuous process throughout the farming systems analysis.

1

Understand the agrarian landscape

Understanding the agrarian landscape consists of a detailed and organized set of observations of the different agro-ecological units that constitute the landscape and includes their internal characteristics, spatial arrangements and possible relations between them.

These observations are made at different scales and allow the formulation of hypotheses about the nature of the activities and land uses in the agrarian landscape and the most recent changes it has undergone. Observations about cropping practices apply mainly to cropping systems, while observations about grazing activities provide information about livestock rearing systems as well as interactions between cropping and livestock systems. The examination of the spatial organization of different cropping and livestock systems with other land use types informs an understanding of the agrarian landscape.

Identifying and analysing the agrarian landscape is a crucial but demanding exercise. Observation needs to be made in a systematic manner, organized, classified and, ultimately, modelled with the help of one or more meaningful and comprehensive illustrations such as transects or diagram blocks.

2

Study the agrarian history and identify farming systems

In order to identify the diversity of farming systems that populate the study area, there is a need to understand the agrarian history of the study area, an endeavour that is the second main building block of a farming systems analysis. The aim of the historical analysis is to understand the evolution of the land use in connection with changes in agricultural policy, changes in agricultural techniques, and the wider transformation of the economy. It is quite likely that the impacts and influences of these changes have been different across the study area hence it is useful to examine the agrarian history in light of the agro-ecological zonation established earlier.

The characteristics and decisions of any particular type of farm necessarily fall within a limited number of possibilities that reflect the distant and recent agrarian history of the landscape. For this reason, it is important to identify the main differentiation mechanisms that explain why, when and where certain households have followed certain trajectories of evolution, while others have taken other directions. The review of these mechanisms of differentiation assists in establishing a classification of main farming system models that is based on a combination of different cropping and livestock rearing systems. This classification is usually referred to as a farming system typology.

An effective method of elaborating the typology of farming systems requires general knowledge about the changes in land and agricultural policies including access to land; the introduction and uptake of new agricultural techniques or innovations (e.g. irrigation and the introduction of new crop markets); and changes in the management of natural resources that have important implications locally (e.g. out-migrations, the development of the non-farming economic sector). The establishment of the typology also requires knowledge about how farms currently operate: the size of landholding and herds, the combination of different cropping and livestock systems in the agrarian landscape, the level of mechanization, reliance on paid external labour etc. The objective is to identify the farming systems before beginning to study in detail how they operate. This approach enables a decision to be made on which farms to study in detail.

3

Analyse the cropping and livestock rearing systems and other income-generating activities

At this stage in the process, it is important to take a close look at the various cropping and livestock systems that constitute each farming system as well as the variety of other income-generating activities in which family members are involved.

The analysis of the cropping systems implies a detailed description of the crops planted (type of seeds and provenance of the materials), the crop association and succession, and all the techniques applied following a specific routine and under given soil and climate conditions (soil preparation, ploughing, application of fertilizers and phyto-sanitary products, harvesting and processing). A detailed description of labour input for all of these operations, as well as a calculation of the economic performance of each cropping system, is particularly important to document.

As far as the livestock system analysis is concerned, researchers need to examine the practices of aggregation (constitution of units or batches, groups of animals that will be treated specifically according to their sex or age category, and that are related through animal flows), management (reproduction, health and feeding), farming (taking milk, wool, meat and more from the herd), and renewal of the herd (culling, selection of young animals or purchase for renewal purposes) *(Cochet 2015)*. A detailed description of labour input for all of these operations, as well as a calculation of the economic performance, is also needed.

The calculation of the economic performance of each cropping and livestock system rests on the notion of value-added, which measures the wealth created by the system. It equals the difference between the gross output and the value of Intermediate Inputs (II) that are consumed fully during the production process. The value-added serves to assess the productivity of the factors of production: the value added per worker or per working day (also called “man.day”) measures the productivity of the labour engaged, whereas value-added per hectare (or “land productivity”) reveals the more or less intensive nature of the system.

This step also includes the review of all other off-farm and non-farm activities carried out by all the family members. These can be very diverse and play an important role with regard to the formation of family income. These activities include the harvest of common pool resources (capture fisheries and forestry), off-farm and non-farm activities. These activities might require seasonal or permanent migration, in which case the remittances transferred from the migrant work might be a source of income for the family in the village. A detailed description of these activities includes labour allocation, the interest of the family in these activities, a description of which family members are engaged in these activities, the conditions of employment, the networks established between the household and the outside community through these activities, the income generated and the possible costs incurred.

4

Assess the performance of the farming systems and determine the family income

The analysis does not end with the identification of a farming system typology and the description of how each crop and livestock system operates technically and how it performs economically.

It is important to assess the economic performance of each farming system. The farm income is defined as the part of the value-added left to the family after payment for the different services necessary for rearing livestock or cultivating crops: the payment of land rent fees, the payment of wages to an external workforce, the payment of interest on borrowed capital and the payment of taxes on land or products. In other words, the farm income results from the distribution of the value-added between the different operators involved in the production and depends on the conditions of access to resources mobilized in the production process. Where relevant, it is important to detail the support received by the farmers through subsidies.

Comparing the total farm income per worker to the opportunity cost of the workforce brings the evolution of each farming system into perspective. The calculation of the farm income provides a reliable indication of whether or not the different farming systems generate sufficient resources to grow and invest, those that just make ends meet or, in contrast, those that are unable to ensure the basic reproduction of the system.

Additionally, it is central to analyze the strategies guiding the allocation of family labour between all activities (farm and non-farm). The key questions to be addressed are: Who does what? When? Why? To answer these questions, it is useful to establish a family labour calendar that identifies the occupations of each active labourer throughout the year, the labour peaks and lean periods, and the way each family manages them. It is also important to understand the interaction between each system, for instance the fertility transfer from livestock to cropping systems, the use of off-farm income to support agricultural innovation or, in contrast, the use of farm income to invest in non-farming activities.

Ultimately, the income generated by these different activities, farming and non-farming, needs to be integrated within total family income to provide a comprehensive picture of the capacity of each family to meet their livelihood needs.

1

Selective Case Study One: The Evolution Of Farming Systems And Diet In Hakha Township, Chin State, Myanmar

1. Overall assessment of the study
2. Landscape attributes
3. Historical analysis
4. Current cropping systems
5. Current animal husbandry systems
6. Typology of current farming systems “archetypes”
7. Conclusions

1 The Evolution Of Farming Systems And Diet

1. Overall assessment of the study

The study is one of the first to document the link between farming systems and local diets in Myanmar. The research addresses the transformation of shifting cultivation systems into various forms of sedentary agriculture and its impacts on crop production and dietary diversity. The analysis provides a comprehensive historical analysis that describes in detail the transformation of shifting cultivation in Chin state since 1885. Although the history is specific to the villages studied, it captures the dynamics that are occurring in many parts of Northern Chin with respect to the transformation in agricultural systems in this upland agro-ecological zone.

The study's main finding is that the diversity of cereals and legumes has decreased in the diet of rural people in Hakha, mainly due to the simplification of shifting cultivation systems. The political implication of the research is important as Chin State has the highest levels of stunting of children. A further key contribution of the research is its methodological approach that demonstrates that the farming systems analysis approach can be easily and successfully tailored to address specific research questions, including on topics such as nutrition.

2. Landscape attributes

Chin State is a mountainous region (Indo-Myanmar Ranges) branching southwards from the eastern Himalaya, with peaks and valleys running from North to South. Hakha Township is at an elevation 2,000 m above sea level and is described as a highland landscape. Due to the steep slopes and elevations, farmers have adapted their farming systems to address the physical and climatic conditions.

The majority of the rainfall is concentrated during four months beginning from May through to October with the remainder of the year being relatively dry *(Figure 7)*. The mean annual rainfall is 1,617 mm. The winter season runs from November to February and is characterized by cool day and night temperatures. The summers are dominated by higher temperatures with associated humidity.

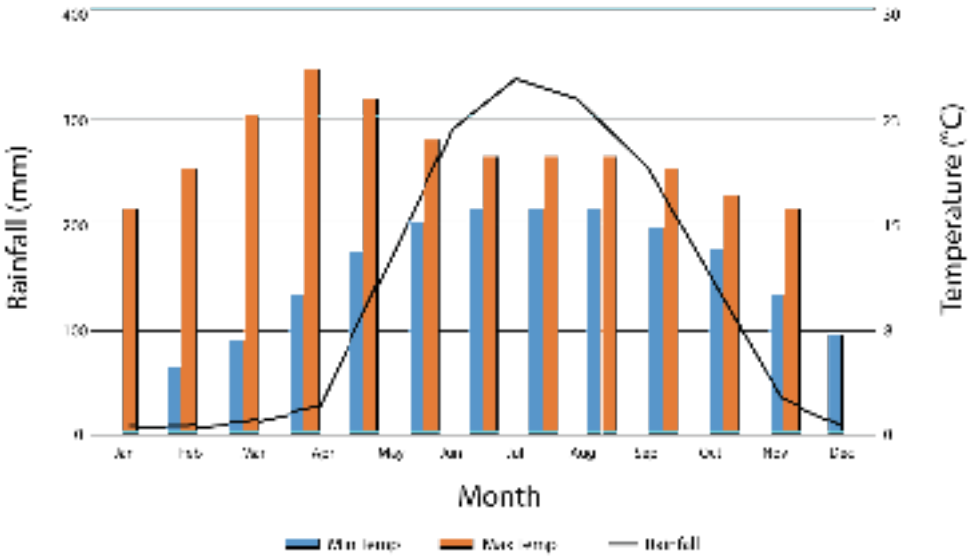


Figure 7: *Mean monthly maximum and minimum temperature and rainfall in Hakha Township*

2.1 Organization of villages

Villages are often situated close to road infrastructure for ease of access to transport connections to towns (markets and services). In the past, the agrarian systems of the region were exclusively based on shifting cultivation. Villages would physically move to follow the different *lopil* (i.e. block of land and rotation unit for the shifting cultivation cycle) that were opened up for cultivation. A few households (that have sufficient labour to clear a "new" *lopil*) often create new villages from a neighbouring village. They are considered as the founders of the village and therefore have a higher rank in the newly created village.

Figure 8: *A satellite view of crop and livestock production halos surrounding Bualtak village, Chin State*

Farmers usually differentiate two types of land units: cold lands (*zo lo*) and warm lands (*lai lo*). These local categorizations of land are based on criteria that include orientation and exposure to the sun, altitude as well as soil type (clay soils having higher thermal inertia than sandy soils). A wider diversity of crops can grow on *lai lo* land units, however, *zo lo* land units are predominantly cultivated with potatoes and corn. Farmlands are organized in halos around the village. The first halo is in close proximity to the village and is reserved for permanently cultivation fields *(Figure 8)*. A second halo is for less intensive land uses that includes shifting cultivation and grazing *(Figure 8)*.

2.2 Permanent orchards and paddy terraces: Halo 1

Permanent plots and orchard crops require regular attention and greater labour inputs throughout the year. They are usually cash crops that need to be protected from livestock. The close proximity to the village allows shorter transportation times and greater protection against livestock depredation. Strategically, livestock are kept away from the village in pastures lands that make up halo 2.

Paddy terraces are also located within the first halo around the village often alongside rivers and streams for irrigation. Usually, one set of paddy terraces includes terraces of multiple households. Gravity irrigation is undertaken by diverting water from rivers/streams with pipes (plastic or bamboo) or along constructed earthen channels. Water is brought to the upper most terraces and allowed to flow down the terraces as a cascade *(Figure 9)*. When water supply is insufficient to meet demand by individual households, priority in the allocation of water is given to the first settlers that developed the irrigation system.

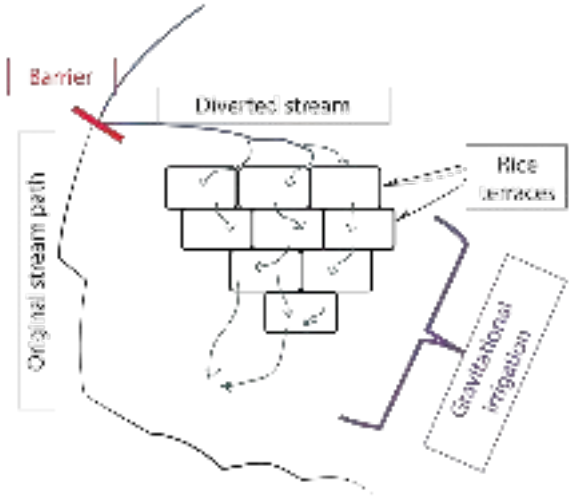


Figure 9: *Irrigation system of a set of paddy terraces in Northern Chin*

2.3 Shifting cultivation in *lopil*: Halo 2

A *lopil* refers to a large area of land (up to 50,000 ha) that is opened up for shifting cultivation. Each *lopil* includes a set of plots grown by each household in the village that practices shifting cultivation *(Figure 10)*. The size of the plots depends on the number of household members. Currently, farmers usually change *lopil* annually. The location of the *lopil* is decided at the village level by the village track administrator (VTA) and the village committee, in agreement with shifting cultivation producers. *Lopil* are then left fallow for a period of 6 to > 20 years (depending on the village) before cultivation is resumed. Secondary forest is allowed to regrow on the fallowed areas.

Figure 10: *Northern Chin landscape. Forefront: First halo around the village that incorporates paddy terraces and permanent fields. Background: Second halo with forests and shifting cultivation lopil. Photo: Frissard*

2.4 Protected and/or sacred forests

Protected and sacred forests are not part of the shifting cultivation cycle. They are left intact either to protect a water resource or due to the close proximity of the forest to the village, making it too dangerous to burn. Forests are where hunting is undertaken and the collection of non-timber products that are sold or consumed. They are utilized as a forage reserve for cattle during the dry season. Further, these forests are used to produce cash crops that include elephant foot yam *(Amorphophallus paeoniifolius)*.

2.5 Pasture land

Within lands designated as pasture, large livestock (buffaloes, cows, mythons, horses) are left to graze from May to November that are situated away from the permanent fields. In the past, large livestock spent the daytime in the forest and were brought back to the village at night. However today, this is not undertaken because of the risks of crop destruction in permanent farming plots that are in close proximity to the village. Cattle are left in the pastures from May to November (with the risk of losing cattle to wolves) and moved to paddy terraces after harvest from November to April to feed on crop residues.

3. Historical analysis

3.1 Pre-colonial period before 1885

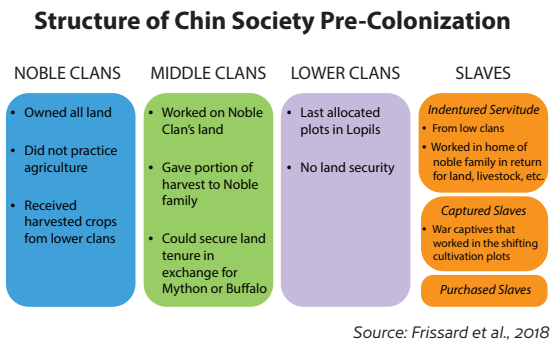
A hierarchized social organization

The agrarian system of Hakha was intrinsically linked to the social organization of pre-British society[1]. Chin society is a patrilocal, patrilineal clan-based society that was predominantly animist. The village chief was part of the bawi or noble clan, and was believed to have a spiritual connection to the land that granted him the power to manage the lands and resources.

In pre-colonial times, Hakha Chin society was not monetized and most transactions were undertaken through the trading of livestock. General wealth was measured through the type of livestock and number of head owned by a household. As an animist society, the value of the livestock was ranked according to its use for religious ceremonies.

The social structure of Chin society (*Figure 11)* is presented. The social structure had implications on access to shifting cultivation plots with slaves being restricted from land access and worked as farm labourers.

1. A comprehensive analysis of the social organization of Northern and Southern Chin is presented in anthropologist F.K Lehman's book published in 1963: The structure of Chin Society, and built upon specifically for Hakha town-ship in the Land Tenure report published by GRET in 2017



Source: Frissard et al., 2018

Figure 11: *Structure of Hakha society in pre-colonial times*

Shifting cultivation as the exclusive cropping system

The area around villages consisted of either permanent forests (usually above the village, or in some cases surrounding the village to be used as a firebreak), and either fallow or cultivated lands as part of the shifting cultivation cycle. All households practicing shifting cultivation cultivated their plots in the same *lopil* (block of land and rotation unit for the shifting cultivation cycle) in the same year. Forests would not be used apart from the collection of products for consumption, or hunting.

A *lopil* would be cleared from November-January, and burned in March. Sowing of crops would begin in April. A *lopil* would be cultivated for one to three years depending on village customary land tenure. As a general trend, warm land (*lai lo*) was cultivated for three years, and cold land (*zo lo*) for one year after which the land would be left to fallow through the regeneration of successionary forest species that restored soil fertility. Fallow periods were reported to be over 27 years in some villages. When managed within customary systems with extended fallow periods, the approach does not result in significant deforestation as the forest cover does not reduce - it simply "moves" - and the soil is given sufficient time to replenish fertility. Along with the high diversity of crops that were grown, these systems effectively control weeds, pests and diseases.

Shifting cultivation systems relied on communal spatial organization along with communal work organization. The land clearing was organized at the household level with each male household member, being responsible to clear the plot their household would cultivate with all other farm tasks managed collectively.

The shifting cultivation systems were highly diversified (both in terms of species and varieties) that were designed to cover the household food requirements throughout the year *(Figure 12)*. This had significant implications on dietary composition with a variety of foods from diverse food groups all year round. It is interesting to note that upland paddy was only introduced during the British colonial period.

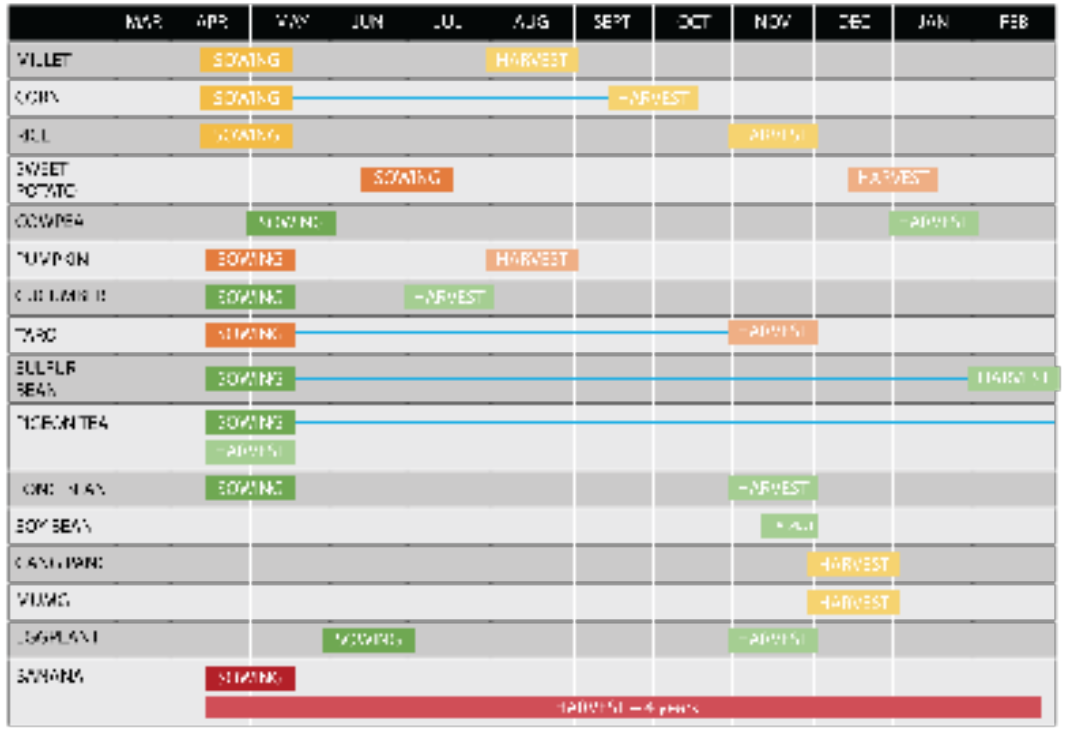


Figure 12: *Seasonal calendar of the shifting cultivation system (in lai lo warm plot). Cang Pang and Mumg are local cereals of the millet family.*

Animal husbandry systems

General wealth was measured through the type of livestock and number of h ead owned. This animist society ranked the value of the livestock according to its use for religious ceremonies. Chickens and pigs were slaughtered for specific ceremonies (religious, weddings, funerals, hunting celebrations etc.) and to ensure heritage transmission. Apart from these ceremonial activities, livestock were consumed by households occasionally and were kept in the compound or under the house and fed with leftovers.

Cows and mythons had no other purpose than showing off the wealth of the household. They were slaughtered or given away during particular celebrations but only male mythons could be sacrificed for religious purposes. Their management was the responsibility of active household members under 15 years of age and were responsible for taking the herd out every morning to the forests to graze whilst keeping them at a safe distance from the cultivated *lopil*. Every evening, the herd was brought back to the compound to spend the night safely inside.

3.2 The colonial period (1885-1948)

Chin State was annexed by the British Empire despite fierce resistance from the population. The British delineated fixed boundaries for village areas that are still in place today. With the arrival of the British came the first Christian missionaries, the abolishing of slavery and their absorption into lower clans. This also marked the emergence of monetization that was associated with new road construction and the payment of labour. There were no major changes with respect to agricultural calendar other than the introduction of upland paddy *(Figure 13)*.

Figure 13: *Changed crop rotations on lai lo plots associated with the introduction of upland paddy under British colonial rule in Northern Chin*

Rice began to enter Hakha diets over the period 1940s-50s however, it was confined to wealthy households. As upland rice cultivation required access to flat land with clay soil, which were still owned by noble families, villagers started purchasing rice from Gangaw or traded for rice. Whilst maize and millet were still staple crops consumed on a regular basis, rice represented a small proportion of the diet and was consumed on rare occasions often in a soup with the chicken broth.

During this period three types of farming systems were intrinsically linked to social status:

- ⇨ *Bawi* – the landowners – still did not practice agriculture as they continued to receive harvested crops from lower clans. Pastoral livestock was still their main agricultural activity.
- ⇨ *Middle Clans* – the majority had ancestral land ("purchased" from the bawi), some livestock, and some land claims in certain lopil.
- ⇨ *Lower Clans* – this social class now included former slaves. They continued to work on lands of the bawi and gave a portion of harvested crops to noble families.

3.3 Post-colonial "U Nu" period (1948-1962)

The agricultural landscape began to change rapidly after independence. Shifting cultivation was still the primary means of agricultural production. However, an increasing number of higher clan families began to cultivate paddy terraces. This led to a series of changes that included the individualization of land use (from the land within *lopil* that were part of the communal pool), and the introduction of agricultural wage labour along with buffalos as draught power.

Christianization continued to spread rapidly through the hills. Corn and rice gradually replaced millets, notably due to the stigmatization of the crop by the Church due to its use in the preparation of local alcohol *zupu* (GRET, 2018). The government began to provide agricultural loans for growing coffee and tea in some specific localities supported by the Colombo Plan.

Money became increasingly important as rural households had increasing access to schools, healthcare, and a preference for rice as the staple crop. It is of note that better-off households with terraces were not able to produce sufficient rice for consumption over the entire year and therefore reverted to procuring rice from Gangaw or Kalay for at least part of the year. Apart from salt and at times oil, no other edible goods would be purchased – self-consumption was still the main trend.

Work in shifting cultivation plots continued to be organized communally (working groups), however, the emergence of paddy terraces introduced daily agricultural work: to build the paddy terraces and cultivation of the crop (transplanting, land preparation, and harvesting). Depending on the households, workers were paid either in rice (½ big tin/day) or cash (2 MMK/day). Rice cultivation required specific draught animals and hence buffaloes were acquired particularly by noble households. They were purchased from Gangaw or Kalay. The nature and purpose of livestock changed in Hakha with the increased adoption of paddy terraces. While in the past, households would prioritize mythons (most valued meat during ceremonies and a marker of social prestige) when investing in livestock, they would now prioritize buffaloes for the ploughing of paddy terraces as the most valued livestock component.

Home gardens developed in the residential compounds, especially when it was time in the shifting cultivation cycle to cultivate the *lopil* furthest away from the village, as it was not convenient to grow vegetables that far from homes. The application of animal manures collected from stalls where livestock was kept overnight within the confines of the compound were applied to vegetable plots in order to maintain soil fertility.

3.4 Socialist period (1962-1988)

Political and economic changes impact the agrarian system

As the State gradually took more control of the Chin Hills under Ne Win's rule, the agricultural landscape of Hakha continued to adapt to the social and political environment. However, the political environment coupled with Christianization devalued the status of noble clans within Chin society (GRET, 2017). The "protection" role assured by the *bawi* in pre-colonial times was transferred to the church and as the region pacified, physical safety was no longer an issue. Churches acted as a social and economic safety net for vulnerable households, particularly widows who were not able to inherit land. Instead of giving part of harvested crops to the *bawi*, Hakha people would now donate 1/10th of their harvest, "first fruits", or first born livestock to the church that they worshiped at. Noble clans began cultivating land themselves which were invariably the highest quality lands within *lopil*.

During this period, the government prioritized and encouraged farmers to produce rice, forcing farmers to build paddy terraces, even in areas where suitability was questionable. Farmers would buy and sell ancestral land for terrace construction informally.

Between 1962 and 1988, Myanmar experienced three phases of demonetization that had a direct consequence on household saving strategies. Rather than saving cash, people invested in livestock (i.e. cattle). With the development of paddy terraces, interest shifted from mythons to buffaloes and as a consequence, a new livestock

trade emerged with traders purchasing buffaloes and cows from lower Myanmar, selling buffaloes in Chin State and all the way to Mizoram.

Emergence of animal husbandry systems and changes in shifting cultivation

Figure 14 presents the spatial organization within village boundaries and the changes that occurred with the development of paddy terraces. Grazing resources declined. This resulted in changes in the way in which large livestock was managed. Management of livestock became semi-collective and seasonal *(Figure 14b)* in contrast to individual and daily *(Figure 14a)*. With the establishment of paddy terraces in close proximity to the village, it was not possible to have free ranging livestock traversing the cultivated terraces on a daily basis. Consequently, the villages' large livestock component shifted to specifically dedicated pasture areas from mid-April to the end of November. From December to mid-April, households with paddy terraces would bring their livestock to graze crop residues within these plots. Only buffaloes would be kept near the terraces during land preparation time. Horses would be used at harvest to transport grain from the plots to the compound, whilst keeping them in the compound at night.

With this new management system, two constraints emerged. Livestock were left to spend the night away from the village without supervision resulted in increased livestock losses associated with wild animal attacks (i.e. wolves, bears). Further, without supervision, the increasing livestock population would regularly destroy shifting cultivation plots requiring livestock owners to compensate affected farmers.

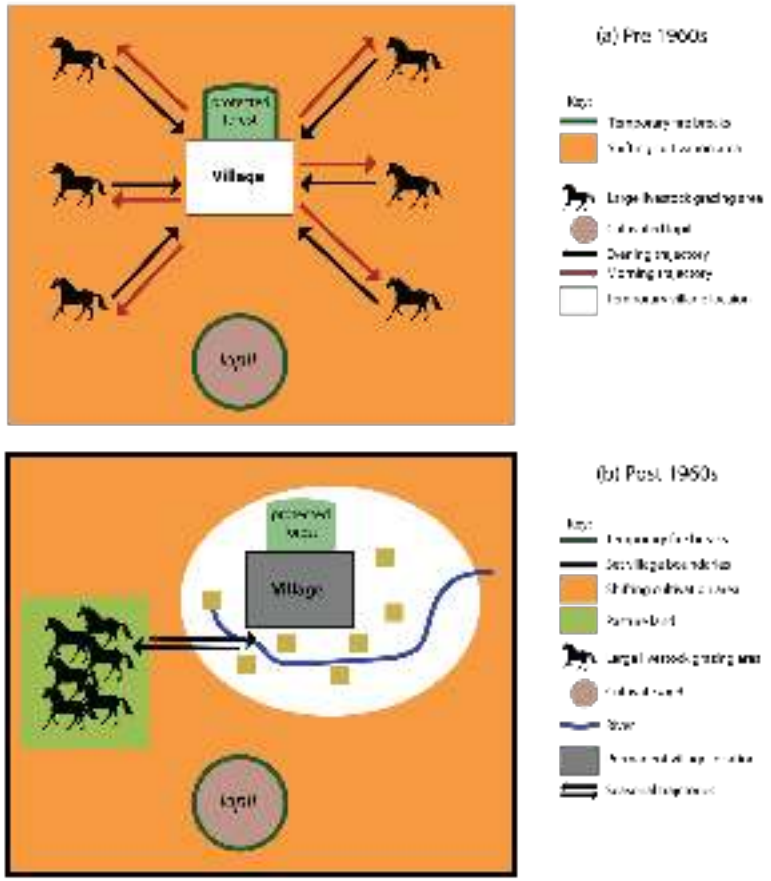


Figure 14: *Spatial organisation of livestock management systems (a) pre-1960's and (b) post-1960's in Northern Chin*

Crop diversity within shifting plots was high and all households practiced shifting cultivation through working groups. However, crop rotations were reorganised to adapt to the reduced labour available. Those households that owned paddy terraces were required to divert part of their workforce to the cultivation of paddy cultivation on the terraces.

The growth in sedentary farming systems (paddy terraces and permanent gardens) 1970 – 1988

There was a shift in central governments views on shifting cultivation with the narrative being propagated that the practice resulted in deforestation and erosion and strongly encouraged a transition to permanent farming. The government offered loans for rice production, heavily subsidized fertilizer, and continued promoting the construction of paddy

terraces in villages. Plots within the first halo that had not been converted to paddy terraces were cultivated with annual or perennial crops in permanent gardens. However, households continued to undertake shifting cultivation, although with simplifications. These changes were driven by a greater need for labour to cultivate permanent plots and hence working groups had less time to devote to shifting cultivation. Individualization of work and wage labour became common place and fences were built around the villages (including part of the 1st halo) to protect permanent plots from wild animals and livestock. The emergence of permanent gardens and cash crops enabled households to have new income sources that allowed the purchasing of goods.

The development of sedentary farming systems was not equal across villages. Those villages furthest away from a market, did not witness significant changes cropping patterns as those that were closer to markets such as Hakha and Chuncung.

During this period, corn was viewed as a "poor persons' crop" and was replaced by rice for daily consumption in those households cultivating rice terraces. In addition, millet consumption declined with the exponential increase of Christian converts. Millet, traditionally used and valued during animist celebrations (both grains and *zupu* form) fell out of favour and was fed to pigs. Corn and to a lesser extent millet continued to be consumed by poorer households.

With the decline in the social significance of clans, archetypes of farmers were defined by the number of livestock a household owned and the types of cropping systems practiced. The main archetypes identified through focus group discussions were:

- *Large livestock (cattle) + shifting cultivation + rice terraces (+permanent orchard):* These were predominantly *bawi* or higher clans, who transformed suitable land closer to the village to rice terraces. They previously owned livestock as a status symbol and additionally, now own buffaloes to work the rice terraces. Shifting cultivation was practiced to meet food requirements of household, as well as to produce corn and millet to feed smaller livestock. These households retained priority of choice in *lopil* because of their inherited ancestral land claims.

- *Large livestock + shifting cultivation (+permanent crops):* These households were most likely middle or upper clans who owned large livestock, but did not have suitable land or resources to transform land into rice terraces. These families often had ancestral land within *lopil*.

- *Small livestock + shifting cultivation:* These households did not own large livestock or land to transform to rice terraces. They practiced shifting cultivation and owned chickens and/or pigs to be used in weddings, funerals, and other ceremonies.

3.5 1988 Uprising: Human rights violations in Chin State (1988-present)

Outmigration: Following the 1988 uprising, university students returned to Chin State and formed the Chin National Army to fight against the military regime. In response, the military established 54 camps in Chin State. Regular demands for forced labour by the military and extortion by the State Peace and Development Council (SPDC) affected people's livelihoods *(Human rights watch, 2009)*. It was also reported that 91.9% of households experienced forced labour and rights' violations that commonly included "food theft, livestock theft or killing, forced displacement, beatings and torture, detention, disappearances, and religious and ethnic persecution" *(Sollom et al. 2011)*.

Within the context of oppression and associated economic hardship, many people fled. Village populations shrunk as the most economically productive community members left to find work and safety abroad. This included seasonal migration to Mizoram to work in road construction and timber industries. It also included long-term migration to Mizoram, Malaysia, the United States, Australia and other countries as illegal or legal migrants or as official refugees. Remittances gradually became an essential contribution to those who remained in Chin villages.

Impact on farming systems: Outmigration had an impacted on farming systems with shifting cultivation progressively declining. Limited labour, especially men for clearing shifting cultivation sites, coupled with an increased need for cash, led households to switch to other forms of agriculture that were either less labour intensive, more profitable, or both. This included rotational ginger fields, permanent vegetable gardens, and fruit orchards (mangos, strawberries, bananas, citrus). With a decline in population and the number of households practicing shifting cultivation, plots were cultivated for a single year as opposed to three years and occurred in *lopils* close to the village. The *lopil* were divided into *sub-lopils* with only part being cultivated in a year and the fallow period between cultivation ranging 7 to 10 years. The diversity of crops grown on the shifting cultivation plots also declined. Today corn, millet, cucumber and pumpkin (on warm land) and corn and potatoes (on cold land) are grown *(Figure 15)*.

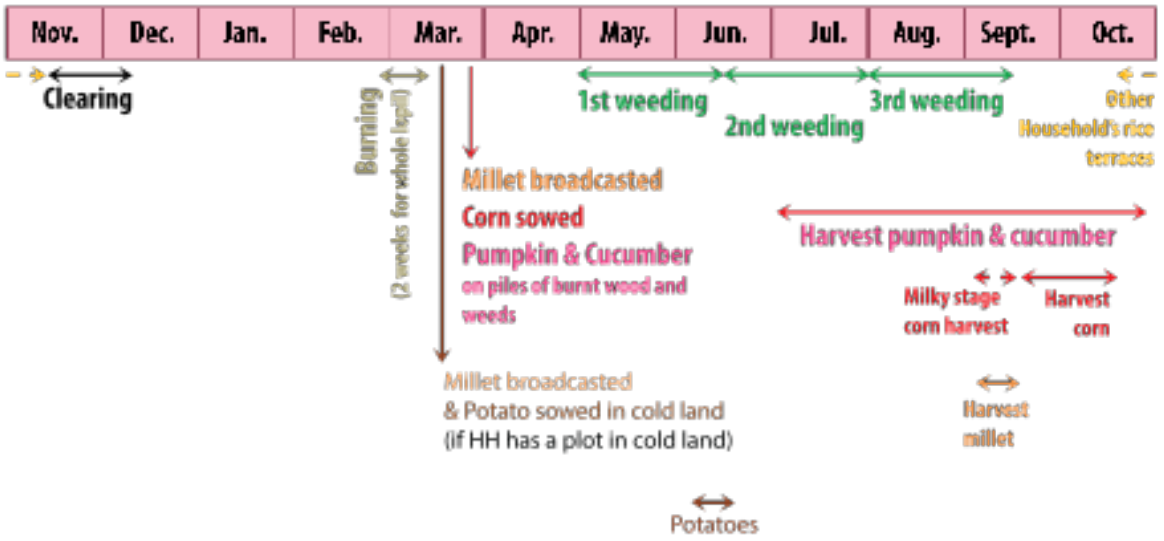


Figure 15: *Work calendar of a shifting cultivation cropping system currently practiced in Hakha Township, Chin State*

4. Current cropping systems

Agricultural activities are organized at the household level and incomes are supplemented in most households by off-farm employment that includes road construction, logging, and working as labourers in other household's rice terraces. The characteristics and sequencing of activities are presented below for the different production systems that are currently being practiced.

4.1 Shifting cultivation

Clearing Tall grass and small trees are cut and large trees are pruned exclusively by men. Each household is responsible to clear their own plot and on average 35 working days is required to clear an acre.

Burning The activity is undertaken by men with each household that is practicing shifting cultivation in the village spending at least one working day to create "fire breaks" around the lopil. On average 10 working days are required to secure the entire lopil.

Sowing The task is undertaken by both men and women. Each household is responsible to sow its own plot. Millet is broadcasted first followed by the sowing of corn using a small hoe. Cucumber and pumpkin are sown on the piles of burnt wood ash and debris. An average of 16 working days is required to sow 1 acre.

Weeding This task is mainly undertaken by women using a small hoe. On average, it is undertaken three times per year exclusively

on the household plots. On average 45 working days are required to effectively weed 1 acre/time.

4.2 Permanent farming

An increasing number of farmers transitioned from shifting cultivation on plots located in close proximity to the village, into permanently cultivated fields. A diversity of cropping systems and patterns emerged and are describe in brief below.

Ginger Fields: Plots are located in the 1st halo of crops around the village and are not rotated nor do they have fallow periods in their rotational cycle. Traditional rotation structures within these plots consist of the first year ginger; second year sticky rice or ginger; and the third year taro, sweet potato or ginger.

Permanent gardens for cash crop production: Permanent gardens consisted of vegetable gardens, banana and mango orchards as well as elephant foot yam agroforestry plots. Vegetables grown to sell in either Hakha's daily market or within the village. Prices at village level are often lower than in Hakha even accounting for transportation costs and time. Very popular in southern Chin, elephant foot yam is a developing enterprise in Hakha. Market prices are strong which has motivated farmers to invest in this crop. An additional factor that has contributed to increased interest in the crop is its low demand on labour that includes minimal clearing/burning compared to shifting cultivation plots, and no requirement for land modification as with rice terraces. Elephant foot yam can also withstand long transport hauls on rough roads with limited bruising or spoilage.

Rice terraces: Rice is grown during the wet season providing the necessary water requirements for the growth of the crop. Irrigation if available, is used before the commencement of land preparation as it occurs at the end of summer. At the end of land preparation, plots are kept with standing water throughout the growing season and are drained a month before harvest to facilitate grain fill and
harvest operations. The specific tasks that are undertaken over the growing season are as follows:

- ⇨ *Nursery beds and sowing (May):* Paddy is broadcasted on a small area either beside the set of rice terraces or on upland area.
- ⇨ *Land preparation (April):* Undertaken by men with at least one pair of buffaloes. This includes ploughing and harrowing.
- ⇨ *Transplanting (July):* Transplanting by hand is usually undertaken by women hired on a daily basis and it takes an average of 23 working days to establish 1 acre.
- ⇨ *Weeding (August and November):* Undertaken by women using a small hoe.
- ⇨ *Harvest/Threshing (End of November, December).* Both men and women from the household along with hired labour if necessary. Approximately 27 working days per acre are required.

5. Current animal husbandry system

Large livestock (cows, mythons, horses, and buffalos) have two main functions, as draught animals for ploughing and carrying loads and are viewed as a form of savings to be sold in times of need or emergencies. The livestock management calendar is presented in *Figure 16.*

5.1 Cows, buffalos, and mythons

Cows and mythons are managed the same way and interbreed with each other. Farmers having livestock along with rice terraces will move their cattle to the harvested rice terrace in December whilst those households that do not have rice terraces will keep their cattle in pasture land all year. Pasture land location is decided by the village as a whole to mitigate damage to crops.

During the rainy season, cattle forage for food on forested pasture lands and are supplemented with salt whenever they are checked. Once the paddy is harvested, the livestock (cattle and buffalos) are brought to the rice terraces, as free range pastures, to feed on crop residues.

Buffaloes receive limited care, notably, the provision of salt when checked along with annual vaccinations.

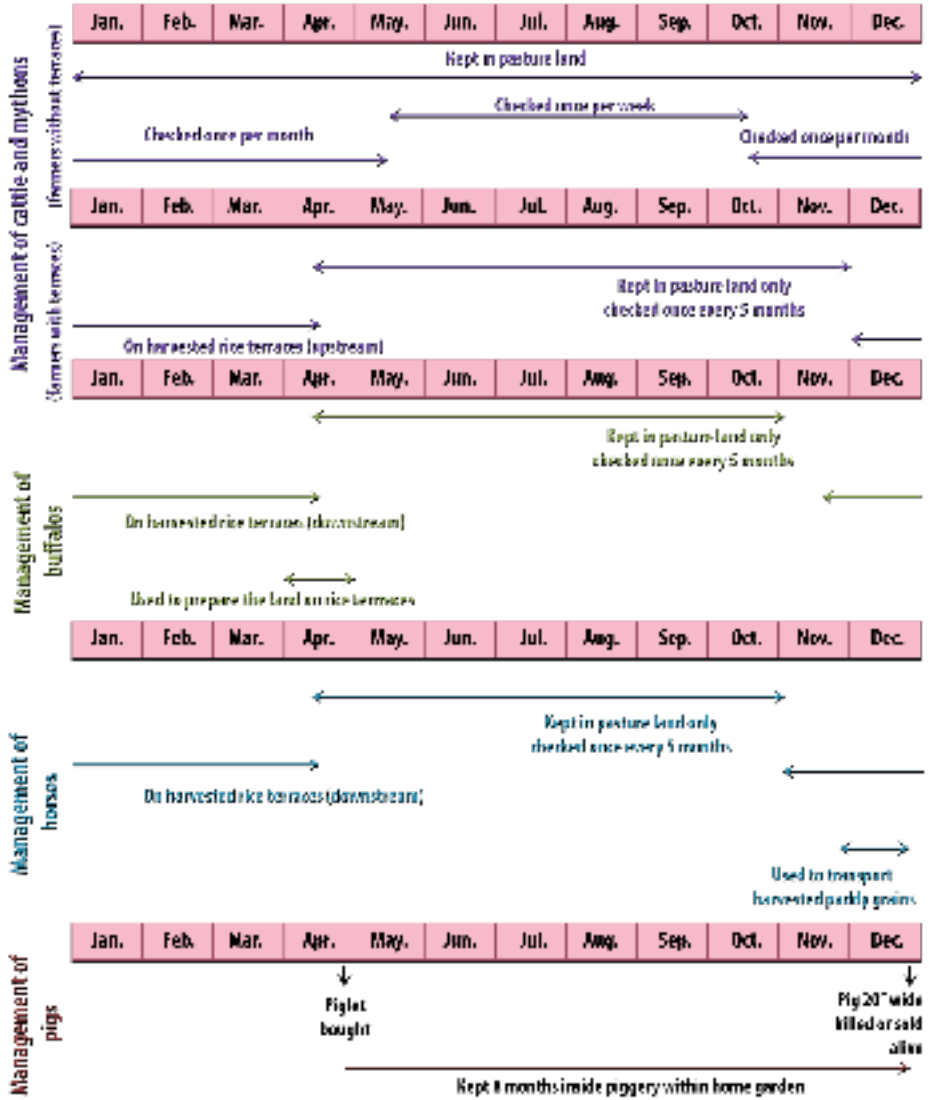


Figure 16: *Smallholder livestock management calendar from 1988-2014 in Hakha Township, Chin State*

5.2 Horses

Farmers tend to purchase mares, due to their ability to produce foals, from either farmers or through the church. As with other livestock, the first foal is donated to the church that the household belongs to. Stallions that are bred are sold off whilst mares are retained to increase the herd size. On average, farmers tend to keep a maximum of four horses.

Horses are used at harvest time in November to carry the harvested rice from the terraces to the household where it will be sundried. As multiple households have their rice terraces in a same location, it is common to organize transportation of the rice harvest as a group. One member of each household will be responsible to guide the horses back and forth during the day. It is also possible for households not owning horses to profit from their neighbours' horses. During rice harvest period when horses are used extensively, they are fed with corn and rice bran in addition to the grass eaten in close proximity to the terraces.

5.3 Small livestock (pigs and chicken)

Small livestock include pigs and chickens. Pigs also act as a living savings, especially for families with little other monetary resources. There are two distinct specializations that are undertaken by farmers with respect to pig production. Some farmers practice pig breeding: they have a reproductive sow(s) and sell piglets throughout the year. Other farmers specialize in fattening whereby they buy in piglets, keep them for a minimum period of 8 months and then sell them out.

Pig feed comprises of the following components: corn grown in shifting cultivation plots or home gardens, rice bran leftover after cleaning, chayote grown in home garden, pumpkin leaves or other leaves from forest, leftover rice and food from household, pounded banana stem and low quality rice (sold as pig rice) purchased from Hakha or Kalay.

Chickens in villages are referred to as "Chin chickens", that is, a different breed to "Burmese chickens". Although its meat is more expensive than that of Burmese chicken, it is rarely sold since households do not have enough chickens to make the journey to the market profitable. All households have at least five chickens.

Chickens are used for household meat consumption and for eggs. Eggs are fed to children and elderly people, but the majority are kept to hatch. Chickens are free range and are supplemented on corn twice a day. Chicks are fed broken rice. There is no vaccination regime against 'bird flu' and other bird related diseases and hence outbreaks occur every year and can have devastating impacts.

6. Typology of current farming systems "archetypes"

During the last decades, shifting cultivation has declined, particularly in villages that are in close proximity to Hakha. Those farmers with large livestock and rice terraces were the first to stop shifting cultivation, as they had assets to invest in more intensive forms of farming (e.g. paddy terraces, gardens, orchard etc.). Some farmers continued to practice shifting cultivation, however they have simplified their systems, or have modified the system to align with other types of permanent fields, by transitioning their shifting land into permanent fields. The number of "archetypes" ("types" of farmers) doubled as households practiced all three types of cropping systems (shifting cultivation, paddy farming on terrace, and garden/orchards) *(Table 2)*. Over this period, the total number of agriculturally productive people decrease due to outmigration.

All villages reported losing multiple types of agricultural land, including rice terraces during the devastating landslides of 2015 which affected Chin State following exceptionally intensive rainfall. After these events, archetypes of farmers remained the same although some households may have shifted from one archetype to another. However, the landslides caused many households to lose part or all of their rice terraces. Irrigation canals or pipes to rice terraces were also destroyed in many cases, making terraces impossible to cultivate. Access to shifting cultivation land was limited, and livestock were lost. Even though time has passed since the landslide, many households have not been able to rebuild agricultural infrastructure lost due to the landslide.

It is of note that there are no major inequalities in land access. In the identified archetypes, land access varies to from 1 acres up to 6 acres with no genuine landless since it is always possible for villagers to access shifting cultivation plots if they need to.

Type 1-a	Cash crops (permanent vegetable garden), rice terrace, reproductive large livestock
Type 1-b	Cash crops (orchard), rice terrace, reproductive large livestock
Type 2	Cash crops (permanent vegetable garden), reproductive large livestock
Type 3	Cash crops (permanent vegetable garden), rice terrace, shifting cultivation (SC) with staple crops (corn & millet) and vegetables for home consumption, reproductive large livestock
Type 4	Cash crops (orchard), rice terrace, SC with staple crops (corn & millet) and vegetables for home consumption, reproductive large livestock
Type 5	No cash crops. Only rice terrace and reproductive large livestock
Type 6	No cash crops. Rice terrace, SC with staple crop (millet) and vegetables for home consumption and reproductive large livestock
Type 7	No cash crops. Shifting cultivation with staple crops (millet, pigeon pea, upland rice) and vegetables for home consumption. No large livestock

Table 2: *Key archetypes of the current farming systems in Hakha Township, Chin State*

1

7. Conclusions

Since the late 1800s, the agrarian systems of Hakha have evolved in response to political, social, economic, and demographic drivers of change. Outmigration from the region is placing pressure on the farming systems as economically productive individuals continue to leave and the workforce ages. An agrarian system formerly exclusively based on shifting cultivation has emerged as a consequence of these drivers towards permanent gardens, orchards, and rice terraces. Impacts of these transitions include temporal and spatial changes to land management and tenure, biodiversity, and a marked change in the diets of communities who depend on these systems for their daily subsistence. Farming systems today are marked by a shrinking labour force, and in turn high labour costs. With high transportation costs, it is not feasible for most farmers to pay as well high labour costs. Decreased labour availability is a key driver in the reduction of shifting cultivation. If trends of outmigration continue, it is anticipated that farmers will adopt less labour intensive farming systems that include orchards and elephant foot yam production. However, since crops involved in these forms of farming take years before coming into production, it is also important for farmers to have land tenure security.

7.1 Dietary changes and links to farming systems

As Chin State has the highest levels of child stunting in Myanmar, it is pivotal to understand how the transformations in agrarian systems affects the diversity of food available in rural households. This assessment found that the diversity of cereals and legumes has decreased in the diet of rural communities, mainly due to the simplification of shifting cultivation systems. Vegetable diversity has increased but priority is placed on cash crops such as cabbage, onion, and garlic. Fruit production is diversifying, however a focus on transformation of fruit to wine has been observed. Wild meat consumption has declined with a perceived declining population of game and fish. Consumption of animal based products such as eggs and meat is low, and dairy products are virtually absent from the Hakha diet.

More specifically, the transition from millets, sorghum, and maize to primarily white rice could have impacts on nutrition. Many millets that used to be grown contain high levels of essential protein, vitamins, and minerals when compared to paddy rice. Diversifying staples ensures consumption of a wide array of micronutrients. Not only has the number of cereal crops declined, but the interspecies biodiversity of these crops has also declined (with the exception of rice). In historical interviews, some elder farmers could name over 10 varieties of millet cultivated in the past. Now, only one or two is cultivated with almost the complete loss of sorghum and "*mumg*" from cropping systems in Hakha. Both types of biodiversity – inter- and intra-species – created resilience in cropping systems through pests and disease resistance and climatic shocks whilst providing a wide array of micro-nutrients. Furthermore, both millets and sorghum perform better than maize and rice under drought conditions, heavy rainfall, and endure longer storage. They also grow on less fertile soils, and are useful crops for farmers with limited access to fertilizer *(Kerr, 2016).* However, social stigmatization of millet and the political promotion of rice, coupled with high labour demands of shifting cultivation systems has resulted in a transition away from these crops in Hakha.

As shifting cultivation systems simplify, other crops such as sweet potato, taro, pumpkin, sulfur bean, and cowpea are becoming less frequently consumed. A marked reduction in legume cultivation can be observed as shifting cultivation is replaced with other types of cropping systems.

Home gardens and permanent fields have incorporated some of these crops historically grown in shifting cultivation plots, as well as added new crops, such as cabbage, onion, and celery. However, as previously mentioned, the frequency of consumption of nutrient rich crops traditionally found in shifting cultivation plots (sulfur bean, pumpkin, taro, sweet potato, millet, long bean, soybean, pigeon pea) are declining from local diets.

7.2 Increase in grazing livestock

Over time the role of livestock, its location in the village areas and the way it is managed has evolved in response to changes as highlighted previously. The livestock population has increased substantially over the past 40 years and most farmers still invest their savings in livestock (large or small). Farmers, especially those still practicing shifting cultivation, struggle as livestock often destroy their crops. As it is difficult to prove whose livestock destroyed the crops, and people do not want to walk the long distances to the shifting cultivation plots to assess damage, farmers are often left uncompensated for the damage caused. There is interest in expanding livestock herds, so this is likely to continue to be a major issue in the future that will need to be addressed at the community level.

7.3 Other issues

Agrarian systems are intrinsically linked to the health and well-being of the people who cultivate them, and the health and resilience of the environment they are dependent upon. Agricultural and health policies should support and promote diversification of cereals, as well as nutrient rich vegetables and legumes in the diet. Special consideration of women's limited time and access to resources should be taken into account in the design and implementation of programs. The voices and aspirations of rural youth should also take a central focus in future research, as they are the future stewards of the agrarian system and the environment. Ensuring Chin people secure land tenure recognized by the government is necessary to protect the food and environmental security of the region.

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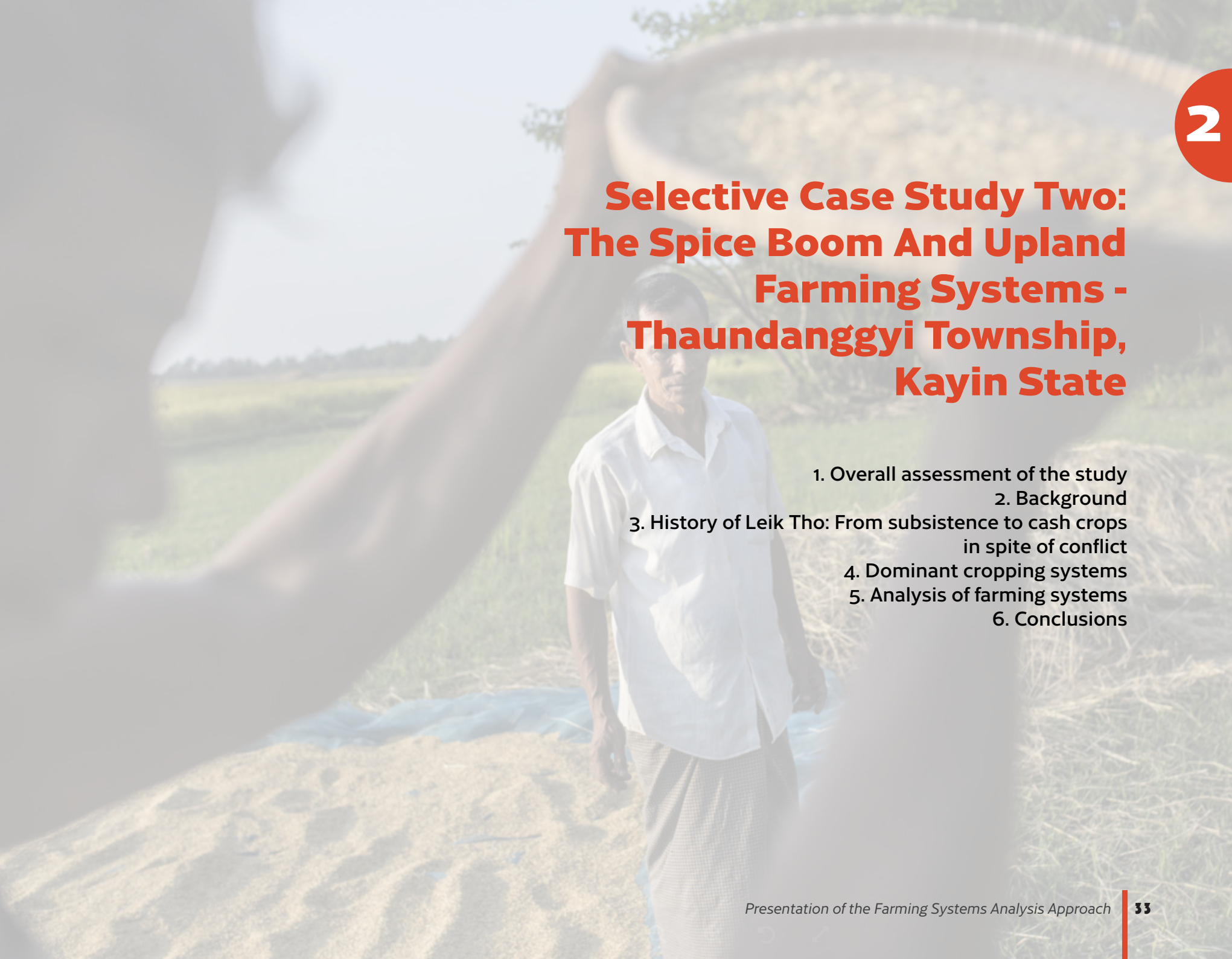


2

Selective Case Study Two: The Spice Boom And Upland Farming Systems - Thaundanggyi Township, Kayin State

1. Overall assessment of the study
2. Background
3. History of Leik Tho: From subsistence to cash crops in spite of conflict
4. Dominant cropping systems
5. Analysis of farming systems
6. Conclusions

2

The Spice Boom and Upland Farming Systems

1. Overall assessment of the study

The study is a fascinating example of an upland transition from subsistence based shifting cultivation systems to permanent cash crop systems in the midst of armed conflict. With an emphasis on the social-anthropological dimension of this process, the study provides a vivid account of the differentiation process among farmers and the gradual abandoning of all food crops. The main drivers that have transformed a relatively equitable society composed of shifting cultivators into a more stratified social structure, with large commercial growers cultivating over 50 acres along with much smaller farmers are highlighted. The study details the major cropping systems in the region as well, and provides a typology of the main farming systems.

2. Background

The study was undertaken in Thaundanggyi Township, the northernmost Township of South-eastern Kayin State *(Figure 17)*. Kayin State is predominantly populated by the Karen ethic group which is characterized by a number of sub-ethnicities and languages including Gheba Karen, Ghekko, and "White" Karen.

Leik Tho is the largest town in the study zone *(Figure 17)* and the nearest city is Taungoo with a population of 108,569 based on statistics from 2014. Taungoo is located in the Sittang valley, and is on the main axis road running from Yangon to Mandalay via Nay Pyi Taw.

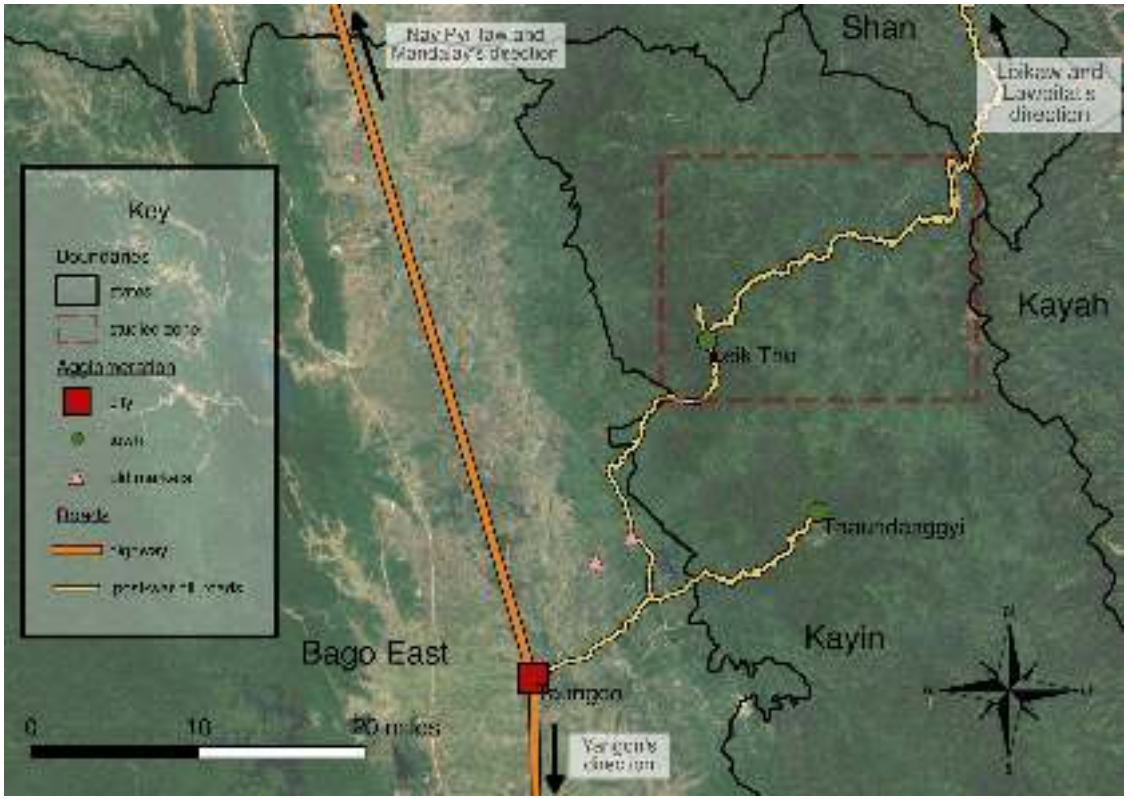


Figure 17: *Location of the study area in Kayin State*

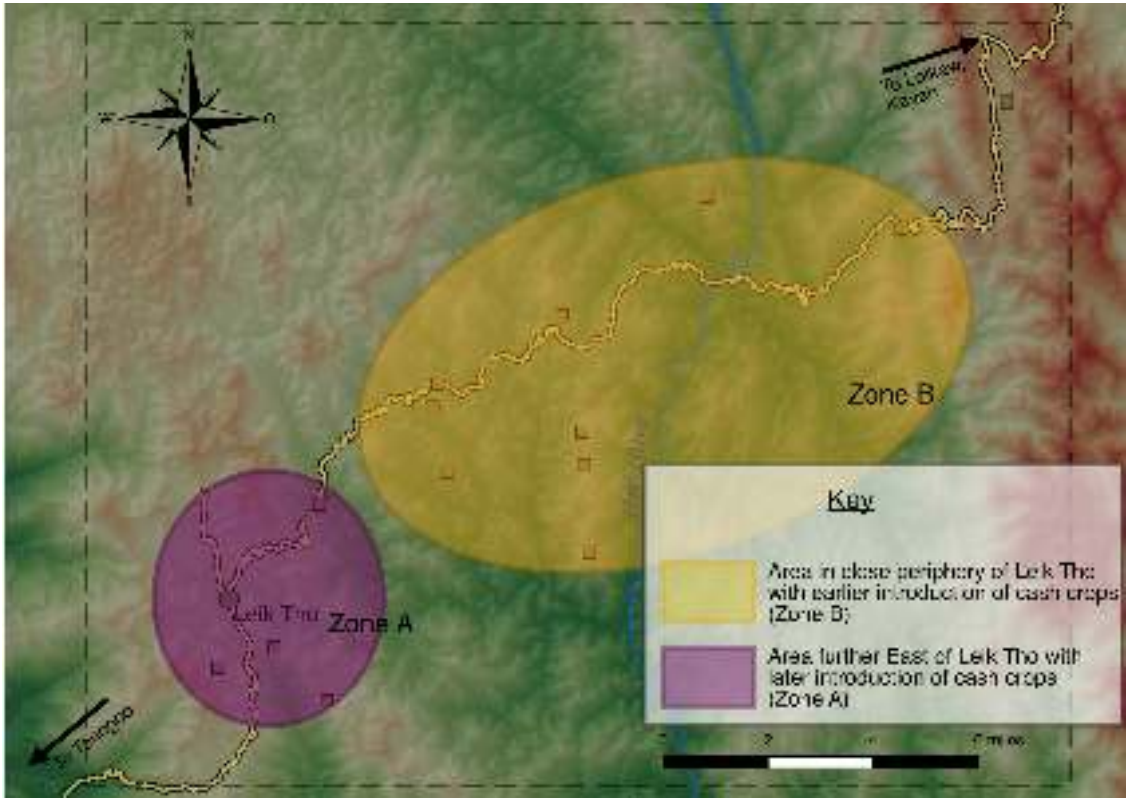


Figure 18: *Map showing the two zones in which the study was undertaken with Zone A being in close proximity to Leik Tho and Zone B further east*

Leik Tho is located in a more favourable position for trade with Taungoo and the Sittang valley if compared to the eastern part of the study zone, which has historically been more isolated. Agricultural innovations in the target zone appeared initially in Leik Tho and diffused eastwards. This is reflected in the introduction of coffee and black cardamom[2] *(Amomum villosum)* as cash crops that were initially introduced in villages closest to Leik Tho *(Zone A, Figure 18)* and diffused to villages located in the east which are isolated due to the mountainous terrain *(Zone B in Figure 18).*

2. Please note that for the sake of simplicity, black cardamom or medicinal cardamom *(Amomum villosum)* is referred to in the text as cardamom. It is distinct from the common green cardamom specie *Elettaria cardamomum*

2

2.1 Topography and climate

The area is characterized by an undulating topography dissected by a dense network of streams. The altitude ranges from 1,300 feet (396 m) in the low-lying river valley bottoms to 4,000 feet (1,219 m) at the highest point in the study area. Leik Tho sits at an altitude of 2,500 feet (762 m) above sea level. Most of the land has slopes of over 45 degrees and are deep red ferralitic soils. Many soils are of a sandy texture and are subject to soil erosional forces in the absence of vegetation cover. The natural vegetation is dominated by deciduous species.

Leik Tho has a Tropical Savannah climate according to Köppen's classification and has three distinct seasons: rainy, winter, and summer. The rainy season, from June to October, provides the greatest portion of the average annual precipitation of 2500 mm *(see Figure 19 with annual temperatures and rainfall of Taungoo- data not being available for Leik Tho)*. Both winter and summer are dry. The winter, from November to February, is characterized by cool temperatures while the summer from March to May, is significantly warmer.

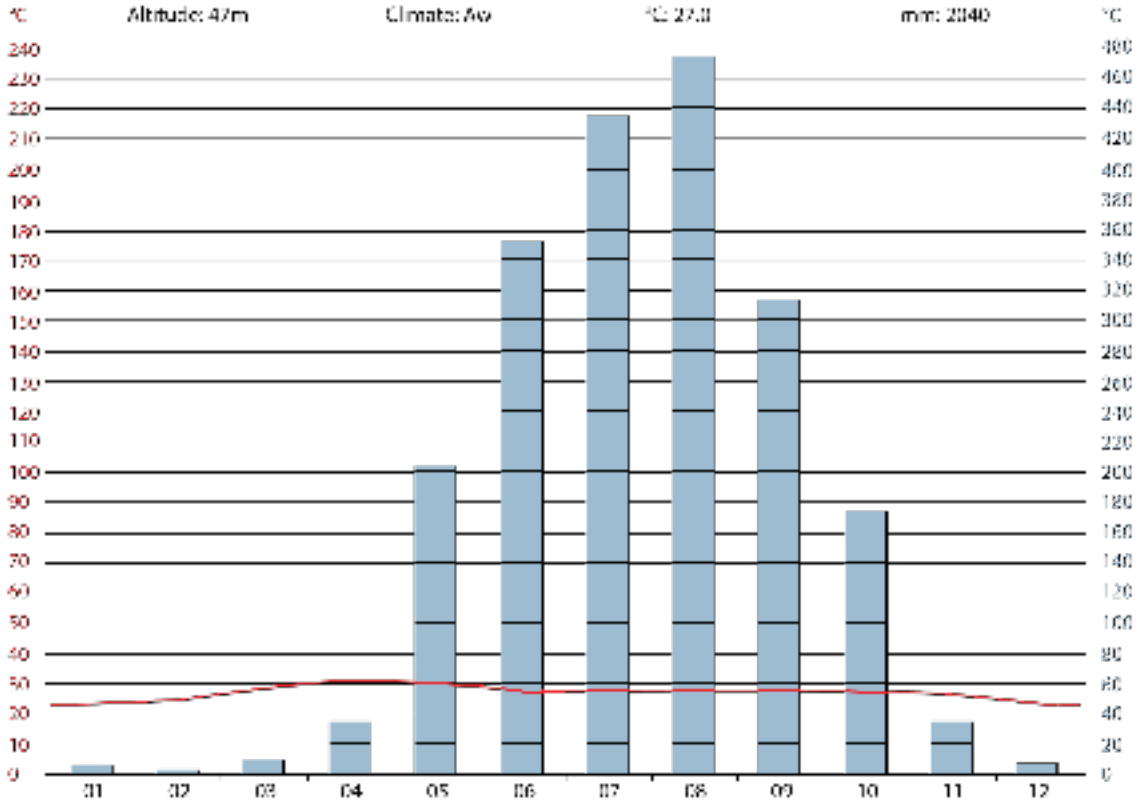


Figure 19: *Annual rainfall (in blue) and temperature (in red) in Taungoo*[3]

3. When compared to Taungoo, the temperatures in Leik Tho (at higher altitude) are considerably cooler, with more day-night variations. Rainfall is higher during the rainy season (mainly concentrated from June to September.

2.2 Village and farm organisation

Most villages in the study zone are located on hilltops. In areas closest to a village, various trees that include betel palm, coffee, bananas, and other fruit trees are grown and small livestock (i.e. pigs and chickens) often roam freely. On slopes below the village with the greatest exposure to sun, small mono-crop fields of turmeric *(Curcuma longa)* are common. These plots located close to the village are systematically fenced off to prevent damage caused by the wandering pigs who are free to forage. Black cardamom *(Amomum villosum)* plots are often located further down from the village. As the crop requires shade to ensure fruiting occurs, it is cultivates in an agroforestry system under forest cover.

At the bottom of the hill, along riverbanks and in flat areas, villagers have built paddy terraces with gravity irrigation by diverting water from streams. The soils in these lowlands are darker and are alluvial in nature and high in organic matter *(Figure 20).*

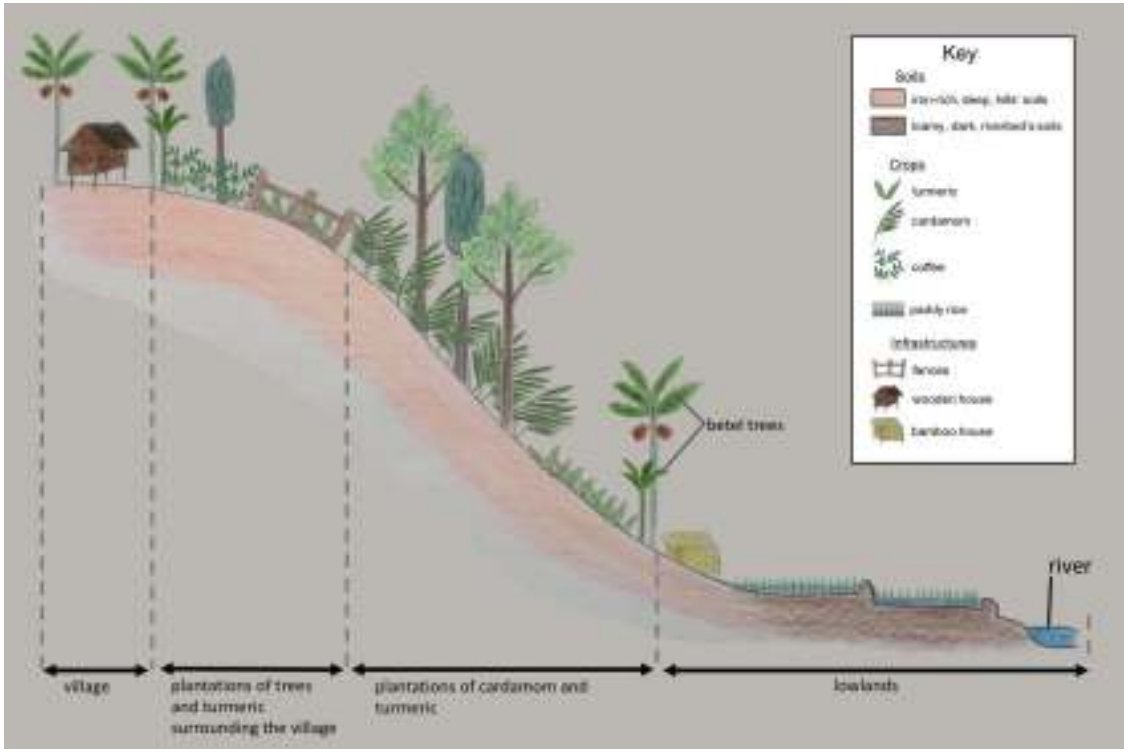


Figure 20: *Transect of a typical village land use in Leik Tho from July to September*

2

3. History of Leik Tho: From subsistence to cash crops in spite of conflict

3.1 Pre-World War II: Isolation and subsistence-based agriculture

Prior to World War II, the Leik Tho area was isolated with no road infrastructure and no significant commercial agriculture. Leik Tho itself was a small village and most settlements were composed of three to six households. In contrast, Thandaunggyi town, only ten kilometres away, saw a significant British presence and hosted tea plantations.

Within the study zone, the main activities of villagers was shifting cultivation on hillsides commonly called '*taung yar*[4] '. It was the primary source of food. Under such a system a family of four needed to cultivate approximately three acres of *taung yar* to meet their annual food requirements. The *taung yar* system, shown in Figure 21, consists of an average cycle of seven years with six years of fallow and one year of production. A family of four thus required at least 21 acres of land to facilitate the entire cycle.

Taung yar was supplemented by monsoon paddy, grown on riverbanks by a limited number of farmers, the gathering edible fruits and roots from the forest and hunting. Hunting and gathering made substantial contributions to local livelihoods. Ayvayan (2018) describes in detail the technical complexity of the local *taung yar* system and the knowledge-intensive nature of the system.

During this period, lands were managed communally, in particular the terraced paddy fields on the valley floor. There were few economic differences between households, this often determined by the availability of family labour, the ownership of paddy fields and the livestock (i.e. cattle). Most families were self-sufficient with regard to food supply, although some families had to borrow paddy from neighbours during periods of food scarcity.

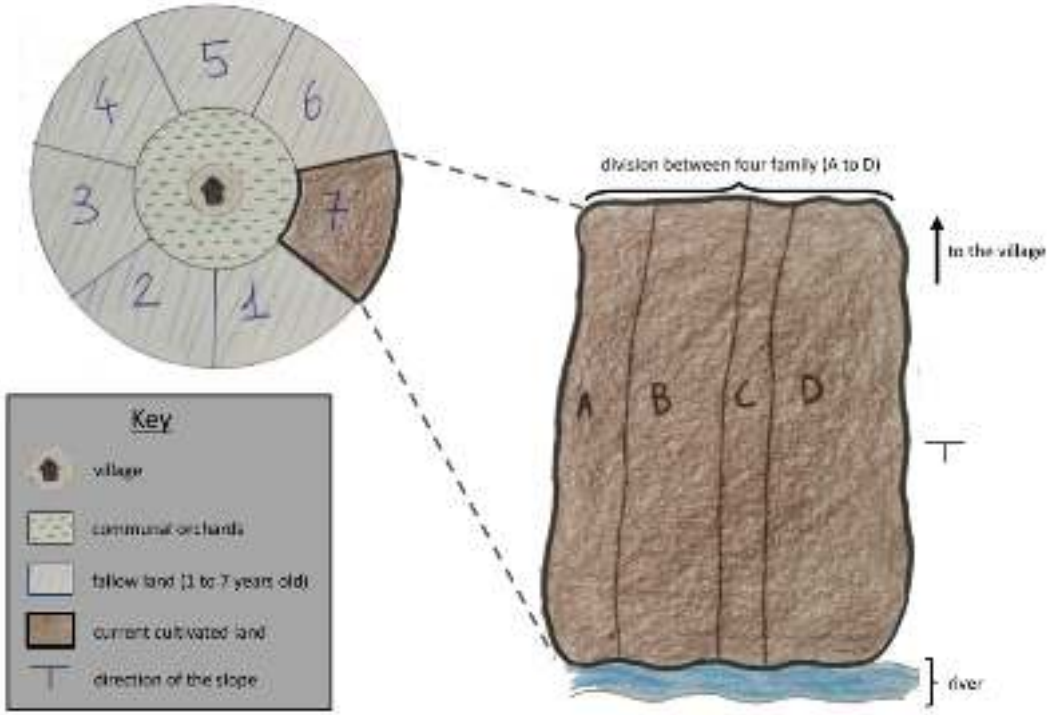


Figure 21: *Village organisation and the taung yar shifting system that was in place until the 1970s*

During World War II, the Japanese occupied the area and the associated violence of the conflict disrupted livelihoods and food security, thus forcing many villagers to flee to the forest.

4. In fact, taung yar is a generic term (in Myanmar language) referring to all forms of hillside cultivation. For brevity, it refers here specifically to shifting cultivation *(shwe pyaung taung yar)*

3.2 Post-WWII period and the opening of the Leik Tho region

Burma gained independence in 1947. The Karen National Union (KNU) was formed to demand an autonomous Karen state and stronger representation of Karen in government and militias. This did not impact the study zone, as the conflict between the government and the KNU began in the Delta. As part of the WWII peace agreement, the Japanese had to compensate Burma for the damage incurred during the occupation. This led to the construction of the Lawpita hydroelectric dam (for Yangon's power supply) and construction of the Taungoo-Lawpita road, which runs through Leik Tho. As the area opened to the outside world, new off-farm income opportunities were created due to road construction, the tin mines of Maw Chee in Northern Kayah State, or in the Sittang tea plantations. It became common place to work outside the village. During this period, buyers from Taungoo bought dog fruit *(Archidendron pauciflorum)*, a fruit harvested from wild trees growing in the forested hills. This became the first local "cash crop".

With gradual population growth, the area available for shifting cultivation declined and fallow periods decreased, falling from seven to three years. This led to the gradual decline in soil fertility and crop yields. It became more challenging for shifting cultivators to cover their families' food needs. During food gaps, households would borrow paddy from the few farmers who had paddy lands. With income from dog fruit and/or other labour opportunities, most families were able to pay back their loans.

3.3 Socialist Period (1962-1980s)

Following the ascension of Ne Win, a military base was built in Leik Tho. After losing a few key battles in the lowlands, the KNU retreated to the hills within the study zone. As the conflict escalated, villagers moved away from the roads to avoid danger. It became harder for the villagers to travel or to buy food because of the numerous checkpoints established by the army. In spite of these challenges, the communities from the more isolated parts of the study zone *(Zone B- Figure 18)* were hired as seasonal harvesters to work on coffee plantations around Leik Tho in *(Zone A)* where cash crops – particularly coffee developed around 1960. The establishment of the of these coffee plantations in Zone A was approximately 10 years earlier than in Zone B. Villagers from Zone B brought coffee seeds from Zone A and started their own Robusta plantations later in the 1970s.

During the 1970s, the government promoted paddy cultivation in upland regions, and this accelerated individual land appropriation. Those that built terraces became the owners of these paddy lands with a greater number of families cultivating rice. However, these rice producers remained a minority within the village. With the cultivation of rice, buffaloes were introduced to plough paddy lands. Paddy farmers were able to save money from the surplus paddy or from other activities (i.e. selling of dog fruit and craft bamboo products) and opened the first shops in the villages.

At the end of the 1970s, a further cash crop opportunity emerged: black cardamom, mainly in zone B where a higher proportion of land had not been developed for coffee plantations. Black cardamom grows naturally in the local forests and its fruit is used in Chinese traditional medicine and cuisine. By clearing the vegetation under the forest cover, cardamom can be grown more intensively. It can be propagate naturally through its rhizomes or by planting seeds.

3.4 The black cardamom boom and rising inequality (1980-2000)

Despite the armed conflict, villagers from the eastern part of the zone continued to migrate for seasonal work in the coffee plantations near Leik Tho during the harvest (January-February) and cultivated paddy rice or *taung yar* in their villages. Many farmers progressively switched to commercial plantations (coffee and cardamom in zone A and cardamom in zone B) during this period and most of the inhabitants of this zone converted the *taung yar* communal lands into private perennial plantations. Due to these changes, food security through self-production declined with households needing to purchase rice at least six months prior to the harvest, since both paddy rice and *taung yar* rice were

harvested between October and November. During this period the majority of people were working on *taung yar.*

Cardamom production increased rapidly however, due to the limited availability of cardamom seed locally in the villages of zone B, villagers collected seeds from villages where cardamom plantations were already established. With the limited labour and investment constraints of cardamom plantations, and constantly increasing prices which made it a reliable cash crop, more profitable than coffee (with its fluctuating prices), cardamom raised strong interest among farmers. It rapidly developed throughout the region, and by the early 1980s, most farmers were growing cardamom even in the most remote villages.

Two transformations followed in the wake of the cardamom wave. Firstly, the expansion of cardamom accelerated the decline in the region's food security, particularly in staple crops (note at this point in time, villagers were still self-sufficient in vegetables). Families increasingly preferred to secure their food supply by purchasing food with profits generated through the sale of cardamom, rather than growing food under the labour intensive *taung yar* system. They would convert their *taung yar* plots (two to three acres that had been cleared and harvested) into cardamom plantations, with the permission of the village headman. Secondly, the area set aside for grazing by buffaloes declined as contiguous plots of *taung yar* decreased.

Simultaneously, dog fruit all but ceased to be a viable cash crop. Dog fruit trees became infected with disease and yields declined and traders' shifted their focus to cardamom. In turn, these changes fed an accelerated cardamom-reliance feedback loop along with socio-economic polarization.

All farmers adopted cardamom, but the acreage transferred from the common pool *taung yar* lands to private cardamom plantations varied greatly. Poorer households, especially those dependent exclusively on *taung yar,* did not produce sufficient food and income to ensure year round food security. They increasingly sold their cleared *taung yar* lands to better-off farmers, who converted them into cardamom plantations. The sellers became mired in a debt cycle with farmers to whom they sold their land. Contrasting this, better-off farmers, notably those with paddy terraces and buffaloes, were increasingly able to generate rice surpluses and lend them to their neighbours, predominantly to villagers dependent on the cultivation of *taung yar.* Hence, the majority of farmers became dependent on both loans and wage labour in plantations, in the hands of a small number of farmers who thrived and continued to expand their lands.

An important social consequence of the increasing land ownership polarization and rice lending is the normalization of social disparities. By lending rice to families in need during times of food scarcity, more economically stable households increasingly became accepted as community benefactors. As some households accumulated land far beyond their basic needs, those with limited access to land had to work as labourers inside or outside the village in order to ensure household food scarcity.

This highlights the gap between individual and collective-level adaptation in the context of the commercial cardamom boom. At the individual level, and because of their favourable position, some farmers adapted quickly to the new commercial opportunities by expanding commercial cropping systems. At a regional level, the sudden boom of commercial opportunities overwhelmed the communities. They were not able to adapt natural resource management rules (e.g.: regulation of land sales, conserving communal spaces...), leading to a total deregulation of local land markets and rapid social stratification.

3.5 The decline in food-crop production (2000-present)

After the mid-2000s, the armed conflict de-escalated until the national ceasefire agreement (NCA) was signed between the government and the Karen National Union (KNU) in 2012. Both the Tatmadaw and KNU kept their positions to demonstrate their presence and authority in this complex mixed control area. The Tatmadaw still controlled the population's movements and activities, and tensions with communities are still noticeable today.

Transport in the region moved forward again with the introduction of Chinese motorbikes in 2010. Villages collected money collectively to fund the construction of motorbike paths to connect them to the main roads. This facilitated the development of a motorcycle-based vegetable trade, which supplied most households that abandoned shifting cultivation and no longer produced vegetables.

The expansion of cardamom continued with a reduced proportion of farmers still practicing the *taung yar* system on a declining area. This further exacerbated soil fertility issues with declining fallow periods that resulted in reduced yields with fewer months of household food security, noting that twenty years ago, the harvests from the *taung yar* system were sufficient to cover food needs of the villages for most of the year.

In the mid-2010, turmeric *(Curcuma longa)* emerged as a new cash crop sold to Taungoo traders along with a significant number of farmers adopting the production of turmeric. Unlike cardamom, turmeric requires significant sunlight in order to grow. Farmers in the region thus clear-cut land parcels and sowed mono-crop fields of turmeric. Its expansion was limited by its labour-intensiveness, as rhizomes have to be replanted annually. However, turmeric's labour peak *(harvest time from December to February - see cropping calendar in section 4.3)* corresponds to a slack work period for cardamom and coffee, making it an attractive option for farm diversification and increased resilience to fluctuations in the cardamom market. It is also an opportunity for the few *taung yar* farmers remaining to earn extra income and live through the hunger gap periods. Even if they work as farm labourers in large farmers' plantations and have their own small cardamom plots, these farmers often run out of money at the beginning of the summer. As in the previous periods, they borrow rice from the village's shop owners to pass the hunger season. However, the terms of loans are subject to change: pay back in kind with fresh cardamom. New credit providers also appear, such as the Taungoo cardamom wholesalers offering an advance sale system with an interest rate of five percent/month.

With the expansion of cardamom and turmeric, the farming systems have become exclusively cash crop based. Self-subsistence is no longer a priority for farmers who find it more beneficial to produce and sell cash crops and buy in their food.

Further, access to land gap increased in the 2000's. Although landlessness does not exist (or landless farmers do not remain in villages), there are limited farmers that still farm *taung yar* and own limited acres of cardamom, while some large landowners have greater than 50 acres and rely heavily on employed labour for the majority of farm operations. These large landowners focus exclusively on cardamom production and have stopped cultivating their paddy terraces, due to the high labour requirements and the lack of pastures for their draught buffaloes. This is associated with the reduced area under shifting cultivation and its associated fallow areas that were traditionally used for animal feed. The paddy terraces have been sold, given to others families in the villages, or donated to churches or schools, further legitimizing the status of large landholders. The challenge in finding buffaloes to rent for ploughing at the beginning of the rainy season has also led other farmers to abandon paddy cultivation.

With the expansion of cardamom plantations, there has been an increase in the demand for firewood that is used in the drying of cardamom to meet suitable quality standards. This has had an impact on forest sustainability and soil erosion issues. Farmers are currently exploring improved and more efficient drying options.

A schematic of the farming systems that have dominated the region over time is presented in *Figure 22.*

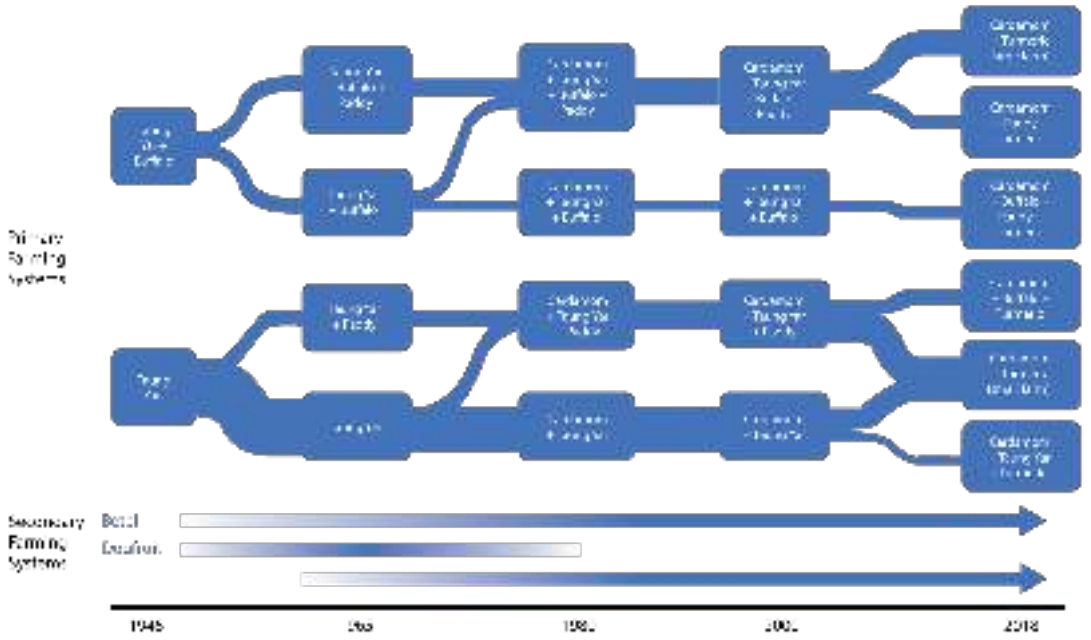


Figure 22: *Schematic of the evolution of farming systems over time in the Leik Tho region.*

4. Dominant cropping systems

The main cropping systems studied and there productivity included:

- ⇨ Taung yar – a shifting cultivation system that produces approximately half a ton of rice and 100 viss of garden products per cultivated acre.
- ⇨ Cardamom (10 to 13 viss of dry product per acre)
- ⇨ Turmeric (approximately 160 viss of dry roots per acre)
- ⇨ Paddy (rice production on terraces produce half ton per acre)
- ⇨ Betel vine (300 viss of leaves per acre)
- ⇨ Coffee (approximately 30 viss of dry seed after decortication per acre).

These systems and aspects of production are outlined briefly below.

4.1 Taung yar (shifting cultivation)

The plot of land is cleared, burned, and planted with diverse crops including corn, upland rice, and a wide range of vegetables (e.g., tomato, chili, cucumber, pumpkins, potatoes, etc.) during a single season *(Figure 23)*. At the end of the production season, the land is traditionally returned to a fallow cycle that last for up to 7 years. The fallow period has consistently declined due to the lack of sufficient area to undertake the process and seven years of fallow rarely achieved. Currently, plots are often not fallowed but rather planted to cardamom or turmeric.

To address the significant workload, labour is organized through communal work exchange groups composed of families who cultivate a contiguous set of plots. Each family cultivates individual plots, however, some operations are conducted jointly such as the felling of trees, clearing of lands, building fences, watching over fields against pests, and for some post-harvest operations.

The reduction in area available for shifting cultivation (mainly at the expense of cardamom) made it increasingly difficult for groups of families to have contiguous plots. This impacted the functionality of labour exchange groups and in part contributed to the decline in shifting cultivation. Currently, few families undertake *taung yar.* A limited number of elders still perform *taung yar* as they are strongly committed to food self-sufficiency, however, it is likely that the last *taung yar* plots will be turned into cardamom or turmeric plantations.

CS Taung yar (one acre)	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	Workload(WD)
Cutting grass													5
Cutting grass, branches													12
Making firelines, burning													4
Settling fire again													10
Building the bamboo hut													3
Planting corn (stream)													8.5
Planting corn (slope)													3.5
Sowing rice													5
Weeding													20
Harvesting corn													2
Weeding (2nd)													20
Weeding (3rd)													20
Harvesting rice													25
Post-harvest (thresh)													11.17
Bringing back the bags													15
													156.17

Figure 23: *Cropping calendar for taung yar and the estimated labour demand for activities (i.e. working days (WD)).*

4.2 Cardamom

Following the previous year's harvest, dead branches and old cardamom branches are removed from the tree and plots *(Figure 24)*. During the dry season, farmers collect wood that is required to dry the cardamom harvest. The wood is stored under stilt houses or in a hut near the house. Wet wood is collected during the monsoon as a mix of wet and dry fuel wood is preferred for cardamom drying. There has been a shift from bamboo drying facilities to steel grids that are more convenient and last longer. A farmer requires approximately 12 cubic feet of wood in order to dry the harvest from one acre.

In May, before the cardamom flowering period, plots are cleaned and leaves and branches are pruned to enhance flowering and the residues left to decompose. The cardamom is harvested in September and October. Once dried, it is sold to traders who come to the villages or it is sent to Taungoo.

It is of note that there are differences in yield between large and smallholder farmers, this being due to older cardamom trees found on large farms as they were the first to transition away from shifting cultivation. Further, they do not replace their cardamom plants as frequently as do smallholders who work their lands more intensively and generate greater outputs.

Figure 24: *Cardamom cropping calendar and the estimated labour demand for activities (i.e. working days (WD))*

Figure 25: *Turmeric cropping calendar and the estimated labour demand for activities (i.e. working days (WD))*

4.3 Turmeric

This tuber crop has traditionally been produced in the *taung yar* plots. However, since 2010 it has been produced intensively in mono-crop fields. Most turmeric is sown on former cardamom parcels with cardamom and turmeric sometimes grown in a multi-year rotation: old, lower-yielding cardamom plants are replaced with turmeric for one or two years before cardamom is sown again.

Part of the harvested roots (mainly root "knots" from which all the roots of the plant emerge) are harvested and kept for sowing the following year. After harvest, the turmeric roots are boiled and sundried. Farmers who are starting turmeric cultivation can often only sow a limited quantity of seeds. Most families use their first year's entire harvest to be used as seeds for the following year.

Turmeric is appealing due to its cropping schedule, which complements cardamom's one *(Figure 25)*. Turmeric is labour intensive, which limits production for many farmers. Weeding and harvesting are especially labour intensive (turmeric requires three annual weedings) and increase production costs. Only large cardamom growers can afford the investment, including workers' salaries needed to cultivate over one acre of turmeric, while families with low investment capacity cannot sow more than half an acre. Large farmers are more likely to maintain the profitability of crops due to their ability to sell their harvest later in the season when prices are higher.

CS Monsoon paddy (on terraces) one acre	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	Workload(WD)
Sowing the seedlings													5
Clearing parcel													5
Plough													10
Harrow the soil													20
Sowing													27
Weeding													12
Weeding (2nd)													20
Harvest													35
Post-harvest													12
Bringing back the bags													9
													155

Figure 26: *Monsoon paddy rice cropping calendar and the estimated labour demand for activities (i.e. working days (WD))*

4.4 Monsoon Paddy

The initial production step is the establishment of a seedling nursery *(Figure 26)*. Seeds[5] from the previous years' harvest are used to establish the nursery in a 50 m2 plot that is ploughed and harrowed using draught buffalo. Seedlings are sown in a fenced parcel to protect them from buffalo, which graze freely in the lowlands during this time of year. After fifty to sixty days, the seedlings are transplanted into the terraces.

Paddy terraces are ploughed and harrowed with buffalo and weeded twice *(Figure 26)*. After fifty to sixty days, the seedlings are transplanted. Farmers have various techniques to perform weed control through different flooding and water management techniques.

The major constraints in paddy cultivation are:

- ⇨ Renting buffalo for ploughing is difficult since it costs around 6 bags of paddy, which corresponds approximately to a quarter of the average yield. The constraint is becoming greater as buffaloes are harder to find due to shortages of pasture land. Approximately one third of farmers growing paddy do not own a buffalo and rent them once the owners finish ploughing.
- ⇨ Labour is difficult to find. Most workers are no longer interested in "in kind" payments of rice. For an agricultural labour wage of 5,000 MMK per day, labourers prefer to work in cardamom plantations rather than in paddy terraces.

5. The species cultivated in the terraces are different from the bumu and the pihi varieties cultivated in taung yar.

4.5 Comparison of the performance of cropping systems

Food cropping systems that includes *taung yar* and paddy crops have the lowest labour and land productivity *(Figure 27)*, this explains why most farmers have converted to growing cash crops. Cardamom has the highest labour productivity and land productivity is higher than crops such as *taung yar*, coffee, and paddy. This in part explains its rapid and widespread expansion in the area.

Although land productivity of *taung yar* is relatively low, it is more profitable to spend a day of work for *taung yar* than for paddy. Indeed, the variety of products that are produced in the *taung yar*, and the high cost of vegetables makes it a more effective enterprise in terms of labour productivity.

Turmeric is the most recent cropping system introduced and requires significantly greater human resources than *taung yar*. Yet, the work peaks for growing turmeric are during down periods for paddy and cardamom cultivation, and this makes it a convenient diversification crop for farmers. Its land productivity is double that of cardamom, which explains why even very small farmers are producing it. This is due to farmers wanting to make the most out of their limited land resources, with the family labour they have at hand. Indeed, the work productivity of turmeric is lower compared to cardamom, and hiring workers on turmeric plots does not seem worthwhile because labourers receive daily wages of 5,000 MMK, whereas the work productivity of turmeric is a slightly over 3,000 MMK/working day. This provides an explanation regarding why turmeric has expanded slowly with a small acreage for each household.

Turmeric represents an option to diversify production in the same way as coffee has in the past.

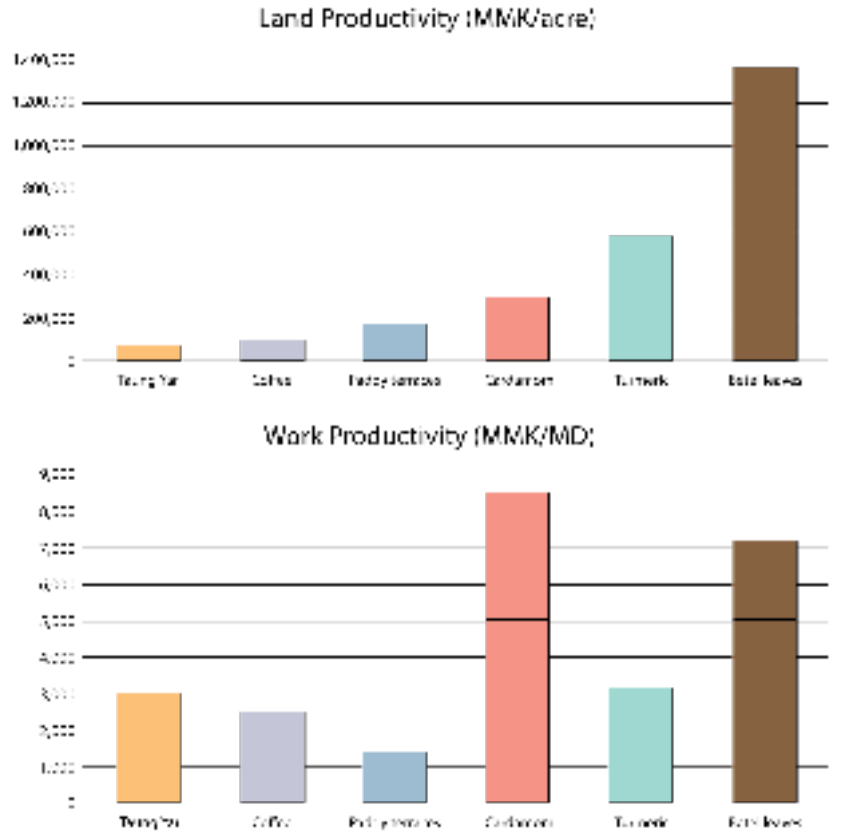


Figure 27: *Land productivity and work productivity of key cropping systems*[6]

6. Note the data for coffee and betel leaves is based on 1 or 2 interviews. Data should be treated with caution due to the limited sample size.

5. Analysis of farming systems

An assessment of the elements of the five farming systems assessed in the study is presented below.

5.1 Subsistence-oriented small farmers (cultivating *taung yar*) – Farming system 1

Within a subsistence-orientated smallholder farming system (farming systems 1 – FS1) the division of land allocated to different enterprises is presented in *Figure 28.*

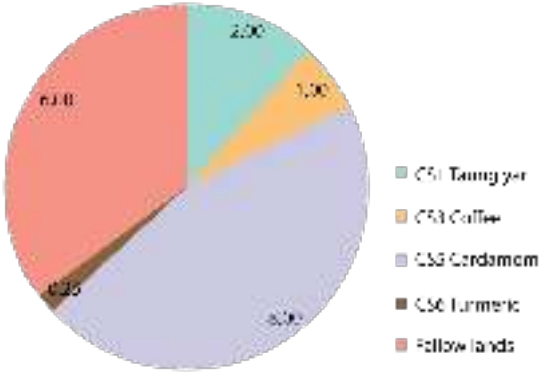


Figure 28: *Land use for FS1 Subsistence-oriented small farmers (in acres)*

- ⇨ Total land area: Approximately 11–15 acres
- ⇨ cultivated with some remaining lands under fallow
- ⇨ Work force: Predominantly family labour and mutual aid with relatives (except for the cardamom work when it peaks)
- ⇨ Others activities: Working as a labourer in cardamom plantations or mining
- ⇨ Equipment: Two small grids to drycardamom, a third hand motorbike
- ⇨ Estimated portion of the population: 10%

Other features:

- ⇨ There is insufficient available land to perform sustainable shifting cultivation cycle with a sufficient fallow period (estimated to be seven years). Decreasing yields lead farmers to cultivate greater areas of taung yar (three acres instead of two acres in the past).
- ⇨ They own the least amount of land, due to not having inherited paddy terraces and/ or they had to repeatedly sell their shifting cultivation plots that are turned into permanent crops whenever they face a debt crisis during hunger gaps.
- ⇨ They have diversified crops and attempted to make the most out of their limited resources.
- ⇨ They were the last to make the transition to permanent crops such as cardamom, due to a lack of investment capacity. This is the only farm type still practicing shifting cultivation.
- ⇨ Many of them are young parents whose children are not old enough to assist on the farm. They have inherited a small share of land after their parents' lands were divided amongst their siblings.
- ⇨ Their income as labourers is relatively limited, as they remain in their village for their own farming activities most of the year.

5.2 Small farmers cultivating commercial crops – Farming system 2 – FS2

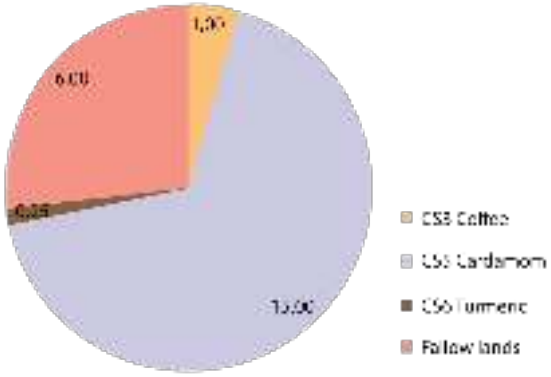


Figure 29: *Land use of FS2 – small farmers with commercial crops (in acres)*

- ⇨ Total land area: Approximately 16 acres cultivated with some remaining fallow lands (currently in conversion process to permanent cultivation) *(Figure 29).*
- ⇨ Work force: Predominantly family labour and mutual aid with relatives (except during cardamom work peaks)
- ⇨ Others activities: Working as labourers in other cardamom plantations or mining.
- ⇨ Equipment: Two small grids to dry cardamom, one third-hand motorbike.
- ⇨ Estimated portion of the population: 60%

Other features:

- ⇨ These farmers did not inherit paddy terraces.
- ⇨ They own the amount of land needed for a sustainable *taung yar* rotation of 7 years, on 2 or 2.5 acres/year (average area cultivated in the past by households under *taung yar*).
- ⇨ Most have never sold their lands.
- ⇨ They gradually converted their *taung yar* into cardamom relatively late (four to seven years ago).
- ⇨ The majority of the cardamom plantations were sown two or three years ago.
- ⇨
- ⇨ The focus is on the most productive crops.

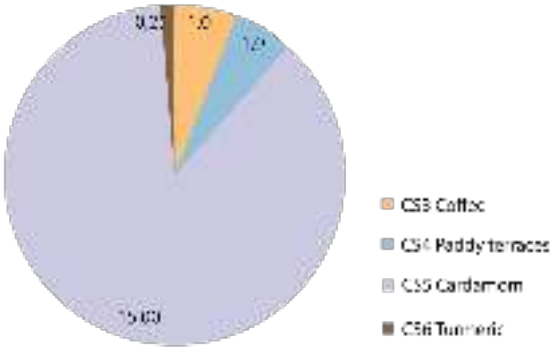


Figure 30: *Land use for medium sized farmers (in acres) (FS3 and FS4).*

5.3 Food self-sufficient medium farmers with both commercial crops and paddy terraces – Farming system 3 (without buffalo) – FS3, and farming system 4 (with buffalo) – FS4

- ⇨ Total land area: 10–20 acres.
- ⇨ Work force: Predominantly the family members *(Figure 30).*
- ⇨ Others activities: Working as labourers in cardamom plantations or mining.
- ⇨ Equipment: Two small grids to dry cardamom, one third or second-hand motorbike.
- ⇨ Estimated portion of the population: 15%

There are two sub-categories within this FS, namely farmers who do not own their own buffalo (FS3); and farmers who own buffalo (FS4). The former farming system (FS3) plough their lands later in the season, impacting yields and incurring additional costs. FS4 own their buffalo and can achieve higher yields as they are able to prepare their lands during the optimal period and may generate additional income through services provided by their buffalo. In both categories, there is a trend to abandon paddy terraces, due to the higher productivity of cardamom and turmeric, and due to a shortage of pastures and challenges to find and/or manage buffalo.

5.4 Large commercial cardamom based-farmers – Farming system – FS5

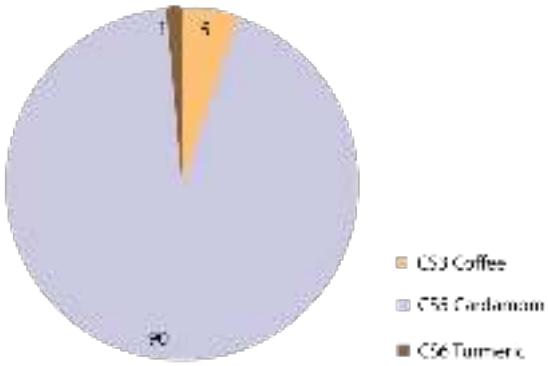


Figure 31: *Land use associated with large commercial cardamom based farmers (in acres) (FS 5)*

⇨ Total land area: 50–100 acres *(Figure 31).*

⇨ Work force: Predominantly hired labour.

⇨ Others activities: Local traders of commercial crops, small shops and money lending.

⇨ Equipment: Three large steel grids to dry cardamom, two first-hand motorbikes, sometimes a car.

⇨ Estimated portion of the population: 5%.

Other features:

Although these households do not rely on food crops, they were the first to build paddy terraces in the 1960s. They were also the first to cultivate paddy with the assistance of domesticated buffalo (rather than only exclusive hand labour). This allowed them to generate a food surplus that was then loaned to other farmers during the hunger season. The money lending scheme allowed them to accumulate land by buying land from the indebted farmers.

In the 2010s, farmers turned to 100% cash crops, abandoning paddy cultivation for cardamom and turmeric.

In recent decades, and despite the internal conflict between the KNU and the Myanmar armed forces, there has been a shift from subsistence crops within a shifting cultivation system to commercial crops within permanent cultivation systems. The first cash crops were dog fruit through the production of endemic forest trees, and later came coffee in the areas close to Leik Tho town. In the 1980s, cardamom boomed and this led to a complete change in people's relation to land and enhanced differences between farmers. Swidden cultivation occurred for a single year and the lands were then established for cardamom, instead of returning to fallow as in the previous *taung yar* system. During the 2010s, turmeric was introduced as a cash crop. Some farmers were more reactive to change due to food surpluses generated by the paddy terraces. They were in a position to convert their previous shifting cultivation plots into permanent crops, and were able to buy lands from indebted farmers, gradually expanding the lands they "own" by two to three acres per year. Others were less adept in adapting to this change due to a range of constraints linked to the aggravated food deficit, decreasing fallow periods, yields, and a debt cycle that led them to sell their lands.

Currently, all farming systems include cardamom and turmeric cropping systems with the main differentiating factor being the amount of cardamom cultivated, which varies from 15 to 90 acres. All farming systems require the hiring of external labour and have additional sources of income.

	FS1	FS2	FS3	FS4	FS5
Work load per year (Working day)	691	635	790	891	3,672
Gross Added Value (MMK)	2,636,029	4,507,100	4,674,867	4,924,867	26,868,000
Household's farm income (MMK)	2,028,362	2,448,567	1,940,833	2,240,833	10,620,800

Table 3: *Farm income of key farming systems of Leik Tho*

Table 3 indicates similar levels of farm income among FS 1, 2, 3 and 4 whilst the large commercial farmers (FS5) show significantly higher income levels. It also demonstrates that ownership of paddy terraces (FS3 and FS4) does not have a measurable impact on farm income.[7]

7. Monetary value of self-consumed products is also counted in the farm income

2

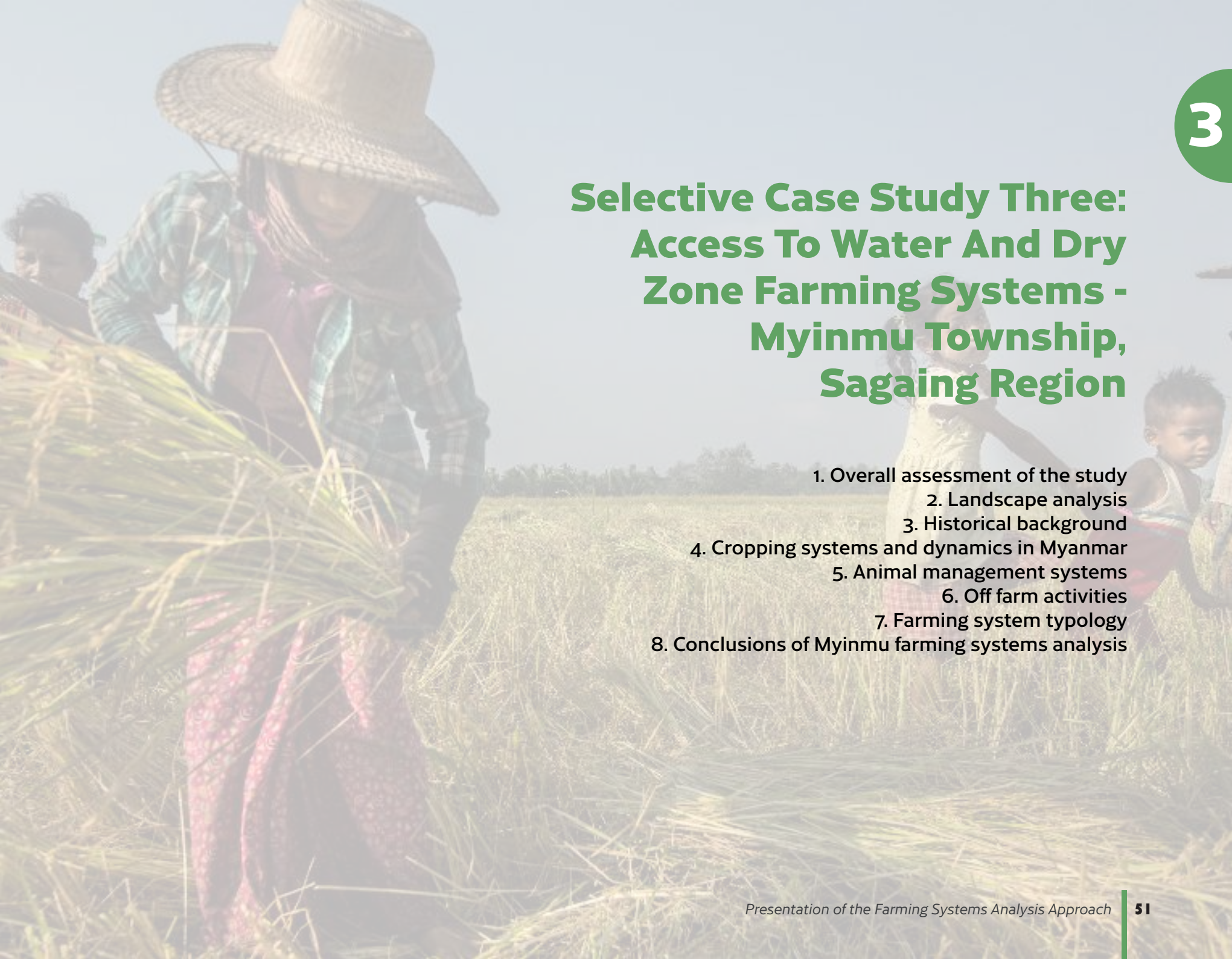
6. Conclusion

The residents of Leik Tho and the surrounding towns have shown remarkable resilience and resourcefulness in the development of their livelihood systems over the last century. Agriculture in northern Kayin has always been challenging, and similar to many tropical upland regions, irrigation is problematic or impossible for poor hilltop communities. This is due to limited valley floors that constrain the production of staple crops, and animal or mechanical labour is unmanageable at best. Extension services are essentially absent, markets are difficult to access, and seasonal rains render much of the region impassable for up to one third of the year. These challenges were exacerbated by decades of armed conflict. Whole villages have chosen survival through inaccessibility, retreating from roads to hilltop locations. While these areas are more secure, relocation has compounded the disadvantages of upland agriculture. The situation has been offset by the pragmatic adoption of new cash cropping opportunities. The adoption of cash crops, especially cardamom beginning from the 1980s, and later turmeric in the 2010s, have fortuitously offset the gradual loss of the *taung yar*'s viability. This shift to cash crops and permanent cultivation have also led to a sharp rise in inequities and stratification among farmers.

The traditional *taung yar* system is no longer a viable farming system with the population outstripping the land required for *taung yar*, and with each passing year, the remaining practitioners of *taung yar* declining. With the availability of imported food via motorbikes, the sheer physical difficulty of achieving food security through *taung yar* ensures its disappearance.

However, the transition from farming for household food security to near-total cash cropping represents a significant risk for food security in the region. Despite farmers' diversification to both cardamom and turmeric (and to a much lesser extent coffee), they remain highly vulnerable to market price variations. The region has no sustainable competitive advantages in any of its cash crops, nor any strategies to counteract demand or price fluctuations. Cardamom, now the economy's backbone, is threatened by production from neighbouring countries, and weaknesses in the local value chain, many stemming from the armed conflict between the KNU and the *Tatmadaw*. This has an impact on the ability of farmers to improve their competitiveness. Finally, many of the current cash-cropping practices may simply be unsustainable in their current forms. On the one hand, cardamom requires significant quantities of wood, and on the other, turmeric raises some soil erosion issues due to its root system and yearly uprooting of crops on steep slopes.

There may be opportunities for the re-introduction of some of the principles of *taung yar* polyculture farming systems, resource management based on local knowledge, and cooperative work for village food security within current farming systems. Shade tolerant vegetables, fruit trees, and other options can be introduced to existing cash crop fields, and if appropriately chosen, may improve productivity for both food crops and cash crops and enhance farmers' livelihoods, which are currently at risk given their high level of specialisation in one cash crop and quasi-absence of food production. It will be crucial to consider labour and land productivity of crops in all agricultural development actions to ensure "solutions" are realistic. There are many technical and social challenges to realising this integration, but in the context of sustained peace and development cooperation, it is a feasible goal.



3

Selective Case Study Three: Access To Water And Dry Zone Farming Systems - Myinmu Township, Sagaing Region

1. Overall assessment of the study
2. Landscape analysis
3. Historical background
4. Cropping systems and dynamics in Myanmar
5. Animal management systems
6. Off farm activities
7. Farming system typology
8. Conclusions of Myinmu farming systems analysis

3 Access To Water And Dry Zone Farming Systems

1. Overall assessment of the study

The study primarily focuses on irrigation and access to water for family farmers, specifically on a large-scale pump irrigation scheme. It provides a comparison between rainfed production systems and other traditional and non-traditional forms of irrigation that exist locally. The study attempts to understand farmers' strategies with respect to their water management constraints with the following question: "Is access to water the main factor affecting the diversity of farming systems and their evolution in Myinmu Township, central Dry Zone of Myanmar?" The study findings suggest that labour is one of the main constraints in the scheme and that access to water is not necessarily always the main driver behind crop choice.

2. Landscape analysis

Myinmu is a small Township in Sagaing district, Southern Sagaing Region, bordered by Ayadaw Township to the north, the Irrawaddy River to the south, Sagaing Township to the east, and Myo and Cha-U Townships to the west. Agriculture is the main source of livelihood and the main crops grown are oil seeds – particularly groundnuts, sunflowers, soybeans – as well as pigeon pea, cotton, and paddy rice *(DOA-Myinmu data 2017 in Fue Yang 2018).*

The climate is characterised by an annual precipitation of less than 1,000 mm[8], with the regular occurrence of water deficits. The rainfall pattern is bimodal with a frequent dry spell in July *(Figure 32).* The unpredictability of rainfall and frequency of droughts has led to farmers increasing their resilience to these events by diversifying their crops and sources of income through raising livestock (cattle, sheep, goats, chicken), weaving, and other off-farm activities *(Boutry et al. 2017).*

Through a series of field observation and consultations meeting with farmers in the study area, four distinct zones were identified that were based on topography, access to water, and cropping systems along with their associated land use systems *(Figure 33).*

Zone 1: Wetlands and river terraces are located in the south and east of the Township, close to Mu and the Irrawaddy Rivers. These areas are flat and in some places submerged. Alluvial soils are commonly found in these areas, with fertile grey-black non-stony soils. The size of agricultural plots ranges between 0.3–2.0 ha, separated by soil bunds, where natural trees and grass can grow.

Most farmers cultivate their crops without irrigation. In alluvial areas close to the river,

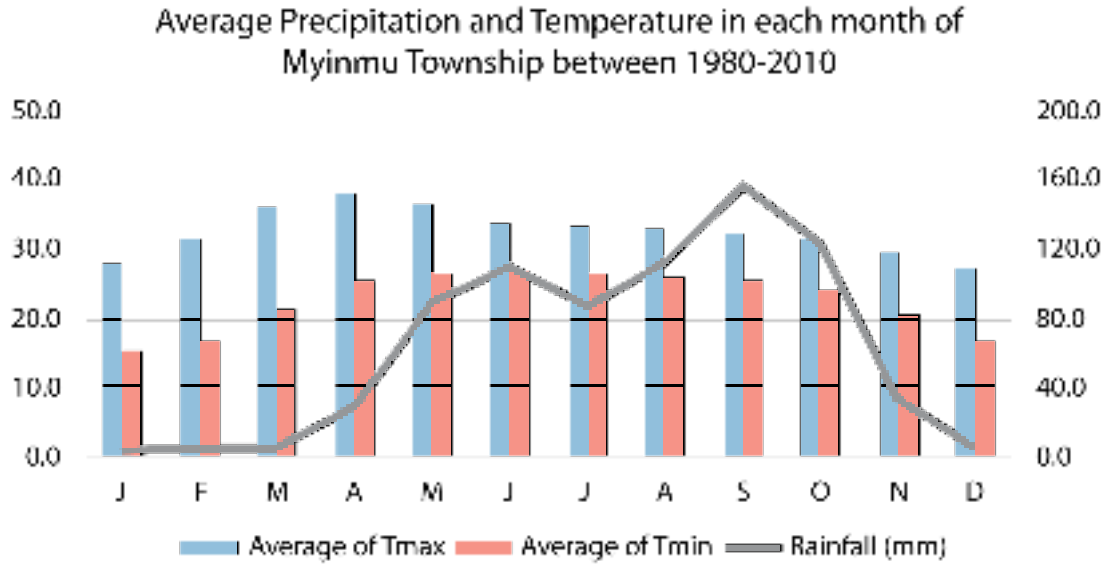


Figure 32: *Average rainfall (mm) and temperature (°C) for Myinmu Township from 1980–2010*

Source: data from Agmerra and processed by ICRISAT, 2010

8. The average annual rainfall is of 717 mm and 845 mm in Monywa and Yinmabin respectively.

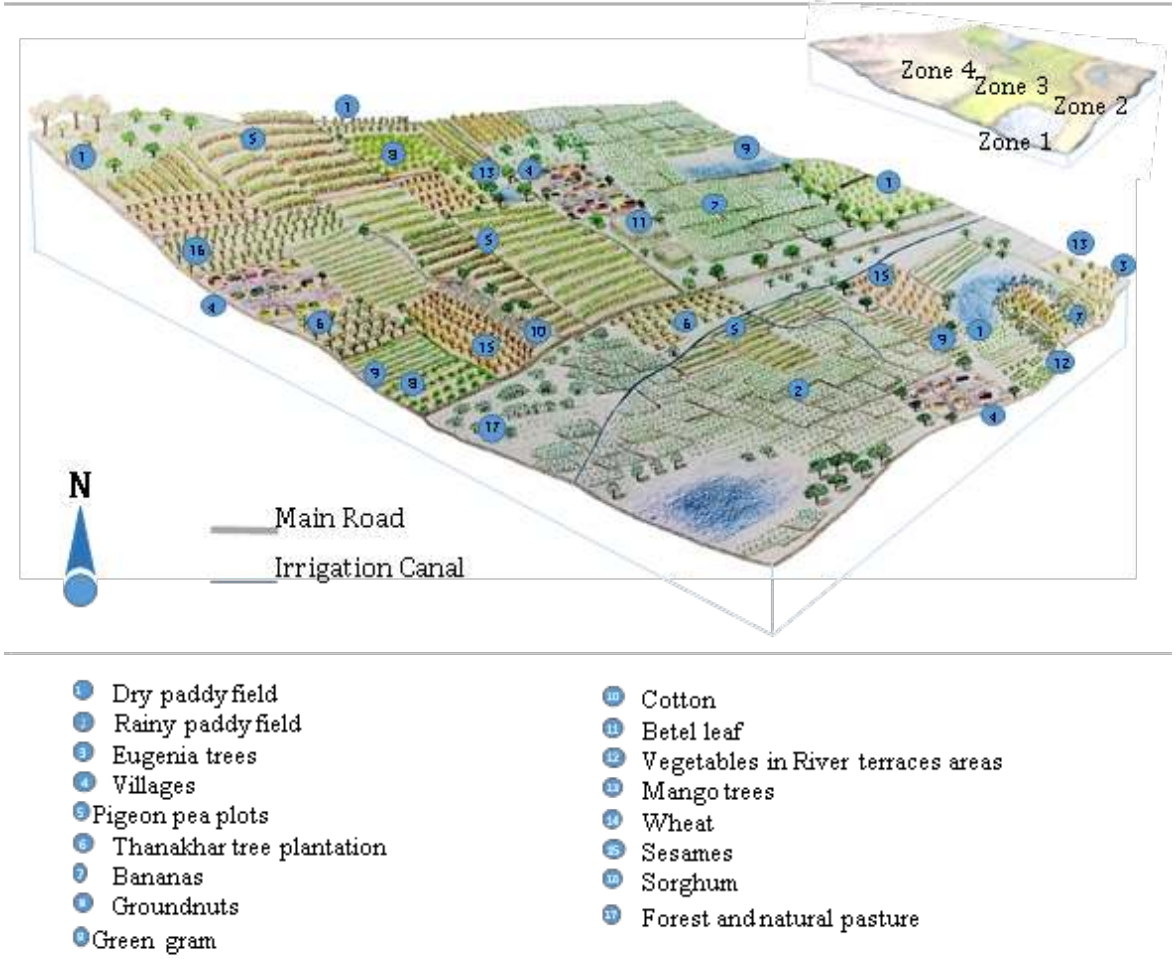


Figure 33: *Schematic of the four agro-ecological zones identified along with their land use in Myinmu.*

water pumps are found in some *Eugenia* and mango plantations to irrigate with groundwater in case of water shortage. Farmers grow selected cash crops in winter and summer (November to June) due to annual flooding. Some farmers grow summer rice in submerged plots by transplanting without irrigation, particularly in Mu Wa Ywar Htaung village.

On river terraces, vegetables such as chilli, eggplants, cucumber, pumpkins, and tomatoes are cultivated in the dry season after the water recedes in the river. Farmers pump water from the Mu River to irrigate by using small water pumps.

Animal rearing systems are also found in these areas, as pasture grows rapidly due to the humidity of soils, and is well suited to grazing cows and sheep, particularly in the dry season.

Zone 2: Lowland Zone is located close to the Irrawaddy and Mu River with an elevation ranging from 50–80 m. The majority of soils are gleysols and grey and brown cracking clays. These are well suited to irrigation and result in higher water use efficiencies for crops in Mu Wa Ywar Htaung and Pyat Ywar village. There are also some sandy clay lands of lower fertility. Farm plots range between 0.3–3 ha and are separated by bunds and natural plants.

This zone is also the main area included in the large-scale Pyawt Ywar pump irrigation scheme *(Figure 34)* which pumps water from the Mu River for monsoon paddy, summer paddy, and summer cash crops. The area of the irrigation

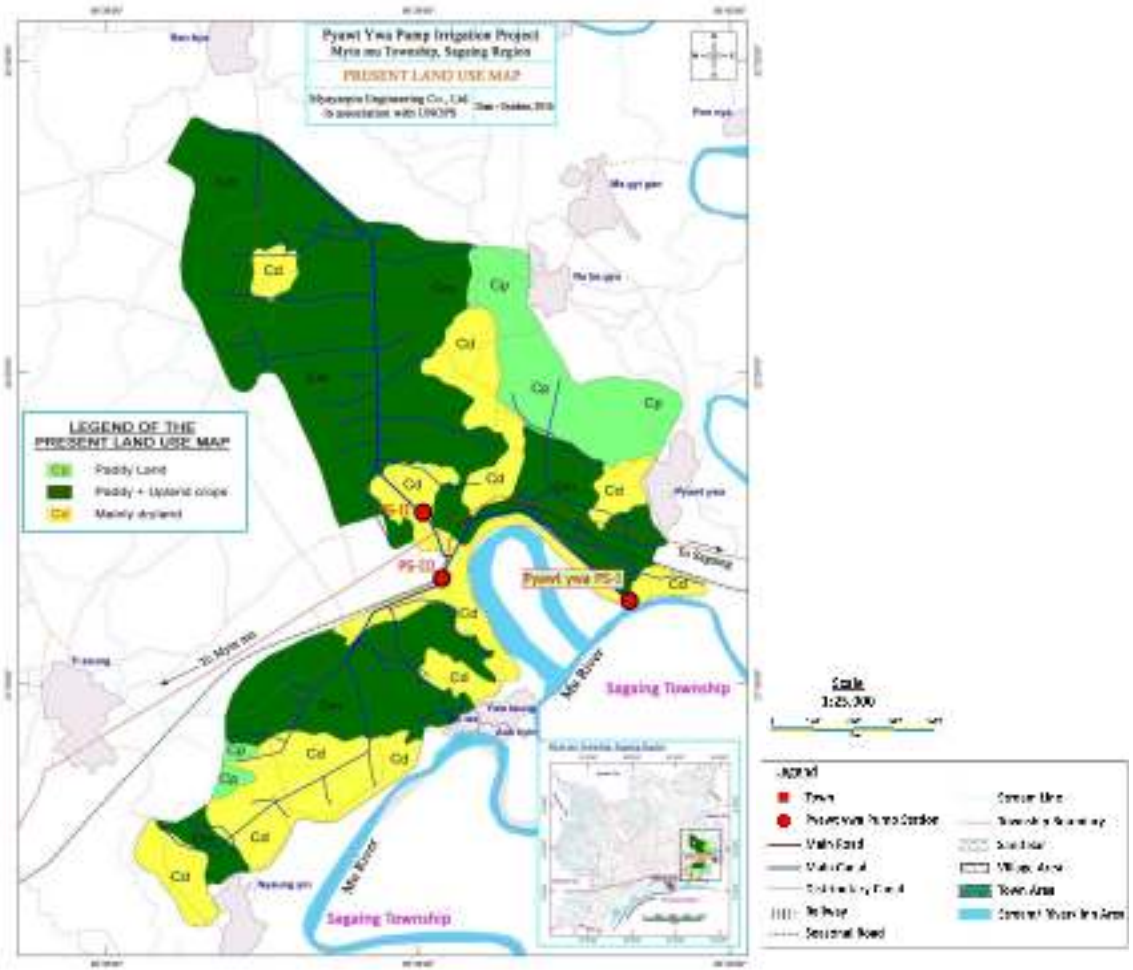


Figure 34: *Irrigation classification under Pyawt Ywar Pump irrigation scheme.*

system covers the agricultural land of six villages: Pyat Ywar, Kan Pyar, Mu Wa Ywar Htaung, Nyaung Yin, Htee Saung and Na Be Kyn. Within the command area, access to irrigation water varies greatly, depending on position and soil type.

For plots close to the pump stations and the main canal (i.e. lands of Pyat Ywar village), irrigation water is sufficient for double paddy cropping with monsoon paddy grown between July to December (with rainfall and supplementary irrigation) and summer paddy between February and June (with irrigation). However, for plots further from the pump stations and the main canal, irrigation water is insufficient to grow summer paddy. Upland cash crops including oil seeds (groundnuts, sesame), pulses (green gram, pigeon pea) and cotton are grown in the summer after the monsoon paddy cycle. For plots with poor water access (above canals and further away), paddy cultivation is impossible year round and farmers often grow two cycles of upland cash crops.

Small individual water pumps are commonly found on plots along the river and are predominantly used in the production of vegetables and other winter crops. In locations furthest from the river, farmers extract ground water (15–24m deep) with individual motorised hydrocarbon pumps.

Tree and orchard plantations are also found along the Mu River particularly mango, Eugenia and bananas as these crops are more resistant to flooding during the rainy season. Some natural trees and grasses found in the area are Leucaena

leucocephala (tree), *Prosopis sp.* (shrub), *mperata cylindrica* grass, *Alternanthera philoxe-roides* (Mart.) Griseb and shrubs (Kandarya tree) and toddy palms. These trees often demarcate the boundaries of agricultural plots. Raising large and small ruminants is also common in this zone, particularly cows and sheep.

Zone 3: Middle Zone is located at an elevation of 80–150 m in the middle of Myinmu Township. The major soil textural class is sandy silt, while in some areas soils are dominated by brown cracking clay. The soil in this area is more fertile than the upland zone and has low erosivity. A wide diversity of crops are produced including pigeon pea, cotton, sorghum, groundnuts, green gram, sunflower, and rainfed rice. Small thanaka tree (*Limonia acidissima L*) and mango orchards are found along with betel leaf gardens at the periphery of villages, in close proximity to groundwater sources that are used for family consumption.

To the east of Kan Taw village, there is a traditional irrigation scheme (allegedly built several centuries ago). The irrigation system is composed of a rainwater reservoir and canals that are used for monsoon paddy cultivation. The system distributes water to downstream plots, but some farmers also use small motorised pumps to irrigate plots that are above the reservoir. After rice transplanting, farmers release water from August to the end of October to irrigate the crop. In November, farmers release water from the reservoir daily and then cultivate sesame, green gram, and groundnuts inside the reservoir on fertile alluvial soils that were deposited from five to six months of flooding and runoff.

In some areas on the west side of the village, the groundwater is saline and is not suitable for crop production. There are, however, small rainwater ponds used for domestic purposes. Cattle and sheep are found in Kan Taw village.

Zone 4: Upland Zone is located to the south-west of Myinmu Township, with topography of small hills with slopes of 5–15%. Sandy soils are commonly found in this area. Soil erosion is a serious problem; in some areas, the soil has been completely removed by runoff. The main crops grown are pigeon pea, sesame, *thanaka* and sorghum with limited production of groundnuts and green gram. Due to the lack of reliable water resources, paddy is not grown. Native vegetation is not as abundant as in the other zones and cattle and sheep are commonly kept livestock.

3. Historical background

3.1 Pre–1975: Agricultural production based on natural resources

During this period most farmers cultivated local varieties and landraces for self-consumption. If there were surpluses in production, they would sell or exchange them with other farmers. Agricultural land was more accessible and households owned between 4 hectares (10 acres) to 40 hectares (100 acres). Other than specific areas, such as Kan Taw which was situated around a traditional rainwater reservoir, irrigation was not practiced. Farmers grew rainfed paddy in lands along the banks of the Mu River. Pigeon pea, sesame, cotton, lablab bean, chickpea and green gram were also grown but in small quantities. Most farmers used manure rather than chemical fertilisers. Crop rotations were based on one year of cultivation followed by two years fallow. Farmers would mainly broadcast seeds.

Large ruminants were raised in herds ranging from 10 to 100 cows on areas of natural pasture that was available. There was a lack of veterinary services and farmers relied on natural medicines to care for their animals. Small ruminants were rarely found during this period.

3.2 1975–1988: Government orders agricultural intensification

Post 1975, farmers gradually converted pastures to farmland along with the amount of fallow land as a response to government wanting to intensify agricultural output. Farmers shifted from broadcasting to the use of row seeders pulled by cows and introduced chemical fertilisers provided by the government. In each village, a tractor for land preparation was provided by the government for farmers to rent. New varieties of crops were introduced, including paddy, groundnuts and sesame. Farmers also began to grow new crops that included cotton (under government incentives) and tobacco (in upland villages). At the same time, farm size per household declined due to increasing population.

Fruit tree orchards were not yet widespread during this period due to the fact that farmers were forced to focus on prescribed crops by the government and quota obligations.

Consequently, they were forbidden to grow fruit trees in lowland areas reserved for paddy. The government was heavily involved in the planning of agricultural production and decided on the targets and crops that each village was to produce. In general, the targeted crops in lowland villages were paddy. In upland villages, cash crops such as cotton, pigeon pea, sesame, and groundnuts were cultivated. These restrictions in cultivation of crops negatively impacted production and investment capacities of small and medium farmers.

Animal rearing activities decreased, particularly for cattle, with the conversion of grazing lands to farmlands and mechanisation. As a result, farmers with a very small amount of land (or the landless) started raising sheep and goats.

3.3 1988–2005: Better access to markets and development of small pump irrigation

In 1988, the government initiated a gradual opening up of the economy and agricultural markets were liberalised. From 1999–2000, some farmers in Mu Wa Ywar Htaung and Pyat Ywar village (lowland area) began to dig tube wells for irrigation, particularly to grow sesame and pulses as cash crops during the dry season. In lowland villages, some farmers started to pump water from the river and double cropping began to develop.

From 2003–2004, the majority of the roads between the villages in the area were upgraded and maintained allowing access to heavy vehicles (i.e. trucks). This enabled farmers to sell their produce at the farm gate or to have it transported directly to a broker and/or collector. They could also access market information due to their strong relationship with traders. With access to information and markets, agricultural production became more diversified as new crops and varieties were gradually introduced by traders. Further, farmers could access credit more easily from the Myanmar Agricultural Development Bank (MADB), although loan amounts were particularly low for non-paddy crops. Agricultural machinery and chemicals, including pesticides and fertiliser, were introduced by government staff from the Myanmar Agricultural Service (now the Department of Agriculture (DOA)).

Between 2000–2005, fruit tree orchards/plantations of mangos and bananas developed, particularly in villages along the river. Fruit trees were mostly grown by farmers who had over 15 acres of land or more than 7 ha.

With these changes small-scale farmers and the landless found greater opportunities in the labour market in nearby towns. This supported household income, and some were able to buy land and expand their farms whilst farmers with limited access to farmland changed their strategy from crop farming to animal raising. To complement their income, farmers sold their farmland and bought sheep and goats, which yielded a quicker return than large ruminants. They were fed on crop residues and grazed with herdsmen on fallow areas. Animal raising, especially for large ruminants, continued to decrease due to the conversion of pastures into farmlands and mechanisation.

3.4 2006–present: New agriculture revolution and construction of a large-scale pump irrigation schemes

From 2006 to present, agricultural production significantly changed in terms of production techniques, particularly in lowland areas. In 2006, an irrigation scheme was constructed in Pyat Ywar village which allowed farmers to begin irrigating their crops in 2007. Concomitant with these changes, new cropping techniques and varieties were introduced by the DOA that included short duration rice varieties, high yielding sesame varieties and groundnuts. Farmers began to grow two seasons of paddy. The emergence of these new cropping systems was contingent on the location of the agricultural land and access to water (e.g. land close to canal, low or high land compared to canal level).

A greater range of cash crops were grown in the area: pigeon pea, groundnut, cotton, sesame, and a range of pulses for domestic and export markets. New varieties were also introduced in the non-irrigated cropping systems; farmers in upland villages grew more tree plantations during this period, particularly *thanaka* and mango. Simultaneously, agricultural credit became more accessible with farmers being able to access credit for inputs with traders and MADB. Currently, cows are still widely used for animal traction by small and medium-scale farmers. However, some large-scale farmers with more capital are gradually shifting to tractors.

4. Cropping systems and dynamics in Myinmu

4.1 Cropping systems in lowland areas

Intensive cropping systems with year round access to irrigation: Intensive cropping systems can be found along the canals that distribute water from the scheme throughout the year and in sufficient amounts. These systems are based on the production of three crops annually. The main cropping systems (CS) are:

- ⇨ Rotation between summer paddy/monsoon paddy/winter cash crops (winter chickpea, winter green gram, or winter wheat) in one year (CS1)
- ⇨ Rotation between summer cash crops (green gram, black gram) / monsoon paddy /winter cash crops (wheat, chickpea or groundnuts) (CS2).

Paddy is grown as a main crop in this area during two seasons to cover food needs, to sell the surplus, and to feed rice straw to livestock. Some farmers grow one season paddy in rotation with two seasons of cash crops.

Cropping systems on plots within the scheme but distant from canals and pumping stations: In plots located far from the canal and the pumping stations (e.g. over 3,000 feet), farmers have cropping systems based on rotations between monsoon paddy and winter cash crops, particularly winter green gram, winter wheat, or winter chickpea. Some plots which are very close to pumping stations (hundreds of feet) and from the main canal are based on a triple cycle rotation between monsoon paddy / summer paddy / winter cash crops. However, in the case of summer paddy, water is not sufficient and farmers indicated that they receive about 50–70% of the required amount of water for the crop resulting in a reduction of between 30–50% in crop yield. Under these circumstances, some farmers have resorted to pumping water from tube wells (shared between three to five farmers) to supplement the pump scheme's irrigation.

Cropping systems outside the scheme: Farmlands outside the scheme are located along the river where some river terraces submerg during the monsoon season. The cropping systems are based on one cycle of winter crop such as winter wheat, winter chickpea, and dry season paddy (grown after water recedes). Perennial crops such as mango trees, bananas, and Eugenia are also grown.

4.2 Cropping systems in mid-land areas

Broadcasted paddy systems are commonly found, particularly in the monsoon season due to the lack of water for nursery bed preparation.

Monsoon paddy (direct seed paddy) is grown based on rainfall and stored water in the reservoir that irrigates by gravitation. Farmers manage rotations between paddy and winter wheat or chickpea in lowland areas (in the reservoir) after water recedes.

Intercropping systems are found between pigeon pea and groundnuts during the monsoon season in plots where water is insufficient for paddy and have soils with a low water holding capacity.

Perennial crops are also found in some places that include mango, thanaka and betel.

4.3 Cropping systems in upland areas

In upland areas, soils are light textured sands with a low water holding capacity that limits their cropping potential. Further water used for agricultural purposes is limited thereby precluding the production of high water requirement crops such as paddy. The dominant cropping systems include:

- ⇨ Monocrop of pigeon pea is the dominant cropping system due to its low labour requirement and limited capital investment.
- ⇨ Intercropping pigeon pea with groundnuts
- ⇨ (practice mainly adopted by small-scale farmers).
- ⇨ Intercropping pigeon pea with green gram.
- ⇨ Winter wheat, chickpea, sesame and groundnut.
- ⇨ Monsoon cotton, groundnuts and tomatoes.

The cropping systems that dominate the Myinmu Township and the calendar of production is presented in *Figure 35*.

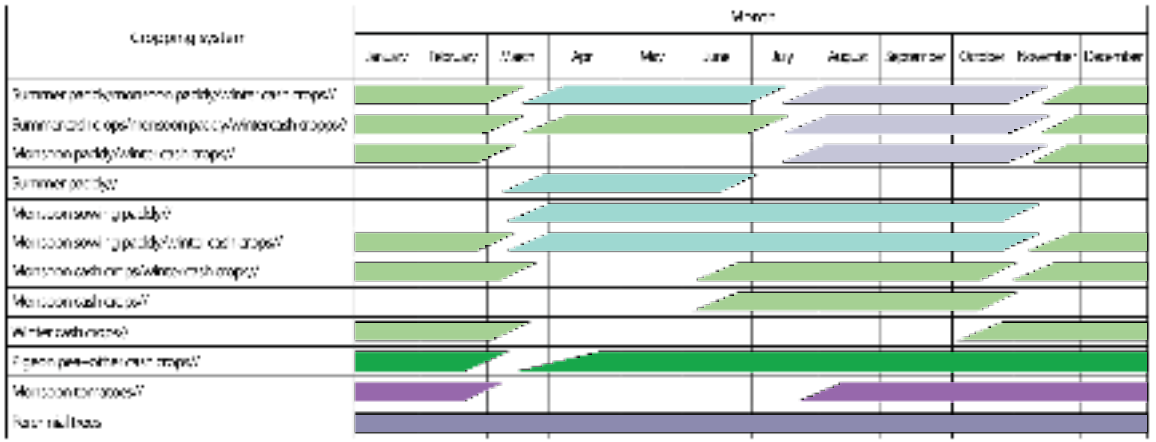


Figure 35: *The current cropping systems and calendar in Myinmu Township*

4.4 Economic analysis of cropping systems

Production costs

Production costs comprises the sum of input costs (seeds, gasoline, pesticide, herbicide, fertiliser etc.) and includes both internal (i.e. cow dung produced on farm) and external inputs (i.e. chemical fertiliser) along with external wage labour cost in a production season of a cropping system, or a cycle of a cropping system (perennial crops). Wage labour costs range between 2,500–3,500 MMK (USD 2) per day for women and 3,500–5,000 MMK (USD 3–4) per day for men, depending on the tasks/activity. For example men earn 3,500 MMK for harvesting paddy and as much as 5,000 MMK for threshing paddy.

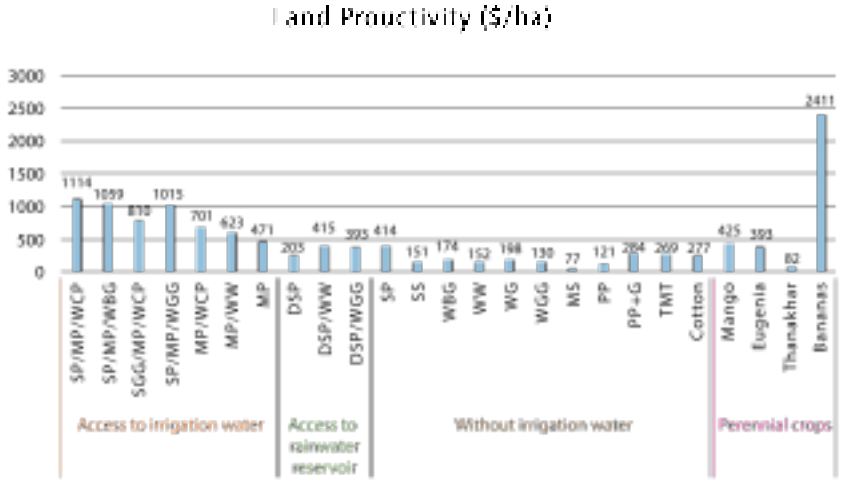
Crop production costs vary from one cropping system to another. For example, transplanted paddy farming is more costly than other crops, due to high labour costs for transplanting and harvesting. The total cost for transplanting paddy (monsoon paddy and summer paddy) is more than USD 400/ha. Most farmers hire external labour for all production activities. Upland cash cropping systems with pigeon pea, sesame and winter wheat have lower production costs *(Figure 36)*. Banana production has the highest cost due to regular inputs of fertiliser (i.e. 50–100 kg/ha/month) *(Figure 36)*. Further, there are additional costs associated with fuel for pumping water during the summer season.

Land productivity

The economic performance of cropping systems was estimated based on the average yields and prices of the main products that farmers regularly sell. This evaluation considered both the main products and the by-products (i.e. residue that are consumed for animal production). This is related to farmers' decisions to grow different crops in the year, as well as contrasting market strategies (*Figure 37*). It is of note that access to irrigation has a greater impact on land productivity when compared to rainfed production systems *(Figure 37)*.

Labour Productivity

Labour Productivity is estimated based on working days that include all internal and external labour in order to compare different cropping systems that are practiced in different areas based on access to irrigation water and other factors that impact the cropping systems. *Figure 38* presents the labour productivity of different cropping systems in different zones with contrasting access to water resources. Labour productively is higher in irrigation areas and the production of the thanakar has the highest labour productively due to its low labour requirements *(Figure 38)*.



Note on cropping systems nomenclature: cropping systems are presented with the annual crop sequence. Crop seasons are separated with one slash /. For crop association within the same season, a + is used. E.g.: SP/MP/WCP: is a triple cycle cropping system, with summer paddy, then monsoon paddy followed by winter chickpea. SS is a one-single cycle cropping system with summer sesame only.

MP	Monsoon paddy
MS	Monsoon sesame
PP	Pigeon pea
PP+G	Pigeon pea + groundnut
SP	Summer paddy
SS	Summer sesame
TMT	Tomato
WBG	Winter black gram
WCP	Winter chickpea
WG	Winter groundnut
WGG	Winter green gram
WW	Winter wheat
DSP	Dry season paddy

Figure 36: *Production costs associated with the different cropping systems in Myinmu Township*

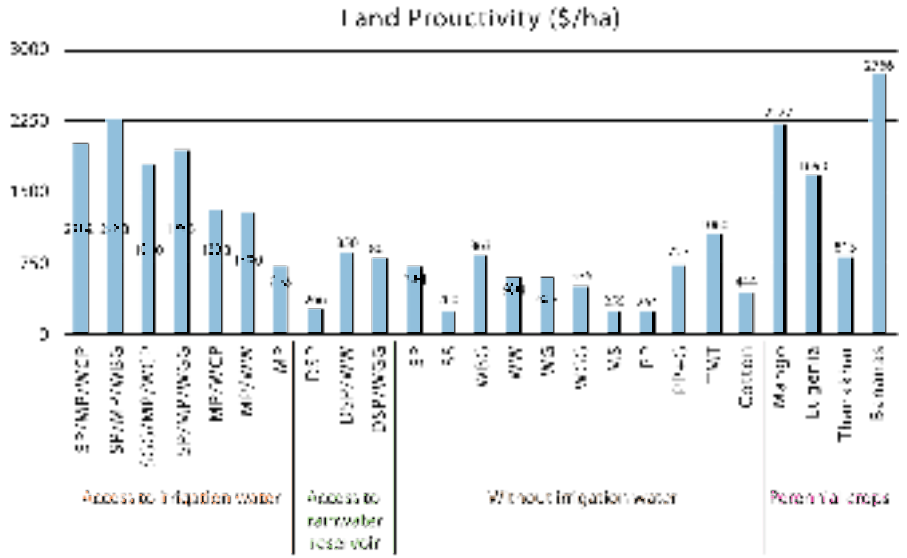


Figure 37: *Land productivity – measured by gross value added (GVA)/ha – of cropping systems in Myinmu Townshio*

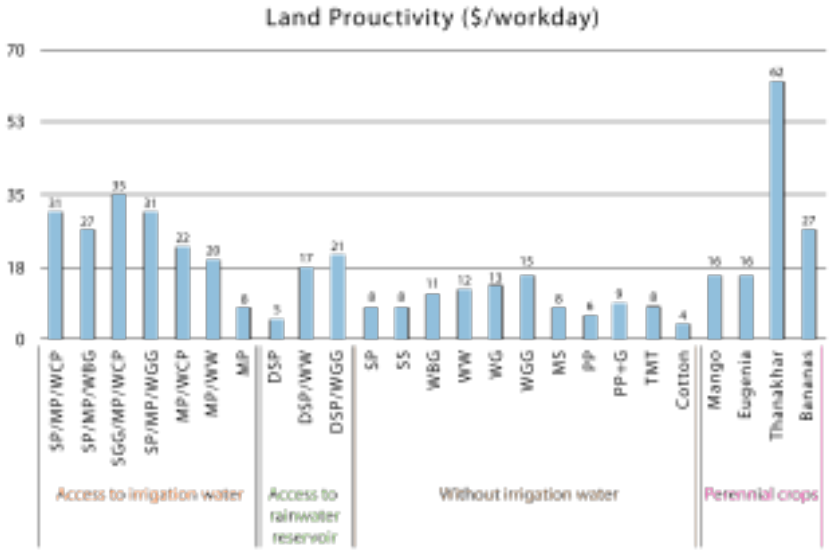


Figure 38: *Labour productivity – measured by gross value added (GVA)/workday – of cropping systems in Myinmu Township*

3

5. Animal management systems

There is a strong correlation between animal rearing systems and cropping systems. Farmers profit from crop residues to feed cattle, use manure for fertilising the soil, and use animals as their main tool in their production systems. Cattle are often used as draught animals in ploughing operations and the pulling of carts. Small ruminants that include sheep and goats, along with pigs are raised by landless farmers, largely due to the rapid economic return on investment.

In general the raising of livestock differs between large and small ruminants. Small ruminants are raised based on natural pasture and cultivated land after harvest, whilst large ruminants are raised in close proximity to cultivated land and on crops residues at the homestead.

5.1 Pig fattening

Pig fattening is undertaken predominantly in Twin Gyi village, in upland areas and among landless farmers. In a single year, farmers are able to rotate through four cycles of fattening that is based on the procurement of piglets and a fattening program of three months before being sold. Farmers raise about ten piglets in a cycle with a daily labour requirement of four hours/day year round. This includes care, food preparation and feeding. Over an entire year, around 182 working days are invested in pig fattening.

5.2 Small ruminants

Sheep and goats are raised by landless farmers, often in flocks of approximately 30–40. They graze on natural pastures or on crop residues. Farmers are required to look after their flocks to avoid animals damaging crops and are later sold to local markets in Mandalay and Monywa. Small ruminants are vaccinated from common local diseases (e.g. foot and mouth disease) in May and October. It is required that a single labourer manage the flock on a daily basis necessitating a labour requirement of 365 working days annually.

5.3 Large ruminant management – cattle

Cattle are predominantly used as draught animals in ploughing and pulling carts. The number of cattle per household ranges from two to eight. The cattle are sold when they are no longer effective as draught animals. They are fed rice straw and crop residue (e.g. green gram, chickpea and sesame). After the crops have been harvested, cattle are allowed to graze plots. Cattle receive vaccinations in May and October and the total labour requirement for management is approximately 74 working days annually.

Figure 39 presents the gross value added for each of the livestock management systems. Pig fattening is the most profitable activity (see higher GVA/year) despite high intermediary consumables/inputs (IC) costs *(Figure 39)*. This is due to the ability of farmers to implement 3–4 cycles/year (about 30–40 pigs/year). On the contrary, cattle are not profitable as they are not raised for income generation, but mainly to provide draught capacity and as a savings element at the household level.

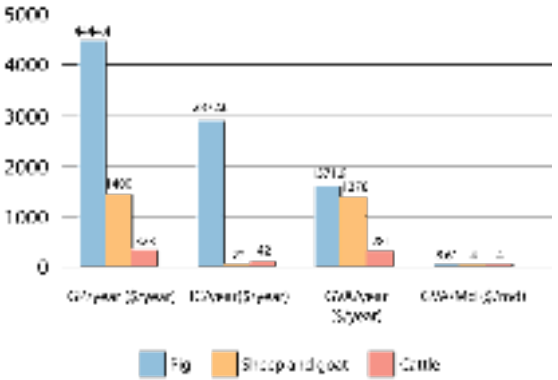


Figure 39: *Economic indicators of animal rearing systems in Myinmu Township*

6. Off farm activities

There is a range of non-farm and off-farm activities undertaken at the household level to diversify incomes. These diverse activities include oil extraction services, threshing services, fodder chopping services, on-farm wage labour, and animal vaccination care services. Contrasting this, non-farm activities include government staff jobs, car transport services, carpenters and tailors.

Non-farm and off-farm activities have links to the farming systems as they provide sources of income that can be re-invested into on-farm activities. On the other hand, these activities may also limit farming activities, due to limitations of family labour availability to manage the farming enterprise.

7. Farming system typology

Based on interviews with respondents and assessments of the different farming systems across the designated agro-ecological zones identified in the Myinmu Township, ten distinct farming systems were identified and are defined below.

Type A: Large farmers with adequate access to irrigation: two seasons paddy, upland cash crops and perennial crops

- ⇨ Cultivated land size: 30–32 acres.
- ⇨ Cropping systems: approximately 1/4 of cultivated land under irrigation with two seasons of paddy. Monsoon paddy and upland cash crops, that include green gram, black gram or chickpea and perennial crops, are grown in other land with limited access to water.
- ⇨ Animal rearing: two to four cows, used for draught and transport.
- ⇨ Household assets: small truck, small tractor, small power tiller, threshing machine, chopping machine, motorbike and cart.
- ⇨ Non-farm activities: government staff (USD 130–150 per month); some farmers rent out their land to grow watermelon for the Chinese export market.
- ⇨ Average annual total income: USD 12,000 *(Figure 40).*

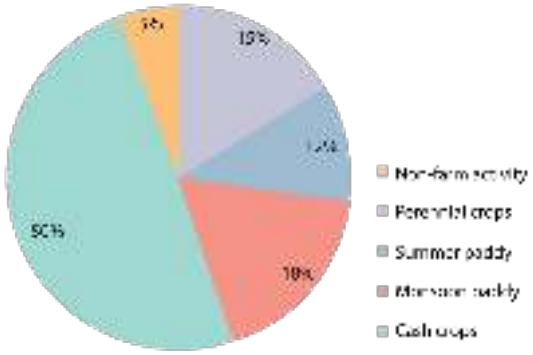


Figure 40: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type A farming systems*

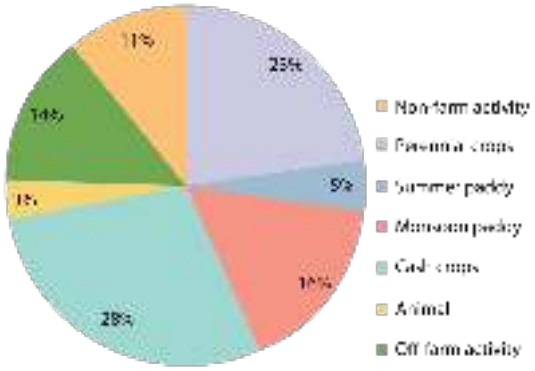


Figure 41: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type B farming systems*

- ⇨ Representation[9] : approximately 5% of farmers

Type B: Large farmers with adequate access to irrigation: two seasons paddy, upland cash crops and perennial crops

- ⇨ Cultivated land size: 25–30 acres.
- ⇨ Cropping systems: approximately ¼ of cultivated land is under irrigation. They grow a single season of paddy and a season of upland cash crops that include winter chickpea, sesame, green gram, or black gram. They can grow other upland and perennial crops (i.e. mango, Eugenia and bananas) in plots located outside the irrigation command area where water is not accessible. In some cases the use of tube wells and/or small water pumps (from the river) are used to irrigate the fields.
- ⇨ Animal rearing: two to four cows, used for draught and transport.
- ⇨ Household assets: small power tiller, chopping machine, threshing machine and motorbike.
- ⇨ Non-farm/off-farm activities: government staff (USD 130–150 per month), rice milling services and rice collecting/selling.
- ⇨ Average annual total income: USD 8,000 *(Figure 41).*
- ⇨ Representation: approximately 15% of farmers.

9. Calculated based on the proportion of farmers in each village as informed by village track leader

Type C: Large farmers with no irrigation: mostly upland cash crops

- ⇨ Cultivated land size: ≥ 30 acres, predominantly found outside the irrigation command area where no irrigation options are available.
- ⇨ Cropping systems: mostly upland cash crops (i.e. sesame, green gram, chickpea, groundnut), but also some rainfed monsoon paddy and perennial crops (*thanaka*, mango).
- ⇨ Animal rearing: two to four cows used for draught and transport.
- ⇨ Household assets: small power tiller, threshing machine, motorbike and cart.
- ⇨ Non-farm activities: carpenter, tailor, government staff.
- ⇨ Average total annual income: USD 5,900 *(Figure 42)*.
- ⇨ Representation: approximately 5% of farmers.

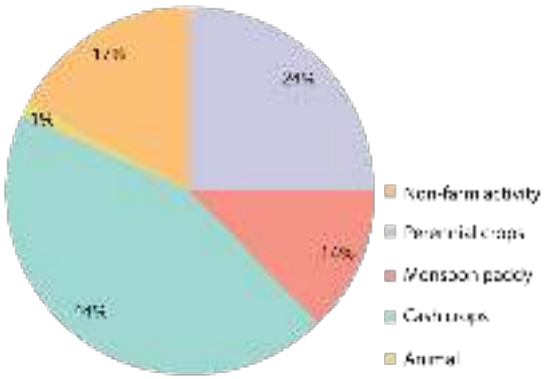


Figure 42: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type C farming systems*

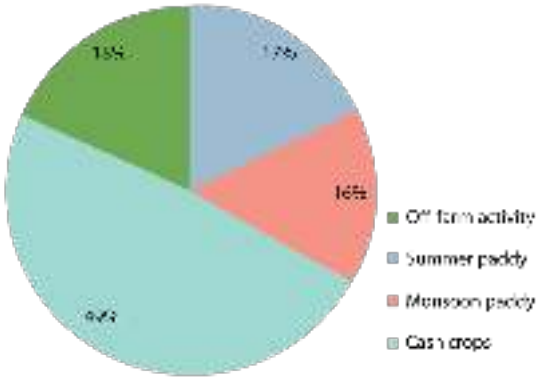


Figure 43: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type D farming systems*

Type D: Medium sized farmers with limited access to irrigation: two seasons paddy and upland cash crops

- ⇨ Cultivated land size: 10–20 acres.
- ⇨ Cropping systems: approximately 12% of the land holdings cultivated land are within the irrigation command area; two seasons paddy in lowlands are cultivated and oil seed and pulse cash crops in upland.
- ⇨ Animal rearing: two to four cows used for draught and transport.
- ⇨ Household assets: small power tiller, cart, motorbike, chopping machine and small trucks.
- ⇨ Non-farm activities: oil pressing, chopping fodder and cracking groundnut services.
- ⇨ Average total annual income: USD 6,000 *(Figure 43)*.
- ⇨ Representation: approximately 15% of farmers within the command area.

Type E: Small farmers with adequate access to irrigation: double season paddy and upland cash crops

- ⇨ Cultivated land size: ≤10 acres.
- ⇨ Cropping systems: approximately 70% of cultivated land is within the irrigation command area with adequate access to water allowing two to three cropping cycles annually, with two seasons of paddy and one season of oil seed and pulses as cash crops in winter.
- ⇨ Animal rearing: three to five large ruminants mainly for agricultural purpose and are sold in emergencies and when the household comes under stress.
- ⇨ Household assets: small power tiller, motorbike and bullock carte.
- ⇨ Off-farm activities: hired labour, veterinary care services.
- ⇨ Average total annual income: USD 4,200 *(Figure 44).*
- ⇨ Representation: approximately 10% of farmers.

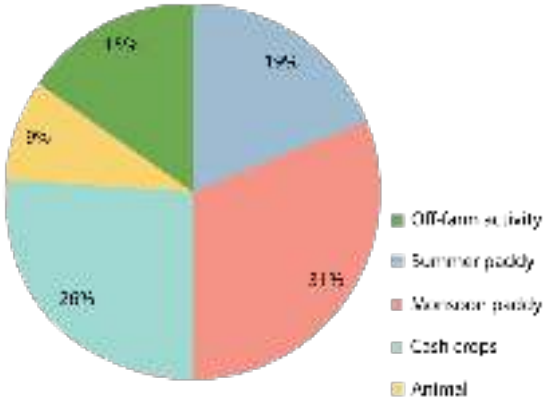


Figure 44: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type E farming systems*

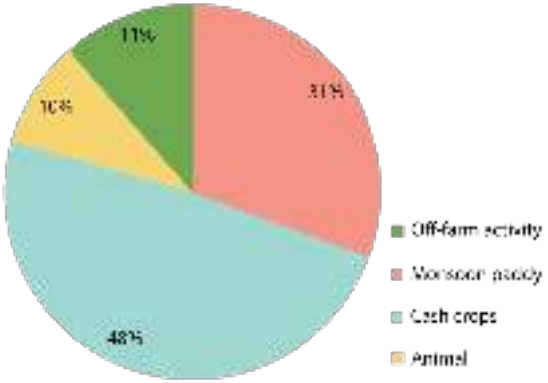


Figure 45: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type F farming systems*

Type F: Medium sized farmers with limited access to irrigation: intercropping and monsoon paddy

- ⇨ Cultivated land size: 10–20 acres.
- ⇨ Cropping systems: approximately ¼ to ⅓ of cultivated land falls within the irrigation command area, however, it is distant from the main canal.
- ⇨ Monsoon paddy and winter cash crops are grown.
- ⇨ Animal rearing: three to five cows.
- ⇨ Household assets: small power tiller, thresher, bullock cart and motorbike.
- ⇨ Off-farm activities: oil pressing and groundnut cracking services.
- ⇨ Average total annual income: USD 3,000 *(Figure 45).*
- ⇨ Representation: approximately 12% of farmers.

Type G: Medium sized farmers with no irrigation and specialised in upland crops

- Cultivated land size: approximately 15–25 acres. These farming systems are typically found in upland areas where water shortage is the main constraint for crop production.
- Cropping systems: specialised in cash crops that include groundnut, sesame and pulses, as well as chickpea, green gram and black gram. In some cases farmers will grow two to three acres of monsoon paddy.
- Animal rearing: four to six cows for draught and sale at times when finance is required.
- Household assets: mostly animal, kart and motorbike.
- Non-farming activities: government staff.
- Average total annual income: USD 4,200 *(Figure 46)*.
- Representation: 10% of farmers.

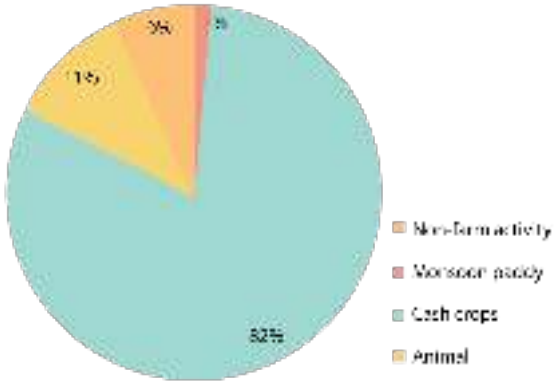


Figure 46: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type G farming systems*

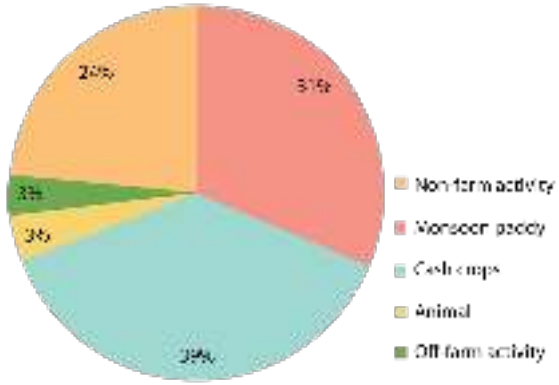


Figure 47: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type H farming systems*

Type H: Small farmers with access to irrigation in monsoon only

- Cultivated land size: ≤10 acres. The majority of farmers falling into this category are found outside the command area and can be found in the midland area (Kan Taw village) where water reservoirs exist for monsoon paddy. Some of these farming systems are also found within the command area but distant from the main canal, where water can only be accessed during the monsoon season. Cash crops are also grown in the monsoon season, based on annual rainfall.
- Animal rearing: large ruminants, with sales of one to two cows annually.
- Household assets: small power tiller, pump, motorbike and bullock kart.
- Non-farm and off-farm activities: government staff, hired labourer.
- Average total annual income: USD 2,000 *(Figure 47)*.
- Representation: 8% of farmers, mostly found in mid-areas.

Type I: **Small farmers with no irrigation**

- ⇨ Cultivated land size: ≤10 acres, found in upland areas.
- ⇨ Crop systems: mainly upland cash crops and some perennials (*thanakar*, *Eugenia*, mango etc.).
- ⇨ Animal rearing: one to two cows.
- ⇨ Household assets: motorbike and chopping machine.
- ⇨ Off-farm activities: Wage labour is mainly for women and threshing services.
- ⇨ Average total annual income: USD 1,100 *(Figure 48).*
- ⇨ Representation: 10% of households, mostly in upland villages.

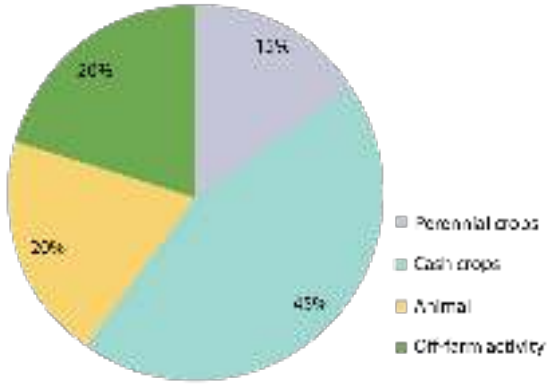


Figure 48: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type I farming systems*

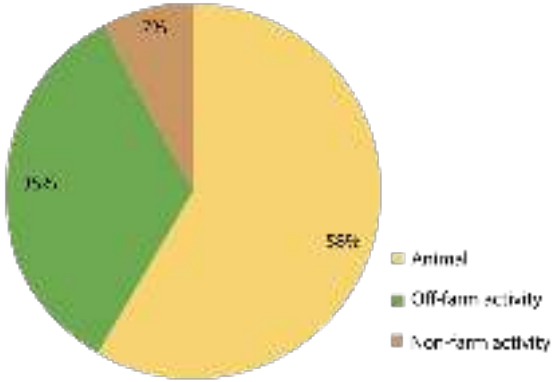


Figure 49: *Estimated contribution of on-farm, non-farm, and off-farm activities to overall household income for Type J farming systems*

Type J: **Landless labourers relying on small livestock**

- ⇨ Cultivated land size: no land, due to land distress sale or did not inherent land from parents.
- ⇨ Main activity is breeding small ruminants (sheep and goats) and pig fattening.
- ⇨ Household assets: motorbike.
- ⇨ Non-farm and non-farm activities: Carpenter, construction worker and hired labour.
- ⇨ Average total annual income: USD 1,800 *(Figure 49).*
- ⇨ Representation: 10%

3

8. Conclusion

Key elements in understanding farmers' strategy

- Small ruminants are reared by farmers that have limited or no land. This strategy is based on rapid returns on investment with limited feed investments as they are dependent on crop residues and are largely based upon a fattening enterprise. These farmers do not require cattle for ploughing and manure production for fertiliser.
- Intensive cropping systems have evolved for those farmers who have limited land resources and for those with adequate access to irrigation that allows for two to three cropping cycles annually. For these intensive farming systems, the outputs from the production system are often sold shortly after harvest, despite lower market prices due to cash flow constraints along with a lack of storage capacity. Consequently these farmers are effectively 'price takers'.
- Contrasting this, less intensive cropping systems are practiced by those with large land holdings and/or those with no access to irrigation. These farmers are effectively compensated for less intensification of their system by using more profitable marketing strategies; they have access to storage and may wait to sell their production outputs when market prices are optimal.
- Perennial crops are grown by the farmers who have large cultivated land holdings, limited labour, but high investment capacity. In the case of mangoes, some farmers collect/harvest and sell them without a middle man, while others have contractual arrangements and sell their mangoes "on the tree". In this case, traders are also responsible for the harvest and post-harvest operations. their land to grow watermelon for the Chinese export market.
- Crop diversification is an option whereby farmers can effectively reduce their exposure to water deficiencies and build a degree of resilience to water deficits. It also allows farmers to spread water and labour requirements more evenly in time to avoid concentrating labour and water needs to short periods of time and prevent acute shortages

Discussion and recommendations

Access to water is one of the key limiting factors affecting farming systems in the Dry Zone of Myanmar. The following discussion and recommendation attempts to address this specific issue.

For areas where irrigation water is accessible throughout the year

Where irrigation water is available for both monsoon paddy, summer paddy, and winter cash crops, water management issues result in water shortages during the cropping season. These issues are largely a consequence from poor management of water distribution from head to tail. Further, some farmers do not respect rules and open water gates whenever they require water which negatively impacts users. There is a need to reform water management regulations and reinforce community leadership to ensure that water distribution and equity is achieved across the irrigation system.

Furthermore, it is important to consider labour shortages during peak times in the cropping calendar. With the majority of farmers growing the same crops in any one season, demand for labour coincided with monsoon and summer paddy. The high labour demands during these seasons for paddy transplanting and harvesting are a significant constraint. Consequently, crop diversification is crucial in order to address labour shortage problems or a shift to less labour intensive production practices through mechanisation (i.e. dry seeding and combine harvesting).

Limited access to credit is an additional factor constraining these farming systems, especially medium and small scale farming systems (type E and F). Due to limited income, it is difficult for these farmers to invest and expand their farming enterprises. Moreover, income is also influenced by selling price. Access to affordable credit would encourage storage, which in turn would increase the farm-gate prices of commodities.

For areas where irrigation water is limited and insufficient for summer paddy

These areas are located further from the pump stations and the main canal. Irrigation water is distributed for two crops a year (monsoon paddy and summer cash crops) with water availability being insufficient for summer paddy cultivation.

Improved access to irrigation water for small and medium-scale farmers (type C and H) would have a significant impact on productivity and would facilitate the growth of crops and allow crop intensification. These farms are limited by the size of the land holdings, however, they have sufficient labour to manage the whole production activity. In cases due to limitation in family labour, some large-scale farmers (i.e. type B) tend to lease out their irrigation lands in the summer.

As in other zones, access to credit is also crucial to increase small and medium farmer household investment capacity to improve their income in the future.

For areas outside the scheme in lowland area and river terraces

Selected farming systems in lowland areas that do not have access to irrigation water are confronted with significant challenges. The majority of farmers have not accessed groundwater through the digging/drilling of tube wells and/or cannot access water from the river. Groundwater levels are often deep and require significant investments in order to access. Consequently these lands are under-utilised with only monsoon rainfed crops. In such areas, small-scale pumping schemes (individual or small producers' groups) would enable increased production and incomes. For example, small-scale groundwater projects in Thailand have provided water for vegetable and fruit production with positive impacts: farmers' income has increased from USD 300–600/ha to USD 600–800/ha (DGWR 2012 in Fue Yang 2018).

One of the main global issues that each farming system has faced is variations in market prices over growing seasons. This has an impact on investment capacity, especially for small and medium-scale farmers due to the limited acreage under crop production. Addressing price fluctuations of key commodities would go some way in addressing this matter.

Furthermore, all farmers in this assessment faced challenges of insufficient access to credit. For example, credit for cash crop lands are approximately 50,000 MMK/acre (about USD 40/acre) and for paddy land approximately 100,000 MMK/acre (about USD 80/acre). Such levels of credit are insufficient to cover the production costs such as labour costs and chemical fertiliser. If formal credit institutions are not accessible to these farmers, village savings and loan funds or village revolving funds should be viewed as an alternative.

3

4

Overall Conclusions And Key Cross-Cutting Findings

1. Comparison between regions
2. Agricultural policies
3. Armed conflicts
4. Farm labour shortages
5. Migration
6. Off farm incomes as a crucial part of local livelihoods
7. Agricultural markets and the influence of China
8. Upland agricultural transition

4 Overall Conclusions and Key Cross-Cutting Findings

1. Comparison between regions

Whilst the six FSA studies that were conducted differed in terms of population, history, topography, agro-ecology, and climate, a common characteristic that links all of the studies is that they have undergone similar trends in agrarian change and transformation. This section attempts to highlight key trends as well as important differences in the farming systems across the studies.

Figure 50 and 51 highlight differences in land holding sizes and farm income (including farm wage labour and livestock breeding and the value of self-consumed products). Although these figures are not statistically representative for each region and need to be treated with caution, they do provide insights into the structure and economic status of these farming systems that are typical to the regions.

Chin is characterised by a somewhat equitable land distribution with farms being of a small uniform size (one to two acres in general per household) with limited variability *(Figure 50)*. This contrasts with Kayin where the land distribution is unequal with land holding sizes varying from 10 to 100 acres. This in part is associated with the dominance of cash crops.

With respect to farm income, Chin has the lowest income among households associated with the farming enterprise whilst Sagaing and the Delta have the highest farm incomes *(Figure 51)*. This is predominantly due to access to water resources that allows for the growing of more than one crop a year and the ability to diversify into high value perennial crops (i.e. mangoes).

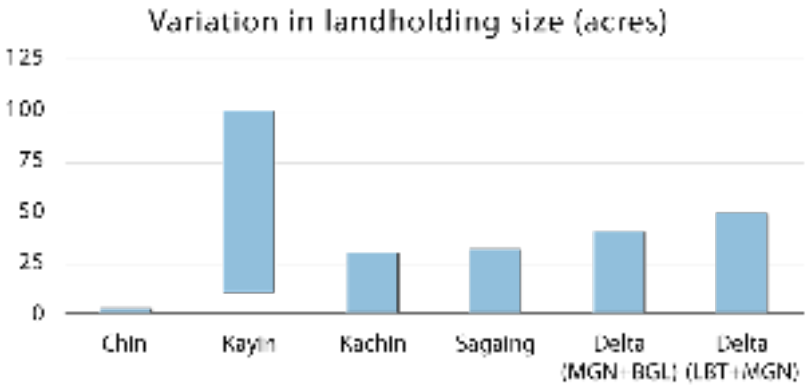


Figure 50: *Minimum and maximum range of farm-holding size as observed in the six FSA studies*

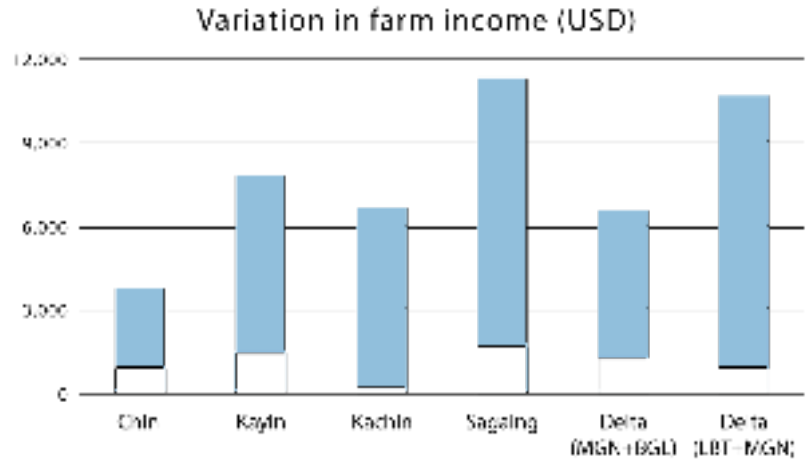


Figure 51: *Minimum and maximum farm income as observed across the six FSA studies*

2. Agricultural policies

A striking feature arising from the cross-analysis of the FSA studies is the resilience of farmers and their production systems despite the numerous inadequate and harmful agricultural policies that have been imposed over the last decades. Myanmar's contemporary agrarian history may be characterised as a history of a farmers' daily plight to adapt to draconian agricultural policies and their ability to navigate and adapt to change. A striking characteristic that pervades all case studies is the number of forceful state interventions on agricultural production that have affected farmers country wide since the 1950s. The requirement to grow specific crops (e.g. cotton or sugarcane in Kachin, paddy in the Delta and the Dry Zone etc.); to turning grazing lands into farmlands (Kachin); converting shifting cultivation areas into paddy terraces (Chin); and the implementation of compulsory procurement quotas (for paddy and pulses) to be sold to the government at prices well below market value was common place, as in many centrally planned economy countries (i.e. the previous Soviet Central Asian States). As highlighted in the Dry Zone and Delta studies, the State was heavily involved in planning agricultural production, particularly during the socialist period. This continued into the 1990s, with the State continuing to impose the production of particular crops by farmers (cotton and castor oil in Kachin, summer paddy in the Delta etc.). In addition, crony capitalism of the 1990s and 2000s led to predatory land policies and land confiscations, as exemplified by the Kachin FSA case study and its account of land concessions to government staff and powerful people who later sold these assets to Chinese companies for the establishment of rubber plantations. The impact of these draconian interventions on the part of the State have contributed to the current impasse affecting smallholder agriculture and endemic rural poverty.

The farming systems analysis case studies do provide several accounts of agriculture "flourishing" when the State loosened its grip on agricultural production and markets as occurred in 1990s. In Kachin, it led to the growth of oilseed crops along with new perennial crops that included bay leaf (*Laurus nobilis*) trees. Paddy production made dramatic progress[10] . Furthermore, it allowed farmers the opportunity to diversify their cropping systems and to shift to lucrative crops (i.e. mango production in the Dry Zone).

These changes mirror such transformations in the agrarian sector as has occurred in other Mekong countries where the States' over-reaching regulatory control over agricultural production has stifled growth in the sector. Cambodia, Laos, Myanmar and Vietnam all suffered the constraints of collectivisation, which when lifted and agricultural production became once more the responsibility of the family farmers, the production of rice per capita along with other commodities started to increase. This does lead to the conclusion that family farmers are not passive food producers trapped in traditionalism and risk-averse attitudes. Once farmers see an opportunity and have the means to respond, they are able to intensify their production *(Diepart and Castellanet, forthcoming)*. This observation holds true for the production of export-oriented commodities *(Byerlee 2014; Bissonnette and Koninck 2017)*

10. According to Theingi Myint. Production increased of 30% between socialist 1974-87 period to the 1988-2010 period.

3. Armed conflicts

Between the 1950s and today, armed conflicts have affected all six regions in which these case studies are drawn from. These conflicts against the State and diverse "coloured rebels" (e.g.: the Red Flag and White Flag communists factions etc...) and ethnic armed organisations (EAO) such as the Karen National Union (KNU, Kayin) and the Kachin Independence Army (KIA, Kachin). Affected villagers within these conflict areas had numerous accounts of being caught in the crossfire between the Myanmar army and insurgent groups, as well as having multiple strategies to escape conflict. Even the Dry Zone, the cradle of Burmese culture and the country's most stable region, was affected by conflict in the decade following independence. Elders of Kan Taw village (Dry Zone FSA) remember their village being burnt to the ground by the Burmese army who suspected them of supporting communists. In Kachin state, a portion of the inhabitants in study villages was made up of internally displaced people who voluntarily or were forcefully settled during the 1961–1994 conflict between the KIA and the *Tatmadaw*. Due to the conflict, farmers that migrated from the Kachin highlands had to adapt their farming systems to lower, warmer, and flatter topographies. In the case of Kayin State, this had an impact on the location of settlements with whole villages relocating to inaccessible areas, retreating from roads to hilltop locations during the conflict between KNU and the Myanmar army. Surprisingly, these destabilising armed conflicts have not prevented farmers from finding innovative ways to access markets, as evidenced by the introduction of coffee, cardamom, and turmeric.

Conflict has also had an impact on land use

changes. In both Kachin State and the Delta, significant deforestation was encouraged to combat insurgent rebels who would strategically use the cover of forests to their benefit.

Conflict and counter insurgency actions have affected these areas, as insecurity, extortion, and forced labour have all contributed to supporting migration. In the case of Chin, the 1990s was characterised by oppression and human rights violations that led to significant numbers of people fleeing to foreign countries. These changes in demographic patterns and labour scarcity has impacted livelihoods and farming systems, including the emergence of remittance dependency and the shift away from labour intensive cropping systems, such as shifting cultivation.

4. Farm labour shortages

A key finding drawn from the review of the six FSA studies is that the majority of farmers studied required external wage labour to support their farm operations. Further labour shortages were viewed as a serious constraint to farming enterprises in all study areas. It is particularly obvious in highly specialised agricultural settings, such as Ayeyarwaddy division, where paddy cultivation labour peaks occur at the same time for all farmers. However, labour shortages are also an important constraint in the Dry Zone or Kachin State, characterised by a variety of crops with different cropping calendars and labour peaks. In some cases, this has resulted in delays in the timing of key agronomic operations that affected crop yields. For example, in brackish areas of Bogale and Mawlamyinegyun, farmers are challenged in ensuring that the summer paddy ripens before seawater intrusions make surface waters too saline for irrigation. Failure to mobilise sufficient labour can lead to yield losses.

Labour shortages are managed by farmers through a range of adaptation strategies and tactics. This has included a shift to less labour-intensive practices, as demonstrated by the widespread transition from transplanting to broadcast sowing of paddy and mechanisation (power tillers, threshers, tractors, reapers, combine harvesters etc.) in the Delta. Other adaptations include the decision to cultivate less acreage and to rent out unused land as documented in Delta and Dry Zone, through diversification towards less labour-demanding crops.

Contrasting this, Yi Jen Lu's FSA in the Delta highlights a paradox of agricultural labour, namely the lack of wage labour opportunities for those who need it (e.g. landless labourers), and the shortage of labour for farmers who need to hire labour. A growing number of landless or land poor family farmers need to allocate part of their time and human resources to wage labour, and are often required to migrate to find additional sources of income. As a result, labour needed for some specific labour-demanding agricultural activities is not available locally and hence demand is not met. This situation has incentivised the mechanisation of agriculture and further reinforced the lack of labour opportunities in rural villages. Thus, mechanisation is the consequence of labour shortage, but also the cause of its aggravation. It has reduced labour wage opportunities that would allow wage labour-dependent households to sustain themselves, forcing them to migrate for job opportunities. Development practitioners may ask why development efforts to address this mismatch have been in vain until recently: is it due to the lack of understanding of labour markets and rural households' labour mobilisation strategies?

5. Migration

Migration is a common feature across all of the FSAs conducted, although the characteristics of migration varies across regions. In Chin, international migration dominates driven by the human rights violations following the 1988 uprisings. Village populations shrunk and the most economically productive migrated to find work and safety abroad. This included seasonal migration to Mizoram and permanent migration to India, Malaysia, the United States, Australia, and other countries, as legal or illegal migrants, or as official refugees. In the Delta, internal migration to other rural areas (e.g. Mon and its rubber plantations), urban towns and upland mining areas (Hpakant), and activity hubs (Muse) are prevalent. In all cases, migration had been, and continues to be, an essential factor shaping Myanmar's agrarian world. Livelihoods of family farmers are now trans-local and deployed over a much larger distance. Remittances become increasingly significant in rural household incomes and in their capacity to invest in farming and non-farm activities.

6. Off farm income as a crucial part of local livelihoods

An important finding in the economic analysis of farming systems and activity systems across all FSAs is that off-farm activities are now n essential part of most rural households' income structure with households dependent exclusively on farming activities now becoming an exception. With the development of transport infrastructure and communication, it has become easier for rural people to grasp job opportunities and to migrate. Increased movement of goods also leads to the development of local services (shops, transport etc.). Locally produced handicrafts also provide better market opportunities (e.g. weaving in Dry Zone and Chin). These off-farm activities are often interlinked with farming, in terms of household investment flows and labour mobilisation strategies.

7. Agricultural markets and the influence of China

All FSAs raised the issue of agricultural markets and documented farmers' vulnerabilities to market price fluctuations. During the monsoon season, Delta farmers have a preference to cultivate local varieties such as Bay Gyar Lay, which has a high demand in domestic markets, thereby resulting in stable prices. In Kachin and the Dry Zone, farmers have adapted to price fluctuation by diversifying their crops to take advantage of price shifts thereby demonstrating their ability to be flexible in deciding on crops on a seasonal basis.

A common element across the FSA studies is the importance of China in Myanmar's agricultural sector. A large part of Myanmar's summer paddy production is for Chinese markets. Even in the remote region of Chin, Chinese stakeholders have played an important role in the introduction of new cash crops, such as elephant foot yams. Kachin is a case in point where the influence of Chinese markets has had a significant impact on influencing the course of agriculture. Since the 1990s, it has shaped Kachin's rural economy and value chains for a wide diversity of crops: The Thai conglomerate Charoen Pokphand Group (CP) have promoted the production of corn, rubber and agarwood plantations and intensive production of vegetables and bananas targeted for export to China. Chinese entities not only operate in the market sphere but also in the production side with Chinese companies operating through technicians and brokers in rented land from farmers at relatively high prices, for intensive banana and vegetable production (Kachin) and watermelon (in Dry Zone). It provides some market opportunities for local farmers, but also raises considerable threats, notably land security and environmental sustainability.

8. Upland agricultural transition

The three FSA studies conducted in the upland regions of Chin, Kachin, and Kayin all document the transition from subsistence based shifting cultivation to cash crop based permanent cultivation systems, and the impacts on land use patterns. This transition is intertwined with social changes (social differentiation, labour shortages, ageing populations), political changes (agricultural policies, land insecurity), and economic changes (monetisation, households' increased monetary needs, emergence of markets, commoditisation of land).

It is interesting to note that this transition has occurred in contrasting ways. In Chin and Kayin, the first shift towards permanent cultivation was through the introduction of paddy terraces promoted by the government with the introduction of cash crops emerging when market opportunities arose. In Kachin, the sense of land insecurity, following the 1990s land confiscation wave, was a key factor that led farmers to establish tree plantations.

Furthermore, there are different levels of "specialisation" of crops under the "new" systems. In Kayin, the development of cash crops was characterised by a high level of specialisation and mono-crop systems, with the 1980–1990s cardamom boom along with the 2010 turmeric boom. In contrast, in Kachin and Chin a wide range of cash crops (perennials and non-perennials) was introduced, including polyculture agroforestry systems. These changes have not been without impacts on producers as they become dependent on market fluctuations with its associated risks.

A similar pattern of gradual substitution of shifting cultivation to permanent cultivation across the three regions has occurred with plots cultivated for a single year using "*taungyar*" crops which are then established to permanent crops (i.e. cardamom in Kayin; a variety of spices, fruit and timber trees in Kachin; and elephant

foot yam in Chin). As a result, fallow areas for shifting cultivation have declined. This has led to decreased yields for those farmers who continue shifting cultivation. In addition, as available pasture areas have also decreased, the shift often creates issues with livestock management, as regulations and livestock rearing practices do not always adapt to these changes.

These changes are often coupled with a shift from communal to individual land tenure along with different levels of recognition of land rights: from the issuing of land use certificates *(Form 7)* on paddy terraces to a total lack of recognition of rights on lands that are still considered under vacant, fallow and virgin lands or Public Forest Estate. Community forestry remains marginal and seems to require systematic NGO support in order to withstand constraints and red tape from the Forest Department (e.g. Kachin).

The shift to individual land tenure brings into focus social inequity around land access. Land appropriation dynamics can lead to differences between farmers, with those who have embraced the commercial rationale more quickly, compared to those with more family labour or higher investment capacities. The Kayin FSA is particularly compelling in this respect with the account of how, within only 20–30 years, a relatively equitable society composed of shifting cultivators evolved into a more stratified farming structure. This stratification ranges from very small farmers to large commercial growers cultivating over 50 acres.

Finally, the upland agricultural transition creates significant changes in peoples' diets (less self-consumption and a greater dependence in the purchase of food products). For example, the Chin FSA presented the implications of transformations in the agrarian system on the diversity of food available to rural households. The decreased diversity of cereals and legumes, and reduced consumption of millets, tubers and pulses – such as sweet potato, taro, pumpkin, sulphur bean, and cowpea – is the result of the simplification of shifting cultivation systems. While Chin farming systems tend to combine both subsistence crops (paddy, corn etc.) with cash crops, the Kayin and Kachin farming systems tended to evolve towards exclusively market / cash crop. This is particularly explicit in the Kayin FSA where food production has almost totally disappeared and where paddy terraces are abandoned due to higher opportunity costs for labourer in cardamom plantations and the difficulty in raising buffalo due to the lack of pastures. This also increases vulnerabilities at the household level with increases in food prices and / or cash crop price declining.

The six case studies provide a rich, although not exhaustive, description of the drivers of farming systems changes that occur across the agro-ecological zones of Myanmar through the lens of a farming systems analysis. The cases described in this manuscript provides a "flavour" of these systems and the transformations they have undertaken over the past several decades. We encourage you to review the remaining three case studies (available upon request). What is clear from the analysis is that the agrarian sector in Myanmar is undergoing a dramatic transformation, the speed at which these changes are occurring has not been experienced in the past. This brings with it greater opportunities along with risks that will need to be managed.

These case studies demonstrate the value of adopting a farming systems analysis approach that complements the guidebook that has been developed as resources for development practitioners, agronomists and students. Annex 1 and 2 provide a synopsis of comments and perspectives that those involved in the six case studies have made and the reader is encouraged to review.

Annexes

Annex 1. Reflections of users on the FSA approach
i) How useful is the farming systems analysis approach for development?
ii) Limitations and challenges for future use of the approach
Annex 2. Feedback from the FSA researchers

Annex 1: Reflections of users on the FSA approach

1. How useful is the farming systems analysis approach for development?

Through the experience of the six implementing partners, we observed that the work process organized around the farming systems analysis (FSA) is particularly useful and instrumental for development practitioners, particularly those involved in agricultural development. We identified six main areas where the approach was deemed to be helpful:

1.1 Understanding the bigger picture (seeing the forest for the trees)

In a complex world, the FSA approach helps establish linkages between a large variety of elements and processes that influence family farms. By doing so, it helps draw a more holistic and rich picture of the context in which development practitioners' work. Deciphering complexity was useful, even in the context of a project working on a particular agricultural development issue, such as the access to water:

> *FSA has been very useful to understand the complexity in the cropping systems in function of water availability. The linkage of farmer typologies, farm size, crop intensification with water access was really interesting and insightful. (Petra- Schmitter- IWMI).*

Identifying underlying trends and the general context in which farmers evolve is key to link local action and policies, in particular when it comes to ensuring sustainability of development actions.

> *The FSA process helps identify the policy and governmental context to our work, which is useful for planning and sustainability. Our project has to work hard in its final year to be sustainable and will need to link up with government. Having this general overview of the agrarian system helps us to understand the present sustainability context and its underlying trends, so we are well informed when we have those conversations with relevant local government departments. The report also helps make the connection between our fieldwork and policy, which I find useful (Alex Fenwick. MIID)*

1.2 Support the design and evaluation of development projects

FSA is useful at different stages of the project cycle, from the identification to impact assessment phases. The agrarian diagnostic is useful at the inception of the project because it helps provide the project components with a sound understanding of the actors and the landscape in which the project operates. In fact, funding and time constraints often lead NGOs to formulate projects without in-depth understanding of their project areas. In some cases, this may lead to overlooking the context and challenges, thereby misunderstanding the multiplicity of strategies deployed by rural communities in their livelihoods. In addition, it leads to inappropriate standardised approaches, which sometimes fail to address farmers' needs. In this regard, the farming systems analysis is very helpful in defining meaningful and relevant project objectives that carefully take into account the interest and knowledge of local communities.

The farming systems analysis is also useful for monitoring and evaluation. It can help to draw a baseline against which mid-term review, final evaluations, and impact assessments can be conducted. It helps reflect on the project development, and adjust project approaches and actions accordingly:

> *One thing my project lacked when I joined was a singular, empirical baseline. Instead the baseline was spread across many qualitative reports. I'm working on consolidating a baseline from these and the FSA is a component of this. (Alex Fenwick. MIID)*

The FSA process is particularly useful when working in post-conflict context as well:

> *The FSA has provided a useful overall context of the region based on primary research. Our project region has been characterized by armed conflict for decades, and this has shaped everything from individual attitudes to the locations of villages. As a foreign advisor, having a reliable "big picture" view based on interviews with locals is a great asset to understanding how to work in this sensitive area. (Quote from Jose Molina, CDN)*

1.3 Historicize the changes in the local agrarian system

A strong contribution of the farming system approach is to embed the analysis of current practices in the deeper history of the agrarian system. This helps identify the continuous patterns and persistent issues, as well as particular and unusual events. As a representative of one partner organization explained:

> *The most useful element of the FSA has been the detailed treatment of the evolution of farming systems in the region. This information is not readily available elsewhere, and has provided extremely valuable context to help inform programming decisions. (Jose Molina, CDN)*

The review of agrarian history allows researchers to identify profound trends in agricultural development of the region, which are not necessarily obvious to detect. This is particularly important to consider for development practitioners, as it may lead to project re-orientation:

> *Recently, our project team has been debating whether or not to include the promotion of vegetables for value chain development. The FSA has provided strong evidence that farming trends in the region have been moving toward cash crops, and away from vegetable production, for many decades. This is because of the high labour requirements and low profitability of vegetable production. In our project region, reliable data is very scarce but the clear qualitative trends shown by the historical analysis have proved to be a useful proxy, showing conclusively that moving away from vegetable production has been a long-term trend, implicitly showing that cash crops are more profitable and desirable for local farmers, and that targeting these for Value chain development is more appropriate. (Jose Molina, CDN)*

1.4 Place 'differences' at the centre of the analysis

While it is tempting to see uniformity and homogeneity in rural landscapes and livelihoods, the farming systems analysis puts 'differences' and differentiation processes at the centre of the analysis. The approach values the variety of skills and interests amongst fellow farmers, the diversity of agro-ecology conditions, the differences between categories of farming systems, the contrasts between cropping and livestock rearing techniques, etc.

Farming system analyses recognize that differences between farming systems are historically produced. In other words, the FSA begins with a key hypothesis that the diversity of farming systems observed today is partly a legacy of the past. The farming systems analysis offers tools to identify and understand the differentiation process that has produced key differences.

The weight of the past, combined with the different constraints and opportunities of the present and the interests of farmers, explain the variety of farming systems visible today. This variety is captured in a farming system typology (classification), which translates not only in different landholding sizes (or herd sizes) but also in different rationales and technical management of cropping and livestock rearing systems.

The farming system typology allows development practitioners to formulate recommendations adapted to different farming systems, which may contribute to a better design and targeting of development actions. It also allows development practitioners to formulate recommendations that are specific to the nature and the technicality of farming systems. This approach professionalizes the discussion and goes beyond the classic *sustainable livelihood* approach, which poses the discussion in terms of relative availability of different forms of capital (or lack thereof).

> *"Banning shifting cultivation practices and promoting permanent farming systems have been the official messages relayed in the last decades by both political leaders and development organizations due to the environmental effects of shifting practices (deforestation, soil erosion and landslide occurrence, increased dried water source in summer season, reduction of biodiversity...). Development strategy and interventions have thus been strongly supporting the development of permanent field/systems regardless of the categories of households that would be favoured or disadvantaged through this strategy.*

By providing a better picture of the situation in terms of household typology and of the historical evolution of those systems, the FSA is contributing to a better understanding of the target groups and their means of production that could be further integrated into the design of development projects and strategy. For instance, it is worth noting that vulnerable families primarily rely on the shifting cultivation systems that are less capital and input demanding (except labour) and targeting them requires other strategy than the development of permanent farming systems." (Murielle Morrisson, Gret)

1.5 Centre labour allocation strategies in agricultural development

The question of labour is at the core of the farming system approach. A detailed examination of family labour allocation strategies, and how these strategies evolve along the life cycle, is important to understand the interest and readiness of certain categories of farmers for certain types of farm or non-farm activities. The FSA requires practitioners to look at labour management in a holistic way, and not consider farming activities in isolation from non-farm activities. Of particular importance is the management of labour peak periods and the growing availability of non-farm work opportunities that compete with work on the farm. In the Dry zone, one of the partner organizations stated:

It was interesting to find that labour is one of the main constraints in the scheme and that access to water is not necessarily always the main driver behind crop choice. Given the introduction of new crops by WHH the information on labour shortage and water access is extremely helpful because it will guide the decision in suitable crops beyond the normal biophysical aspects. There is a need to transfer this information to DOA as well because focus remains so far on rice and pulses...(Petra-Schmitter- IWMI).

1.6 Seek a middle way between technical support and activism

The farming systems analysis is beneficial in articulating a discussion about support to family farmers, particularly in reconciling competing approaches between technical support NGOS and activist groups. The farming systems analysis approach has created a space for dialogue, particularly welcoming people to discuss the future of shifting cultivation:

.... "I do find the report useful, and refer to it often, as a comprehensive overview of the farming system. It is especially good to explain climate change in a way that does not put the blame on farmers - especially rare when discussing shifting cultivation. I think there is a potentially useful conversation to be held around shifting; between (broadly) technical NGOs and activist CSOs. Sometimes there are competing priorities regarding farmers' rights. (Alex Fenwick. MIID)

2. Limitations and challenges for future use of the approach

Throughout the process, however, the coordination team and partner organizations have also identified limits to the FSA approach and to the manner in which it has been implemented.

2.1 Look at historical continuity

The second part of the FSA process (agrarian history) inevitably leads to identifying distinct periods that reflect particular moments of national and local history. However, it is important to look at the transition between these periods:

..."The phases the history moves through, from pre-colonial to contemporary, are categories of human history - and therefore quite arbitrary from an environmental point of view. Good to emphasise there was no sudden and neat movement from one ecological phase to the next" (Alex Fenwick. MIID)

2.2 Bring non-farm issues into the farming systems analysis

The farming system approach has a strong focus on agricultural activities. Even if labour management is theoretically addressed in a holistic manner, the implementation of the farming systems analysis by the book often leads to neglecting the off-farm activities. This can be problematic given the importance of these activities for farmers.

With the advance of agrarian transformation and the urban transition, the question of non–farmers cannot be excluded. What is particularly important is to understand the linkages between

farm and non-farm activities, both in terms of labour allocation strategies and interaction in income formation mechanisms.

This problem has been partly addressed in the guidebook, where these non-farm activities are discussed and taken into account. However, the issue needs to be brought to the attention of researchers and development practitioners involved in the FSA process and integrated into their methodology.

2.3 Go beyond agro-ecological and economic factors

Farming systems analysis integrates a large number of parameters, but the parameters of farmers' decision-making that are not strictly economic or agro-ecological, are not always factored in, or are not necessarily easy to integrate within farming system models. This is problematic because these factors can be extremely important in explaining farmers' rationales and decision-making processes. These can include:

- ⇨ The political economic forces that include or exclude certain groups in accessing land and natural resources;
- ⇨ The elements that determine the security (or lack thereof) of land tenure that might be key in explaining the level of investment farmers make in their land;
- ⇨ The ideological or socio-cultural constraints related to taboo, generational, or gender differences that limit certain people in doing certain things in certain ways.

In fact, the farming systems analysis approach does not exclude these parameters *a priori* but they are not necessarily explicit in the "standard" FSA approach. The person who conducts the analysis needs to keep them in mind throughout the process and to craft his/her own analytical tools. It is crucial to avoid drawing conclusions that are a representation of the real world.

The issue appeared several times in the process and is echoed clearly by one of the partner organizations:

> *The thesis covered as much as possible the different types of cropping systems and discussed the issues of labour etc. However, when looking at an irrigation scheme the crop choices are also influenced by reliability of water access and challenges with infrastructure and overall management of the scheme by IWUMD and fellow institutions (DoA). Whilst the quota on rice and pulses has been stopped, the focus in the area on rice and pulses influences as well farmers' choices as information to seed, fertilizer etc. is biased. A bit more in-depth analysis on the political and governmental influence on crop system and choices would be really helpful and interesting as it will help to define suitable cropping system alternatives for the area". Petra-Schmitter- IWMI*

2.4 Bridge the gap between diagnosis and recommendations

One of the main limitations of the FSA approach is that it does not necessarily lead to operational recommendations. The methodology potentially provides the space to do this, but it is not always easy for the researchers (particularly for juniors) to do it, as it greatly depends on their personal capacities and prior practical experience.

2.5 Need to triangulate the information

An important part of the FSA process (agrarian history, identification of differentiation processes between farming systems) essentially relies on testimony from elders and local resource people. Since they might re-construct the history as they please, it is important to crosscheck their accuracy with other resource people and triangulate information with secondary sources where possible. This issue was addressed by two partner organizations:

> *Because the approach relies much on oral testimonies, there is a risk that nostalgia skews results (research team confirmed interviewees seemed very nostalgic). There is no doubt that report's description of the past is accurate, but some aspects might have potentially been overemphasised. It is regrettable if false impression of historic food/nutrition security or agro-ecological history is given because of nostalgia. I think this is a classic tendency in anthropology, but also something that can often be balanced or verified with quantitative analysis, and it would be good to explore this (Alex Fenwick. MIID)*

In our project, we also made village profiles, including production and consumption datasets for our project villages, and these underpin project planning as well as work planning on an operational level - for example they are available to our community facilitators for seeing what crops are most relevant in our field schools in monthly planning sessions. These are mini farm systems analyses, and after a full year of monthly analysis they will make a good body of knowledge that can be held under the more general umbrella of the FSA - to add meaning and context to the datasets.(Alex Fenwick. MIID)

2.6 Make better use of local knowledge

A further important observation made by a partner organization relates to the fact that researchers are sometimes tempted to work on their own, without significant interaction with local resource people. This is partly due the FSA methodology is structured and might give the impression that researchers may work independently. This can be problematic sometimes if the researcher works in a remote area with difficult access:

I feel that one of the main limitations of the study has been practical and related to access for the researcher. Due to difficulties with travel authorizations, the researcher lost a tremendous amount of research time and information as a result. In the future, I feel that very strong local resource people should work alongside the researcher, so future studies are not paralyzed by these access issues, and high quality research can still be undertaken. Jose Molina, CDN

2.7 High requirements in terms of time and skills

The full-fledged farming systems analysis is a relatively lengthy process. The classical FSA approach, as conducted individually by university scholars often take 5 to 6 months with intensive field-work (4-5 months) and sufficient time (1 to 2 months) for data processing, analysis, and report writing. This is of course a relatively lengthy and costly process. Despite these limitations, the FSA approach is flexible. Thus, the methodology can be tailored for a less comprehensive research approach and specifically focus on research and/or development questions. The researcher's ability to adapt the FSA methodology to one's specific needs, questions and means (in terms of resources and item) is also essential.

Given the holistic and multidisciplinary approach of the FSA, it requires researchers with sufficient skill sets in various disciplines, adequate knowledge in different fields of interest (e.g. history, soil science, socio-anthropology, agro-economics) as well as suitable behaviour to conduct field work in an unassuming manner and engage in real dialogue with farmers.

To cope with these various issues, it is also possible to "hybridize" the FSA approach with rapid appraisals and methodologies, such as participatory rural appraisals (PRA). The output would of course be very different, and it would not be as detailed and comprehensive as a 'classical' FSA report. For example, it is extremely relevant, both in terms of the expected "assessment" output and in terms of the learning opportunities for project teams, to conduct a rapid "FSA" following the same methodological sequence (landscape analysis, history analysis, analysis of cropping systems and livestock systems and activity systems, analysis and comparison of farming systems) using participatory tools and regular validation processes with the community.

Annex 2: Feedback from the FSA researchers

Learning FSA approach will be very useful for my career because I learned so many things about farmers. I am now conducting research in Ayeyarwaddy on farmers' adoption of good agricultural practices (GAP) practices. FSA approach has made this very easy for me. I can now engage discussions with farmers effectively and I have a better understanding of farmers' challenges, and the reasoning behind the decisions they take.

— Mya Darli Thant

I got from this FSA valuable knowledge on Myanmar and local agricultural issues. This is useful now that I work in rural development for an NGO here. Conducting FSA also enabled me to improve my communication as well as reasoning skills during the field work. Making sure that we (farmers and me) have a clear and (as much as possible) unbiased understanding of what the other is saying."

The most important thing I learned from all my FSAs is the resilience and adaptability of family farms to the contextual changes (political, economical or social...).

— Clarisse Frissard

I learned that being humble in front of the unknown is the best way to understand it. It is also important to take the time to share casual moments of life with the people aside of work. Surprisingly, sharing something that is not related to the study can also lead to understanding things from another angle. I learned to recognize those appropriate moments and to let them happen during the study.

I also learned that getting a sense of how hard farm work is was probably the best way to understand the changes that occurs throughout the local history.

— Simon Ayvayan

Personally, FSA gave me a glimpse into the development sector and inspired me to work for development. Now I am working in a donor organisation that is supporting agricultural projects. I will use FSA approach as a comprehensive framework that provides information for the sake of monitoring and evaluation.

I also learned that farmers are those who care most about the land and the environment, not only under its economic aspects but also in terms of sustainability.

— Yi Jen Lu

Personally, farming system analysis gave me valuable experiences, especially working closely with farmers, and discussing with farmers to understand what they are doing, what their constraints are.... I have learned that farmers have their own strategies to deal with the risks that may affected the stability of their households.

FSA approach is a simple tool that I use for identifying the roots causes of some issues faced by farming systems. I also use for teaching the students in university.

— Fue Yang

Apart from the valuable qualitative and quantitative research methods learned in this study that will certainly help me in my future career as a researcher, completing the FSA cultivates curiosity and creativity. Gathering stories from farmers about the past and present, and listening to their dreams and anxieties about the future, allowed me to gain a nuanced perspective and appreciation of the life of smallholder farmers and the knowledge they hold about the environment they live in and depend on. This methodology is pivotal to apply to any development project to ensure that the project is listening to and fitting the needs of the people who it is trying to help. Farmers hold expert knowledge about how to manage and rejuvenate their local environment, and it was an honour to learn from them.

— Alyssa Pritts

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