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People's Dependence on Forests and their Participation in Forest Conservation in Myanmar

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Abstract

Involvement of local communities in forest conservation has been recognized as a key strategy employed worldwide in the conservation of natural resources and development. However, the efficacy of participatory forest management (PFM) with the involvement of local communities in achieving ecological and socioeconomic goals is highly different; a significant factor preventing their success is a lack of consideration and understanding of related social systems. This is particularly true for PFM in Myanmar; where the information regarding the perceptions and potential responses of local communities to the participatory conservation programs is neither available nor used in the forest management planning process. Despite a large recognitions of the critical role of local communities in meeting the goal of conservation, and the need to better understand and incorporate socioeconomic factors into the forest management, socioeconomic factors and perceptions of local communities continue to be treated as inferior to the ecological factors. Given the ongoing expansion of reforestation and forest conservation with the involvement of local communities globally, there is a pressing need to better understand and incorporate socioeconomic factors into the design and management of forests.

The overarching goal of this research is to improve our understanding of livelihood dependency on NTFPs, and socio-economic factors related to participatory forest management, and to provide guidance on how this knowledge can be incorporated into forest conservation and reducing deforestation and forest degradation. Focusing on Taungoo District, Myanmar, three research objectives was set out to achieve this goal, which address the knowledge gap related to the problem statement in the study areas focusing on dependency on NTFPs and how the perceptions and potential responses of forest-dependent communities on government incentive schemes are related to the participatory

conservation program. The three objectives are to: 1) examine factors determining local communities' dependence on NTFPs and how these can be cooperated into policy implications, 2) observe perceptions of forest-dependent communities toward participation in forest conservation, and 3) investigate which policy instruments would be necessary to motivate their participation.

The first objective seeks to provide understanding of the interaction between ecological system and social system by exploring the underlying forces of overexploitation of non-timber forest products (NTFPs), particularly in relation to local communities' dependency on NTFPs. This objective was addressed by examining factors determining local communities' dependency on NTFPs and their contribution to households' income. The findings highlighted the significance of households' poverty, food insecurity, fuelwood usage, land ownership, and education to NTFPs dependence.

The second objective seeks to contribute to our limited understanding of the factors affecting local communities' perception associated with forest resources use and participation in forest conservation. This objective was addressed by examining how local communities perceive government programs. The research pointed out which factors need to be considered most to have higher participation in different geographical areas.

The third objective seeks to support the limited understanding on how the governance system could contribute between social and ecological system to achieve win-win situation. The research aims to fill the gap of knowledge on the government intervention that could motivate local communities' participation in forest conservation programs. An interdisciplinary approach was conducted drawing from literature on human behavior and motivations to incentive mechanisms. The research proved the suggestive evidence that participation of local communities can be different according to their preferences on incentives related with the socioeconomic characteristics.

This thesis highlights that better understanding of the interaction between the social, ecological and governance systems, and incorporation of socioeconomic considerations in design and management of forests will help ensure this conservation contributes to the well-being of local communities in long-term. In addition, it provides the key messages that incentives need to be thoughtfully designed using good scientific information about the targeted population. To increase participation of local communities in the forest conservation programs, Government needs to find a way how to interact with local communities by understanding how they are interacting with their surrounding forests.

Keyword : communities; forest dependency, participation; incentives; conservation; Myanmar
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This is for you, Mom and Dad.
Thanks for always being there for me.

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Chapter 1. Introduction

1.1. Significance of the Study

Being complex ecosystems that are related to many species on our planet, forests play many crucial roles, not only in mitigating climate change by acting as the greatest terrestrial carbon sinks (Bonan, 2008; Houghton, 2002; Pan et al., 2011) and as participants in the carbon exchange between the atmosphere and the land surface (Hendrikson, 1990). As well as they are a home for biodiversity and act as resource banks for humanity by providing numerous ranges of goods and services (Godoy, Lubowski, & Markandya, 2013; Secretariat of the Convention on Biological Diversity, 2001).

Since prehistoric times, millions of people from different cultures and livelihood systems living in or adjacent to tropical forests have been dependent on the direct goods and services provided by forests but not having much in common (Isager, Theilade, & Thomsen, 2002a). Traditional forest users lack secure property rights, and those property rights should be secured both on paper and in practice to achieve sustainability in forest management (Kanninen et al., 2007). In many tropical countries, because of different types of forest use and no secure land tenure systems, the debates among government and environmental conservation organizations and social and human rights organizations and the conflicts between government and forest-dependent people have been sparking due to plans for the development of a "green economy" (Meijaard et al., 2013).

Unsustainable practices and policies at multiple scales, from global to local, continue to threaten forests and people who are dependent upon them. They have impacts on the forests that can be local, such as overexploitation of forest products to meet the local

and global demand, and global, as in the wood and agricultural products trade associated with changing consumption patterns in the developed countries. Forest resources extraction can drive up local economic development (Sayer et al., 2012), but environmental degradation can, in turn, get worse because of modern economic growth proven by the environmental Kuznets curve (Shafik, 1994). Several studies have investigated that most tropical forests in developing countries have been facing deforestation and forest degradation by a mixture of socio-economic factors (Angelsen & Kaimowitz, 1999; Boucher et al., 2011; Geist & Lambin, 2002; Kissinger, Almeida, & Coello, 2006; MEA, 2005; Weatherley-Singh & Gupta, 2015).

Forest degradation is a global phenomenon and has become a serious social, environmental, and economic problem [4]. This global problem calls for a comprehensive set of actions to address its drivers. According to Decision 1/CP.16, para 72, Cancun agreements (UNFCCC, 2011), UNFCCC (the United Nations Framework Convention on Climate Change) requests that the developing countries participating in the UN-REDD program (United Nations collaborative initiative on Reducing Emissions from Deforestation and forest Degradation) develop and implement national strategies or action plans. The intention is to address the safeguards where "ensuring the full and effective participation of relevant stakeholders, inter alia, indigenous peoples and local communities in REDD+" is one of them. Moreover, these Cancun Agreements encourage the developing countries parties to undertake REDD+ by taking the needs for sustainable livelihoods of local communities into account while incentivizing the protection and conservation of natural forests and their ecosystem services (UNFCCC, Decision 1/CP.16, Appendix I, 2011). Being one of the countries implementing REDD+, Myanmar is contributing to green development by protecting environmental resources, promoting reforestation and forest restoration, improving livelihoods of forest-dependent communities, and raising awareness and

adaptation to climate change. The Government of Myanmar was designated to increase the national permanent forest estate (PFE) by increasing reserved forest (RF) and protected public forest (PPF) to 30% and protected area systems (PAS) to 10% of the total national land area by 2030 (Myanmar INDC, 2015). Each district in Myanmar produces a 10-year forest management plan to meet the overall goals, including decreasing the rate of deforestation and preserving natural forest cover to maintain biodiversity and ecosystems. Meanwhile, Myanmar is implementing the rehabilitation and restoration of degraded land and reserved forest through community participation to not only mitigate climate change but also for the socio-economic development of local communities.

Participatory forest conservation is a management strategy that strengthens the involvement of local communities into forest conservation and has the capacity to reach sustainability in forest management. Local communities' participation in government forest conservation programs is critical to the success of sustainable forest management in Myanmar, where many people are heavily dependent on forest products for their livelihoods. The forest conservation projects without local communities' participation and without considering the alternative to forest resources or compensation for forest-dependent people will not be effective and may fail.

While REDD+ goes beyond deforestation and forest degradation and includes the roles of conservation, sustainable management of forests and enhancement of forest carbon stocks, in the ongoing stage to achieve its goals, the understanding of forest-dependent communities' perceptions of forest conservation, their awareness of a changing forest environment and how their livelihoods are interconnecting with the forests are essential to meet the targeted actions. There are relatively few studies on perceptions of local communities related with protected area management, plantations and community forestry, and people participation in forest

management in Myanmar (H. Aung, Roachanakanan, Sucharitakul, & Pumijumnong, 2010; N. Z. Htun, Mizoue, & Yoshida, 2012; Maung & Yamamoto, 2008; Soe & Yeo-Chang, 2019), and the contribution of forests to rural livelihoods (P. S. Aung, Adam, Pretzsch, & Peters, 2015; Hlaing, Kamiyama, & Saito, 2017; Moe & Liu, 2016; Toe & Kanzaki, 2017). However, the studies on the possibility of local communities' participation taking into account the potential government incentive schemes are still limiting. This study, therefore, estimates local communities' perceptions on participation in forest conservation, and investigates potential policies and measures through examining their livelihood dependency on non-timber forest products as a case study in Myanmar.

1.2. Problem Statement

Myanmar is a country with 44.2% forested land and stands as the country with the third highest annual net loss of forest area within 2010-2015 (FAO, 2016). In the early 1990s, Myanmar's forest cover was approximately 57.9% of the total land area, being one of the most forested tropical countries in mainland South-East Asia, but it declined to 51.5% in the early 2000s and 44.2% in 2015 (See figure 1.1) (FAO, 2015). With an increasing population, the increased demand for timber and forest products, both locally and globally, has been putting pressure on Myanmar forests. Subsistence needs of local people and commercial interests of local and non-local people continue to motivate extraction of forest resources (Myint Aung, 2007). Approximately 70% of country population live in rural areas depending on forest resources and this makes the rehabilitation of the country's forests and conservation of forest ecosystems an important matter for the livelihoods of forest-dependent communities, as well as a challenging one.

In accordance with the forest policy imperatives in Myanmar, people's participation in forestry activities has been promoting by

implementing community plantations, and conservation programs through raising public awareness to provide basic needs for the local communities from the forest. However, not all participatory forest conservation programs are succeed due to the absence of the long-term development program for local people (Maung & Yamamoto, 2008) while protecting and conserving the forests, thus their encroachment to the reserved forests have been a big challenge to deal with sustainable forest management in Myanmar.

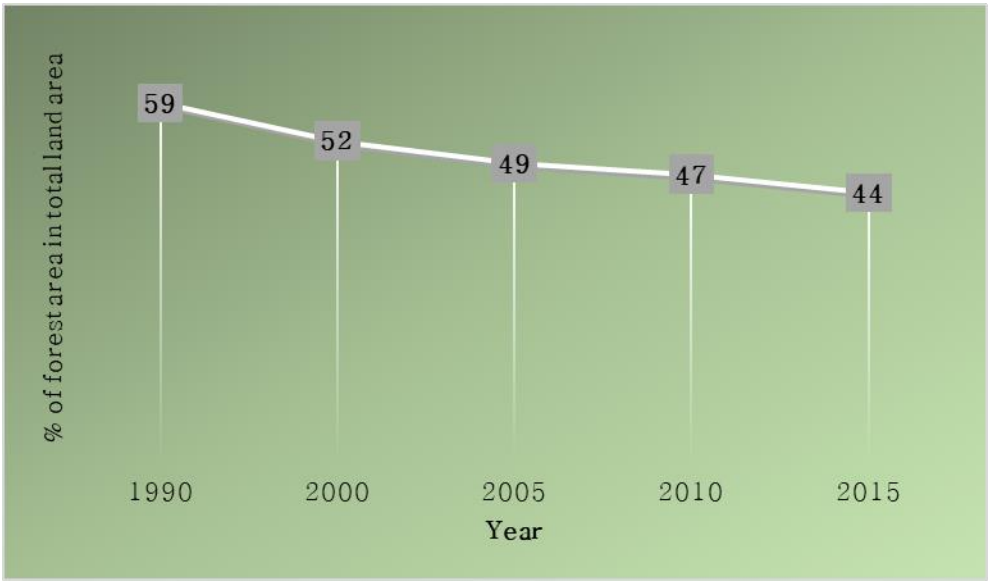


Figure 1.1 Trend of forest cover area in Myanmar, (1990-2015)

Source: (FAO, 2016)

The increasing deforestation and forest degradation rate reveals the depleting forest and forest products. The study area in Bago Mountain Ranges is famous for Myanmar teak and has been managed especially for timber and non-timber forest products production (Forest Department of Myanmar, 2015). Mon, Kajisa, Mizoue, & Yoshida, (2010) reported that forest degradation was much severe than deforestation in some reserved forests in Bago mountain area within 1989-2006. They postulated that those reserved forests are adjacent to the communities' settlements and are susceptible to fuelwood collection and encroachment by

surrounding communities. Moreover, the study area has the tendency of more forest degradation in the future due to increasing fuelwood demand (Win, Mizoue, Ota, Kajisa, & Yoshida, 2018). Combined with those activities, the forests have been depleted and degraded due to illegal logging, overexploitation of forest resources, and shifting cultivation, agriculture expansion, mining, hydro power and infrastructure establishments (Kissinger, San, Arnold, Mon, & Min, 2017).

Myanmar joined UN-REDD program in 2011 and the REDD+ readiness roadmap was approved by the Government of Myanmar in 2013. Reducing deforestation or forest degradation, promoting the sustainable management of forests, the conservation of existing forests and the establishments of new forests are the main activities to mitigate climate change and remove greenhouse gases under the REDD+ mechanism. While Myanmar is on its way of adapting this mechanism, it is important to understand the underlying causes of deforestation and forest degradation to have effective participation of local people in forest conservation programs. As well as the information on how local people perceive government' s forest conservation programs, and their perceptions on participation are essential to have a long-term management.

Although there is the strong forest policy, governmental institutions, and management systems, inadequate information and planning is still one of the constraints to enhance the contribution of the forestry sector toward socioeconomic development of Myanmar in a sustainable manner. It is important that decision makers possess sufficient information on the local communities to guide the implementation of policy for future forest management. It is necessary to consider the information on the interactions between forests and local communities, how they value their surrounding forests, their perception on conservation programs while designing and implementing the required management strategies and policies for forest restoration and rehabilitation. This research set out to provide that information to address the above challenge and fill the

knowledge gap that needs to bridge between local communities and conservation processes.

1.3. Research Questions

The main research questions addressed in this study include:

1) What makes local communities to depend on NTFPs?
2) What are the influencing factors for local communities to participate in government's forest conservation program?
3) Which kind of policy instrument could motivate local communities' participation?

1.4. Thesis Goal and Objectives

The overarching goal of this research is to improve our understanding of livelihood dependency on NTFPs, and socio-economic factors related to participatory forest management, and to provide guidance on how this knowledge can be incorporated into forest conservation and reducing deforestation and forest degradation. I set out to achieve this goal through three research objectives, which address the knowledge gap related to the problem statement in the study area focusing on dependency on NTFPs and how the perceptions and potential responses of forest-dependent communities on government incentive schemes are related to the participatory conservation program. The three objectives are to:

1. Examine factors determining local communities' dependence on NTFPs and how these can be cooperated into policy implications
2. Observe perceptions of forest-dependent communities toward participation in forest conservation and
3. Investigate which policy interventions would be necessary to motivate their participation

1.5. Thesis Structure

The three objectives of this thesis was conducted through two data-based research chapters, which are presented in this thesis as a series of manuscripts formatted for publication in peer-reviewed journals. Thus, this thesis consists of 6 chapters (Figure 1.2).

Chapter 1 (this chapter) provides the rationale for the goal and objectives of the thesis. In this chapter, the relevance of the study and the problem statement were highlighted.

Chapter 2 describes theoretical framework on which the research was designed. It includes the concept of social-ecological systems, framework for analyzing social-ecological systems, and incentive theory of motivation. Hypotheses of the study were described and the theoretical framework of the thesis was explained in this chapter.

Chapter 3 presents the former and the current state of the research. It includes the brief context of forest conservation and people participation, the studies on non-timber forest products and forest degradation, and the theory of participatory forest management.

Chapter 4 addresses Objective 1. In this chapter, the question on "How much local communities depend on NTFPs and what are the driving forces for that?" was addressed. To address this question, local communities' dependence on non-timber forest products and factors determining their dependence on those products in Taungoo District, south-central Myanmar was examined. Moreover, the policy implications on reducing overexploitation of NTFPs were provided. The results of chapter 4 provide insights into the underlying reasons related to socioeconomic characteristics behind the overexploitation of NTFPs. Thus, this chapter helps address the weak evidence base for socioeconomic impacts on NTFP dependence and incorporate into

designing policies and measures to reduce deforestation and forest degradation.

Chapter 5 addresses Objective 2 and 3. In this chapter, the questions on "Are the geographical locations of villages, and household socioeconomic characteristics and their environmental knowledge related to forest-dependent communities' willingness to participate in forest conservation?" "Are forest-dependent communities' willingness to participate in forest conservation different according to their preferences on different government incentive schemes?" were addressed. To address these questions, the same case study in Chapter 4 was employed. The integrated approach to investigating socioeconomic factors related to participation was performed, and the literature on behaviorist theories and policy instruments was drawn to support the study design. Local communities' participation in forest conservation programs in Taungoo District, South-central Myanmar was examined. In addition, their participation was estimated by providing possible incentive mechanisms. The results of this chapter 5 contribute to building our limited knowledge of the perceptions and potential responses of local communities to the participatory conservation programs, which is an important knowledge gap needed to be considered in the forest management planning process.

Chapter 6 provides a description of how these data-based research chapters (chapter 4 and 5) addressed the three objectives of this thesis, including policy implications. Further, some shortcoming of this work and opportunities for further research were highlighted.

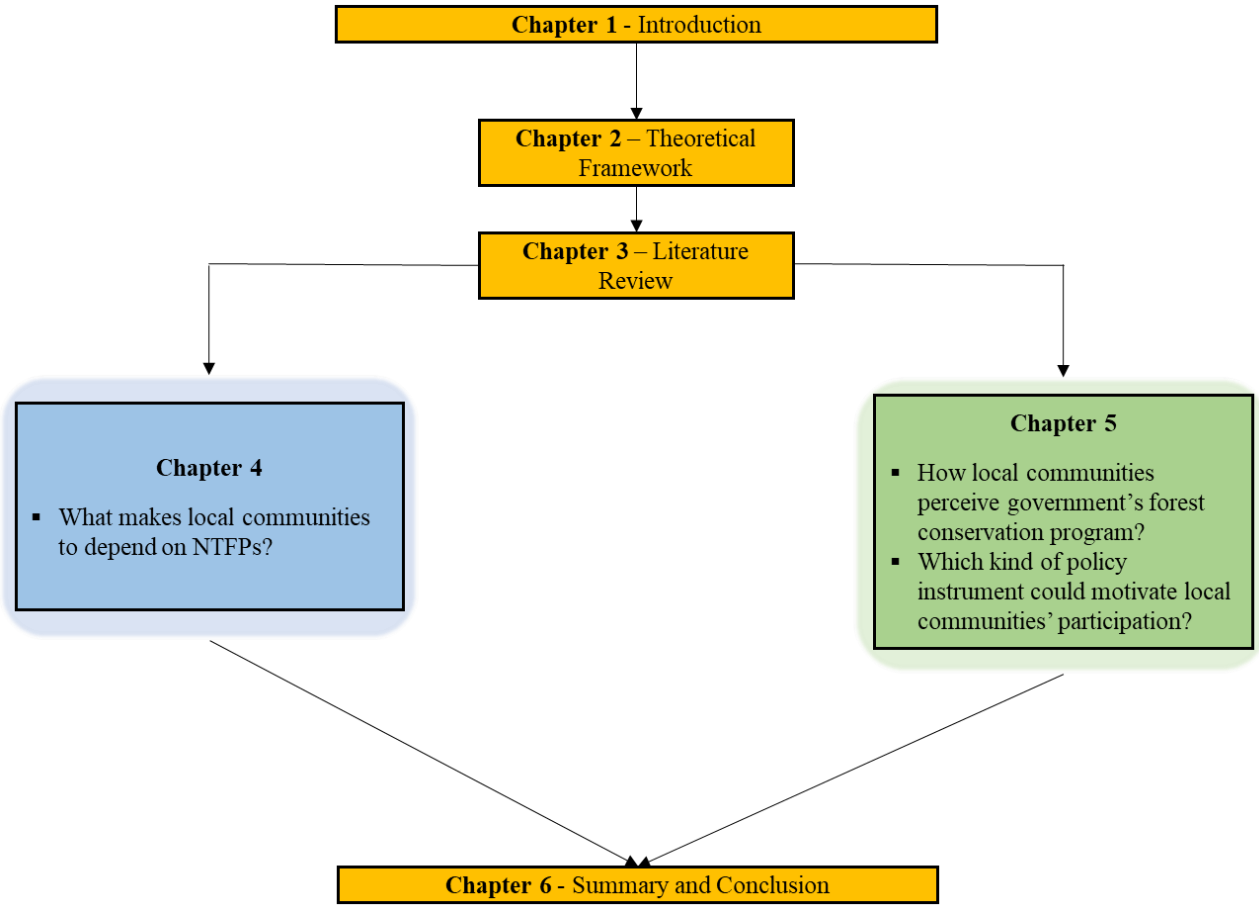


Figure 1.2 Thesis structure

Chapter 2. Theoretical Framework and Hypotheses

2.1. Theoretical Framework

An interdisciplinary approach was conducted to examine the livelihood dependency on non-timber forest products and investigate the factors related to forest-dependent communities' participation in forest conservation by drawing on multiple cases of empirical and theoretical literature on nature and human interactions, human behavior developed in economics, natural and social sciences. Specifically the social-ecological framework (Ostrom, 2009), the incentive theory of motivation promoted by the behavioral psychologist, Burhus Frederic Skinner and the theory of participatory forest management were employed.

2.1.1. Concept of Social-Ecological Systems (SES)

"Social-ecological systems are integrated complex systems that include social (human) and ecological (biophysical) subsystems in a two-way feedback relationship through institutions or governance" (Berkes, 2011). "The system outputs are returned to the system as an input, either to oppose the initial input (negative feedback), or to enhance it (positive feedback)" (Berkes et al., 2016).

Forest ecosystems provide a wide range of services to human well-being by several means (Díaz et al., 2015; MEA, 2005). Human not only benefit from the ecosystems but they are part of the ecosystems impacting and shaping their capacities to generate ecosystem services for human well-being and societal development from local to global scales (Fischer et al., 2015; Kalaba, 2014). This mutual relationship occurs whenever people interact with their environment (Berkes et al., 2016), where social systems are

affected by changes in the functions of ecosystems; while human behaviors could alter the capacities of ecosystems in providing their services (Berkes, 2011; Díaz et al., 2015; IPBES, 2016; MEA, 2005) (Berkes, 2011; Díaz et al., 2015; IPBES, 2016; MEA, 2005).

Figure 2.1 explains the two-way interaction between the two sub-systems of a coupled social-ecological system, the term used by (Berkes & Folke, 1998), where governance filter serves as a mediate between human actions and ecological systems (Kotchen & Young, 2007). Governance filter could be institutions, environmental values, ecological knowledge, culture and worldview (Berkes, 2011). People and nature interact reciprocally and form complex feedback loops (Liu et al., 2007), besides, the dynamics of these systems are influenced by many factors including organizations, institutions, networks, system of rules and government policies (Berkes et al., 2016).

Overexploitation of forest resources is increasingly threatening the world's forest ecosystems. The search for the social causes of this crisis has often focused on inappropriate approaches to governance and lack of incentives for conservation (Arun Agrawal & Gupta, 2005; Isager et al., 2002a; Nguyen, Bauer, & Uibrig, 2010). If forest management does not fit within these social-ecological systems coherently, failure in terms of conservation and in the development of both systems can occur (DeCaro & Stokes, 2013; Folke, Pritchard, Berkes, Colding, & Svedin, 2007; Sarkki, Rantala, & Karjalainen, 2015). Implementing the appropriate and applicable management systems would help to fill this gap (Arun Agrawal & Gupta, 2005; Arun Agrawal, Smith, & Li, 1997). Applying the integrated SES thinking, participatory forest management has been described as a link connecting local people (social system) and forests (ecological system) (Sarkki et al., 2015), in which win-win situation can be achieved if careful analysis and understanding of the context of both systems in the specific area could be conducted.

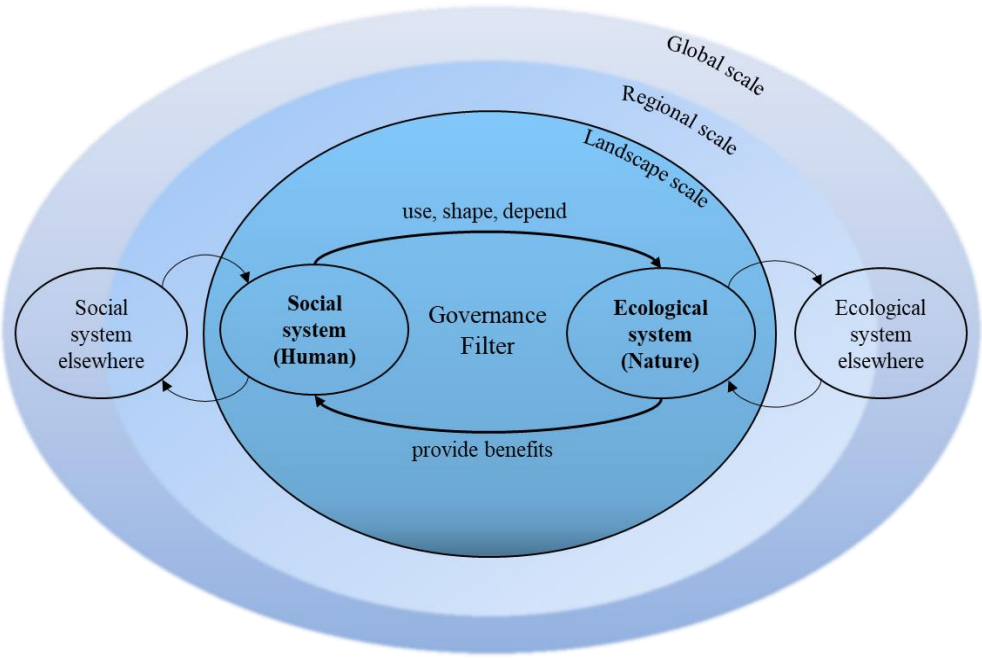


Figure 2.1 Social-ecological system consisting of social (human) and ecological (biophysical) subsystems, and integrated by two-way feedbacks through institutions or governance (adapted from (Berkes, 2011; Fischer et al., 2015))

People are part of the ecosystem; they use, shape and depend on ecological system and they provide benefits to social system, from local to global scales.

2.1.1.1. Framework for Analyzing Social-Ecological Systems (SES)

Elinor Ostrom's SES framework provides an understanding of the complex processes of the loss of natural resources that lead to improvements in or sustainability in SES (Ostrom, 2009). It conceptualizes the ecological system from an anthropocentric perspective; the ecological system is seen as a service provider for the human well-being (Ostrom, 2010). This general framework for analyzing sustainability of social-ecological systems explains the relationship among four subsystems of an SES that affect each other as well as link with social, economic, and political settings and

related ecosystems. The subsystems are (i) resource systems (e.g., forests, marine ecosystems), (ii) resource units (e.g., trees, fish), (iii) governance systems (e.g., institutions, management systems, rules), and (iv) users (e.g., loggers, fishers); all of them link each other through interactions producing outcomes (Ostrom, 2009).

To explain the logical linkage between two researches, I adapted Elinor Ostrom's social-ecological system framework (Figure 2.2) (Ostrom, 2009). The outcomes can be success or failure according to the interactions. Here, the expected outcome of the research is to reduce deforestation and forest degradation, and foster conservation through participatory forest management. The subsystems denoted in this research are (i) resource systems-(forests), (ii) resource units-(forest resources, NTFPs), (iii) governance systems- (government), and (iv) users- (local communities); all of them link each other through interactions producing the above mentioned outcome.

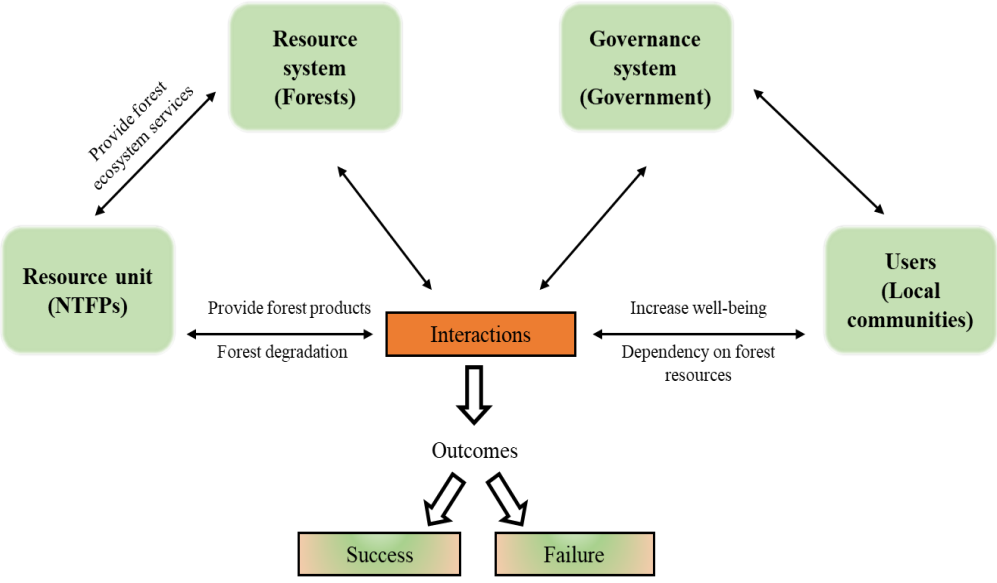


Figure 2.2 Conceptual framework of two data-based researches (adapted from framework for social-ecological systems of (Ostrom, 2009)

Integrating Ostrom' s SES framework into forest conservation can provide the nuanced social considerations into participatory forest conservation planning in the specific local conditions because it explicitly address the reciprocity between the social and ecological systems (Ostrom, 2010). By understanding the interactions among four subsystems, integrated and multi-faceted management strategies would be able to develop under the forest resource governance systems.

Forests are (resource systems) which provide forest products such as NTFPs (resource units) to local people (resource users). They are common property resources and if people have open access to them without restriction, this can lead to overexploitation and degradation (Hardin, 1968). Accordingly, the livelihoods of local people depending on those forest resources were also affected. This explains the interaction of coupled human and natural systems in a two-way feedback relationship influenced by government policies (Berkes et al., 2014; Liu et al., 2007). In applying social-ecological system to forest conservation, it is crucial to understand which governance system can promote conservation that sustains forest ecosystem services and human well-being as outcomes (Berkes et al., 2016).

2.1.2. Incentive Theory of Motivation

Motivation is the reason for people' s actions, willingness and goals. A person' s motivation may be influenced by intrinsic (internal or inherent) motivation or extrinsic (external) motivation (Ryan & Deci, 2000). Intrinsically motivational behaviors are performed if a person carries out an activity for no reward but for its own satisfactory, while extrinsic motivation refers to the performance of an activity that provides external rewards (Ryan & Deci, 2000). Thus, intrinsic motivation represents engagement in an activity for its own sake. Extrinsic motivators are often used to

impact someone who shows little interest in a potentially positive activity.

Implementing participatory forest management needs to promote motivation for the participants. Such motivation can either be intrinsic which is inherent to an individual, and may relate to a sense of enjoyment, satisfaction, accomplishment, responsibility and obligation or be extrinsic which is directed by payments or sanctions (Reeson, 2008).

Incentive theory is a specific theory of motivation, derived from the behaviorist theories, which concerns an incentive or motive by the behaviorist principles of reinforcement. It proposes the idea that a person's behavior is usually motived by the beliefs that they will obtain something profitable by engaging in certain activities. Incentive theory is promoted by the behavioral psychologist, Burhus Frederic Skinner, known as B.F. Skinner. This theory treats motivation and behavior of the individual as they are influenced by beliefs, such as engaging in activities that are expected to be profitable. A person is more likely to continue a behavior if the consequences are positive and less likely to continue if the consequences are negative.

Maslow A.H., (1943) proposed the idea of human motivations affected by deficiency needs and growth needs. His hierarchy of needs include 'physiological', 'safety', 'belonging and love', 'social needs' or 'esteem', and 'self-actualization'. He expressed that a human's motivation was effected initially by deficiency needs which are the first four levels. Maslow considered the physiological needs (such as food, water, shelter, cloths) the most important and all other needs are secondary until these needs are met.

The incentive theory of motivation, and Maslow's hierarchy of needs show how humans behave related to the incentives, how their behavior is motivated and which factors would be the effective motivators. Based on these two theories of motivation, I observed which potential incentives would motivate local communities to

participate in forest conservation and how their participation differ according to their physiological needs and preferences on incentives (Figure 2.3).

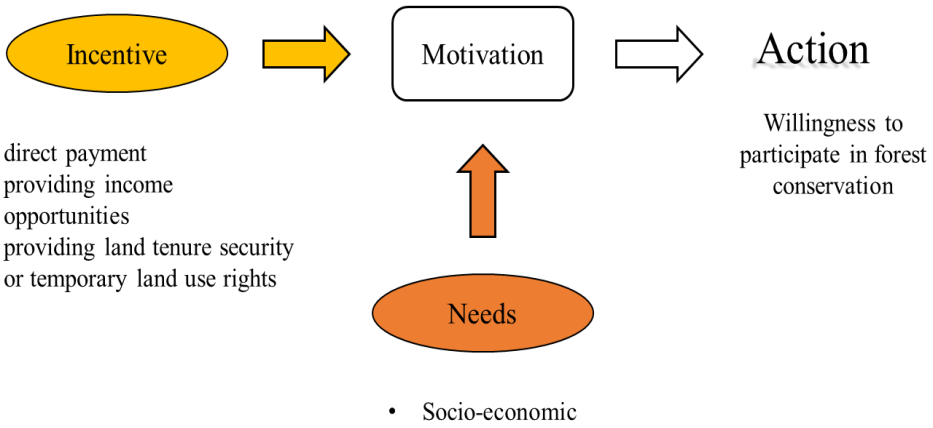


Figure 2.3 Diagram showing theory of motivation by incentives and needs (adopted from B.F. Skinner; Maslow A.H., 1943)

2.2. Thesis Theoretical Framework

Based on the theoretical background and state of research, a theoretical framework for my thesis was constructed. To accomplish the research objectives, two researches were conducted; (1) livelihood dependency on non-timber forest products: implications for REDD+, and (2) perceptions of forest-dependent communities toward participation in forest conservation.

Figure 2.4 presents the theoretical framework of thesis to explain the interaction among social, ecological and governance systems. This framework explains how government interacts with local communities to have win-win situation between forest conservation and social development. The systems denoted in this framework are (i) ecological system- (forest products), (ii) social system-(local communities), and (iii) governance system-

(government); all of them link each other through interactions – (i.e. government provides incentives to increase local communities' participation) producing the above mentioned outcomes.

This framework proposes the idea that in the two-way interaction between social (local communities) and ecological (forest products) systems, governance filter (government) serves as a mediate. Local communities interact with their surrounding forests by depending on forest resources for their livelihoods. However, overexploitation and the extraction of forest resources in an unsustainable way lead to the degradation of forests. If government could take the nuanced social considerations of local communities into forest conservation programs by exploring their dependency on forest products and providing incentive mechanisms, there is high possibility of increasing their participation. As a consequence, this could lead to reduce forest degradation and have win-win situation between social and ecological systems.

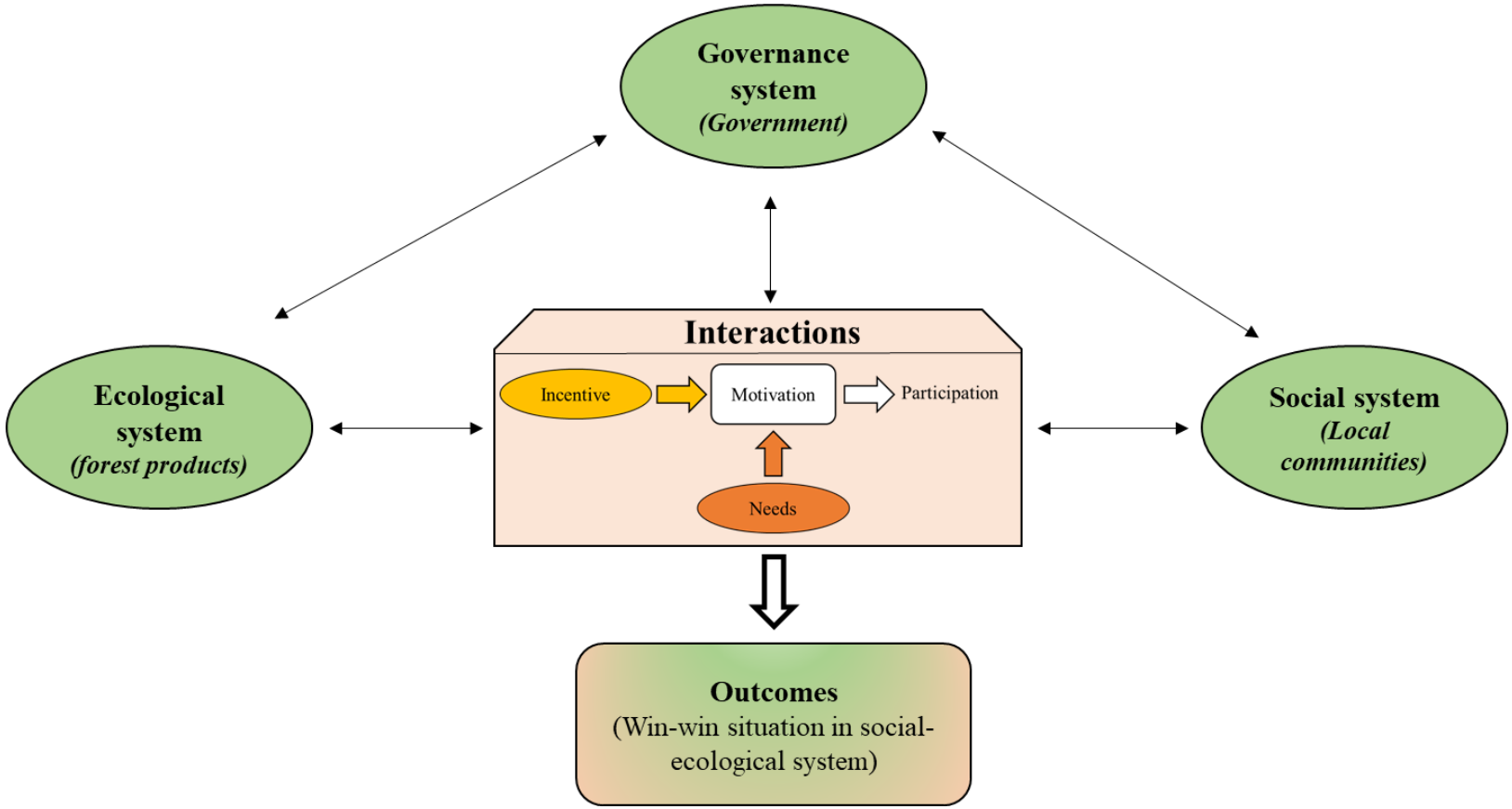


Figure 2.4 Theoretical framework of thesis

2.3. Hypotheses of the study

Based on the problem statement of forest resources utilization and participatory forest management, and the concept of the above interdisciplinary approach, the following hypotheses were tested in this research.

1.1 The lower the education level, and the poorer the households, the higher is the dependency on NTFPs.

1.2 Landowners are less dependent on NTFPs compared to landless households.

The relative share of income from NTFPs in total household income is defined here as the dependency on NTFPs by the households. The aim is to test how much is this NTFPs share of income and if the determinants for the dependence related to the socio-economic characteristics of the households.

2.1 The higher the relative NTFPs income, the more willing to participate in forest conservation.

2.2 Households living in high mountainous areas are more willing to participate in forest conservation compared to those living in low mountainous areas.

2.3 Households who are aware of deforestation have more willingness to participate than those who are not.

2.4 Households who prefer direct payment are more willing to participate compared to other two incentives.

A person's behavior is usually motived by what will be gained, such as recognition or rewards, and that motivation depends on their deficiency needs (Maslow A.H., 1943). This study focused on two financial incentives to motivate forest-dependent communities' participation in forest conservation, namely, direct payment and providing income opportunities, and; one non-financial incentive, namely, providing land tenure security or temporary land use rights to cultivate crops in forest lands. Analysis will be conducted if forest-dependent communities'

willingness to participate in forest conservation are different according to their preferences on the above incentives.

Chapter 3. Literature Review

Westoby, (1989) has shown that *"the starting point for policy formulation must be the social objectives and the creation of a forest policy is a process which should involve all groups and institutions who have a direct or indirect say in the forest or responsibility for implementing policy"*. Nilsson, (2003) also explained forest sector policy making *"as a process by which we formulate what society wants from the forest sector and forestry in the future"*.

Until a few years ago, forest management practices were focusing on the production and protection of environmental resources with less focus on social robustness, thus it fails to achieve sustainability in forest management. Several mechanisms have been established to mitigate climate change by means of protecting forests and reducing emissions from deforestation and forest degradation. To meet the increasing global environmental conservation regulations, the national policies have been maintaining a state-defined land tenure system with little recognition of local customary rights that restrict forest resources use by local communities (Roe, Nelson, & Sandbrook, 2009). This is how the conflicts between governments and forest-dependent peoples begin (Meijaard et al., 2013). The integrated solution or participatory approach often comes with community forestry where effective conservation and sustainable resource use is vital for securing local people's economic and social benefits through participatory processes (Jeanrenaud, 2002).

In line with the goals of sustainable forest management; "to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations" described by (UN, 2008), forest management should be multidimensional while maintaining and enhancing forest values through human interventions.

The conservation without local participation can be a failure and the outcome much depends not only on the legal framework but also on the education and interests of local people (Isager, Theilade, & Thomsen, 2002b). Increasing their interests needs the incentives. In recent decades, policy scientists, social theorists and policy makers have been facing the challenge of how to influence people's attitudes and behaviors and develop numerous policy instruments. Finding out the locally effective incentives for the specific social conditions needs a careful consideration of local communities' needs and perceptions toward their participation in forest conservation and their awareness about changing forest environments. Building incentives could help to increase local people's support of conservation, and the initial agreement should be made revealing that the output benefits can fulfill their needs and ease their pressure in sustainably utilizing the natural resources (Tisdell, 1995).

To obtain higher effectiveness, participants' preferences over the type of incentive should be considered as they would respond more positively to those matching their wants and desires. There are several approaches for such schemes, and they differ from place to place and time to time (Isager et al., 2002a). Some alternatives can increase local people's income and reduce their pressure on the forests at the same time (Leach, Mearns, & Scoones, 1997), while others can be subsidized for undertaking target-oriented activities and fiscal incentives with careful assessment, revision and design (Kissinger et al., 2006).

3.1. Non-Timber Forest Products and Forest Degradation

In this study, we used the definition of NTFPs (DeBeer & McDermott, 1996), which is compatible with the features of NTFPs in Myanmar. Thus, NTFPs are products that encompass "all biological materials other than timber which are extracted from forests for human use" (DeBeer & McDermott, 1996). The NTFPs

used by local communities include firewood, charcoal, poles, thatching grass, bamboo, rattan, resins, ornamental plants, wildlife (products and live animals), fibers, animal fodder, fruits, mushrooms, and other food and medicinal plants (Angelsen et al., 2014; DeBeer & McDermott, 1996).

The contributions of forest ecosystem services to the livelihood of the local communities have been highlighted by several studies (A. Agrawal et al., 2013; Angelsen et al., 2014; Costanza et al., 1998; McElwee, 2008; Reddy & Chakravarty, 1999; Schaafsma et al., 2014; Sunderlin et al., 2005). In most developing countries, forest provisioning services are especially important in terms of providing direct benefits to the local communities and, thus, represent a major part of the total economic value of their livelihoods (Mullan, 2014). In addition to its role as a resource for house construction, NTFPs are also used to generate biomass and energy, as well as they provide basic needs: food, clothing, and shelter. At first, the value of forests was recognized primarily in terms of timber production at the national level. Later on, NTFPs became significant not only at the local level but also at the national level. There is growing evidence that NTFPs contribute significantly to rural livelihoods in developing countries, but are frequently underrepresented at the national level in terms of economic reporting because they are often part of the informal economy (Akanni & State, 2013; Croitoru, 2007; DeBeer & McDermott, 1996; Heubach, Wittig, Nuppenau, & Hahn, 2011; Uberhuaga, Smith-Hall, & Helles, 2012). Literature on the factors influencing forest dependence indicated that off-farm employment opportunities, agricultural income, and access to markets have a negative relationship with forest dependence (Adam, Mirghani, & Tayeb, 2014; Hegde & Enters, 2000).

The literature on the interaction between forests and people has focused on the contribution of forest resources to the livelihood of rural people. Several studies reported the benefits of NTFPs to the livelihood of local communities (Akanni & State, 2013; Angelsen

et al., 2014; DeBeer & McDermott, 1996; Heubach et al., 2011; Uberhuaga et al., 2012; Vedeld, Angelsen, Bojö, Sjaastad, & Kobugabe Berg, 2007). Some others argued that the commercialization of NTFPs adds to the value of forest products by helping the conservation and development of local communities while contributing to the regulation of forest services such as carbon sequestration, hydrological regulation, and biodiversity conservation (Norman Myers, 1988; Solomon, 2016). However, several works also confirmed the negative effects of overexploitation and unsustainable extraction (Chidumayo & Gumbo, 2013; Datta & Sarkar, 2012; Murali, Shankar, Shaanker, Ganeshaiah, & Bawa, 1996; Ndangalasi, Bitariho, & Dovie, 2007; Shankar, Murali, Shaanker, & Ganeshaiah, 2018). The disadvantages included altered regeneration, species composition (Murali et al., 1996; Ndangalasi et al., 2007), and change in population structure and density of NTFP species, floristic diversity (Dao & Hölscher, 2018; Murali et al., 1996; Shankar et al., 2018), and forest degradation (Chidumayo & Gumbo, 2013; Datta & Sarkar, 2012). These studies supported the notion that the higher the dependence on NTFPs, the higher the forest degradation. This is consistent with the current state of forest degradation in Myanmar arising from the overexploitation of NTFPs.

To address the drivers of deforestation and forest degradation, the developing countries participating in the UN-REDD program (United Nations collaborative initiative on Reducing Emissions from Deforestation and forest Degradation) are encouraged to develop and implement PAMs to support climate change mitigation and adaptation actions. Similar to other participant countries, government bodies in Myanmar formulate PAMs as part of a national strategy and implement them to meet the country's mitigation targets. Studies on developing REDD+ PAMs are relatively limited and this analysis is further complicated by the fact that the development and selection of appropriate PAMs depends on region-specific deforestation and forest degradation drivers,

national circumstances, and the purposes of the national REDD+ strategy. Scriven, (2012)provided contextual data and information to aid the development of PAMs targeted to the Peruvian Amazon and reported that care must be taken to build and structure practical PAMs in the local context. As only a few countries have submitted their national REDD+ strategy to the UNFCCC REDD+ platform, their strategies, approaches and national programs are the only illustrations of PAM development available.

3.1.1. Forest Law and Status of Non-Timber Forest Products in Forest Management of Myanmar

Forest resources have been increasingly recognized as taking part in a significant role for rural communities not only for subsistence, but also for commercial used in Myanmar. The Myanmar Selection System(forest management system) described under the National Code of Harvesting Practices has been set the bounds of annual allowable cut for the timber and the Myanmar Forest Certification System has been developing to promote sustainable forest management and timber legality certification. In addition, a legal framework was developed to control the timber trade, under which all wood or wood produce is considered legal if it has the stamps of Myanmar Timber Enterprise under the permission of the Ministry of Environmental Conservation and Forests), and is exported through Yangon city harbor (Woods, 2013). Although the regulations and certification systems for timber has been developing, the regulations on NTFPs harvest systems, conservation and management is still lacking and at the same time the research on NTFPs is limited.

Illegal logging is not only environmental matter but also criminal act in Myanmar. According to Forest Law (2018), forest produce may only be extracted after obtaining a permit from forest department. Any harvest, transportation, and sale of teak and reserved trees in violation of laws is illegal logging in Myanmar.

However, in the case of subsistence used for agricultural or fishery enterprise, forest produce may be extracted in an amount not exceeding the stipulated quantity, without obtaining a permit (The Pyidaungsu Hluttaw, 2018). Teak and other trees reserved under this law are not allowed to be cut for both commercial and substance used. Forest Department (FD) shall use the competitive bidding system for commercial usage except the production is done by national enterprise. However, the commercial production of NTFPs does not need to use the competitive bidding system. Though the extraction and production of NTFPs commercially is legal, making and producing charcoal needs permission from the FD. In addition, the transportation of forest products or furniture from one district to another also needs the permission if it is more than the stipulated quantity. Myanmar has five self-administered zones and division (including Shan state and Sagaing division), which have some of the largest of relatively untouched forest. Illegal timber trade from those areas to neighbor countries is the highest (UNODC, 2015), and thus, they contribute the highest for the deforestation and forest degradation in Myanmar (Brunner, Talbott, & Elkin, 1998).

Due to the crucial role of non-timber forest products in the rural communities' livelihoods, the Myanmar National Forest Policy 1995 acknowledged the importance of NWFPs and stated a policy measure to recognize their socio-economic role as one of the priorities for forest development. FD set the strategic objectives for the sustainable management of forest; notably one of them is *"to develop and exploit the potential of non-wood forest products for meeting local needs and supporting small-scale rural forest-based industries for providing employment and off-farm income to the rural population"* (Ministry of Forestry, 1995). In addition, to promote the forest regeneration and afforestation, the strategies on the implementation of management programs to provide the growing needs of NWFPs in Myanmar was also developed. Particularly, to reduce market constraints in NWFPs

trade and to enhance their important roles in both national and local economies, the strategies for assembling, synthesizing and documenting the existing knowledge of various NWFPs were designed.

One of the effective forest management that the government of Myanmar incorporates the issue of NTFPs is community forestry (CF) management. Under the instructions of community forestry (CFI), addressing the basic needs of timber and NTFPs for local people is embedded together with enhancing environmental services for climate change mitigation and adaptation through conservation of deforestation and forest degradation by promoting participatory forest management (Union Minister, 2016). However, due to the overexploitation and ineffective implementation of regulations on NTFPs, the availability of these products are diminishing in certain areas. Therefore, under the 10-year district management plan for the period of 2016-17 to 2025-26, the working circles for the production of NTFPs was planned to manage in each district to have a sustainable production of NTFPs for local communities and to protect the natural forests from the over exploitation by the local communities (Forest Department of Myanmar, 2015). In addition, monitoring and follow-up activities, and providing technologies and extension services to the local communities related with the extraction of NTFPs in the sustainable way were also one of the activities to be conducted.

3.2. Participatory Forest Management (PFM)

Participatory approaches to forest management have been evolving regulatory forest policies using top-down approaches for decision making. These approaches have been embraced by academics, institutions and governments over recent decades, and have operated in differing ways according to varying situations in terms of geographical diversity, socioeconomic conditions, cultural values, traditional beliefs, general attitudes, policies implemented

and specific institutional frameworks (Worah, 2008). The definition of participation and the range of levels understood as entailing participation have varied (Arun Agrawal & Ostrom, 2001). Some scholars (e.g., Clarke, 2008; White, 1996) see participation as the inclusion of suitably empowered people who can express their views, stand up for their rights, and influence the creation and development of institutional arrangements and policies, while their participation may vary according to the nature of people's interests. Agarwal, (2001) also identified six different levels of participation, ranging from simple involvement as a member of an interest group working for a decision maker to active participation in decision making. Michener, (1998) describes two levels of participation, involving "genuine participation" where local people have effective authority, and "pseudo participation" in which local people play a minimal role (e.g. information sharing). In general, PFM has operated as an umbrella term involving several approaches such as joint forest management (JFM), community forestry (CF), social forestry (SF), community-based natural resource management, and community-based forest management (CBFM). These diverse PFM approaches pursued by different countries have differing implications for the forest ecosystems and livelihoods of the people involved; thus, the outcomes of PFM practices differ according to the approach adopted (Rasul, Thapa, & Karki, 2011a).

The complex interaction of natural (ecological) systems and social systems can produce strongly contrasting demands (Herring, 1988), and if forest management does not fit within these systems coherently, failure in terms of conservation and in the development of both systems can occur (DeCaro & Stokes, 2013; Folke et al., 2007; Sarkki et al., 2015). As participation has been demonstrated to be a bridge between local residents and conservation processes (Sarkki et al., 2015), providing effective and suitable policy instruments for social and ecological systems could aid with a more efficient exploration of opportunities for social-ecological innovation.

To manage forests sustainably, the following should occur, namely, the implementation of three-attribute cooperation (social, economic, and environmental) through increasing the benefits available to ensure that society's needs and the conservation and maintenance of forest ecosystems are advanced. Additionally, a balance between these attributes must be attained to protect the forest resources and prosperity of forest-dependent communities. To attain a balance in participatory processes, local social conditions need to be explored, acknowledged (Sarkki et al., 2015), and incorporated into management plans aiming to enhance social innovation.

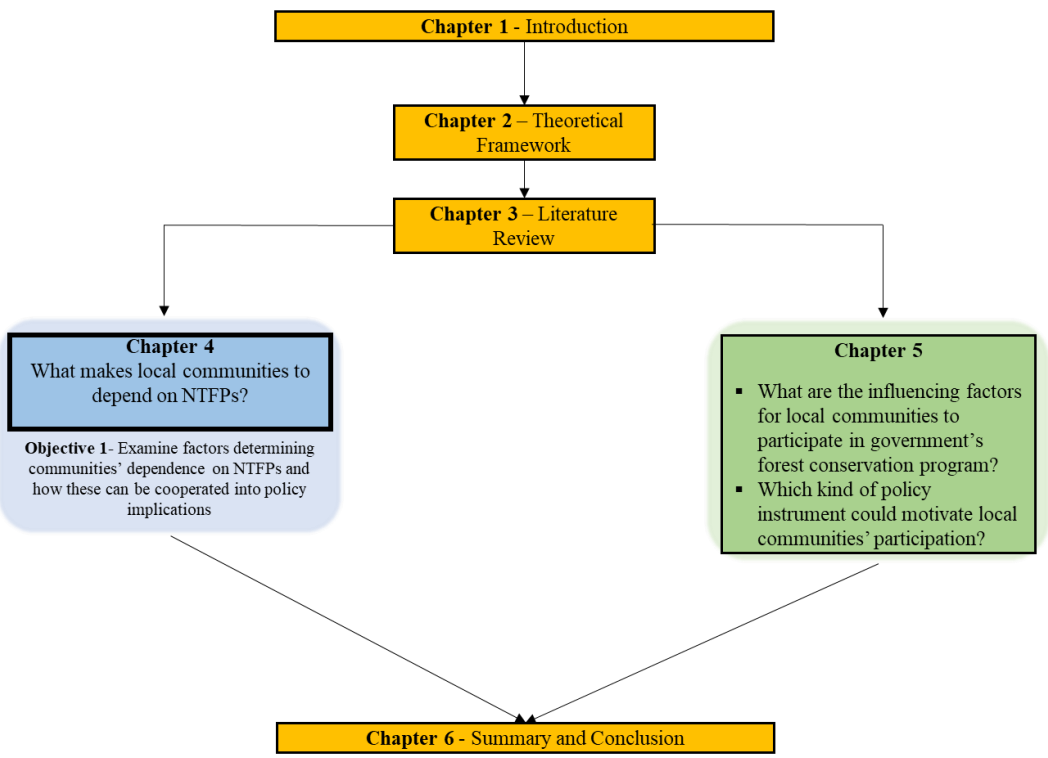
Forest management that involves local people requires a change in local people's attitudes, after a careful analysis and understanding of the context of existing social and ecological systems in the relevant area. Policy scientists, social theorists, and policymakers have been faced with the challenge of how to influence public attitudes and behavior, and develop policy instruments. A policy instrument is *"a deliberate structured effort by a governing body to solve a policy problem by modifying the actions of the governed"* (Brukas & Sallnäs, 2012) that works to link governing institutions and society in general through technical and social intermediaries (Lascoumes & Le Gales, 2007), and which is intended to provide optimum solutions through a careful balancing of interests (Bemelmans-Videc, Rist, & Vedung, 2011).

The effects of a policy instrument depend on its effectiveness, efficiency, legality, and democratic extent (Bemelmans-Videc et al., 2011); thus, a legitimate human-oriented environmental conservation program is likely to include a combination of policy instruments, including incentives to enhance social and environmental benefits (i.e., social-ecological innovations) to help change attitudes. Because stakeholders' priorities change depending on their attitudes, the identification of attitudes in relation to changing the condition of forests could facilitate the design of policy measures and management decisions (Nijnik et al.,

2017). A bottom-up approach through attitudes-based policy instruments could be the key to changing local communities' attitudes and perceptions regarding government forest programs and increasing motivation to participate in these programs.

Chapter 4. Livelihood Dependency on Non-Timber Forest Products: Implications for Policies and Measures

In chapter 4, local communities' dependence on non-timber forest products and factors determining their dependence on those products in Taungoo District, south-central Myanmar was examined. This chapter contributes to providing insights into the underlying reasons related to socioeconomic characteristics behind the overexploitation of NTFPs. Chapter 4 is published in *Forests.*[①] The research question for this chapter was developed, data was analyzed, and the chapter was written by me. The study design, coordination and the data collection was collected by the author (with research assistants). YOUN provided advice in the development of the research question, and assisted with structuring and editing the manuscript.



① Soe, & Yeo-Chang. (2019). Livelihood Dependency on Non-Timber Forest Products: Implications for REDD+. Forests, 10(5), 427. https://doi.org/10.3390/f10050427

4.1. Introduction

4.1.1. Research Background

Deforestation and forest degradation are one of the biggest threats to sustainable development; their exponential rate of growth poses a severe risk to the world' s ecosystems. Forests are common property resources in many parts of the world. As Hardin, (1968) argues, forests, if open to all for access without restriction, can be overexploited and degraded. Many non-timber forest products (NTFPs) production operate in open or semi-open access systems of resource tenure, resulting in exploitation of NTFPs (Shackleton, Delang, & Angelsen, 2011). For the sustainability in NTFPs harvest, land and resource tenure is crucial (Angelsen & Wunder, 2003); rapid market expansion of products with little or no tenure security leads to over-harvesting (Alcorn, 1995). Nevertheless, the institutional innovation, policies, and law enforcement at the local and international levels could help reduce the tragedy of commons (Herring, 1988) and lead to the sustainable utilization of common resources.

Forest degradation critically affects millions of people who depend, directly/indirectly or fully/partially, on forest goods and services at the local, regional, and global levels (FAO, 2011). This phenomenon is a direct threat to the livelihood of forest-dependent communities as it reduces forest productivity. Degradation often happens due to the complex interaction between direct drivers operating at the local or regional levels and indirect drivers operating at the local, regional, national, and international levels (Weatherley-Singh & Gupta, 2015). In terms of general causes, degradation is primarily due to human action in developing countries, while natural events are usually the cause in developed countries (FAO, 2011). Fuelwood collection, charcoal making, and timber logging are the most severe problems fostering forest degradation in Africa and subtropical Asia, while timber logging and uncontrolled

fires are the main drivers of degradation in Latin America (Hosonuma et al., 2012; Kissinger et al., 2012). Kissinger et al., (2017) reported that the primary direct drivers of forest degradation in Myanmar are illegal logging, overexploitation of forest resources, fuelwood collection, and shifting cultivation. Overall, the common perception is that forest degradation in Myanmar is due to anthropogenic activities, specifically the overexploitation of forest resources. However, little is known about the reasons behind these activities driving forest degradation. It is thus important to understand how much people depend on forest resources such as NTFPs and to identify the underlying factors affecting this dependence.

Reducing Emissions from Deforestation and Forest Degradation (REDD+) is an international voluntary mechanism under the United Nations Framework Convention on Climate Change (UNFCCC) designed to mitigate climate change by reducing greenhouse gases (GHG) emissions (UNFCCC, 2007). Since addressing the drivers of deforestation and forest degradation taking into account both social and natural systems is at the core of the REDD+ mechanism, understanding the underlying mechanisms behind the drivers of forest degradation is imperative to achieve the goals of REDD+. In Myanmar, overexploitation of forest resources resulting from the high dependence of the communities on these materials is one of the main causes of forest degradation. Thus, investigating the underlying causes of the dependence on NTFPs would help design and/or reform policies to address the problems under REDD+.

Another aspect of our research on NTFP dependence by forest-dependent communities in Myanmar is the potential for developing policies and measures (PAMs) that could be used to reduce forest degradation and restore or otherwise improve forest management. PAMs are nationally enacted policies and actions that countries undertake to address the causes of deforestation and forest degradation (Angelsen, Brockhaus, Sunderlin, & Verchot, 2012; Murphy, 2011). The combination of PAMs from different

sources are required to collectively address priority direct drivers and barriers to implementation, in a coherent way (Myanmar REDD+ Programme, n.d.). Depending on the country context (i.e. priority, political preference, capacity, and stakeholders involved), PAMs may be a mixture of legal and institutional reforms, regulatory measures, and incentives taking social and environmental safeguards into account as well as capacity building (Hugel et al., 2017b). The Myanmar National REDD+ Strategy specifies the PAMs to address the priority drivers of deforestation and forest degradation and to overcome the barriers to the sustainable management of forests (Myanmar REDD+ Program, 2017). Some PAMs such as legal or regulatory reform need to be implemented at the national level while some need to be implemented at the local level. Currently, Myanmar is at the finalizing stage of its National Strategy. So, while some PAMs such as land tenure security and the recognition of customary rights are still in development, others are already being implemented, including the distribution of efficient cooking stoves, development of fuelwood plantations, raising environmental awareness in the local communities, and capacity building of government and NGO staffs. The challenges to address the causes of forest degradation are in the implementation stage of PAMs due to the limited information on the underlying causes of forest degradation and the complex links between forests and the local communities. One study also conducted in Myanmar (Than, Wen, & Zaw, 2016) reported that REDD+ intervention did not have a significant impact on the livelihood of the local communities except for contributing to increase environmental awareness. This situation highlights the need to further explore the underlying causes of deforestation and forest degradation and the dependence of local communities on forest resources when the REDD+ plan is implemented in a specific region. We postulate that to reduce overexploitation of NTFPs, a policy agenda could be developed based on a close examination of the factors that influence local community dependence on NTFPs.

4.1.2. Rationale of the Study

A little more than a third of Myanmar' s land area consists of forest land – 29 million hectares out of a total land area of 65.8 million hectares (FAO, 2015). Myanmar ranked third in annual net loss of forest area during 2010–2015 (FAO, 2016) and the area of its degraded forests continues to increase at a rate of 0.29% annually, which is much higher than the global average of 0.13% (FAO, 2010a). The estimated indigenous population is approximately 14 – 19 million and most of the population live in or around forest areas (IWGIA – AIPP, 2010) and depend on forest resources for the collection of NTFPs for sustenance and for generating income (K. Htun, 2009). The rural population is approximately 70% of the total population (Department of population, 2015) and the extraction of NTFPs occurs in most of the protected areas (PAs) of the country. As a consequence, PAs in Myanmar are threatened by grazing, hunting, fuelwood extraction, and permanent settlement of rural communities (Rao, Rabinowitz, & Khaing, 2002).

Both the 1992 Forest Law and the 2016 Community Forestry Instructions (CFI) stipulate that local communities have a right to extract a stipulated quantity of forest products for subsistence use, but permission is needed if extraction activities take place on a commercial scale (Ministry of Forestry, 1992; Ministry of Natural Resources and Environmental Conservation, 2016). However, common resources are vulnerable to powerful interests due to inadequate PAMs for the conservation of forests. In particular, inefficient monitoring on the utilization of forest resources and inadequate implementation of conservation programs are the limitations to address over–exploitation of forest resources, illegal logging or illegal charcoal making and related activities. Thus, addressing these drivers needs a new management regime considering PAM options.

Poor regulation and unsustainable extraction of NTFPs is

affecting millions of hectares of natural forest in Myanmar. According to Taungoo District 10-year forest management plan (Forest Department of Myanmar, 2015), the demand for bamboo in Oaktwin township in 2015-16 is 3.45% higher than the estimated production from reserved forests while the production in Yaetarshae township could meet the estimated demand in the township (see Figure 4.1). In the case of firewood and charcoal, the production of forests could not fulfill the demand in both townships.

Figure 4.1 The demand and estimated production of bamboo in Taungoo District (2015-16)

Note: no records for Kyauk Gyi and Htan Ta Pin townships

Source: 10-year Taungoo District management plan (Forest Department of Myanmar, 2015)

A few studies have been conducted in different areas of Myanmar attempting to explain the determinants of forest income, economic contribution of NTFPs to the rural livelihood, and the

relationship between basic needs and forest products (P. S. Aung et al., 2015; Hlaing et al., 2017; Moe & Liu, 2016; Than et al., 2016). Win, Mizoue, Ota, Kajisa, & Yoshida, (2018) studied the consumption rates and patterns of firewood and charcoal in Yaetarshae township. They reported that as the demand for firewood and charcoal is increasing, increased production of firewood and charcoal could risk of further forest degradation in that area.

As overexploitation and unsustainable extraction of NTFPs lead to forest degradation (Chidumayo & Gumbo, 2013; Datta & Sarkar, 2012) and the tendency of further forest degradation in Myanmar, our research seeks to answer the question concerning the factors that determine community dependence on NTFPs. Answering this question provides a number of policy implications that can aid in the development of PAMs as part of a national REDD+ strategy at a local scale.

4.2. Methods: case study description, data collection and analysis

To attain the research objectives of two data-based researches, the methods including data collection and analysis were explained as follows.

4.2.1. Case Study Description

The study area, Taungoo District, is located in the North-eastern part of the Bago Region in Myanmar between 18°8' and 19°20' N and 95°50' and 96°45' E (see Figure 4.2). It is connected with Bago Yoma (Yoma means mountain ranges) in the west, with Kayin mountain ranges in the east and plains occur from north to south (Forest Department of Myanmar, 2015). At present, more than 80% of the forest in the Bago region is degraded (Bhagwat et al., 2017).

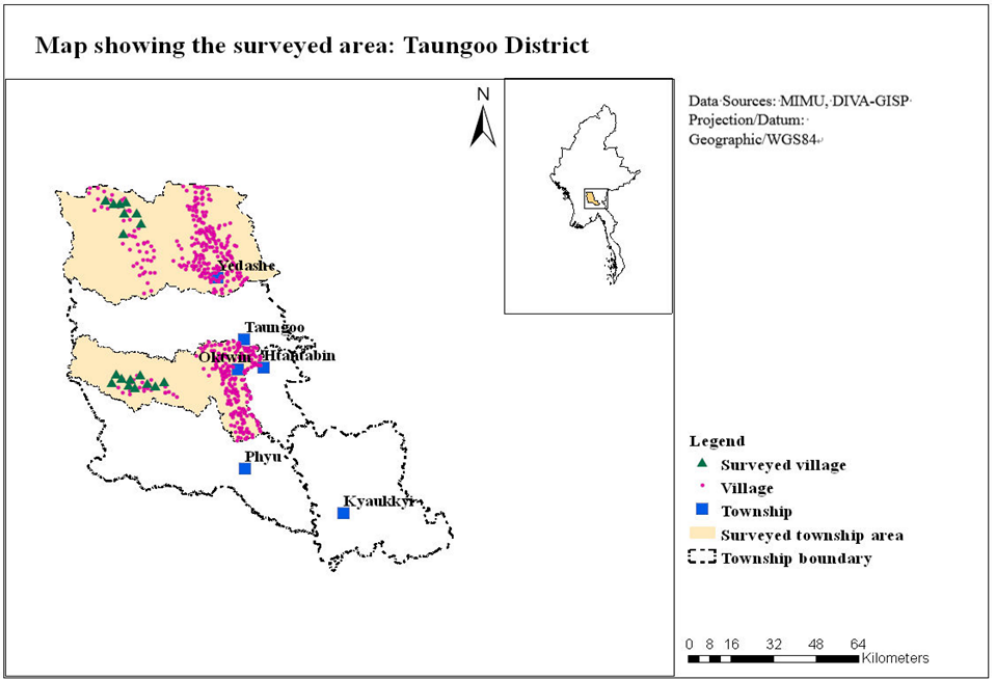


Figure 4.2 Taungoo District in the Bago Region, Myanmar

Note: Map created by the author, February 2018.

With a population of approximately one million, almost 80% of the people in the region live in rural area. The mean annual precipitation is between 1,400 mm~ 2,400 mm and the average temperature is 27.18 ˚C (Forest Department of Myanmar, 2015). This district is along the Bago mountain range (Bago Yoma), also known as the home of the Myanmar Teak (*Techona grandis*). Apart from teak and hardwood, Taungoo district provides diverse NTFPs contributing to the livelihoods of local communities. Figure 4.3 shows the production of studied NTFPs in Taungoo district during 2006–07 and 2015–16. Taungoo District was chosen for the case study because of its high percentage of degraded forest area, high rural population, and also due to the fact that it is one of the main target areas for REDD+ implementation.

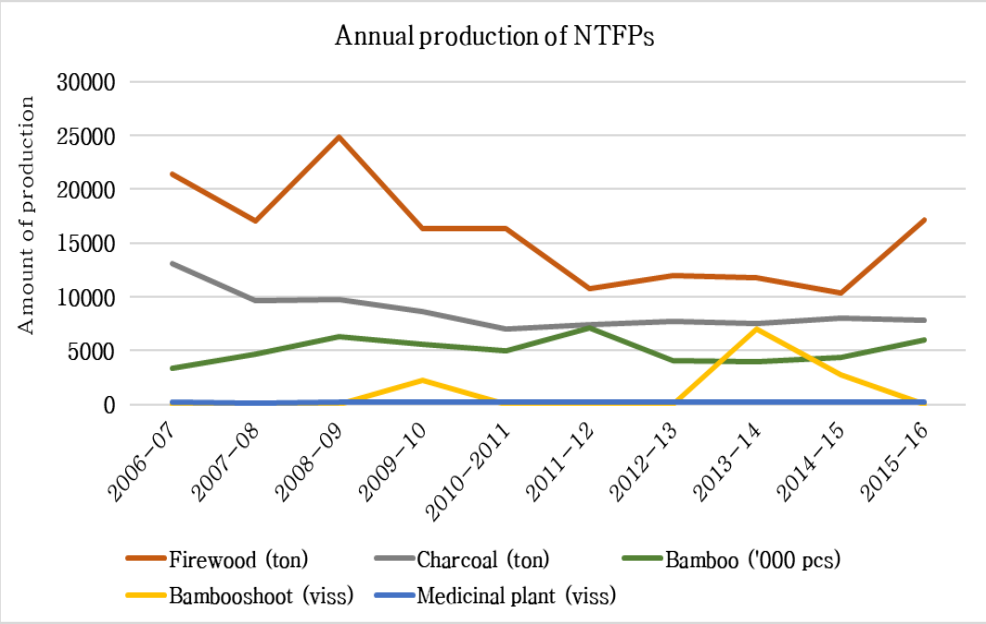


Figure 4.3 Production of studied NTFPs in Taungoo District, (2006-07~2015-16)

Source: 10-year Taungoo District management plan (2016-17~2025-26) (Forest Department of Myanmar, 2015)

4.2.2. Data Collection

We designed our research to gather both secondary and primary data. The secondary data concerns forest cover, geographical information, demographic data, and area maps were collected from township and district forest departments and the Forest Department at the Ministry of Natural Resources and Environmental Conservation (MONREC). Two townships - Yaetarshae, located within the lower mountainous areas (LMA), and Oaktwin, located within the higher mountainous areas (HMA), were selected as sampling areas for the field survey. The population in both areas were around 200 thousand in LMA and 160 thousand in HMA according to 2015 census (Forest Department of Myanmar, 2015). The surveyed villages were located within low mountain ranges (ranging in elevation from 251-500 meters) and high

mountain ranges (ranging in elevation from 501–750 meters) (MIMU, 2013). The qualitative and quantitative data collection were conducted in October and November 2016 through interviews with key informants, focus group discussions, and face–to–face individual interviews with local residents.

The key informants consisted of government officials (senior officers, foresters) of forest departments at Yaetarshae and Oaktwin townships and Taungoo district. The interviews with key informants were conducted to understand the geographical conditions of the study areas, forest cover, forest resources extraction and the general livelihood conditions of communities. Moreover, four focus group discussions with village leaders and elders at the village tract level were organized to understand the general conditions of the villages, livelihood of the communities, forest resource use, and the main types of NTFPs extracted from the surrounding forests. Households were randomly selected simply from total 77,863 rural households and face–to–face interviews were performed using semi–structured questionnaires. Ultimately, 330 sampled households with valid answers were selected for analysis.

4.2.2.1. Variable Descriptions

The field survey was conducted to collect socio–economic and demographic information about forest–dependent households and their use of NTFPs.

NTFP dependence. The dependent variable measuring NTFP dependence is defined as the relative share of income from NTFPs in total household income, following the definition of forest dependency in (Uberhuaga et al., 2012; Vedeld et al., 2007), and is denoted as DEPEND. The definitions of the explanatory variables are given in Table 4.1.

Hypothesis on the effect of socio–economic and demographic

characteristics on NTFP dependence. The variables postulated to influence NTFP dependence include socio-economic and demographic characteristics. The effect of each explanatory variable on the dependent variable was hypothesized based on previous studies (see Table 4.1).

Table 4.1 Description of the explanatory variables

Variable	Description	Unit	Hypothesized effect	Literatures
AGE	Household head age	Years	Positive	Older rural people are assumed to have greater knowledge on the utilization and extraction of NTFPs than younger ones and their dependence would therefore be higher (Heubach et al., 2011; Vedeld, Sjaastad, Angelsen, & Kobugabe Berg, 2004).
SEX	Household head sex	Male = 1 Female = 0	Positive	Men are presumed to be more likely to engage in high-return NTFPs extraction activities than female-headed households (Kamanga, Vedeld, & Sjaastad, 2009; Moe & Liu, 2016; Uberhuaga et al., 2012) while some argued that female are more dependent on subsistence forest income (Illukpitiya & Yanagida, 2008). Sex of household had is no longer significant (Mamo, Sjaastad, & Vedeld, 2007; Vedeld et al., 2004).
EDU	Household head completed schooling years	Years	Negative	Education level is expected to have a negative effect (Hlaing et al., 2017; Illukpitiya & Yanagida, 2008; Uberhuaga et al., 2012; Vedeld et al., 2004).
HHSIZE	Number of family members	Persons	Positive	The more labor available, the more participation in labor intensive NTFP extraction activities should be reported, thus implying more dependence on NTFPs (P. S. Aung et al., 2015; Mamo et al., 2007; Prado Córdova, Wunder, Smith-Hall, & Börner, 2013).
LANDOWN	Land ownership	Yes =1 No = 0	Negative	In general, greater land ownership and level of food-sufficiency characterize wealthier households in Myanmar's rural communities. The size of owned land has a negative effect on NTFP dependence (Moe & Liu, 2016).

RICINSUF	Number of rice insufficiency months in a year	Months	Positive	The number of rice insufficient months within a year was hypothesized to have a positive effect on NTFP dependence (Mamo et al., 2007; Uberhuaga et al., 2012).
OFFINCOM	Income from off-farm employment	US$/year	Negative	Households lacking other employment opportunities appear to be more dependent on NTFPs (Mamo et al., 2007).
POV	Regional poverty level [a]	Poverty=1 Non-poverty=0	Positive	As forest products help as safety nets, support of current consumption, and as a pathway out of poverty (Angelsen & Wunder, 2003; Cavendish, 2002; Vedeld et al., 2007), people under the poverty line depend more on NTFP extraction (McElwee, 2008; Vedeld et al., 2007).
RESIDE	Residency in high and low mountainous areas (HMA, LMA)	HMA=1 LMA=0	Positive	Remote areas may have fewer income opportunities and higher dependency on forest resources than those areas with better infrastructure.
EXTEN	Received extension services	Yes = 1 No = 0	Positive Negative	Receiving effective extension services on extraction of NTFPs in a sustainable way may decrease the income share of NTFPs in short term, but increase it in long term.
CCUSE FWUSE BOTHUSE	Utilization of wood fuel	Charcoal user=1 Firewood user=2 User of both fuels=3	Positive Negative Positive	Fuelwood usage by local people may have an effect on NTFP dependence. The annual household income for charcoal users were significantly higher on average than for firewood users (Win, Mizoue, Ota, Kajisa, Yoshida, et al., 2018).

[a] (based on 387,785 Myanmar Kyats, MMK/year = $308/year, as of November, 2016) (UNDP Myanmar, 2013a)

Variable refers to the independent (explanatory variables) on which the dependent variable (relative share of income from NTFPs in total household income) depends. Description refers to the explanation of the abbreviations of the independent variables. Unit refers to the measuring unit for continuous variables and the denotation of categorical variables. Hypothesized effect on dependent variable refers to the estimated effect of each explanatory variable on the dependent variable.

4.2.3. Methods

Income accounting. We define household annual income as the sum of the cash income generated from different activities (e.g. crop cultivation, livestock raising, collecting NTFPs, income from migrant family workers, casual labor, and small scale businesses) and the monetary income equivalent to the value of the output of those activities (non-cash income) (Cavendish, 2002). Income accounting for the annual income of forest-dependent households was calculated as follows:

Household annual income = (NTFP income + migration income + casual labor income + crop cultivation income + livestock income + other income)

$$Y_{tincome} = \sum_{i=1}^{n} [S_i],$$

where $Y_{tincome}$ is total household income and S_i stands for income from source i.

Income from NTFPs was calculated by adding cash and non-cash income received from NTFPs, where non-cash income is the non-monetary income or in-kind value of NTFPs consumed by the households for their self-usage and cash income is the value received from selling them. As we suppose that households have market access, both cash income from selling NTFPs and non-cash income were calculated using market prices or the household self-reported value. If the household receives the wages sent by the household members working outside of the study area, that wage is referred to as migration income. Casual labor income is the income received by working as daily laborers receiving daily wages. Other income is the one generated from small business activities such as home shops. In addition, 'off-farm income' was calculated to examine its effect on NTFP dependency. Off-farm income is the

combination of all income activities apart from agricultural production income, thus it is calculated by adding migration income, casual labor income, livestock raising income, and income from other small business activities.

For the calculation of crop cultivation income, we use the income definition in (PEN, 2007):

$$I = \sum_{i=1}^{n} p_i y_i - \sum_{j=i}^{m} q_j v_j,$$

where I is gross income value, namely, (price x quantities of all n products) – total costs (price x quantities) of m purchased inputs (e.g. seeds, hired labor) including family labor costs. Income from livestock includes the sales of livestock, livestock products, and associated services but excludes incremental stock value changes.

Household poverty was determined based on the annual per capita income of the sampled households compared with the regional poverty line (387,785 Myanmar Kyats (MMK/year) = $308/year, as of November, 2016) for the study area in the Eastern Bago Region estimated in (UNDP Myanmar & Schmitt-Degenhardt, 2013). If the annual per capita income of a household is below the poverty line, then the variable poverty is 1 and 0 otherwise. The descriptive analysis on the included variables were conducted by using the Statistical Package for Social Sciences IBM SPSS Statistics 23.0 (IBM SPSS, 2017).

4.2.3.1. Empirical Model

A beta regression model was developed to explain NTFP dependence as a function of socio-economic and demographic characteristics of the forest-dependent communities. The beta regression model is defined as:

$$g(\mu_i) = x_i^T \beta = \eta_i,$$

where $\beta = (\beta_1, \cdots, \beta_k)^T$ is a k x 1 vector of unknown regression parameters ($k < n$), $x_i = (x_{i1}, \cdots, x_{ik})^T$ is the vector of k regressors (or independent variables or covariates) and η_i is a linear predictor (i.e., $\eta_i = \beta_1 x_{i1} + \cdots + \beta_k x_{ik}$; usually $x_{i1} = 1$ for all i so that the model has an intercept) (Cribari-Neto & Zeileis, 2015). In this study, we built three beta regression models to explain NTFP dependence. The value of NTFP dependence is a proportion that ranges between 0 to 1. Model 1 includes all sampled households; Model 2-1 only includes landowners; Model 2-2 only includes the landless households. The models were estimated using the R Statistical Package version 3.5.1.

4.3. Results

4.3.1. Descriptive Analysis of the Livelihood of Forest-Dependent Communities

In the communities surveyed, most households were forest-dependent farmers with 98% of the households engaged in the exploitation of NTFPs and/or related activities for subsistence and commercial use. Around 70% of households were agricultural land owners, including official and non-official land tenure holders and farm-forestry tenants, while the rest were casual laborers and small business owners. In LMA, almost all land-owning households practiced upland cultivation of rice, groundnut, and sesame, while rice, groundnut and corn were mainly cultivated in HMA and shifting cultivation is their main farming system. The categorical socio-economic characteristics of the respondents are shown in Table 4.2. Among the respondents, only 3% were the female-headed households. Only 28% of respondents in the studied areas received the extension services related with agricultural technologies, forest plantation and community forestry related information. None of the communities in the study area had access to government-supplied electricity, so more than 50% of the households used only firewood

for cooking, whereas 37% used only charcoal and the remainder used both wood fuels. Myanmar suffers from significant energy insufficiency as only 13% of the population has access to electricity (Sovacool, 2013). Current electricity consumption in Myanmar is relatively low with only 16% of people used electricity for cooking in 2014, while over 90% of the rural and 50% of the urban population use firewood or charcoal for cooking (Department of population, 2015; UNDP Myanmar, 2013).

According to the focus group discussion, some of the households' farm lands were lost due to the lack of secure land tenure and most of them expected alternative income opportunities especially in the HMA. Moreover, only a few villages participated in the extension programs such as extension on farming technologies and community forestry and participated in plantations while some did not even notice about the programs. Although they showed positive attitude to the conservation programs generally, their main concern is getting job opportunities. Key informant interviews with government officials from forest department explained the existence of illegal charcoal making in the study areas and the limitations for monitoring on those activities were mainly due to lack of human capacity and huge area of forest.

Table 4.2 Descriptive statistics for the categorical socio-economic characteristics of sampled households

Variable		Total (n=330)		Landowner (n=238)		Landless (n=92)		$\chi 2$
		Freq. [a]	%	Freq. [a]	%	Freq. [a]	%	
Gender	Male	320	97.0	233	97.9	87	94.6	2.510 (p=0.113)
	Female	10	3.0	5	2.1	5	5.4	
Fuelwood usage	Charcoal user	122	37.0	72	30.3	50	54.3	16.757 (p=0.000)
	Firewood user	174	52.0	140	58.8	34	37.0	
	Both fuels user	34	10.3	26	10.9	8	8.7	
Regional level poverty	No	101	30.6	79	33.2	22	23.9	1.961 (p=0.161)
	Yes	229	69.4	159	66.8	70	76.1	
Received extension services	No	238	72.1	164	49.7	74	80.4	4.385 (p=0.023)
	Yes	92	27.9	74	22.4	18	19.6	
Residence	Low mountainous area	114	34.5	77	32.4	37	40.2	1.815 (p=0.178)
	High mountainous area	216	65.5	161	67.6	55	59.8	

[a] Number of responses

Source: Survey results (author's calculation)

The independent-samples t-test was used to compare the mean difference between landowner and landless groups (see Table 4.2). The results proved that the landless households had a statistically significant higher share of income from NTFPs (61.59±40.52%) compared to landowners (29.32±28.56%), $t(328) = -8.13$, $p = 0.000$, explaining that landless households were more dependent on NTFPs than landowners. This leads to a further question, namely, which socio-economic and demographic characteristics other than land ownership are relevant for the dependence on NTFPs. Thus, the descriptive statistics of non-categorical socio-economic characteristics of the respondents are shown in Table 4.3. The mean age of landowners was 45.91 and 42.37 for the landless. The education levels of households were determined based on their finished schooling years. The mean schooling year of all sampled households was 3.69 that is equivalent with the primary school level. Landowners had more family members than that of the landless households. The possibility is that the households with land owned can feed more family members compared to those without land owned. Among landowners, around 90% of the households grew rice, thus the rice insufficient months were lower than that of landless households. In the case of off-farm income (measured in US$/year), the landless households earned a higher amount (US$590.77/year) than the landowners (US$390.06/year). Landowners earned higher amount of per capita income (US$322.79/year) than that of landless households (US$303.14/year). There was also a significant difference in income diversity between landowners and the landless. In other words, landowners had more than 2 sources of income (2.17) whereas the landless households generally had less than 2 sources of income (1.79).

Table 4.3 Description of socio-economic characteristics of sampled households

Variable	Total samples (n=330)	Landowner (n=238)	Landless (n=92)	t-test statistics, p-value
	Mean			
Age (years)	44.92 (12.08)	45.91 (11.56)	42.37 (13.06)	$t_{(149.266)} = -2.277$, p= 0.024**
Education (years)	3.69 (2.24)	3.71 (2.25)	3.65 (2.24)	$t_{(166.027)} = -0.210$, p= 0.834
Family size (number of family members)	5 (1.72)	5 (1.79)	4 (1.46)	$t_{(201.352)} = -3.203$, p= 0.002***
Rice insufficient months (months)	1.48 (1.88)	1.46 (1.85)	1.51 (1.95)	$t_{(157.810)} = 0.206$, p = 0.837
Off-farm income (US$/year)	446.01 (793.99)	390.06 (683.80)	590.77 (1015.93)	$t_{(124.201)} = 1.748$, p = 0.083
NTFP income composition (%)	28.32 (35.38)	29.32 (28.56)	61.59 (40.51)	$t_{(328)} = 8.13$, p = 0.000***
Agricultural land holding size (ha)	1.66 (2.25)	2.29 (2.35)	0	$t_{(237)} = -15.067$, p = 0.000***
Per capita income (US$/year)	317.31 (391.06)	322.79 (430.82)	303.14 (263.05)	$t_{(267.232)} = -0.502$, p = 0.616

Note: ** $p < 0.05$, and *** $p < 0.01$,

Standard deviations (in parentheses)

Variable refers to the continuous independent and dependent variables included in the regression model. Mean refers to the mean value of each variables for total sampled households, landowner group and landless group. The t-value refers to the value of t-test statistics. P-value tells the likelihood of the differences in means of each variables between two groups.

Source: Survey results (author's calculation)

4.3.1.1. Household Annual Subsistence Level and Cash Income from NTFPs

In this study, we focused on the major NTFPs consumed by the households in the study areas. These included bamboo, poles, wild vegetables, medicinal plants, firewood, and charcoal, all of which were collected for subsistence and commercial purposes. The pattern of household NTFP utilization was described in Figure 4.4. Among the NTFPs extracted, bamboo was the most common, accounting for more than 90% of the households surveyed, followed by wild vegetables (85%), firewood (62%), pole (33%), and charcoal (33%). Poles and firewood were extracted only for household use.

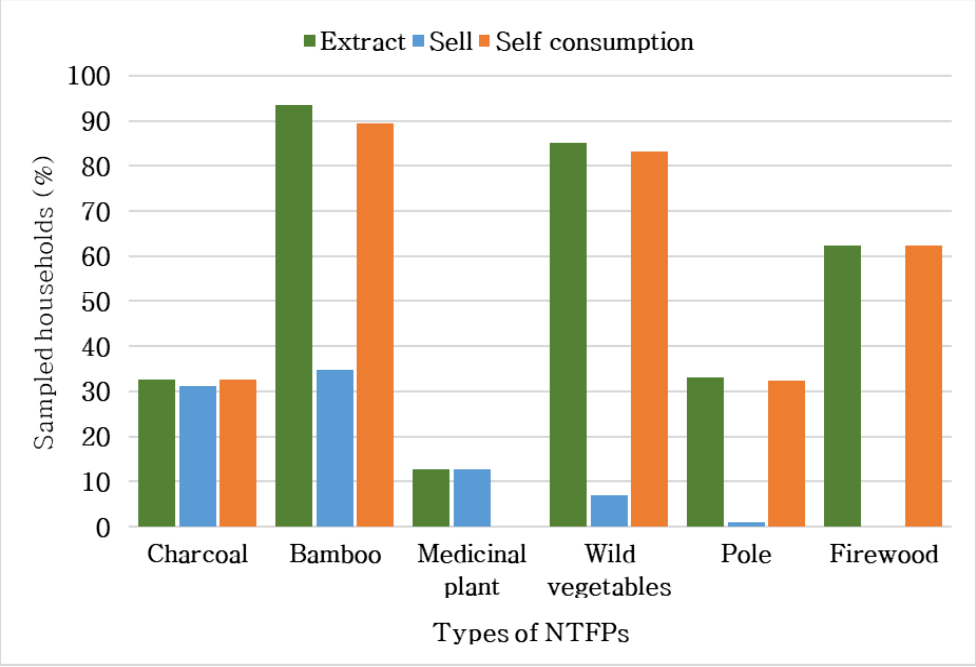


Figure 4.4 NTFP utilization pattern by sample households
Source: Survey results (author' s calculation)

Table 4.4 Household annual income from NTFPs, absolute and relative (%), Taungoo District, 2016

NTFP income source	Absolute NTFPs income, '000 MMK[a]	Relative NTFPs income (%)
Charcoal	267	49.6
Subsistence	32	5.9
Cash	235	43.8
Bamboo	195	36.2
Subsistence	31	5.8
Cash	164	30.5
Poles	4	0.8
Subsistence	4	0.8
Cash	0	0.02
Wild vegetables	10	1.9
Subsistence	8	1.5
Cash	2	0.4
Firewood	46	8.6
Subsistence	46	8.6
Cash	0	0
Medicinal plants	15	2.9
Subsistence	0	0
Cash	15	2.9

a 1 USD = 1,259 MMK (Myanmar Kyats), as of November, 2016
Subsistence income refers to the non-monetary income or in-kind value of NTFPs consumed by the households for their self-usage. Cash income refers to the monetary income received from selling NTFPs.
Source: Survey results (author's calculation)

Cash made up 77% of the total NTFP income while subsistence (non-cash) income was 23% (Table 4.4). Cash income from charcoal production was by far the most important source of income for households accounting for 43.8% of the total NTFP income,

followed by bamboo cash income (30.5%), and medicinal plant cash income (2.9%). Firewood income only accounted for non-cash in the study areas as the households collected firewood for their own use only. Nevertheless, the value for firewood was calculated based on the market price in the nearest township. Income from poles for house construction and wild vegetables was mostly subsistence non-cash income. These results showed which NTFPs the households were more dependent on for their income generation.

4.3.1.2. Relative Annual Household Income

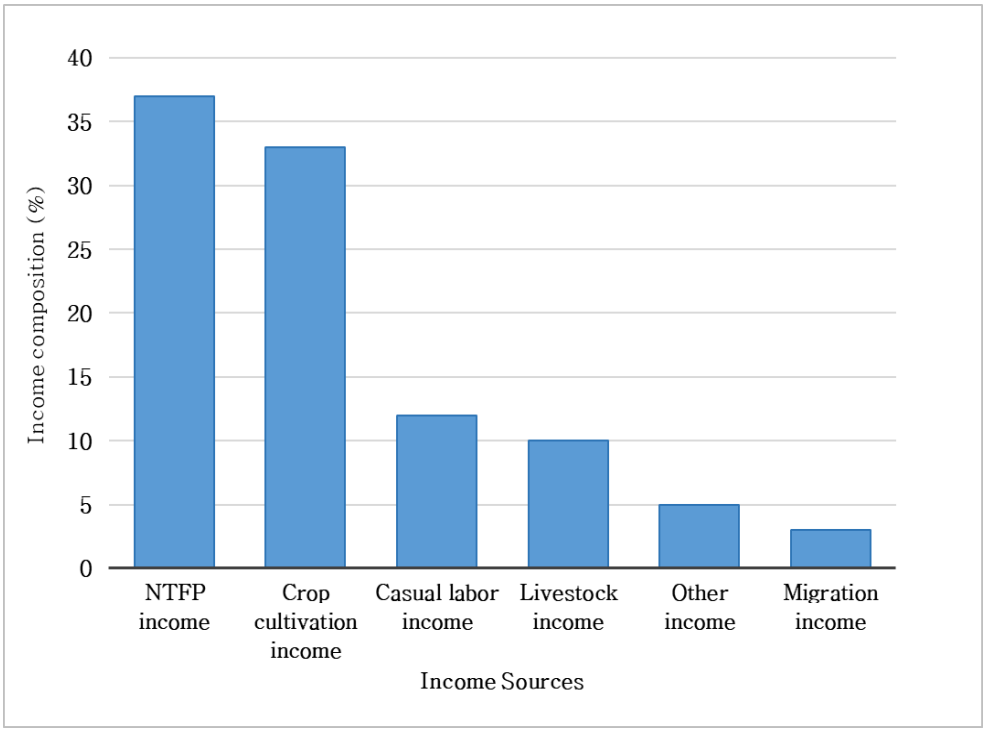


Figure 4.5 Relative annual household income by income source (n=330), Taungoo District, 2016

Source: Survey results (author' s calculation)

The relative annual household income by source is presented in Figure 4.5. Households were engaged in at least two sources of income on average while almost 70% of the households surveyed

were below the poverty line. We may at this point postulate that the income sources in the study areas may not have much effect on reducing poverty, thus suggesting that policies should explore the issue of creating better income opportunities. According to the analysis, the share of NTFP in total income was the largest, accounting for 37% of total household income, followed by crop cultivation income (33%), casual labor income (12%), and income from raising livestock (10%). Migration income was the smallest contributor at 3%, whereas other income such as small business shops and tailoring accounted for 5%. NTFP dependence can range widely depending on the diversity of the household income sources and the geographical area (Uberhuaga et al., 2012; Vedeld et al., 2007). Other studies on different areas of Myanmar (P. S. Aung et al., 2015; Khaine, Woo, & Kang, 2014; Moe & Liu, 2016) reported that forest and NTFP income contributed to household income by 25%~55% of household income, while the contribution rate varied with the conditions of different geographical areas and socio-economic characteristics of the households.

4.3.2. Livelihood Dependence Estimation

Three beta regression models were employed to identify the determinants of the dependence on NTFPs. In Model 1, all sampled respondents (n=330) were included in the sample and the livelihood dependence on NTFPs was explained by the socio-economic, demographic variables and fuelwood usage described in Table 4.2 and 4.3. Models 2-1 and 2-2 explained the livelihood dependence on NTFPs for the sub-groups of landowners and landless, respectively. In these two models for sub-groups, all socio-economic, demographic characteristics and fuelwood usage except landownership (LANDOWN) were included as explanatory variables. The Phi-coefficients, log-likelihood and pseudo R^2 were used to evaluate model fit. The results of our model estimations and their respective fit were presented in Table 4.5, 4.6 and 4.7.

In Model 1 (Table 4.5), the level of education, land ownership, off-farm income, residency area and type of fuelwood used were found to be related to the livelihood dependence on NTFPs in the expected directions. Moreover, the interaction of land ownership with poverty, level of education, rice insufficiency period were also related to the livelihood dependence on NTFPs. Specifically, the higher the education level, size of land owned, and income from off-farm activities, the less dependent on NTFPs the households are. The respondents reside in high mountainous areas were more dependent on NTFPs. The landowners who were below the poverty line, and who have higher rice insufficient periods depended more on NTFPs. Although not statistically significant, family size, food shortage, charcoal usage, receiving extension services, and firewood usage were nevertheless related to dependence on NTFPs in the hypothesized directions.

Model 2-1 (Table 4.6) predicted that, among landowners, those who had higher level of education, higher level of off-farm income, and used only firewood depended less on NTFPs, while those who were under the poverty line, and used only charcoal were more dependent more on NTFPs. The landowners who were under the poverty line with higher rice insufficiency period depended more on NTFPs, while those who have higher education level with charcoal usage also had higher dependency level on NTFPs. Though statistically not significant at a higher level, the effect of food shortage showed related to NTFP dependence. The higher coefficient of poverty for landowner group (B=1.59) explained that their option of earning income was extracting NTFPs once they became under the poverty due to failure in agricultural production.

The estimation result for the landless household group (Model 2-2) was shown in Table 4.7. Off-farm income, and receiving extension services were significant in explaining the dependence on NTFPs. The higher off-farm income of the landless households, the more these households depended on NTFPs. Similarly, among the landless households, those who had higher

income from NTFPs, but higher rice insufficiency periods were more dependent on NTFPs.

Table 4.5 Estimation results: All samples

Variables	Model 1, All sampled respondents			
	Coefficients Estimate	Std. Error	z-value	Pr(>|Z|)
(Constant)	1.229e+00	7.056e-01	1.741	0.0816.
Age	1.093e-03	4.990e-03	0.219	0.8266
Sex (male)	-2.372e-02	3.526e-01	-0.067	0.9463
School years	-1.935e-01	5.185e-02	-3.731	0.0001***
Size of household	1.122e-02	3.626e-02	0.309	0.7570
Own land (Yes)	-1.631e+00	5.015e-01	-3.252	0.0011**
Rice insufficiency period	-1.017e-02	1.413e-02	-0.720	0.4715
Off-farm income	-9.720e-04	7.903e-05	-12.299	< 2e-16***
Poverty (Yes)	8.426e-02	2.408e-01	0.350	0.7263
Geographic area (HMAs)	2.872e-01	1.366e-01	2.102	0.0355*
Received extension (Yes)	2.321e-01	1.463e-01	1.586	0.1127
Fuelwood usage (charcoal user)	3.983e-01	3.969e-01	1.003	0.3156
Fuelwood usage (firewood user)	-2.095e-03	4.049e-01	-0.005	0.9958
Own land (Yes)*Poverty (Yes)	7.033e-01	2.935e-01	2.396	0.0165*
Own land (Yes)*Rice insufficiency period	1.288e-01	4.070e-02	3.164	0.0015**
Own land (Yes)*Charcoal user	1.362e-01	4.693e-01	0.290	0.7715
Own land (Yes)*Firewood user	-5.937e-01	4.641e-01	-1.279	0.2007
Phi	2.6255	0.1932	13.59	<2e-16 ***
Log-likelihood: 192.3 on 19 degrees of freedom				
Pseudo R^2 = 0.4995				
Number of observations = 330				

Note: Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.',
Dependent variable = NTFP dependence (relative share of income from NTFPs)

Table 4.6 Estimation results: Landowners

Variables	Model 2-1, Landowners			
	Coefficients Estimate	Std. Error	z-value	Pr(> | Z |)
(Constant)	-0.7305	0.7523	-0.971	0.3315
Age	-0.0025	0.0056	-0.454	0.6497
Sex (male)	0.2634	0.4562	0.577	0.5637
School years	-0.2231	0.1010	-2.208	0.0272*
Size of household	-0.0166	0.0385	-0.431	0.6668
Rice insufficiency period	-0.1806	0.0937	-1.927	0.0540.
Off-farm income	-0.0002	0.0001	-2.111	0.0347*
Poverty (Yes)	1.5922	0.1933	8.234	< 2e-16 ***
Geographic area (HMAs)	-0.0577	0.1539	-0.375	0.7076
Received extension (Yes)	-0.1435	0.1645	-0.872	0.3831
Fuelwood usage (charcoal user)	0.5823	0.2438	2.388	0.0169*
Fuelwood usage (firewood user)	-0.4928	0.2239	-2.200	0.0277*
Poverty*Rice insufficiency period	0.2798	0.1010	2.768	0.0056**
School years*Charcoal user	0.2417	0.1119	2.159	0.0308*
School years*Fuelwood user	0.1770	0.1035	1.709	0.0875.
School years*size of household	0.0290	0.0156	1.858	0.0631.
School year*Received extension (Yes)	-0.0954	0.0664	-1.436	0.1510
Phi	3.4707	0.3059	11.35	<2e-16 ***
Log-likelihood: 128 on 18 degrees of freedom				
Pseudo R^2 = 0.4559				
Number of observations = 238				

Note: Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.',
Dependent variable = NTFP dependence (relative share of income from NTFPs)

Table 4.7 Estimation results: Landless

Variables	Model 2−2, Landless			
	Coefficients Estimate	Std. Error	z−value	Pr(> | Z |)
(Constant)	1.251e+00	1.011e+00	1.237	0.2159
Age	−6.863e−04	8.713e−03	−0.079	0.9372
Sex (male)	9.573e−02	4.777e−01	0.200	0.8411
School years	−1.405e−02	4.527e−02	−0.310	0.7563
Size of household	1.010e−01	7.988e−02	1.265	0.2059
Rice insufficiency period	−3.049e−01	2.400e−01	−1.270	0.2039
Off−farm income	−2.711e−03	4.006e−04	−6.767	1.31e−11 ***
Poverty (Yes)	1.195e−01	2.488e−01	0.480	0.6310
Geographic area (HMAs)	2.979e−01	2.435e−01	1.223	0.2212
Received extension (Yes)	8.515e−01	2.572e−01	3.311	0.0009***
Fuelwood usage(charcoal user)	5.034e−01	3.625e−01	1.389	0.1649
Fuelwood usage (firewood user)	−4.253e−01	3.912e−01	−1.087	0.2769
Off−farm income*Rice insufficiency period	0.2798	0.1010	2.768	0.0056**
Rice insufficiency period*Received extension (Yes)	0.2417	0.1119	2.159	0.0308
Rice insufficiency period *Charcoal user	0.1770	0.1035	1.709	0.0875
Rice insufficiency period *Fuelwood user	0.0290	0.0156	1.858	0.0631.
Off−farm income*Size of households	−0.0954	0.0664	−1.436	0.1510
Phi	5.0174	0.7659	6.551	5.71e−11 ***
Log−likelihood: 96.83 on 18 degrees of freedom				
Pseudo R^2 = 0.6058				
Number of observations = 92				

Note: Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.',
Dependent variable = NTFP dependence (relative share of income from NTFPs)

4.4. Discussion

4.4.1. Factors Affecting NTFP Dependence by Forest-Dependent Communities

In Model 1, four explanatory variables were statistically significant for NTFP dependence in a beta regression analysis context. The negative effect of education may be due to the fact that more educated households had better access to a wider range of income opportunities and the extraction of NTFPs may not be their main income source. This is consistent with a previous study (Hlaing et al., 2017) on Myanmar reporting that households with low educational level were more dependent on the forests. Generally, wealthier households in rural Myanmar communities have more opportunities for education and greater access to farmland. However, the descriptive analysis showed that there was no much difference in education level of landless and landowner groups. Thus, we can postulate that although education showed significance, it may not have an effective measure. It is possible that the households with higher educational level in the study areas had better access to farmland and were more involved in agriculture than in forest activities. Landownership had a negative effect on dependence on NTFPs as well, indicating that the respondents who own land were more dependent on NTFPs, and the larger the size of the agricultural land, the less the household will depend on NTFPs (Heubach et al., 2011; Vedeld et al., 2007). One can expect that if a household owns more land, there is a higher probability of having both food security and cash income from agricultural farming. The finding that NTFP dependence decreased with increases in off-farm income was consistent with previous results (Hegde & Enters, 2000; Illukpitiya & Yanagida, 2008; Moe & Liu, 2016) and was also consistent with our expectation that households who earned higher income from raising livestock, casual labor, and other small businesses would depend less on labor-intensive NTFP extraction

activities. The households living in high mountainous areas are found to depend more on NTFPs. We can assume that remote areas may have fewer income opportunities, weak transportation and access to market, thus higher dependency on forest resources than those areas with better infrastructure.

Contrary to our initial hypothesis, age, sex, family size, and food shortage, were not significantly associated with dependence on NTFPs. We may postulate that since there were limited income opportunities or non-forest income generating options in the study areas, then regardless of age, gender, and family size, local people were dependent on the extraction of NTFPs (Uberhuaga et al., 2012). The general findings in most household surveys pointed out that in most cultures, female-headed households are widowed or divorced, and their income is lower than that of male-headed households due to the lack of adult labor (Vedeld et al., 2004). In our study, the sample included 320 male-headed households and 10 female-headed households. There is probability that the total number of female-headed households are less than that of male-headed households in the rural areas of Myanmar due to the traditional culture. This could be one limitation to support our hypothesis that gender is not significant to determine the NTFP dependency, whereas this is supported by the previous studies conducted in Ethiopia and the study on the relationship between forest income and rural poor (Mamo et al., 2007; Vedeld et al., 2004).

The results of Model 2-1 and Model 2-2 showed the comparative effects of socio-economic, demographic characteristics of the respondents and their fuelwood usage who owned agricultural land and those who did not. The income from off-farm activities was the only variable significant in both models, and was consistent with the result of Model 1. As in the case of Model 1, education level, off-farm income, and fuelwood usage were significantly associated with NTFP dependence which is similar in Models 2-1 and 2-2. The estimation results in Model 2-

1 suggested that poverty was positively related to NTFP dependence as expected, indicating that the landowners who were under the poverty line depended more on NTFPs as a fall back resource or as a means of income diversification. Previous studies (McElwee, 2008; Vedeld et al., 2007) supported our findings. Therefore, among the landowners, those who were under the poverty line tend to extract NTFPs as a fall back option in times of emergency, thus increasing their dependence on NTFPs (McElwee, 2008; Vedeld et al., 2007). Although this variable does not have significant effect for Model 1 and 2-2, they implied the same effect in terms of direction. Higher education level of the landowner groups in Model 2-1 had lower dependency on NTFPs, which is similar to the estimation of Model 1. Our results on Model 2-1 were also supported by (Shackleton et al., 2011), which reported that NTFPs can fulfill several livelihood requirements starting from subsistence to safety nets and cash income to alleviate poverty. The positive effect of charcoal use on the NTFPs dependence implied that among the land-owned households that used fuelwoods, those which only used charcoal for subsistence and/or selling were much more dependent on NTFPs for their livelihood than those who used both charcoal and firewood. Among total sampled households that used charcoal for cooking, almost 70% made charcoal themselves not only for subsistence but also for commercial purposes. This explained the hypothesis that the households were more dependent on NTFPs if they could get non-cash as well as cash benefits as part of their income. As expected, the utilization of firewood alone led to significantly less dependence on NTFPs than for the households that use both fuels. This would imply a similar hypothesis to the one mentioned above where a higher relative income from NTFPs may be expected when the contribution of income from charcoal making was significantly higher than the subsistence income from firewood. Considering the interactive effects on NTFP dependency for Model 2-1, the landowners who were under the poverty and higher rice insufficient, as well as those who had higher education level and used only charcoal had higher

dependency.

Similar to Model 1 and 2-1, having a higher amount of off-farm income (OFFINCOM) had a negative correlation with NTFP dependence in Model 2-2. This implied that among the landless people, those who had higher off-farm income were less dependent on NTFPs (Heubach et al., 2011). It is, therefore, likely that the presence of more diverse sources of income for the landless people would help reduce the overexploitation of NTFPs. Receiving extension services on community forestry, forest plantation and agricultural technologies made the landless group in Model 2-2 were more dependent on NTFPs. Whereas this variable was not significant for Model 1 and 2-1. In the consideration of interactive effects on Model 2-2, higher share of off-farm income but longer periods of rice insufficiency (RICINSUF) made the landless group more dependent on NTFPs. Moreover, those who had higher rice insufficiency and received the extension services depended more on NTFPs. This is possible because most of the landless people may be rice-insufficient due to their lack of agricultural land so they tended to engage more in forest extraction activities. This hypothesis was supported by previous studies (Prado Córdova et al., 2013; Uberhuaga et al., 2012).

The comparison between Models 2-1 and 2-2 highlighted the differences in terms of the dependence of landowners and the landless people on NTFPs with respect to their socio-economic, demographic characteristics and fuelwood used. As these models showed fuelwood usage, it could help anticipate NTFP exploitation trends in the study areas. Overall, landownership, educational level, off-farm income, poverty, and fuelwoods used were the most impactful variables on NTFPs for the study areas. These findings may help to develop PAMs that would help reduce overexploitation of NTFPs in forest-dependent areas.

4.4.2. Implications for Policies and Measures

The findings from our study showed that poverty, food insecurity, land ownership, energy inaccessibility (electricity) and low education were the main causes of dependency on NTFPs in rural communities in Myanmar which would lead to overexploitation. Obviously, the study area was located in a region with limited development, where almost 70% of the respondents lived under the poverty line, 45% reported rice insufficiency, 30% had no agricultural land, and all depended solely on charcoal and firewood for cooking. Given this situation, addressing the drivers of overexploitation of NTFPs can only be successful if it is done considering the livelihood of the local communities and their living conditions. Well-designed and comprehensive policies are needed to reduce overexploitation of NTFPs in a socially, economically, and environmentally sustainable way. More importantly, REDD+ safeguards should be considered to ensure that those policies and measures 'do no harm' to people or the environment, but also 'do good and enhance' social and environmental benefits (Swan, Walcott, Paz, Eggerts, & DeValue, 2017). For this reason, we suggested the following policy implications conceived with the idea of long-term benefits for both the local communities and the surrounding forests, and the improvement of existing policies.

Policy implications for poverty

The results revealed that NTFPs contributed substantially to the income of forest-dependent communities as the average NTFP income share in total annual household income was 37% (see Figure 5.3). Still, almost 3/4 of the respondents lived below the regional poverty line. In addition, our study revealed that households below the poverty line were more dependent on NTFPs. This condition was the root cause behind the increasing exploitation of NTFPs by the communities, thus increasing forest degradation in the study area. An important conclusion we can draw from our results

combined with our examination from the focus group discussion was that the first reliable income option for the recently landless respondents was the exploitation of NTFPs due to the lack of alternative income opportunities in the area. Hence, policies creating non-farm employment opportunities would help local communities become less dependent on NTFPs (Bernard & Gélinas, 2014) while raising their income beyond the subsistence level. Support for raising subsistence livestock such as poultry, goat, pig would also be an alternative option as it could create both cash and in-kind income while enabling the possibility to save for future needs. Moreover, raising these livestock would not need a huge area for the pasture and no harm their surrounding forests. As the most abundant and collected NTFP in the study area is bamboo, supporting to establish the small or medium enterprise on producing value-added bamboo products or handicrafts would be a better alternative to increase the income of local communities. Although our result did not show the significant NTFP dependence between male-headed and female-headed households, supporting this enterprise would incorporate gender considerations, one of the safeguards to be addressed under REDD+ planning. Thus, providing technologies for the value addition of NTFPs as well as developing the appropriate marketing channels for those products (He, Dong, & Stark, 2014), incorporated with the extension services on harvesting NTFPs in a sustainable way could help not only increase their income but also reduce forest degradation.

Policy implications for food security

The respondents in the study area suffered from rice insufficiency for 1.5 months on average per year. A high percentage of food insecurity among landowners revealed the need for agricultural development policies in rural communities. Agricultural policies that focus on crop diversification or agroforestry would help increase their production and ensure the yield (San Win, 2005). However, these policies could be implemented at the national level

to prevent conversion of forestland to agricultural land use or other related activities. Such policies could be accomplished through the support of agricultural technologies, some of which have already been proposed by national specialists (San Win, 2005), and the dissemination of information. Despite no significant difference in terms of food insecurity between landless and landowners, agricultural land allocation or providing land leases for the landless people to do agroforestry could help them to not only generate a steady flow of rice for consumption, but would also help reduce overexploitation of NTFPs. However, careful consideration is needed in implementing this measure because it might induce land use change, such as clearing new land for agricultural activities or new plantations. One alternative to practice is participation in forest plantations as the tenants for short-term. This can provide not only job opportunities, but also land for agricultural activities for a certain period of time (2-3 years) together with the plantations. In these plantations with the participation of local communities, the tangible benefit from teak or other forest species goes to the government while intangible benefits from those and tangible benefits from agricultural activities goes to the communities. Providing income opportunities is one instrument to incentivize local communities to participate in forest plantations (Soe & Yeo-Chang, 2019). In addition, the allocation of enough land especially for landless and providing technologies for better agroforestry practices would help to increase the effectiveness of both plantations and agricultural production in long-term.

Policy implications for land tenure security

Previous studies suggested that forest tenure was the most critical factor behind overharvesting of NTFPs (Belcher & Schreckenberg, 2007; Neumann & Hirsch, 2000). Our analysis found out that proportion of NTFP income in the case of landless people was twice as much as that of landowners. Among landowners in the study areas, some were farm-forestry tenants

practicing agroforestry while others were non-official landholders practicing shifting cultivation. Shifting cultivation is not recognized as a legal land use under the farm law. Shifting cultivation land cannot be registered and thus, lack of land tenure. As income from agricultural production was the second highest contribution to household total income, policy interventions allocating land or providing land lease agreements especially formulated for the landless in forest-dependent households could help reduce their dependency on NTFPs. Traditional land use rights could be recognized and registered to secure the local communities by upgrading the informal rights to legally enforceable rights. Through this, it can provide better protection of the land users and may relieve the dependency on NTFPs. Community Forestry (CF) is one alternative for long-term incentive. To address the basic needs of timber and NTFPs for local communities, to create job opportunities and income, and to increase forest area, Myanmar Forest Department has been establishing community forestry since 1995 (Ministry of Natural Resources and Environmental Conservation, 2016). Under the CF instructions, the forest user groups are allowed to establish their community forest for 30 years and they can receive both tangible and intangible benefits from their community forest. Incentivizing local communities to participate in community forestry by allocating land to practice agricultural activities cooperated with forest plantation would be an alternative not only to secure land tenure for long-term but also to induce land use change. In line with that, social safeguards such as land tenure security and recognition of traditional land use rights could be secured to implement REDD+ within the framework of Myanmar' s national land use policy as a means to reduce forest degradation at the national level (Andersen, 2016; Ngendakumana et al., 2013; Springate-Baginski, 2017).

Policy implications for energy supply

All the communities in the study area had no access to electricity and solely depended on charcoal and firewood for cooking. Myanmar energy poverty survey reported by (Mercycorps, 2011) highlights the lack of awareness about renewable energy equipment and alternative fuels by rural households (Sovacool, 2013). One study conducted in the same study areas in the Yaedarship township revealed the effect of using multiple fuels (mainly fuelwood, gas, and electricity) in urban areas on reducing the consumption of firewood and charcoal (Win, Mizoue, Ota, Kajisa, & Yoshida, 2018), thus lessening the adverse impact on the forests. Unless alternative fuels are provided, the rate of degradation of Myanmar forests will be exacerbated. However, how to recompense the negative consequences of this energy transition is a big challenge for Myanmar government. While the national power grid network covers only 7% (4,550 villages) of total 65,000 villages in Myanmar and while 90% of rural population depend on fuelwood and charcoal for cooking (UNDP Myanmar, 2013), energy transition to fuels that are not forest-based could affect the income of local people. The local people would lose their income receiving from selling charcoal and firewood, and spend more to buy the alternative fuels.

With the objectives of providing the sustainable production of fuelwoods for local communities, as well as to conserve the natural forest, FD has been establishing the village fuelwood plantations in each district with the participation of local people. However, due to the increasing population and higher demand, the village fuelwood plantations cannot fulfill the needs of all rural communities. Pode, Pode, & Diouf, (2016) showed the possibility of the rice husk biomass power system as an affordable option for rural electrification in Myanmar. International Energy Agency, (2006)pointed out the approaches improving the way biomass is used: using agricultural residue briquettes and the provision of improved stoves. In the study areas, around 70% of the

respondents are agricultural land owners, and thus, the approach of using agricultural residue briquettes for cooking could be a suitable alternative to fuelwoods. Furthermore, the technologies on producing those briquette such as rice harvesting technologies would be considered. gOn the other hand, providing the technologies to produce the efficient cook stoves could help not only to reduce the charcoal and firewood consumption, but also to create alternative income opportunity for local people.

Meeting this cooking fuel target needs government policies, strategies and actions. Energy policies incorporation with forest policies in Myanmar could focus on introducing and providing incentives for the adoption of alternative fuels such as biomass waste and technologies on the biomass based power system, as well as incentivizing the production and distribution of efficient cook stoves to reduce charcoal and firewood consumption at the national level (Myanmar INDC, 2015; Myanmar REDD+ Program, 2017). Such policies could be implemented through extension services concentrating on how to effectively and easily use alternative fuels and/or the improved cooking stoves. Technologies for building and improving cooking stoves could be provided for long-term distribution. As well as, monitoring and follow-up activities are the key for not only reaching the target of reducing firewood and charcoal usage, also to sustain the energy transition.

Policy implications for capacity building

More than 2/3 of land owners in the study areas were under the poverty line, thus highlighting the need for intensive agriculture technologies to increase the productivity. As practicing intensive agriculture is an alternative to NTFP extraction and may in fact be beneficial for reducing NTFP extraction (Paumgarten & Shackleton, 2009; Sunderland, Ndoye, & Harrison-Sanchez, 2011), agricultural policy could focus on providing extension services related to improved cultivation practices in order to increase crop yields.

In Yaedarshae township, more than 50% and almost 40% of the

rural population used charcoal and firewood for cooking respectively (Win, Mizoue, Ota, Kajisa, & Yoshida, 2018). Our study revealed the high consumption of fuelwood in the study area. Accordingly, charcoal production was conducted not only by local residents but also by the short-term migrants and business owners from suburban areas. Thus, energy strategies could also focus on providing economic support or in-kind supplies for user access to alternative fuels and technologies for the distribution of efficient stoves to reduce the stress on NTFPs (Barnes, 2014).

Our study resulted that the level of education is the significant determinant to depend on NTFPs. The low education level of the households, and their less participation in the extension programs explained the need to conduct the effective extension services which can meet the priorities of the local communities through increasing their capacity. According to the results of Soe & Yeo-Chang, (2019) conducted in the same study area, more than 90% of the sampled households were aware of deforestation and of the benefits they receive, and which actions affect these benefits. Around 19% of the respondents reported that deforestation around their area happens due to the overexploitation of NTFPs. Focus group discussions with local communities reported that only a few villages participated in extension services concerning agricultural farming technologies, establishing plantations and community forestry related information. Previous studies revealed that local communities were aware of environmental problems but did not seek involvement in environmental programs due to lack of interest, time, awareness, and knowledge level (Alkan, Korkmaz, & Tolunay, 2009; Jim & Xu, 2002; Kamaruddin, Ahmad, & Alwee, 2016; Soe & Yeo-Chang, 2019). Educational training providing the information on the consequences of overexploitation of NTFPs, and the benefits of forest conservation is required in the study areas. Polices could emphasize building environmental awareness and knowledge for both fuelwood users and producers. As illegal logging (including charcoal production) and firewood collection are the direct drivers

of forest degradation (Myanmar REDD+ Program, 2017), as well as their highly contribution to the livelihood of local communities, policies for reducing wood consumption by locals with a careful consideration of alternative energy supply could be a solution to the current problem of forest degradation in Myanmar. In addition, the educational training on the adverse effects of fuelwood utilization not only on the environment but also on family health would be a possibility to change their behavior of using fuelwoods for cooking (Myanmar REDD+ Program, 2017). As the average educational level in the study area was around almost 4 years, the visual awareness raising using the banners or cartoons would be more effective. Supported by (Kudryavtsev, Krasny, & Stedman, 2012; Niaura, 2013), the environmental education program to youth could have effect their behavioral intention to the environmental attitudes.

4.4.3. Suggestions for Developing Potential Policies and Measures (PAMs)

To prevent anthropogenic intrusion into the natural ecological systems and take action against climate change, the developing countries participating in the UN-REDD program (United Nations collaborative initiative on Reducing Emissions from Deforestation and forest Degradation) were encouraged to develop and implement PAMs to support climate change mitigation and adaptation actions. PAMs not only can deal with the main activities of REDD+, but can also bring about an integrated rural development while helping mitigate climate change. We developed a potential PAMs package based on the major policy implications mentioned above to address the overexploitation of NTFPs (see Figure 4.6). This figure explained how the main causes of overexploitation of NTFPs (poverty, food insecurity, land tenure insecurity, energy inaccessibility (electricity) and lack of capacity in terms of technology and education) could be addressed by means of potential PAMs. The following combination of PAM suggestions could be considered to solve the problems discussed above.

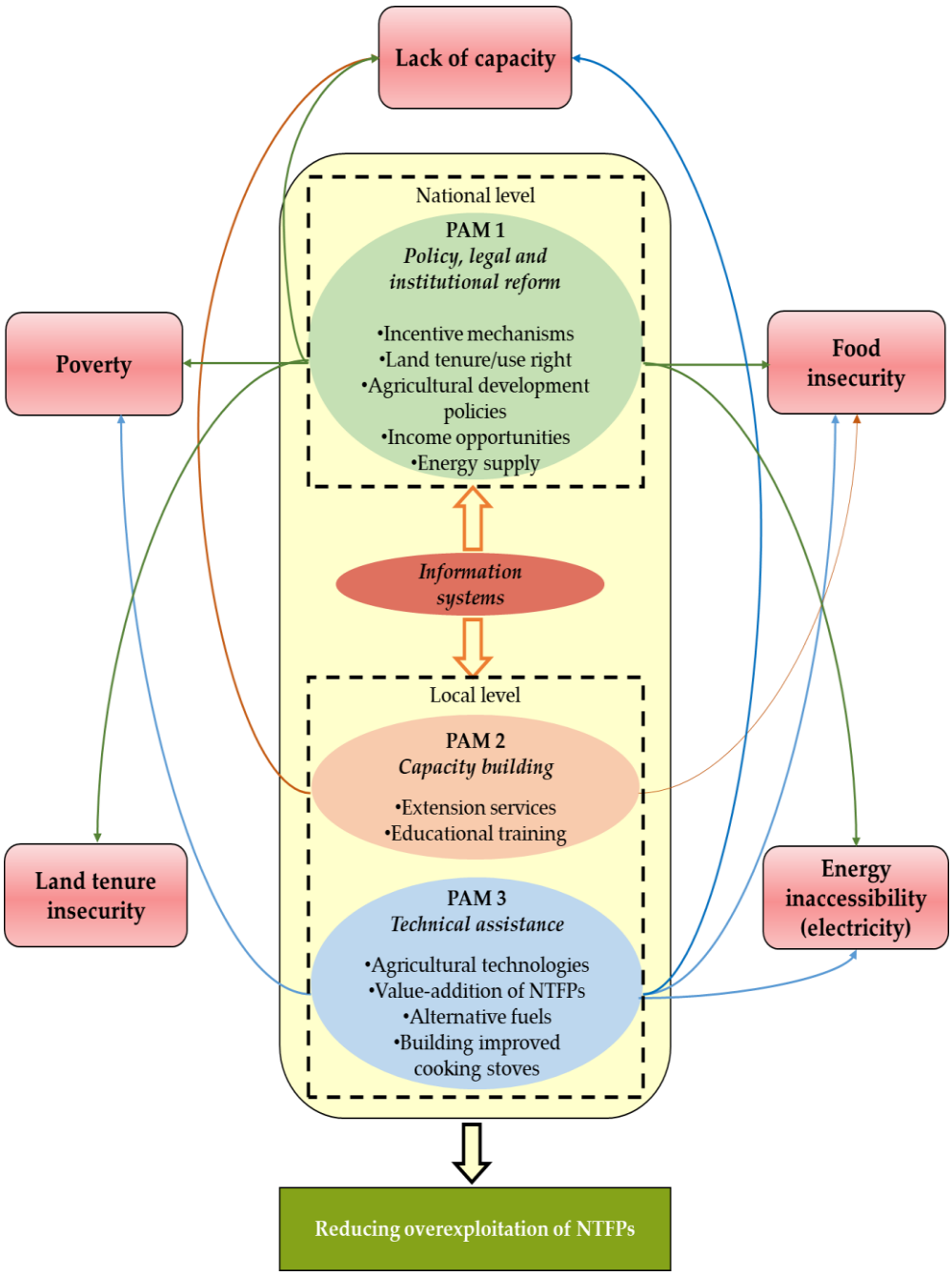


Figure 4.6 Illustration of potential combined package of PAMs to solve main problems of NTFPs overexploitation

Source: adapted from (Hugel et al., 2017a; Myanmar REDD+ Program, 2017)

Combined PAM 1: *To reduce overexploitation of NTFPs, we need to reform policy, law and institutions such that incentive mechanisms, land tenure and land use rights can be improved, and agricultural productivity, income opportunities and energy supply is developed at national level.*

The long-term production of forest products lies at the core of sustainable forest conservation while overexploitation and the extraction in an unsustainable way lead to the degradation of forests. Recently, the value of NTFPs has been recognized along with their contribution to the local and national economy. At the same time, stress on forests due to the exploitation of NTFPs has increased due to poverty, food insecurity, land tenure insecurity, energy inaccessibility and lack of capacity in terms of technology and education. As REDD+ has the potential to be a new paradigm for both conservation and livelihood development (Bayrak, Tu, & Marafa, 2014), PAMs should take into account this two-way feedback relationship and develop win-win situations through the provision of incentives. Securing land tenure, providing enough land leases to do agroforestry by participating in government plantation programs, or creating income opportunities, could help increase participation in conservation programs, consequently reducing overexploitation of NTFPs (Soe & Yeo-Chang, 2019). Indeed, long-term consideration for the communities could assist to ensure such win-win situations. According to key informant interviews, charcoal making has been practiced both legally and illegally in the study area. However, the data on legal or illegal production of charcoal by households were not obtained in our survey. This situation stresses the need for legal reform and action against individuals who focus on maximizing short-term benefits at the expense of the long-term sustainability of NTFPs. Apart from this, the research on NTFPs and fuelwood consumption by households and their perceptions on their utilization warrants further study. The regulations on NTFPs harvest systems is still lacking and the research on the sustainable harvest of NTFPs is limited in Myanmar.

Thus, the provision of guidelines and technologies for the extraction and management of NTFPs in a sustainable way is necessary.

Combined PAM 2: *To solve the problem of food insecurity and lack of capacity, we need to conduct capacity building for forest-dependent communities at the local level.*

Common property resources can be overexploited if tenure systems are weakened or where governance or enforcement mechanisms are ineffective (Lee, Neves, Wiebe, Lipper, & Zurek, 2009). In Myanmar, common property NTFPs enables forest-dependent communities to harvest more forest products and gradually making them faced with an additional challenge of sustaining their livelihoods, due to overexploitation of forest resources in the land tenure system lacking. The security of access to NTFPs could be carefully increased (Lee et al., 2009). As sole dependency on forest products could not provide enough income to the communities (Than et al., 2016), extension services on extraction and management of NTFPs in a sustainable way, agricultural technologies to increase crop production, and educational training on environmental awareness would help reduce food insecurity and increase the capacity of communities.

Combined PAM 3: To solve the problem of energy supply, poverty, food insecurity and lack of capacity, we need to offer technical assistance to forest-dependent communities at the local level.

Despite the fact that charcoal making provided tangible economic benefits to the communities (see Table 4.3), it had a severe impact on the environment due to unsustainable harvesting and the selective harvesting of trees (Chidumayo & Gumbo, 2013; Woollen et al., 2016). It is important to include this understanding in policy discussions and a social-environmental strategic assessment could be conducted. Moreover, technologies related to the use of alternative fuels, building improved cooking stoves (Myanmar REDD+ Program, 2017) could help increase the energy supply, while value-addition to NTFPs together with conservation

programs and environmental awareness raising would reduce the overexploitation of NTFPs.

There is increasing evidence that forest policies and management strategies do not work in developing countries with large forest areas (Said, O' Hara, Tesfaye, Abebe, & Mogessie, 2013). As Myanmar has a large forest area with weak technology development and little human capacity, investigation and follow-up activities to detect and prevent illegal charcoal making cannot be conducted effectively, especially in the remote HMAs. As seen in our survey, households residing in HMAs were more dependent on NTFPs than those residing in LMA. To have effective regulation, the follow-up activities and field investigations concerning potential PAMs are imperative and should be strengthened for the sustainability of all PAMs. Overall, capacity building of government staff and research support would be crucial for PAMs to address the overexploitation of NTFPs.

4.5. Conclusion

Myanmar is one of the REDD+ implementing countries contributing to green development by protecting environmental resources, promoting reforestation and forest restoration, improving livelihoods of forest-dependent communities, and adapting to climate change. Reducing the degradation of existing overexploited forests and preventing future forest degradation is one of the objectives of the Myanmar National REDD+ strategy (Myanmar REDD+ Program, 2017). To achieve this goal, developing and implementing effective PAMs is crucial. This paper set out to generate data and information for the development of REDD+ PAMs. Policy implications for REDD+ to reduce overexploitation of NTFPs and forest degradation were considered in this study based on NTFP dependency by forest-dependent communities, specifically for the area of the Taungoo District, Bago Region.

Overexploitation of NTFPs leads to forest degradation and the

causes vary according to local conditions. We investigated the factors influencing dependence on NTFPs and explored potential PAMs. Our results showed that NTFPs contributed the most to total household income and the main contribution to NTFPs came from charcoal making and bamboo selling. It is worth noting that among sampled households, those who had a lower education level, less agricultural land, less income from off-farm activities, and those who lived under the poverty line, as well as those who used only charcoal, were more dependent on NTFPs. Also, among landowners, those who had lower education level, and under the poverty line were more dependent on NTFPs. Similarly, among landless people, those who were with longer periods of rice insufficiency, less income from off-farm activities and those who used charcoal had a higher dependence on NTFPs.

From the study results, the effects of landownership, poverty, off-farm opportunities and fuelwood used on NTFP dependence reminded the policy makers to take into account local people' s livelihoods while considering the sustainable management of forest at the national level. The suggestions went to paying more attention on creating income generating activities, land tenure security and technologies for alternative fuels integrating in the REDD+ PAMs through increasing the awareness of local communities and participation in conservation programs. As implementing these strategies on human-environment conservation is long-term task, it is challenging for the policy makers to fulfill the priority of the local communities that focused on food security and subsistence income while implementing sustainable forest management. Thus, the cooperation of line ministries would be needed. As energy supply has a huge impact on forest degradation, the cooperation between forestry sector and energy sector would make the effective strategies on reducing fuelwood usage.

Policy makers should refer to the socio-economic and demographic characteristics of forest-dependent communities in considering how PAMs can suit for a specific set of social conditions at the local level. Our study provided this information by

shedding light on potential PAMs based on empirical factors related to the dependence of forest-dependent communities on NTFPs and on the problem of overexploitation of NTFPs. Our results also provided an expanded set of policy implications to be considered in REDD+ implementation by highlighting the underlying causes of the dependence on NTFPs. In fact, our analysis identified the empirical factors that determined this dependence.

The results from our study would be relevant for other REDD+ countries with similar conditions of local communities by reminding the considerations and potential measures when implementing REDD+ programs. However, it must be kept in mind that this study also has limitations related to the representativeness of the two townships selected. Future study should investigate the impact of potential PAMs in different socio-economic contexts so that effective and suitable PAMs could be employed to accurately target the drivers of deforestation and forest degradation at a larger scale.

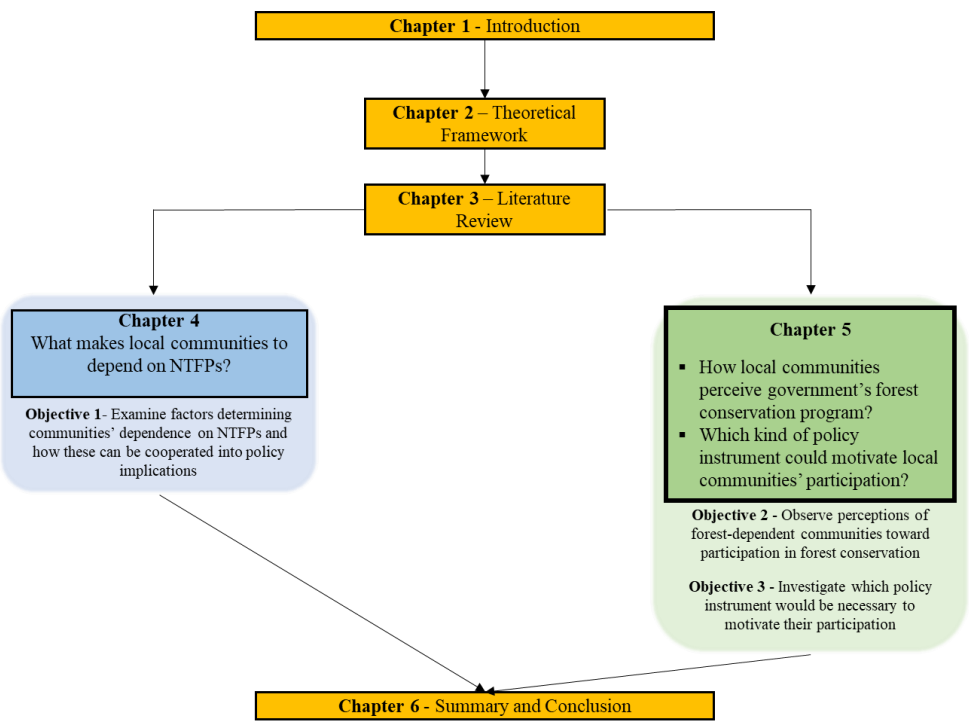
4.6. Summary

Deforestation and forest degradation are one of the biggest threats to forests and people worldwide. In Myanmar, poor regulation and unsustainable extraction of non-timber forest products (NTFPs) is affecting millions of hectares of natural forests; overexploitation of forest resources is one of the main drivers of forest degradation. Although the evidences showed that the extraction of NTFPs results in forest degradation, there have been few studies on what drives rural people to depend on NTFPs and how to address these drivers in terms of policies and measures. Policies and measures are nationally enacted policies and actions that countries undertake to address the causes of deforestation and forest degradation. This study identified which factors determine the dependence on NTFPs in forest-dependent communities. From these factors, we derived policy implications for the main causes of overexploitation of NTFPs to provide suggestions for developing

policies and measures in the design of national Reducing Emissions from Deforestation and Forest Degradation (REDD+) strategies. Focusing on the Taungoo District as a case of dependence on NTFPs by local communities, we conducted a qualitative and quantitative data collection procedure based on interviewing households in the local communities. NTFPs contributed the most to total household income and the main types of NTFPs exploited were charcoal making and bamboo selling. Households with lower education level, less agricultural land, less income from off-farm activities, lived under the poverty line or used only charcoal were more dependent on NTFPs in the study areas. Education, poverty and fuelwood usage were main factors affecting NTFPs dependence for landowners while off-farm income, rice insufficiency, and receiving extension services most affect the NTFPs dependence for landless people. The results suggested that national strategies for REDD+ should take into account local features such as income opportunities and land tenure in order to make local people cooperate with the government to avoid deforestation and forest degradation.

Chapter 5. Perceptions of Forest-Dependent Communities toward Participation in Forest Conservation: A Case Study in Bago Yoma, South-Central Myanmar

In chapter 5, how socioeconomic factors are related to forest-dependent communities' participation in forest conservation programs was investigated. This chapter helps to build our limited knowledge of the perceptions and potential responses of these communities to the potential incentives related to participatory forest conservation, which is an important knowledge gap needed to be considered in the forest management planning process. Chapter 5 is published in *Forest Policy and Economics*[②]. The research questions for this chapter was developed, designed, and data collection was conducted (with research assistants), and data was analyzed by the author. YOUN supervised the overall research, and reviewed and edited the manuscript.



② Soe, K. T., & Yeo-Chang, Y. (2019). Perceptions of forest-dependent communities toward participation in forest conservation: A case study in Bago Yoma, South-Central Myanmar. Forest Policy and Economics, 100(November 2018), 129–141. https://doi.org/10.1016/j.forpol.2018.11.009

5.1. Introduction

The interactions between local communities and forests are complex and, thus, often present policy makers with challenges in forest management and in ensuring care is taken of people dependent on forests (Agrawal et al., 1997; Leach et al., 1997). Designing forest policy for sustainable social-ecological systems requires integrated, multi-faceted win-win solutions in relation to forest management and the livelihoods of forest-dependent people (Ostrom, 1990).

The growing interest in environmental sustainability and development recognizes local communities as important actors within forest conservation, and this recognition has highlighted the need to have local communities involved in forest management, particularly in many developing countries (Agarwal, 2001; Arun Agrawal et al., 1997; Isager et al., 2002a). Governments of developing countries have made efforts to promote participatory forest management (PFM), but many of them have not succeeded, and this may be due to a lack of (or poorly designed) management strategies or a lack of suitable incentives to encourage participation. It appears that the unsuccessful efforts made by governments failed to identify and consider specific local conditions that could meet the needs of local communities in the policy process, which might otherwise have promoted local people' s active participation in the sustainable use of forest resources and in conservation. Offering incentives can increase local people' s support for participation in relation to governance, management issues, decision making and in activities concerning the conservation of natural resources (Arun Agrawal & Gupta, 2005; Brännlund, Sidibe, & Gong, 2009; Nguyen et al., 2010). Moreover, institutional and legal frameworks also determine the success of participatory processes (Isager et al., 2002b). Specifically, incentives can be distinguished as: financial incentives such as direct incentives (cash transfers and participatory management) (UNREDD, 2017), and subsidies to undertake target-oriented activities (Kissinger et al., 2006), and;

non-financial incentives such as land tenure security and user rights (Isager et al., 2002a), access to forests and availability of forest products (Aryal & Angelsen, 2015), and secure property rights (Adhikari, Kingi, & Ganesh, 2014; Arun Agrawal & Ostrom, 2001).

Myanmar lost 2,732 thousand hectares of forests between 2010 and 2015, which was the third highest in the world in terms of annual net loss (FAO, 2016). The drivers of this forest loss have been primarily agricultural expansion (especially rubber and oil palm plantations), illegal logging, mining and hydropower development, overexploitation of forest resources, weak land tenure arrangements, limited government effectiveness, long-standing conflicts over land rights, and the lack of land-use policies and related land-use law until 2012 (Kissinger et al., 2017). Myanmar has been implementing forest policies for the rehabilitation and restoration of degraded land and forest reserves through community participation, to mitigate climate change and to promote the socioeconomic development of local communities.

In many tropical countries, due to differing types of forest use and insecure land tenure systems, conflicts between governments and forest-dependent peoples have occurred within most locations with environmental conservation programs (Meijaard et al., 2013). In Myanmar, there have been various laws intended to regulate land conflicts since the colonial era under Great Britain (Leckie & Simperingham, 2009). However, several challenges have arisen, including different government departments having responsibility for overlapping areas (McCarthy, 2016), little or no awareness of land tenure issues by the public, differing categorizations of land rights and land-use rights held or maintained by several ethnic groups, and the government itself creating tension among government authorities, private investors and local communities. To encourage economic development and attract private investment into the forest sector, the Myanmar government has allocated state forestland for forest plantations to private companies, and restricted the land-use rights of forest-dependent communities; this situation

has led to conflicts between government authorities and local communities.

On the other hand, the Myanmar government has also started community forestry programs which promote local people's participation in forest conservation. Community forestry programs allow local people to engage in forest management activities, such as establishing forest plantations by planting teak or other tree species, and in return they are allowed to intercrop agricultural crops with the newly planted trees. The local people involved in these activities are invited to select a tree species, do the necessary physical work, and are given a temporary land-use access right to the plantation site. One study in Myanmar claimed that local people did not welcome plantation projects implemented by the government because of the failure of Myanmar Forest Department (FD) to adapt and investigate the needs and desires of local people (Kaung & Cho, 2003). (Maung & Yamamoto, 2008) pointed out that local people in Myanmar have participated in plantation projects not because they were fully aware of the benefits of forests for their well-being and the potential of forest plantations for socio-economic development of the country, but because they needed lands to cultivate agricultural crops in the teak plantations for their survival. Their study reported that, while some people were willing to participate in the establishment of plantations, there were many people unwilling to participate in plantation work due to the absence of a long-term development program for local people, and because the incentives offered were only temporary (Maung & Yamamoto, 2008). Some plantation projects in Myanmar have failed to facilitate the participation of local communities in the management of the established plantations. Nevertheless, the findings of Tucher & Ostrom, (2005) suggest that people's participation in state forest management could increase the sustainability of forest-dependent social systems.

Through understanding the perceptions of local people concerning the benefits of forests, we consider that it is possible to determine a set of incentives for local communities that could

promote their participation in state forest management. We postulated that there was not enough information available on local people' s perceptions of forests, how they valued forests and what their state of awareness was concerning the forests in Myanmar for decision makers involved with state forest management. To establish participatory forest conservation effectively in Myanmar, it is necessary to understand the perceptions of forest-dependent communities on forest benefits and their knowledge concerning the drivers of deforestation, which are required for designing incentives that could facilitate the success of the government' s policy tools in being accepted by local people.

Because of the increased emphasis on local communities' participation in the rehabilitation and restoration of degraded land in Myanmar, the challenge of discovering how to motivate and support forest-dependent communities to engage in sustainable participatory forest conservation has become crucial. To allow forest dwellers to play a role as partners within sustainable forest management rather than as excluded and destructive outsiders, the FD has run a community-based forest management (CBFM) scheme since the early 1980s that has involved inviting shifting cultivators or local communities to engage in plantation projects as collaborators (H. Aung et al., 2010; Kaung & Cho, 2003; Maung & Yamamoto, 2008). Although the FD employed the CBFM approach for forest conservation, information regarding the perceptions and potential responses of forest-dependent communities to the participatory conservation programs is either not available or not used in the forest management planning process if available. This situation has meant that policy makers have been unable to design an appropriate incentive scheme, which could otherwise have led to local communities becoming more likely to engage in state forest management as collaborators.

To address this challenge and fill the knowledge gap, we aimed to increase understanding of forest-dependent communities' current perceptions of forest benefits and awareness of deforestation, and determine which policy interventions would

motivate those communities with specific socioeconomic characteristics to participate in forest conservation. We also investigated whether the communities' willingness to participate in forest conservation differed by geographical area and other socioeconomic factors.

More specifically, this study aimed to answer the following research questions, namely: (1) are the geographical locations of villages, and household socioeconomic characteristics and awareness of deforestation related to forest-dependent communities' willingness to participate in forest conservation?, and: (2) are local people's preferences for different government incentive schemes related to their participation in forest conservation? Our specific objectives were to: (i) examine local people's perceptions concerning the benefits of forests among forest-dependent communities, (ii) estimate their willingness to participate in forest conservation, and (iii) determine which policy interventions would be necessary to motivate their participation in forest conservation.

We first provide an overview of the theory of PFM, and present the theoretical framework and methodology of the study. We report the results of our analysis and discuss the implications for forest conservation policy design, and then conclude with a summary and recommendations.

5.1.1. Theoretical Framework

To frame our research, we adopted a trichotomy of "carrots," "sticks," and "sermons," namely, economic means, regulations, and informational instruments (Vedung, 1998), that could influence forest-dependent communities' attitudes and behavior, including their participation in the state's forest conservation programs, and sometimes, even limit their activities (Figure 5.1). This study focused on three economic incentives: two financial incentives, namely, direct payment and providing income opportunities, and;

one non-financial incentive, namely, providing land tenure security or temporary use rights to cultivate crops in forest lands. While there are other incentives, including regulations designed to control people (Kissinger et al., 2006; Leach et al., 1997) and informational services aimed to raise public awareness and knowledge on relevant issues, these are not covered in this study. We included forest extension support (extension services) and awareness of deforestation as variables, as these variables were assumed to be informational incentives that could affect participation. With scenarios involving these financial and non-financial incentives, we analyzed how the perceptions of forest-dependent communities towards participation in forest management could vary.

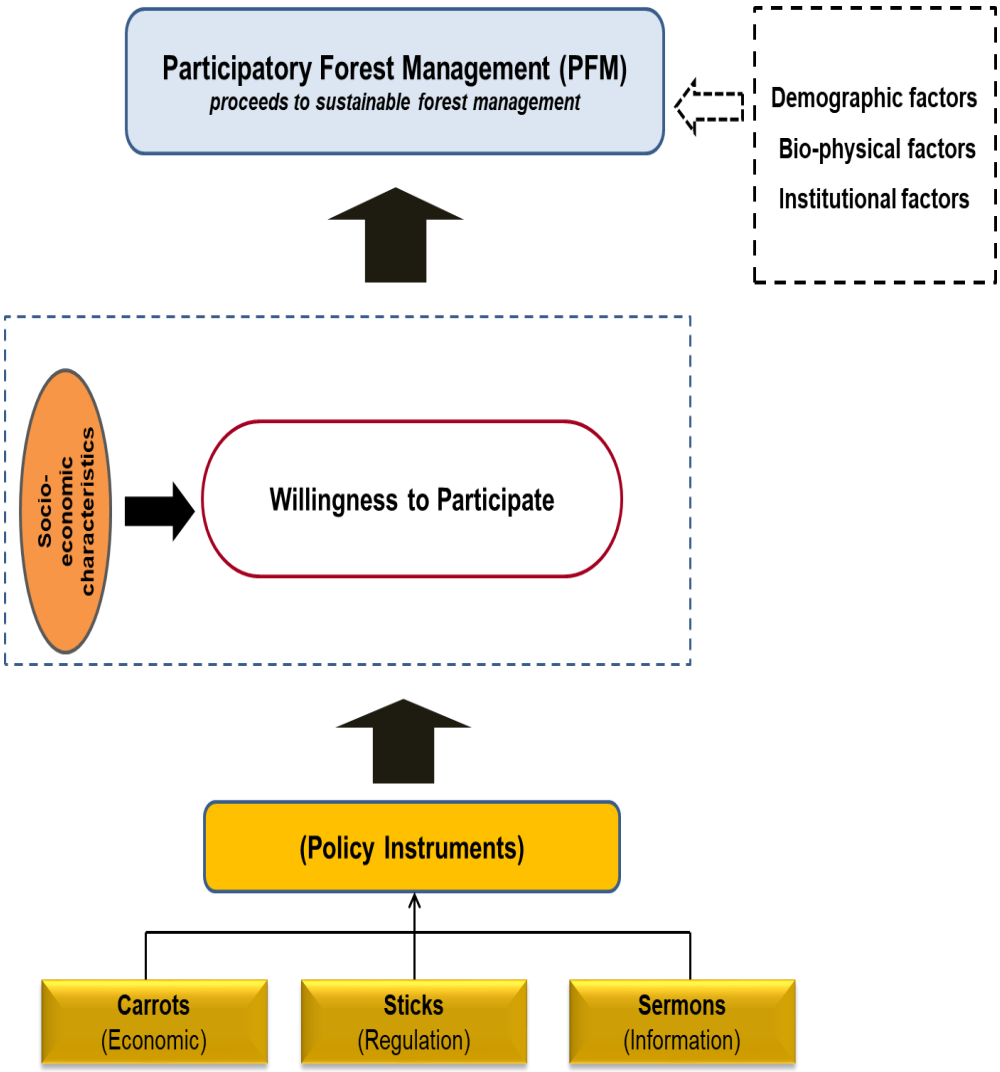


Figure 5.1 Research conceptual framework

Source: Developed based on a previous study (Gashu & Aminu, 2019; Maslow A.H., 1943; Vedung, 1998, p.21−58)

5.2. Methods: Case Study Description, Data Collection and Analysis

5.2.1. Case Study Description

The Bago Yoma (Yoma means mountain ranges in Burmese) extend from the north to the south of the Bago Region. This region is the sixth largest (39,400 km^2) in Myanmar, has a population greater than 4.8 million, and is located in the southern part of the country' s central basin (Department of population, 2015). The Bago Yoma Region has four districts: Bago, Taungoo, Pyay, and Tharrawaddy. These four districts have abundant valuable commercial timber species, including native teak, and comprise one of the country' s major timber-producing areas (Mon, Mizoue, Htun, Kajisa, & Yoshida, 2012).

The study area, Taungoo District, comprises six out of the region' s 28 townships (Figure 4.2). This district has a population of approximately 1 million and is the second most populated district in the region. Additionally, the Taungoo District is located along the Bago mountain ranges and is continuous with other mountains in the eastern part of the region; 80% of the residents live in rural areas; and the mean annual precipitation ranges from less than 1,400 mm to greater than 2,400 mm (Forest Department of Myanmar, 2015). Occupying around 747 thousand hectares of total forest area, Taungoo District has large area of reserved forests (see Figure 5.2). We selected two townships, Yaetarshae Township, located within the lower mountain ranges, and Oaktwin Township, located within the higher mountain ranges (Figure 5.2), because this study aimed to understand the perceptions and attitudes of forest-dependent communities living in different geographical areas regarding forest benefits as well as their willingness to participate in forest conservation. The majority of ethnic groups in low mountain ranges is Burma, while the majority is Kayin, practicing mostly shifting cultivation in high mountain ranges.

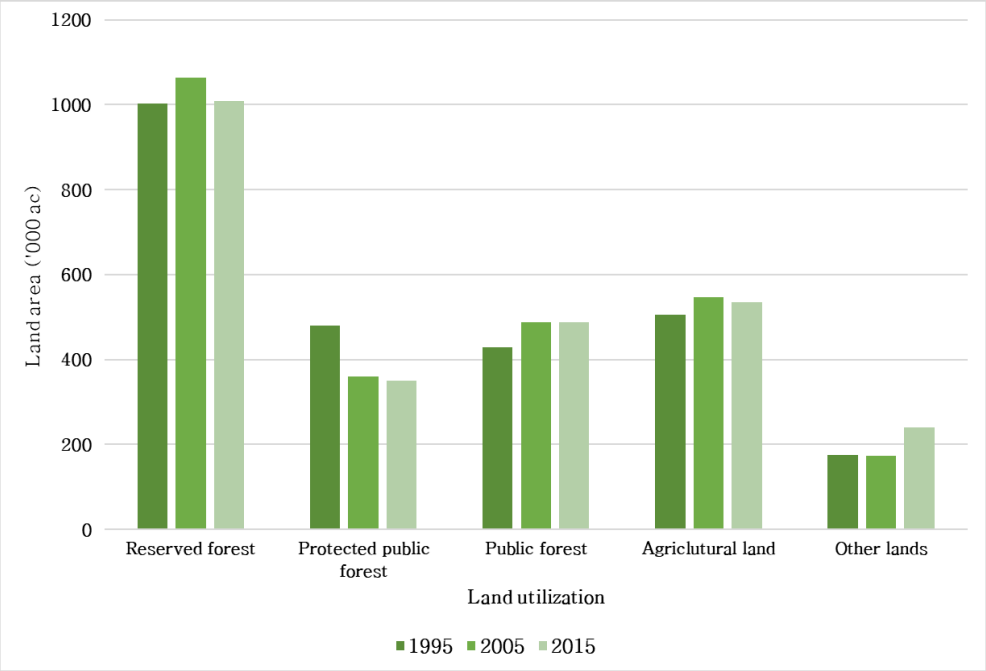


Figure 5.2 Land utilization in Taungoo district

Source: Forest Department, 2016; (Forest Department of Myanmar, 2015)

To select the study sites, the following criteria were used: (1) the presence of plantation programs conducted by the government such as reforestation and rehabilitation of degraded forests and private plantations; (2) a predominance of the population living in rural areas, and; (3) specific landscape characteristics including low and high mountain ranges and engagement of the majority of the local population in forest-related activities.

5.2.2. Methods: Data Collection and Analysis

The study was conducted through secondary data collection paired with a survey. The secondary sources of data covered information such as forest cover area, land utilization, population, and annual rainfall data, and study area maps were collected from the Forest Department, Ministry of Natural Resources and Environmental Conservation (Myanmar), and the Taungoo District Forest Department.

The survey was conducted in October and November 2016 after receiving ethical approval and informed consent. The following methods were chosen to examine the general and specific local ecological and social conditions in the study area and understand the views of the respondents: key informant interviews, focus group discussions, and face-to-face interviews. Three questionnaires were designed for each category of interviews.

The key informant interviews were conducted with government officials from the Forest Department in Taungoo District, to understand the general livelihood conditions and local terrain of the selected forest-dependent communities, as well as the nature and extent of deforestation in the area. Focus group discussions were conducted through a semi-structured questionnaire administered to the village leaders and elders, to help understand the general conditions of the studied villages, in relation to geography, livelihoods, transportation, forest resource use, and particularly, their preferences concerning rewards or incentives for participating in government forest conservation programs. Some of the households in these villages have been engaged in plantation projects implemented by the government. In the case of interviewing households living in high mountain ranges, the main barriers are language and educational problem. As the majority of the respondents were Kayin ethnic groups using different language, and some were not able to read or write, the help from the village leaders for translation was acknowledge in our survey. The individual face-to-face interviews were conducted through a semi-structured questionnaire involving a randomly selected sample of forest-dependent households from a sample of 18 villages within two township areas; 330 households providing valid answers were selected.

5.2.2.1. Socioeconomic Factors

The demographic factors selected as explanatory variables included age, sex, and educational level (school years completed) of

the respondents. The socioeconomic characteristics of selected households included ownership of farmland (yes/no), family labor (the number of family members who contribute labor), the degree of forest utilization (income from non-timber forest products (NTFPs)), rice insufficiency (number of rice shortage months in a year), awareness of deforestation, and experience of forestry extension services. The annual income of the interviewed forest-dependent households was calculated using the market prices of products, with an assumption that the participants had access to the market. We assumed these communities had market access because most of the households sell their products to collecting brokers or wholesalers. The value of the NTFPs consumed by the households was assumed to be the same as their market value, given these NTFPs could be and were sold to the brokers. The NTFPs accounted for included bamboo, poles, wild vegetables, firewood, charcoal and medicinal plants, all of which contribute to the livelihoods of the people.

Household annual income = the sum of the following: NTFP income + migration income + causal labor income + crop cultivation income + livestock income + other income. Using this method, total household income was determined using the following equation:

$$Y_{tincome} = \sum_{i=1}^{n} [S_i]$$

where $Y_{tincome}$ is total household income and s_i is income from source i.

The income from crop cultivation was calculated based on the income definition approach used by (PEN, 2007), with the following equation:

$$I = \sum_{i=1}^{n} p_i y_i - \sum_{j=i}^{m} q_i v_i$$

where I (net income from crop production) is the gross revenue (price x quantities of all n products) – total costs (price x quantities) of m purchased inputs (e.g. seeds, hired labor), but including the family labor wage.

5.2.2.2. Perceptions Regarding the Benefits of Forests and Deforestation

First, after providing the respondents with a few examples of the benefits that forest provide, they were asked what the main benefits were that they received from the forests. Second, the reported importance of the forests was recorded using a Likert scale rating (1 = very important, 2 = moderately important, and 3 = not important). Third, the respondents were asked if they were aware of deforestation: if the answer was "yes," they were asked how they had come to be aware of deforestation and what they thought the influencing factors were. To support this question, the respondents were initially provided with a simplified definition of deforestation derived from the UN Food and Agriculture Organization (FAO), *"the conversion of forest to other land use or the reduction of tree cover"* (FAO, 2010b).

All the respondents' answers were noted to capture their experiences related to deforestation. Because the scope of the study was simply to examine their knowledge regarding deforestation, we did not ask about the factors contributing to deforestation and forest degradation separately; instead, we noted all the factors mentioned. Descriptive analysis was conducted to explain their perceptions regarding forest benefits, their knowledge of deforestation, and their receiving of extension services.

5.2.2.3. Perceptions on Forest Conservation

The forest conservation efforts investigated in this study concerned government plantation projects in the Taungoo District, Myanmar, involving rehabilitation, reforestation, and restoration of degraded forests, and plantations implemented through agroforestry (agricultural crops + teak) that are managed during the first 2–3 years of plantation in reserved areas. Local people are invited to participate in contributing their labor for forest management activities within the plantation projects, such as land preparation and planting teak trees, and are given access to the land for intercropping the cultivation of agricultural crops with teak. In this study, we have considered this kind of local community involvement in state forest management as PFM. The respondents were provided with these examples of forest conservation during the interviews. Next, they were asked about their willingness to participate in forest conservation, and we denoted "yes = 1" and "no = 0" to confirm participation.

5.2.2.4. Empirical Model

A binary logistic regression analysis was used to predict the effects of socioeconomic characteristics, awareness of deforestation, and whether extension services had been received on respondent willingness to participate in forest conservation. The description of the explanatory variables and their expected relationship with the response variable were explained in Table 6.1. The models were analyzed using the Statistical Package for Social Sciences IBM SPSS Statistics 23.0 (IBM SPSS, 2017). The binary logistic regression model is described as follows:

$$\ell = log_b \frac{p}{1-p} = \beta_0 + \beta_1 x_1 + \beta_0 x_2 + \varepsilon$$

Where ℓ is the log-odds, p is the probability of the event that Y=1, and β_i are parameters of the model.

A base model enabled us to predict the forest-dependent communities' willingness to participate in forest conservation (Table 5.2) and led us to construct two models to observe the effects in the different geographical areas (Table 5.3). Finally, the willingness of forest-dependent communities to participate in forest conservation was analyzed in relation to three possible policy incentives (direct payment, providing income opportunities, and providing land tenure security or temporary land use rights to cultivate the crops in forest land), as introduced in the focus group discussions. According to their preferences regarding the provision of possible incentives, we divided the respondents into three groups, and three models were analyzed to observe how groups with different preferences on the incentives then responded in terms of a willingness to participate in forest conservation (Table 5.4).

Table 5.1 Descriptive statistics for the explanatory variables used in the binary logit model and their expected relationship with the response variable (willingness to participate in forest conservation)

Variables	Description	Unit	Mean	Median	SD	Expected sign	Findings from the literature
Age	Household head's age	Years	44.92	45	12.08	+ −	Older people are more involved in forest conservation because they have more knowledge about forests and more confidence in returns from their participation (Ratsimbazafy, Harada, & Yamamura, 2012). Younger people are more willing to participate in physically demanding conservation activities (Shan, 2012; Zhang et al., 2011).
Sex (Male)	Household head's sex	Male=1	0.96	1	0.19	+	Male−headed households have more willingness to participate in forest conservation than female−headed households (Coulibaly−Lingani, Savadogo, Tigabu, & Oden, 2011; Kugonza, Buyinza, & Byakagaba, 2009; Oli & Treue, 2015).
School years	Household head's completed schooling years	Years	3.7	4	2.32	+ −	The more educated people are, the higher the level of understanding on the importance of forest conservation and the greater the willingness to participate in conservation activities (Jumbe & Angelsen,

							2007; Lise, 2000; Oli & Treue, 2015) Higher education levels mean better employment opportunities and less dependence on forest resources, thus less interest in participating in forest conservation activities (Arun Agrawal & Gupta, 2005)
Own land (Yes)	Land ownership	Yes=1	0.74	1	0.44	+	Land ownership is associated with positive attitudes towards forest conservation projects (Ratsimbazafy et al., 2012).
Family labor	Number of members who can contribute labor	Number of family laborers	2.41	2	1.13	+	The larger the number of laborers in a family, the greater the participation in labor-intensive forest conservation activities (Coulibaly-Lingani et al., 2011; Jumbe & Angelsen, 2007; Maskey, Gebremedhin, & Dalton, 2006)
Relative income from NTFPs	Share of NTFPs income in the total household income	Percentage	39.68	27.15	34.13	+	High forest dependency and perceiving the quality of forests as benefits stimulate participation in forest management (Coulibaly-Lingani et al., 2011; Dolisca, Carter, McDaniel, Shannon, & Jolly, 2006; Jumbe & Angelsen, 2007; Oli & Treue, 2015).
Rice insufficiency period	Number of rice shortage months	Number of months	1.48	0	1.88	−	Households with insufficient rice are less willing to participate in forest conservation

	in a year						activities and more interested in other income activities.
Awareness of deforestation (Yes)	Awareness of deforestation	Yes=1	0.92	1	0.28	+	People with more knowledge and awareness of the environmental conditions have positive perceptions and attitudes to conservation activities and management interventions (Alkan et al., 2009; N. Z. Htun et al., 2012; Jim & Xu, 2002).
Received extension (Yes)	Received extension services	Yes=1	0.28	0	0.45	+	Effective extension services can improve the knowledge of local communities, which could increase positive perceptions and attitudes concerning environmental conservation and government interventions (N. Z. Htun et al., 2012)
Geographic area (HMAs)	Residency in high and low mountainous areas	HMA=1	0.65	1	0.48	+	Remote areas have fewer income opportunities and higher dependency on forest resources than those areas with better infrastructure. The more benefits from the forest, the more willing people are to participate in forest conservation (Coulibaly-Lingani et al., 2011; Jumbe & Angelsen, 2007; Maskey et al., 2006)

Note: NTFPs - non-timber forest products; HMAs - high mountainous areas

5.3. Results

5.3.1. Characteristics of Forest-Dependent Communities Living in Low and High Mountainous Areas

Most of the households in our sample were forest-dependent farmers with diverse livelihood systems that combined income from NTFPs, rearing livestock, migration, crop cultivation, causal labor income, farm labor income, and other income (e.g., income from small grocery shops). Income from NTFPs (cash and non-cash) contributed 46% of the total income for the households in high mountainous areas (HMAs), whereas crop cultivation contributed 36% of the total income in low mountainous areas (LMAs) (Figure 5.3). All other income compositions, except migration income, provided lower income in households living in HMAs compared with those in LMAs, revealing the limited nature of income opportunities in HMAs. Among the sampled households, 74% in HMAs and 69% in LMAs were agricultural landowners, including official and non-official land tenure holders, shifting cultivators and tenant farm-forestry households.

Household food security levels were calculated based on the annual per capita income of sampled households compared with the regional food poverty line (283,495 Myanmar Kyats, MMK/year = US$225/year, calculated in November 2016) for the study area in the Eastern Bago Region (UNDP Myanmar & Schmitt-Degenhardt, 2013). Our analysis showed that 55% of households in HMAs and 44% of households in LMAs had food security levels below the food poverty line.

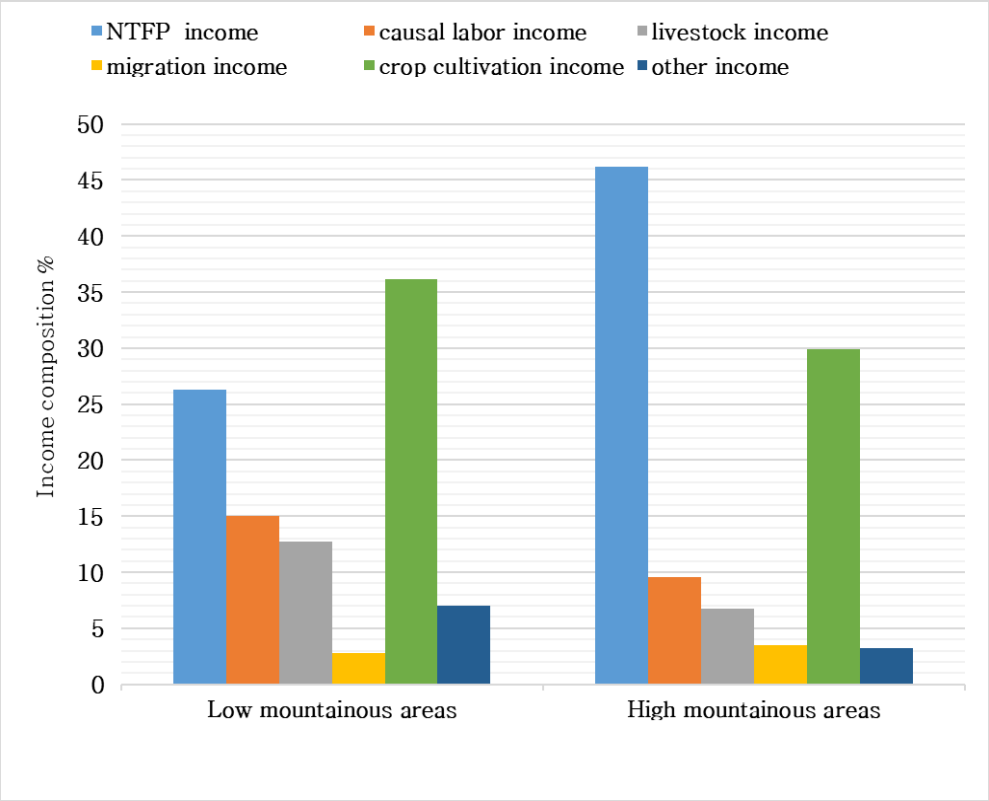


Figure 5.3 Income compositions of forest-dependent communities
Note: NTFPs - non-timber forest products
Source: Survey results (author's calculation)

5.3.2. Analysis of Forest-Dependent Communities' Perceptions Concerning Forest Benefits and Deforestation

The respondents reported that forests were moderately to very important for their livelihoods (100% of households in HMAs and 93% in LMAs). The main benefits of forests were identified as resources for housing (48% of households), regulation of local weather (27% of households), and providing income for the family economy (13% of households). The results showed a diverse range of benefits valued by the households regarding the forests (Figure 5.4).

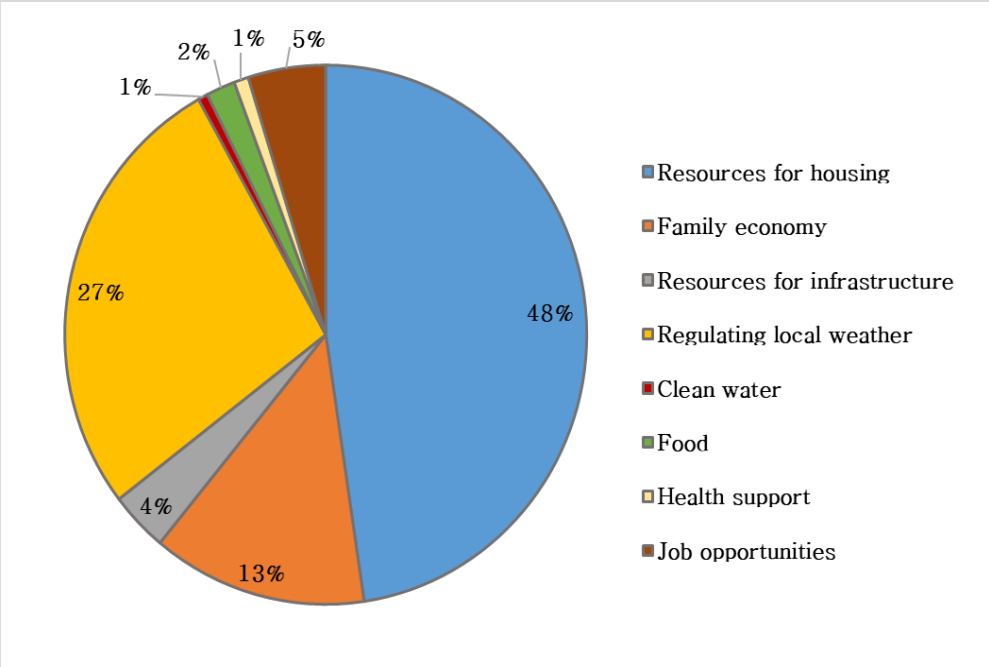


Figure 5.4 Forest benefits valued by forest-dependent households

The Bago Region is one of the most highly deforested areas in Myanmar and, as expected, greater than 90% of the sampled households were aware of the deforestation. They had become aware of deforestation because of the decreasing amount of NTFPs (52% of households) and the longer distances that had to be traversed to collect NTFPs (12%), as well as being only able to gather less mature firewood (10% of households) (Figure 5.5). As the highest income contribution to the family economy in HMAs and the second highest in LMAs, the depletion of NTFPs was the most visible consequence of deforestation mentioned by the households.

More than 20% of the households reported that legal and illegal charcoal making was the main driver of deforestation, while 19% considered over-exploitation of NTFPs as the main driver followed by legal logging, shifting cultivation, and plantation companies (Figure 5.6). Notably, most of the main drivers mentioned by the respondents overlap with the drivers of deforestation and forest degradation in Myanmar as reported in a recent study (Kissinger et al., 2017), apart from the establishment of commercial private

plantation companies being a further specific driver according to the local communities.

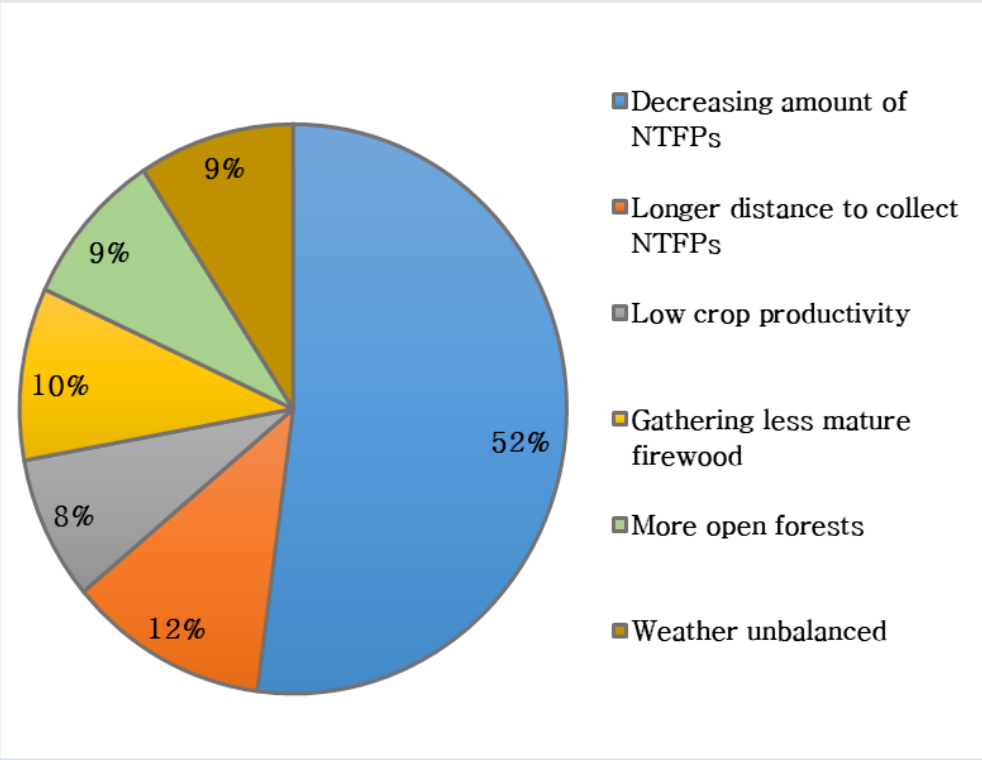


Figure 5.5 How forest-dependent households noticed deforestation

Note: NTFP - non-timber forest product

Source: Survey results (author's calculation)

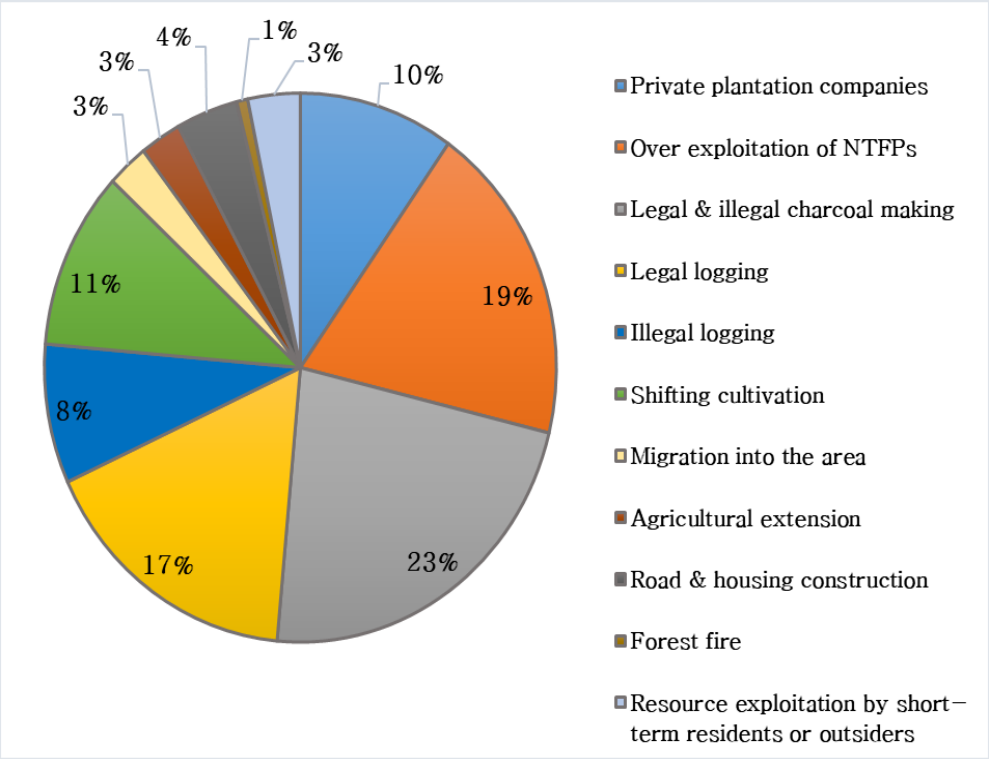


Figure 5.6 Drivers of deforestation perceived by forest-dependent households

Note: NTFP - non-timber forest product

Source: Survey results (author's calculation)

5.3.3. Analysis of Forest-Dependent Communities' Willingness to Participate in Forest Conservation

5.3.3.1. Participation Factors in Relation to Forest Conservation

Basic distributional statistics for the explanatory variables obtained from binary logistic regression analysis and an overview of the expected relationship with the response variables derived from the relevant literature are shown in Table 5.1. Most households were male-headed households living in HMAs. The mean household age was 44.92 years and the household heads had an average of 4 years of completed schooling. Most households own land, and the average number of family laborers per family was 3. The average

share of NTFPs income in a household' s total income was 39.6%. A rice insufficiency period covered the duration of time when households needed to buy rice from the market because of an insufficiency in rice production for self-consumption. The mean rice insufficiency period was 1.48 months. Most households were aware of deforestation. Only a few households had received extension services, such as help with establishing plantations and CF-related information.

To test whether the selected variables (socioeconomic characteristics, an awareness of deforestation, and receiving extension services)and preferences on incentive types influenced forest-dependent communities' willingness to participate in forest conservation, a base model was estimated using a binary logistic regression model (Table 5.2).

Table 5.2 Predicting the odds ratios of forest-dependent communities' willingness to participate in forest conservation

Variables	B	Exp. (B)
Age	.019	1.019
Sex (Male)	1.391	4.021
School years	.168	1.183
Own land (Yes)	−1.814	.163**
Family labor	.402	1.494
Relative NTFPs income	.019	.981**
Rice insufficiency period	−.118	.889
Awareness of deforestation (Yes)	1.625	5.081**
Received extension (Yes)	.276	1.318
Geographic area (HMAs)	1.601	4.957***
Providing income opportunities	1.534	4.637*
Providing land tenure security or temporary land use right	.874	2.395
Constant	−1.399	.247
Chi-square, $\chi 2$	43.042***	
Nagelkerke R^2	32.4%	
No. of correct predictions	94.5%	
No. of observations	330	

Note: * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$; NTFPs – non-timber forest products; HMAs – high mountainous areas; B – coefficient; Sig. – significance; Exp. (B) – exponentiation of the B coefficient (odds ratio)
Dependent variable = Forest-dependent communities' willingness to participate in forest conservation
Direct payment incentive as a default variable.

As expected, negative coefficients were obtained for the "land ownership" and "rice insufficiency period" predictor variables, whereas the "rice insufficiency period" was not significant for the willingness to participate in forest conservation. A negative "land ownership" coefficient indicated that respondents who

owned farmland were slightly less willing to participate in forest conservation compared with landless respondents. According to the focus group discussions, some of the respondents' lands had been allocated to private plantations by the government. Thus, one reason to explain why land owners were less willing to participate in forest conservation could be that they believed their own land might be subject to conservation policies. This possibility suggests concern regarding the fragility of land tenure security in the study areas, and this concern must be considered when facilitating the rehabilitation of deforested and degraded lands with PFM (Youn et al., 2017). Unclear or uncertain land tenure may also lead to likely conflicts over forest conservation projects, as illegal land expansions for agricultural production were observed in the reserved forests in the study areas.

Positive coefficients were found for the respondents' "age," "sex," "relative NTFPs income," "awareness of deforestation," "geographical area," and the incentive on "providing income opportunities." Our study supported a previous study that found older people had more confidence to participate in forest conservation and a more supportive attitude towards it (Ratsimbazafy et al., 2012); although this finding was in contrast to another study which found that younger people were more willing to participate (Shan, 2012; Zhang et al., 2011). In the study area, it appeared that forest-dependent households with older members tended to consider the forests as part of their home, possessed more knowledge about forests, and wanted to share their traditional knowledge of forest conservation with younger people and others interested. Moreover, they regarded planting trees as a gift from their generation that could be passed on to subsequent generations.

The households aware of deforestation were eight times more likely to be willing to participate in forest conservation than those who were not. One possible hypothesis regarding this result is that people who have experienced deforestation and forest degradation would be more willing to participate in forest conservation because they have experienced bad environmental conditions and

understood the necessity for natural resource conservation. Notably, the Bago Region recorded the sixth highest deforestation rate among 15 administrative regions in Myanmar from 2001 to 2010 (Wang & Myint, 2016), and most households in the study area had experienced deforestation.

The households who preferred to receive the income opportunities were 4.6 times more willingness to participate in forest conservation compared with those who preferred direct payment. Descriptive analysis revealed that 67.1% and 32.9% of respondents in HMAs and LMAs, respectively, were willing to participate in forest conservation. This positive effect of living in a specific geographical area on participation in forest conservation was further shown in that households living in HMAs had two times more willingness to participate in forest conservation than those living in LMAs. We hypothesized that job opportunities in HMAs were fewer than in LMAs, and that HMA households expect benefits from participating in conservation activities. To text these hypotheses, further analysis was conducted through comparing the influence of different socioeconomic and demographic characteristics of households in LMAs and HMAs on participation in forest conservation.

5.3.3.2. Differences in Factors Affecting Participation in Forest Conservation According to Geographical Areas

One of the aims of this study was to investigate whether the willingness of communities to participate in forest conservation differed by geographical area and socioeconomic factors. For analysis, two models were estimated: Models (1) and (2) for the households living in LMA and HMA, respectively. The results are presented in Table 5.3.

Table 5.3 Comparison of forest-dependent communities' willingness to participate in forest conservation (by geographical area)

Variables	Model (1): LMAs		Model (2): HMAs	
	B	Exp. (B)	B	Exp. (B)
Age	.094	1.099*	.029	1.030
Sex (Male)	2.727	15.284**	3.471	32.166*
School years	.228	1.256	.218	1.244
Own land (Yes)	−2.681	.068*	−.730	.482
Family labor	.336	1.399	3.346	28.384**
Relative NTFP income	.001	1.000	.003	1.000*
Rice insufficiency period	−.300	.741	−1.154	.315**
Awareness of deforestation (Yes)	2.967	19.436**	2.778	16.095**
Received extension (Yes)	1.459	4.303	1.506	4.507
Providing income opportunities	−1.040	.353	2.511	12.321
Providing land tenure security or temporary land use right	.188	1.207	.485	1.624
Constant	−5.254	.005***	−5.875	.003***
Chi-square, $\chi 2$	32.317***		29.143**	
Nagelkerke R^2	52.5%		50.7%	
No. of correct predictions	93%		97.2%	
No. of observations	114		216	

Note: * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$; LMAs – low mountainous areas; HMAs – high mountainous areas; NTFP – non-timber forest product; B – coefficient; Exp. (B) – exponentiation of the B coefficient (odds ratio)

Dependent variable = Forest-dependent communities' willingness to participate in forest conservation

Direct payment incentive as a default variable.

In the case of land ownership, we observed that land owners in LMAs were less likely to be willing to participate in forest conservation. This result may be because, during the focus group discussions, some LMA households expressed negative perceptions in relation to land tenure insecurity in their areas. Descriptive analysis revealed that greater than 60% of HMA households were practicing shifting cultivation, whereas only 14% of households did so in LMAs. The reason for this result may be due to the availability of land for expansion, and that therefore HMA land owners may think that conservation programs will not have much effect on their agricultural production in terms of land use rights.
The willingness to participate in forest conservation was positively related with income received from NTFPs in HMAs, whereas no relation was observed in LMAs. This result may be because the main income of households living in HMAs came from NTFPs, whereas the main income of households in LMAs was from agricultural production (Figure 5.2).

The longer the rice insufficiency period, the less the likelihood to participate in forest conservation decreased in HMAs. Where rice deficiency was highly correlated to the per capita household income level, this result could also be attributed to a lower income level. According to descriptive analysis, the value of the mean annual per capita income of households was 345,610 MMK (US$274) in HMAs and 501,635 MMK (US$398) in LMAs; a difference of 156,025 MMK (US$124). Generally, livelihoods in LMAs can be assumed to be better than in HMAs because of greater job opportunities, and small businesses can be established with easier access to nearby towns. Our model confirmed the hypothesis that differences in how livelihoods were sustained led to differences in local people' s willingness to participate in forest conservation programs and to differences in their preferences.

5.3.3.3. Willingness to Participate in Forest Conservation According to Incentive Preferences

As any conclusions about which types of conditions and policy incentives preferred by the households regarding the different socio-economic characteristics would be more effective for increasing participation cannot be drawn from this analysis thus far, we further investigated how differing socioeconomic characteristics of forest-dependent communities leading to possibly different incentive preferences might influence their willingness to participate in forest conservation. As noted, the incentives selected were direct payment, providing income opportunities, and providing land tenure security or temporary land use rights to grow crops in forest land. According to descriptive analysis, 21.5% of households preferred the direct payment incentive, while 32.1% and 46.4% of households preferred the incentives of providing income opportunities and providing land tenure security or temporary land use rights to grow crops in forest land, respectively. Among three different incentives, the households who preferred the incentive of providing income opportunities were more willing to participate in forest conservation followed by the households who preferred the incentive of providing land tenure security or temporary land use rights to grow crops in forest land (Table 5.4). The estimated models are shown in Table 5.5.

Table 5.4 Forest-dependent communities' willingness to participate in forest conservation according to their incentive preferences

Incentives	Willingness to participate in forest conservation	
	No	Yes
Direct Payment	8.5%	91.5%
Providing Income Opportunities	1.9%	98.1%
Providing Land Tenure Security or Temporary Land Use Rights	6.5%	93.5%

Source: Survey results (author's calculation)

Among the households who preferred the direct payment incentive, the households who were aware of deforestation were more likely to participate in forest conservation, while those with a longer rice insufficiency period were less willing to participate. The households who preferred the direct payment incentive who were living in HMAs were more willing to participate in forest conservation than those living in LMAs. In the case of households who preferred the incentive of providing income opportunities, male-headed households were more likely to participate than female-headed households. The more aware of deforestation households were, the more they were willingness to participate. As was the case with households who preferred the direct payment incentive, the households living in HMAs who preferred the incentive of providing income opportunities were also more likely to participate than those in LMAs. In the case of households who preferred the incentive of providing land tenure security or temporary land use rights to grow crops in forest land, male-headed households had more willingness to participate in forest conservation as well as households who were more educated, had more rice insufficiency periods and who were living in HMAs. These models explain how the households with different socio-economic conditions with specific preferences in relation to potential incentive schemes differed in their willingness to participate in forest conservation.

Consequently, these models highlight which types of incentive could be suitable for the households with specific socioeconomic characteristics to strengthen or motivate their participation in forest conservation activities.

Table 5.5 Comparison of forest−dependent communities' willingness to participate in forest conservation in terms of incentive preference

Variables	Model (3): Direct payment		Model (4): Providing income opportunities		Model (5): Providing land tenure security or land use rights	
	B	Exp. (B)	B	Exp. (B)	B	Exp. (B)
Age	.100	1.105	.022	1.022	.050	1.051
Sex (Male)	1.294	3.649	3.329	27.922**	3.443	31.291***
School years	.430	1.537	.223	1.250	.492	1.636**
Own land (Yes)	−2.875	.056	−3.127	.044*	−.679	.507
Family labor	−.028	.972	1.789	5.983*	.283	1.327
Relative NTFP income	−.021	.980	.011	1.011	.019	1.019
Rice insufficiency period	−.433	.649*	−.544	.580	.717	2.049*
Awareness of Deforestation (Yes)	2.180	8.842*	1.417	4.126	1.701	5.480
Received extension (Yes)	−.598	.550	1.126	3.085	.788	2.199
Geographical area (HMA)	2.547	12.772*	2.777	16.068*	1.728	5.630*
Constant	−2.970	.051	−5.516	.004	−7.706	.000**
Chi−square, $\chi 2$	30.277***		22.736**		30.154***	
Nagelkerke R^2	65.2%		50.1%		46.7%	
No. of correct predictions	95.8%		95.3%		94.8%	
No. of observations	71		106		153	

Note: * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$; B − coefficient; Exp. (B) − exponentiation of the B coefficient (odds ratio)
Dependent variable = Forest−dependent communities' willingness to participate in forest conservation

5.4. Discussion

5.4.1. Forest-Dependent Communities' Characteristics and Perceptions Concerning Forest Benefits

The households studied had diverse income sources, with the main income coming from NTFPs and crop cultivation. Compared with LMA households, HMA households had a greater dependency on NTFPs and on forests for their household economies. This indicates that HMA households with fewer income opportunities were more dependent on forests. This study revealed that more than half of the households surveyed were under the food poverty line. Because of low self-productivity and lack of agricultural land, they were obliged to buy rice from the market for almost two months per year. This highlights that subsistence farming and forestry are vital in the study areas; thus, providing land tenure security or land use rights for agriculture and forestry are likely to be effective socioeconomic innovations as part of forest governance to promote local people's participation in forest conservation.

The communities studied were highly dependent on provisioning derived from forest ecosystem services (ES) such as NTFPs, firewood, and poles for housing; that is, ESs contributed to the subsistence and commercial incomes of the households. These results further indicate that land tenure that secures people's access to forests will be a key element in any incentives designed to encourage these communities to participate in conservation. Furthermore, as most households value the forests as economic benefits, providing alternative sources of income for income otherwise foregone due to forest conservation is considered as another necessary incentive for them to participate in forest conservation.

Since Myanmar wants to pursue economic development without sacrificing forest resources, the government has been inviting private companies to establish forest plantations, especially in regions where many natural forests have been degraded. According

to Myanmar Forest Law 2018, private companies can establish their plantations only in the designated areas. Initially, any hardwood species was permitted to be grown, but later eucalyptus and rubber trees were restricted. In addition, forest produce from those plantations can only be extracted with permission from the government (Union Parliament, 2018).

During the preparation stages of plantation, the site and tree species are selected and existing trees and shrubs are removed before planting the seedlings. Removal of the existing trees and shrubs for the establishment of commercial plantations was perceived by 10% of the respondents to our survey as one of the drivers of deforestation. This suggests the importance of informational support for forest-dependent communities, which could help prevent misunderstandings concerning cycles of forest planting. Such misunderstanding might otherwise lead to local people distrusting the government's policies, including community-based forest conservation, and even lead to conflicts with government authorities.

Local people considered that charcoal making was one of the main drivers of deforestation. The primary reason for charcoal making is to generate income. Since there are few other alternative opportunities for households to earn income, they are drawn to logging, whether legal or not, for charcoal making. Charcoal making generated 17% of household income, which was the second largest source of income following crop cultivation (33% of total income). This situation highlights the need for providing income opportunities to encourage people not to engage in logging for charcoal making, as well as underlining again the need for secure land use rights for agriculture and forestry.

Our study provided information on forest-dependent communities' socio-economic characteristics, their perceptions concerning forest benefits and their awareness of deforestation and its main drivers. This information could help to determine more suitable approaches to promoting PFM programs in the Bago Yoma Region. Moreover, this information could help extension service

providers to more effectively target their provision of extension services. Particularly in HMAs, the dependency on forest resources was shown to be much higher and the economic condition of local communities much weaker compared to LMAs. It is therefore critical to create an enabling environment for HMA communities, not only for promoting their participation in forest conservation activities but also for social and economic development in remote areas.

5.4.2. Forest-Dependent Communities' Willingness to Participate in Forest Conservation

5.4.2.1. Willingness to Participate

Analysis results provided new insights into the relationships between the socio-economic characteristics and the perceptions of rural people concerning the drivers of deforestation and their willingness to participate in forest conservation activities. By sex, men were more likely to participate in forest conservation than women. This result corresponds with previous studies showing that women were less likely to participate in forest conservation or management. This may be because of gender imbalances in relation to exercising rights and responsibilities over forest resources (Kugonza et al., 2009) or be due to cultural practices (Coulibaly-Lingani et al., 2011; Oli & Treue, 2015). In the case of our study, it may also have been due to women having less knowledge about forest conservation.

The households practicing shifting cultivation and tenant farm-forestry, with official or non-official land tenure, were less willing to participate in forest conservation activities because they were afraid of potential restrictive measures arising from government regulations in the process of implementing the conservation programs. This result differed from previous literature indicating that people with more land were likely to be more affected by

restrictive measures imposed as part of forest conservation (Ratsimbazafy et al., 2012).

The positive relationship found between the proportions of income derived from NTFPs and a willingness to participate in forest conservation indicated that the households with a greater dependency on NTFPs had a greater willingness to participate in forest conservation. This finding is supported in the current literature (Coulibaly-Lingani et al., 2011; Dolisca et al., 2006; Jumbe & Angelsen, 2007; Oli & Treue, 2015). As might be expected, it appears that forest-dependent people are likely to understand the importance of forests, value the provisioning services of forests and are interested in conserving forests.

According to the results of our study, the relationship between a household' s level of education and its willingness to participate in forest conservation is not clear. This is in line with the findings of (Chhetri, Johnsen, Konoshima, & Yoshimoto, 2013), who claimed that education levels were not related to participation in forest protection. The influence of education levels on the participation of local people in PFM remains in dispute among researchers. Some authors have contended that higher household education levels reduce participation in forestry programs (Arun Agrawal & Gupta, 2005), whereas others have claimed that higher education levels increase the level of participation in natural resource management activities (Lise, 2000; Oli & Treue, 2015).

In the study area, 28% of the respondents had experienced extension services, with 46% among these receiving extension services in relation to practicing agroforestry during their participation in plantations and obtaining information on REDD+, 39% receiving extension services concerning CF plantations, and 19% receiving extension services concerning agricultural farming. According to our study, receiving extension services was not related to a willingness to participate in forest conservation. Our interpretation of this result is that the extension programs provided in the study areas were being less effectively delivered than could

have been the case for changing local communities' attitudes regarding forest benefits and conservation. This suggests that extension services for forest-dependent communities should be designed with more information on the recipients' needs and situations.

The study models showed that HMA households were more willing to participate in forest conservation. Because fewer income-generating opportunities were available in HMAs, HMA households with more labor power were more willing to participate in forest conservation because their main income derived from NTFPs. These results are consistent with the literature (Coulibaly-Lingani et al., 2011; Jumbe & Angelsen, 2007; Maskey et al., 2006), which revealed that the forest-resource users were more willing to participate in forest management activities if sizable benefits could be obtained.

Although receiving a forestry extension was not found to relate to participation in forest conservation in our models, an awareness of deforestation was highly associated with a willingness to participate. This result indicates that local communities' attitudes were related to their knowledge levels, similar to the findings of (Alkan et al., 2009; Jim & Xu, 2002). Therefore, to promote local people's participation in forest conservation, capacity building through knowledge sharing and environmental education is needed (Melnykovych et al., 2018). Improvement of extension services, and building awareness of deforestation and its negative effects could lead to social-ecological innovations in forest management, which could in turn lead to an increase in people's participation in forest protection and conservation. Such innovations would be in accordance with expectations expressed in Myanmar Forest Policy 1995 policy imperatives (Ministry of Forestry, 1995).

Among three incentive types, the households who preferred 'providing income opportunities' were more willingness to participate in forest conservation than those who preferred 'direct payment'. Although there is no significant effect, the willingness to

participate was higher in the household groups of preferring 'providing land tenure security or temporary land use rights' compared with those who preferred 'direct payment'.

5.4.2.2. Willingness to Participate According to Each Potential Incentive Schemes

According to our models, the preferences of forest-dependent communities for different potential government incentive schemes were related to their participation in forest conservation. The major factors affecting their willingness to participate with respect to their preferences, as well as factors that were sensitive to the incentives, were sex, education, the number of laborers per family, rice sufficiency and geographical area.

Compared to female-headed households, male-headed households were relatively more willing to participate in forest conservation if the incentives of providing income opportunities and providing land tenure security or temporary land use rights to grow crops in forest land were available. According to the focus group discussions, income opportunities in the study areas especially in HMAs were substantially limited. Moreover, the daily labor wages for farming or for plantation work were higher for male laborers than for female laborers, which helps explain why the incentive of providing income opportunities could motivate male-headed households in the study areas to participate in hard plantation work. Our model confirmed that the incentive of providing land tenure security or temporary land use rights to grow crops in forest land was more persuasive for male-headed households than for female-headed households. This is probably due to the traditional culture of rural people in Myanmar, where men usually make decisions when managing official documents or contracts on behalf of the family, and women stand back. It seemed that women tended to consider themselves less empowered than men in matters concerning land tenure rights or land use rights, which is compatible with the

findings of (Coulibaly-Lingani et al., 2011; Kugonza et al., 2009).

There is evidence that making available the incentive of providing land tenure security or temporary land use rights to grow crops in forest land could motivate more educated households. According to (Jumbe & Angelsen, 2007; Lise, 2000; Oli & Treue, 2015), more educated people have higher levels of understanding concerning the importance of conserving forests and are more willing to participate in conservation activities. Moreover, educated households have been found to respond positively to the incentive of providing land tenure security or temporary land use rights to grow crops in forest land because they can choose an alternative from which they would expect the most benefit (McDonell, Strom-Gottfried, Burton, & Kjosness, 2006; Robbins, Chatterjee, & Canda, 2008).

Correspondingly, for the households with a greater number of family member who were laborers, the incentive of providing income opportunities could be a preferable option as a motivation for gaining wage-related income. These findings are supported by the studies of (Naik, 1997; Salam, Noguchi, & Koike, 2005), in which it was contended that receiving assured benefits from participation in forest conservation and having opportunity costs covered in doing so were crucial in decision making to participate in forest conservation.

Farming provides the basic support for the subsistence food production of the households in the study areas, and receiving land tenure security or temporary land use rights would be of major benefit to the forest-dependent communities. Therefore, the incentive of providing land tenure security or temporary land use rights to grow crops in forest land could be persuasive for households suffering from rice insufficiency.

The incentives of direct payment and providing income opportunities could be more motivational for HMA households than for LMA households. Compared with LMAs, infrastructure development, market access, and transportation facilities are much

more limited in HMAs. If the incentive of providing income opportunities could be made available for HMA households, their willingness to participate in forest conservation would be higher.

Our study proposed three main economic incentive mechanisms to encourage local communities' willingness to participate in forest conservation. The value of these options can be determined especially by means of sustainability in ecological, economic and social way. Direct payment could contribute only for the short-term benefit, while providing income opportunities and land tenure security or land use rights would enhance the benefits for long-term. Proved by our models, we can assume that the respondents chose their preference on incentive related to their socio-economic conditions, in particular based on the priority needs for their livelihoods.

Our study suggested that government plantations can facilitate forest-dependent communities to participate in plantation activities if appropriate incentives relevant to their specific socio-economic characteristics and incentive preferences are provided. Our analysis showed that local communities most prefer income opportunities as incentives, while incentives for land tenure security or for temporary land use rights are also considered important. Forest plantations and reforestation, or rehabilitation of degraded forests, can be more effectively undertaken with the involvement of local communities if the government creates an enabling environment for local people to cooperate with it in the long-term.

5.5. Conclusion

This study provided information concerning the perceptions and preferences of forest-dependent communities of the Bago Yoma Region in Myanmar regarding policy incentives in relation to their willingness to participate in forest conservation. The willingness of people to participate in forest plantation work was also investigated. The primary factors identified as influencing local peoples'

attitudes toward participation in government-initiated forest plantations included food security, ownership of crop lands, tenure security in relation to forests, and awareness of deforestation. The knowledge and attitudes of local communities concerning forest conservation need to be carefully considered when designing and implementing rehabilitation and forest restoration programs. The importance of environmental awareness in local communities needs to be promoted within extensive services. Additionally, providing effective extension services with an informed awareness of local conditions and local peoples' perspectives is also recommended. These recommendations align with one of the objectives of Environmental Conservation Law in Myanmar, namely, enable the promotion of public awareness and cooperation in environmental educational programs (Union of Myanmar, 2012). Enlisting local people's participation in forestry, which could entail engaging them within forest conservation and development along with planting trees to meet their needs and to increase their non-farm income, is a forest policy imperative in Myanmar. Our findings reinforce this policy imperative in relation to formulating effective participation strategies in the mountainous areas. Our results do not support the hypothesis that having previously received extension services is a satisfactory predictor of a willingness to participate in forest conservation. Notably, people's awareness of deforestation was found to be related to their willingness to participate in forest conservation, and extension service providers could make use of this information for more effective extension services.

This study is intended to contribute to an understanding of mountain communities' attitudes and provide relevant information concerning the implementation of socioecological innovations within forest governance in Myanmar where an alarming rate of deforestation has occurred. Our study showed that examining local communities' socioeconomic conditions, their perceptions concerning forest benefits, their knowledge of deforestation, and their preferences regarding possible incentives, provides critically important information for informed decision making for management

interventions, to ensure that the needs and desires of the people affected are considered in any interventions. Furthermore, this information would also assist in the development of appropriate policy instruments to ensure the successful implementation of inclusive, participatory, and sustainable forest conservation initiatives.

However, the results of this study should be interpreted with caution because the study involved only a sample population covering a relatively small part of the country. Thus, a larger scale study that includes an in-depth analysis of forest governance and the interactions of social and ecological systems is warranted. Such an extensive study would provide more comprehensive information towards the development of better targeted policy instruments for sustainable forest management. Nevertheless, we consider this study is likely to help in developing forest conservation policy options which could contribute to improving the livelihoods of forest-dependent communities in mountainous areas.

5.6. Summary

The forestry sector in Myanmar continues to face many challenges concerning sustainable forest management. Even though the participation of local people is a key principle of forest policy in Myanmar, there is ample opportunity for people' s participation in forest conservation to be improved. This study aimed to identify what factors should be considered to promote the participation of local people in forest conservation. The primary objectives were: to investigate the perceptions of people in forest-dependent communities towards forest conservation, and: to determine which policy interventions would be most appropriate for motivating local people to participate in forest conservation. We studied several communities in the Bogo Yama Region of Myanmar as a case study, involving interviews with key informants, focus group discussions, and interviews among 330 randomly selected households using

semi-structured questionnaires to conduct a survey. For the interview survey, three hypothetical incentives to promote forest conservation interventions were specified, namely, (i) direct payment, (ii) providing income opportunities, and (iii) providing land tenure security or temporary land use rights to cultivate agricultural crops. The qualitative and quantitative data attained were integrated and analyzed using binary logistic regression. We observed that the communities utilized forests mainly for domestic energy supply, earning income, and regulating local weather. The respondents reported that deforestation occurred mainly because of legal and illegal charcoal making, over-exploitation of non-timber forest products, and logging. A willingness to participate in forest conservation differed in relation to the physical conditions of local communities, in the form of resource availability, remoteness of the village, and farm-land availability, as well as depending on people' s awareness of the seriousness of deforestation and the need for food security. Providing income opportunities was identified as the most important incentive for peoples' participation. The results of this study suggest that forest policy makers should consider the different preferences for incentives among different communities, which vary depending on the socio-economic characteristics of the people and the physical and social conditions of the locality.

Chapter 6. Conclusion

Reconsidering the role of local communities in forest conservation is a transition toward sustainability in both environmental and development programs (Arun Agrawal & Ostrom, 2001; Arun Agrawal et al., 1997; Isager et al., 2002b). Participatory forest management (PFM) is a key strategy employed worldwide to mitigate forest loss and maintain forest ecosystem services, with the goal of achieving sustainable forest management. However, the efficacy of PFM in achieving biological and socioeconomic goals is highly variable due to different approaches (Rasul, Thapa, & Karki, 2011b; Worah, 2008); a significant factor limiting their success is a lack of consideration and understanding of associated human systems (DeCaro & Stokes, 2013; Isager et al., 2002b; Sarkki et al., 2015). As a global REDD+ mechanism included sustainable management of forests and the roles of conservation apart from reducing deforestation and forest degradation with the intention of ensuring the full and effective participation of relevant stakeholders and local communities, there is a pressing need to better understand and incorporate socioeconomic factors into forest planning and management.

The goal of this thesis was to improve our understanding of livelihood dependency on NTFPs, and socio-economic factors related to participatory forest management, and to provide guidance on how this knowledge can be incorporated into forest conservation and reducing deforestation and forest degradation. To achieve this goal, three objectives were developed that address the knowledge gap related with the information regarding the critical factors determining NTFPs dependency by local communities, and the consideration of their perceptions on forest conservation. The interdisciplinary approach was conducted to frame this thesis based on theoretical underpinnings (chapter 2), and provided the literature review supporting the research (chapter 3). And then, how these data-based researches (chapter 4 & 5) addressed the three

objectives of the thesis, and the main contributions of the research was outlined. Finally, the contributions of the thesis to policy implications was discussed and highlighted some shortcomings of the work, and opportunities for further research.

6.1. Summary

6.1.1. Achievement of Thesis Objectives and Policy Implications

Objective 1. Examine factors determining communities' dependence on NTFPs and how these can be cooperated into policy implications

This objective was addressed by assessing the factors determining NTFP dependence in local communities (chapter 4), including whether these factors differed by the land ownership. In addition, policy implications for the main causes of overexploitation of NTFPs were derived to develop policies and measures in the design of national REDD+ strategies. The income from NTFPs appeared to contribute the highest to the household's total income, with the main contribution of charcoal making and bamboo selling. This research supported our hypotheses that the lower the educational level, and the poorer the households, the higher is the dependency on NTFPs. In addition, it also proved that the landowners are less dependent on NTFPs compared to landless households. Following, policy implications for poverty, food insecurity, land ownership, energy inaccessibility (electricity) and capacity building were drawn which are the main drivers of NTFP dependence that lead to overexploitation. Thus, the potential policies and measures were suggested based on those implications.

Arnold & Perez, (2015)pointed out that a complete understanding of NTFPs is vital to manage and conserve forests sustainably and to ensure their contribution to the welfare of local communities. The research on NTFPs have been increasing with recognizing their important role in the national and local economy especially in tropical countries, where livelihood dependency on them is significant. Some researches focus on commercial collection

of NTFPs in Vietnam (Viet Quang & Nam Anh, 2006) and importance of NTFPs in the valuation of forest in India (Kumar & Tewari, 2005), while other focus on NTFPs governance for improved rural livelihood in Nigeria (Gideon, 2018), and socio-economic contribution of NTFPs to local livelihood in Sub-Saharan Africa (Timko, Waeber, & Kozak, 2010). In the case of Myanmar, there are only a few research on NTFPs related issues focusing on specific case studies such as distribution of forest income among rural households, interaction between rural basic needs and forest products, livelihoods of local communities and their dependence on dry forests, and economic contributions of NTFPs to the livelihoods (P. S. Aung et al., 2015; Hlaing et al., 2017; Moe & Liu, 2016; Toe & Kanzaki, 2017).

This research could contribute to Myanmar academic field by providing the factors of NTFP dependence by forest dependent communities, which in turn could assess some of the estimates of the underlying forces of overexploitation of NTFPs. Importantly, the research highlights potential policies and measures based on research results and previous studies makes a noteworthy contribution to the implementation of REDD+ projects. Thus, has important implications for forest planning and management. The scientific information gained from this research could facilitate better targeting of policies and measures aimed at making strategies to have a more socially and ecologically sustainable forest management.

Objective 2. Observe perceptions of forest-dependent communities toward participation in forest conservation

This objective was addressed in chapter 5 by assessing what the forest benefits valued by forest-dependent communities are and how they perceive deforestation and its drivers. Moreover, their willingness to participate in forest conservation was estimated by assessing how their socioeconomic factors were related to the participation, including whether the factors differed by the

geographical area. Forest-dependent communities reported that they received forest benefits mainly for the house construction and regulating local weather. More than 90% of the respondents were aware of deforestation and they noticed it because of decreasing amount of NTFPs collected. Importantly, they argued that deforestation in their surrounding forests is mainly due to legal and illegal charcoal making and overexploitation of NTFPs. Four key factors were found out that they were related to participation of local people: landownership, income from NTFPs, their awareness of deforestation, and geographical area. This research proved our hypotheses that the higher the relative NTFPs income, the more willingness to participate in forest conservation. Willingness to participation rate was much higher in local communities living in high mountainous area compared to those living in low mountainous area. In addition, households who are aware of deforestation have more willingness to participate than those who are not.

This research advances the literature on participatory natural resource management because it quantitatively assesses how local communities' willingness to participate in forest conservation is related to socioeconomic factors. The research points out which factors need to be considered most to have higher participation in different geographical areas.

Better incorporation of perceptions of local communities will increase the likelihood of achieving socioeconomic goals while protecting biological loss. The knowledge gained could encourage better targeting of investments aimed at promoting community based forest management, ultimately improving the well-being of both people and forest ecosystems.

Objective 3. Investigate which policy instruments would be necessary to motivate their participation

The objective 3 was addressed in chapter 5 by providing potential three incentives to local communities and estimating how they would response to participation in forest conservation

considering their preferences on the incentives. An interdisciplinary approach was conducted drawing from literature on human behavior and motivations to incentive mechanisms. There were five factors that were sensitive to the incentives and related to the willingness to participation: sex, education, number of family labors, rice sufficiency, awareness of deforestation and geographical area. This research does not support our hypothesis that households who prefer direct payment are more willingness to participate compared to other two incentives. Among three economic incentives, the households who preferred the incentive of providing income opportunities were most willing to participate in forest conservation compared to the incentives of providing land tenure security or temporary land use rights and the direct payment. We can postulate that the limitation of income opportunities in the study areas are intense and households preferred the incentive that can last for long term. There was also suggestive evidence that participation according to the preferences on incentives was related to the socioeconomic characteristics of those preference groups.

This research advances the literature on devolved forest management because, to my knowledge, the empirical research on estimating people' s participation by providing potential incentive mechanisms is still limiting. More specifically, this research is an important contribution to the literature on formulating effective participation strategies by exploring opportunities for sustainable forest management. In addition, this research demonstrates the importance of examining the interaction between forest resources and nuanced social conditions for developing the effective policies and measures, echoing the findings of chapter 4.

Better incorporation of socioeconomic factors and human behavior will increase the likelihood of achieving social benefits from participatory forest management, reducing the conflicts and gaining the stakeholders' support, on which the success of conservation depends.

6.1.2. Limitations of the Study

An important limitation of the study is that the self-reported information was considered rather than observed households' financial conditions. Although research on human characteristics and behavior often relies on self-reporting, inconsistency between self-reported and observed behavior can occur (Armitage & Conner, 2001). With relatively limited information and research on overexploitation of NTFP resources in Myanmar, our assumption on the contribution of overexploitation of NTFPs to forest degradation was based on the related research and district management plan (Forest Department of Myanmar, 2015; Kissinger et al., 2017; Mon et al., 2010; Win, Mizoue, Ota, Kajisa, & Yoshida, 2018). It would be preferable to have had both ecological data and the dependence on NTFPs to show the tendency of forest degradation. In addition, there was no specific hypothesis for each PAMs that was developed, which may be more useful with the specific empirical analytical approach. They are the arguments based on theories or related literatures and some information coming from the empirical analysis related to NTFPs dependency.

Although the evaluation included 11 variables of socioeconomic data affecting participation in forest conservation, some important aspects of behavior that could potentially effect participation such as previous perceived benefits, and normative beliefs were unable to consider. Further, while the respondents were interviewed on the preferences of incentives related to the participation, their willingness to participate in forest conservation without incentive mechanisms was not observed and also the concrete monetary value of each incentives were not provided that could potentially provide the important information.

6.1.3. Further Research

The limitations identified in the previous section shed light on how to improve and expand the study of participatory forest management. A larger scale study that includes an in-depth analysis of human behavior and combination with ecological assessment is warranted. Estimating the willingness to participate by providing all three possible mechanisms of incentives (carrots, sticks and sermons) would provide more comprehensive information towards the development of better targeted policy instruments.

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Appendix I

Households Survey Questionnaire

People's Dependence on Forests and their Participation in Forest Conservation in Myanmar

Households survey questionnaire

Department of Forest Sciences, SNU

Date of interview: _____Name of interviewer: _____
Village: _____ Village Tract: _____
Name of respondent: _____

I. Demographic Information of Household Head & Members

1. Household background information

Head & Members (1)	Sex/ Age (2)	Live together (3)	Marital status (4)	Education status		Occupation	
				Completed schooling years (5)	School enrolment or not (6)	Working or not working (7)	Type of work/ family labor (8)
1. Head							
2. Spouse							
3.							
4.							
5.							
6.							
7							
8							

Col. (2). F=female, M=male.
Col. (3). y=yes , n=no
Col. (4) m=married, s=single, d=divorced, w= widow, p=separated
Col. (6) and (7) y=yes , n=no
Col. (8) f=farmer, al=agriculture wage labor, cl=causal, fl=family labor, ls=livestock raising, etc.

Ethnicity_____ Religion_____

II. Socioeconomic Information of Household

1. Household assets

Kinds of Assets	Total Qty	How did you obtain? (Acre)			
		inheritance	purchase	share	rent
Land: -Le (acres) w/o irrigation					
-Le acres receiving irrigation					
-Yar (acres)					
-Others (acres)					
Land type for Yar: slopping land (%)		How far is the land from the nearest forest? (miles)			
Low land (%)					
Area of arable land left (acres)					
Total land under fallow and fallow period	( ) acres ( ) years				
Type of soil & **fertility** (Good, Medium & Poor)					
House type: wall, roofing, etc (**specified detail**)					

Kinds of assets	Total Qty.	Kinds of assets	Total Qty.
Cattle: Draught cattle		Tractor	
Milk cattle		Water pump	
Horse		Thresher	
Goat		Generator	
Sheep		Horse cart	
Pig		Bullock cart	
Chicken		Transportation vehicle	
Duck		Others	

2. Changes in assets (D = decrease, In = increase, C = constant)

Kinds of Assets	Changes in last 5-10 years	Changes quantity (acre or No.)
Le (acres) Yar (acres)		
Livestock number: Cattle Horse Goat/sheep Pig Poultry		
Equipment number: Tractor Transportation vehicle		
Others		
House improvement (from thatch to zinc roofing, bamboo to wooden house, etc.)		

3. Situations of your land (yes/no)

Types of land	Water erosion (yes/no)	Saliniza tion (yes/no)	water log ging (yes/no)	land slide (yes/no)	When it i s started	Affected acres
1. Paddy land: Irrigated land Non-irrigated land						
2. Yar land						

Col (2): S = salinization, W = water logging, F = flooding, D = land slide

4. Household utilities (tick in blanket)

(1) Lightening	Electricity ( )	Generator ( )	Battery ( )	Candle/lamp ( )
(2) Drinking water	Tube well ( )	Open well ( )	Pond ( )	Sand Stream/ river ( )
(3) Water (for livestock)	Tube well ( )	Open well ( )	Pond ( )	Sand Stream /river ( )
(4) Sanitation	Covered pit ( )	Uncovered pit ( )		

III. Resources Utilization

1. Resources utilization

Fuel for cooking	Charcoal ( )bag/month Price( ) kyats/bag	Firewood ( ) cart/year Price ( ) kyats/cart	Others (specify the item) ( )
Sources of fuel: - Charcoal - firewood	Market (Buying) ( ) ( )	Making/Self-collection ( ) ( )	Others (specify the item) ( ) ( )
Wood/bamboo collection for housing(poles, fence)		Yes / No ( ) / ( )	
Collection of Non-Timber forest products (NTFPs)		Yes / No ( ) / ( )	Family use / Selling ( ) / ( )

- **Which NTFPs do you collect? _____**
- **Which NTFP is the most collected? _____**
- **For which purpose, NTFPs is collected? _____**

(1=food, 2=fuel, 3=house construction, 4=medicine, 5=fodder for livestock, 6=Others (specify))

- **How often NTFPs is collected? (times/month)** _____

2. Collection sources

Items	**Sources (highest 1, moderate 2, less 3, least 4)**			**Buying/Own**	**Others (specify)**
	Community/ Plantation	**Reserved forest**	**Natural forest**		
Firewood collection	( )/( )	( )	( )	( )/( )	
Poles/roofing	( )/( )	( )	( )	( )/( )	
Wall/fence	( )/ ( )	( )	( )	( )/( )	
Livestock food	( )/( )	( )	( )	( )/ ( )	
Pasture for livestock	( )/( )	( )	( )	( )/ ( )	
NTFPs collection	( ) /( )	( )	( )	( )/ ( )	

3. Value of NTFPs

Items	**Value (kyats/month) (family use) / (selling)**
Firewood collection	**( )/( )**
Charcoal making	**( )/( )**
Poles/roofing	**( )/( )**
Wall/fence	**( )/( )**
Livestock food	**( )/( )**
Pasture for livestock	**( )/( )**
Foods (crops, fruits, mushroom)	**( )/( )**
Medicinal plants	**( )/( )**
Others (specify)	**( )/( )**

4. If there is alternative for charcoal and firewood (eg, solar, gas) or electricity, will you stop collecting firewood and using charcoal or keep using those? Why?

_____

IV. Production and Income Information of Household

1. Sources of income (Kyats/year or Ks/month) and percentage of total income

❖ **Main income source –**

Head and members	Crop production income	NTFPs income	Livestock income	Charcoal making income	Selling firewood	Farm labor	Causal labor	Migration income	Selling goods/ Crops	Others (sewing, salary, etc.)
Head										
%										
%										
%										
%										

2. Cost of Production and Land Use Change

Cost of production for crops (kyats/acre)		
Cost of land clearing in forest area (kyats/acre)		
Cost of animal fodder (kyats/month)		
Cost of pasturing (kyats/month)		

3. Access to Credit, Extension service, training, market information and market

	Agriculture/ Forestry	From government institution	From NGO	From money lender	From relatives	Others
1.Sources of credit:						
2. Access to extension work - Yes/No						
3.Received extension – Yes/No	Agriculture					
	Community forestry/plantation					
4. Received trainings – Yes/No	Agriculture					
	CF/Forest management					
5. Received market information-Yes/No	Agricultural crops					
	Wood/NTFPs					
6. Access to market & frequency/month						
7. Received Food for work -Yes/No						
8. Received Food for education--Yes/No						

4. Received trainings or activities

	Always	**Often**	**Seldom**	**Never**
<u>Trainings or activities on:</u> - forest resource management - participation in forest conservation/ plantation - community forestry member - Others (specify)				

V. Households Land Use Decision

1. Where is your agricultural land? If it is spread, please put the percentage.

_____

(1=inside agricultural land, 2=inside protected area, 3=inside reserved forest, 4=outside reserved forest, 5=inside natural forest, 6=adjacent to the natural forest, 7=within 1km buffer of the nearest forest, 8=within 1km near to the main road, 9=others (specify))

2. How important is the forest near your village to the rural community? _____

(1=very important, 2=moderately important, 3=not important, 4=useless)

3. Which kinds of benefits do the forest give you? _____

(1= protect from flooding, 2= protect from drought, 3=housing, 4=getting woods for infrastructure (CF), 5=clean water, 6=reduce pollution, 7=others (specify))

4. If there is any compensation/incentive, do you have the willingness to participate in forest conservation? Yes/No

5. Among three incentives; (direct payment, income opportunities, land tenure security or land use right), which one do you prefer? _____

10. Do you have any awareness of deforestation? Yes/No

11. How do you notice it? _____

(1= decreasing collected NTFPs, 2=decreasing resources for housing, 3= low productivity in extended land, 4=less fodder for livestock, 5=getting young-aged firewood (eg. Branches), 6=others (specify))

12. What do you think why deforestation happens? _____

(1=extreme firewood collection, 2= legal and illegal charcoal making, 3=legal logging, 4=illegal logging, 5=agricultural extension, 6=shifting cultivation, 7=mining, 8=infrastructure (houses & roads construction), 9=weak forest management, 10= others (specify))

V. Information on Household Food Security

1. Rice consumption

(1) How many meals taking per day? _____

(2) Total rice consumption/day in your households = tins/day

(3) Name of rice =

2. Rice and oil sufficiency situation

Season	Insufficient or no t (Yes/No)	Rice insufficient months	Oil insufficient months
-Summer 4 months (Jan-April)			
-Rainy 4 months (May-August)			
-Winter 4 months (Sept-Dec)			
Total food sufficient months/year			

❖ **If there is anything you want to mention or give suggestion, your response are kindly welcomed.**

Sincerely appreciate for your participation!

Appendix II

Questionnaire for Focus Group Discussion

Focus Group Discussion

A checklist for focus group discussion

Number of the respondents: _____
Village name: _____Village tract: _____
Date of interview_____

Assessment of Underlying Causes of Deforestation and Forest Degradation

I. Demographic Factors

1) Please tell the general geography of your village.
2) Please define deforestation and the extent that you think the forest is deforested near your village.
3) How is the condition of agricultural land in your area (e.g, soil quality, productivity, slope, etc.,) and how many percent of arable land left?
4) How is the livelihood of small-scale farmers in your village?
5) Is there any medium or large investors for commercial agriculture and any agro-based industry?
6) What is the population of your village, increasing, decreasing or constant? Any migration in or out? Do you know why it happens?
7) Do you think there are more houses near this village (urbanization)?

II. Economic Factors

1) How is the demand and market of agricultural crops compared with non-timber forest products (NTFPs)?
2) What is the main product produced from this area?
3) Please define the poverty and the needed minimum income/month to live in your community?
4) What are your criteria in distinguishing poor household from non-poor household?
5) What are the reasons or causes of poverty? Please also explain the consequences of poverty.

6) What are the changes in the land price and the forest products prices due to increase in scarcity of resources? How it effects on your consumption/income?
7) What are the constraints to reduce poverty or to increase income, production, and employment?
8) What kind of activities do you do to overcome this situation?

III. Technological Factors

1) How is the agricultural production in this area, (increasing, decreasing, constant) during last 2 years?
2) What is the condition of infrastructure? (eg, transportation, etc.)
3) Do you have accessibility to market? Do you get any extension works, improved technology or training, and market information?
4) How far is it to the nearest market?

IV. Policy and Institutional Factors

1) How do you think of land tenure system for forest land or for the land you extend? Is it secure?
2) Do you have traditional land tenure system?
3) Do you know the policy from forest department related with property right?

V. Cultural Factors

1) How many percentage of households are using fuel wood? Which do you prefer to use among firewood, charcoal and electricity?
2) Do you have any concern about environment or do you participate in forest conservation activities?
3) Do you think the trainings help you and your environment?
4) What are the preferences of the development programs (infrastructure, credit, land, technology, training, etc) for your livelihood?

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국문 초록

산촌 주민의 산림의존과 산림 보전에의 참여 : 미얀마 사례

산림 보전에 지역 공동체가 참여하는 것은 전세계적으로 천연자원의 보전과 개발의 주요 전략으로 인식되고 있다. 그러나 생태계 및 사회 경제적 목표를 달성하는 데 있어서 지역 공동체가 함께하는 참여적 산림 관리(PFM)의 효능은 매우 다르다; 참여적 산림관리의 성공을 방해하는 중요한 요소는 관련된 사회 시스템에 대한 배려와 이해 부족이다. 이것은 특히 미얀마의 참여적 산림 관리에서 특히 그러하다. 미얀마에서 산림 관리 플래닝 과정에서 참여적 보전 프로그램에 대한 지역 공동체의 인식과 잠재적 대응에 관한 정보는 사용 가능하지도 않고 사용되지도 않는다. 보전 목표를 달성하는 데 지역 공동체의 결정적인 역할에 대한 인식이 큼에도 불구하고 또한 산림 관리에 사회 경제적 요인을 더 잘 이해하고 포함시켜야 할 필요성이 있음에도 불구하고 사회 경제적 요소와 지역 커뮤니티에 대한 인식은 생태적 요인보다 열악한 것으로 취급 되고 있다. 지역 커뮤니티의 참여가 수반되는 재조림과 산림보전이 계속 늘어나는 중인 것을 고려할 때 산림의 설계와 관리에 사회 경제적 요소를 보다 잘 이해하고 통합 할 필요성이 있다.

이 연구의 가장 중요한 목표는 비목재임산물에 대한 생계 의존성과 참여적 산림 관리와 관련된 사회 경제적 요인에 대한 이해를 높이고, 이러한 이해가 어떻게 산림 보전, 산림 벌채 및 산림 황폐

화에 합쳐지는 지에 대한 지침을 제공하는 것이다. 미얀마의 Taungoo District에 집중하여, 연구 목적를 달성하기 위한 세 가지 연구목표를 설정했다. 이 세 가지 연구목표는 비목재임산물 의존성에 초점을 맞춘 연구 대상지의 문제 상태와 관련된 지식 격차와 정부 인센티브 제도에 대한 산림에 의존하는 공동체의 인식과 잠재적 반응이 참여적 보전 프로그램과 어떻게 관련되어 있는 지에 대해 다룬다. 세 가지 연구 목표는 다음과 같다. 1) 지역 커뮤니티의 비목재임산물에 대한 의존을 결정하는 요소와 어떻게 이러한 요소들이 정책적 시사점과 협력될 수 있는 지에 대해 조사한다 2) 산림에 의존하는 공동체가 산림 보전에 참여하는 것에 관한 인식을 관찰한다. 3) 그들의 참여에 동기를 부여하기 위해 필요한 정책적 도구가 무엇인가에 대해 조사한다.

첫 번째 목표는 특히 비목재임산물에 대한 지역 커뮤니티의 의존과 관련하여 비목재임산물 과잉채취에 대한 근본적인 힘에 대해 탐구함으로써 생태계와 사회 체계 간의 상호 작용에 대한 이해를 제공하는 것이다. 이 목표는 로컬 커뮤니티의 비목재임산물 의존도와 그들의 가구 소득에 대한 비목재임산물의 기여도를 결정하는 요소를 검토함으로써 결론이 났다. 이 연구결과는 가계의 빈곤, 식량 안보, 연료재 사용, 토지 소유권과 비목재임산물 의존에 대한 교육의 중요성을 강조된다.

두 번째 목표는 산림 자원 이용과 산림 보전에 참여하는 것에 대한 지역 공동체의 인식에 영향을 미치는 요인에 대한 제한된 이해에 기여하는 것이다. 이 연구목표는 지역 공동체들이 어떻게 정부 프로그램을 인식하는 지에 대해 조사함으로써 결론이 났다. 이 연구는 서로 다른 지리적 영역에서 더 높은 참여율을 가지려면 어떤 요인을 고려해야하는 지에 대해 지적했다.

세 번째 목표는 윈윈(win-win) 관계를 성취하기 위해 거버

넌스 시스템이 사회와 생태계 사이에 어떻게 기여할 수 있는지에 더 알 수 있도록 하는 것이다. 이 연구는 지역 공동체가 산림 보전 프로그램에 참여하도록 동기를 부여 할 수 있는 정부 개입에 관한 지식 격차를 해소하는 것을 목표로 한다. 인간 행동과 인센티브 메커니즘에 대한 동기에 관한 문헌에서 도출 된 학제간 접근법이 수행되었다. 이 연구는 지역 사회의 참여가 사회 경제적 특성과 관련된 인센티브에 대한 선호에 따라 다를 수 있다는 암시적인 증거를 입증했다.

이 논문은 사회적 시스템, 생태계 및 거버넌스 시스템 간의 상호 작용에 대한 더 나은 이해와 산림의 디자인 및 관리에 사회 경제적 고려 사항을 융합하면 이러한 보전이 장기적으로 지역 사회의 복지에 기여할 수 있음을 강조한다. 또한 인센티브는 대상 집단에 대한 훌륭한 과학적 정보를 사용하여 신중하게 설계될 필요가 있다는 주요 메시지를 제공한다. 산림 보전 프로그램에 지역 공동체의 참여를 증가시키기 위해, 정부는 그들이 주변 숲과 어떻게 상호 작용 하는지를 이해함으로써 지역 사회와 상호 작용하는 방법을 찾아야 할 필요가 있다.

주제어 : 커뮤니티, 산림 의존, 참여, 인센티브, 산림보전, 미얀마

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