早稲田大学審査学位論文

博士（人間科学）

Toward development of desirable REDD-plus implementation system: how sustainable forest management can be achieved by dealing with socio-economic diversity in local communities

望ましいREDD+実施体系の構築に向けて：コミュニティの社会経済的多様性を踏まえた持続的森林管理の達成

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Table of Contents

Tables

Figures

Abstract

As a mitigation measure for global warming by conserving forest biomass, the mechanism of reducing greenhouse gas emissions from deforestation and forest degradation with forest management (REDD+) has been expected and discussed under the United Nations Framework Convention on Climate Change. Since the Paris Agreement entered into force in 2016, each country has accelerated preparation for the REDD+ strategy and demonstrations at the local level by utilizing supports from developed countries. When compared with a conventional project-based approach, a REDD+ approach will deal with more various stakeholders in broader jurisdictional boundaries.

For effective REDD+ implementation in broad and diverse socio-economic situations, appropriate identification of deforestation agents and drivers would be needed. At the same time, there are concerns that REDD+ could invite negative impacts on local level, for example conflicts on customary practices and land tenures as seen in Indonesia. Although REDD+ safeguards can help to mitigate social and environmental impacts, its role and sustainability could be limited in the minimum requirement. Based on the background, this thesis aims to provide a practical REDD+ implementation system ensuring effective safeguards and sustainability through appropriate identification of local conditions. In order to understand local situations with various socio-economic variables, multivariate analysis as well as an aspect of Capability Approach (CA) were utilized. By targeting villages around the Gunung Palung National Park (GPNP) in Indonesia, data collection was conducted mainly as questionnaire surveys with a stratified sampling method.

Socio-economic survey and multivariate analyses, mainly a canonical discriminant analysis (CDA) and a principle component analysis (PCA), were combined to identify agents and drivers. The results of CDA indicated that it was more appropriate to distinguish the agents based on uses or non-uses of the forest rather than on differences in ethnic groups. The PCA was utilized to extract the principal components that helped to integrate plural socio-economic variables through the scatter diagram The results explained that various agents and drivers of deforestation could be identified by the multivariate analysis. By comparing influences of forest uses on forest ecosystems between the two villages, relatively diverse forest and carbon pooling was observed in the village practicing traditional forest uses. It was also revealed that livelihoods and forest practices tend to be converted to commercial use for farm expansion and rubber plantation. Besides that, ambiguous tenures and miscommunication cause distrust between governments and communities. As a response to those situations, appropriate management activities such as trust-building and collaborative actions were discussed.

Four practical measures of the challenges in the REDD+ implementation at the local level were presented based on the findings. 1) By considering the variety of deforestation drivers and peoples' capabilities, comprehensive technical and policy measures need to be taken. 2) REDD+ safeguards can play an effective role in enabling the communities to access REDD+ by applying it step-by-step for securing rights and participation. 3) More effective and sustainable benefits for communities can be explored by considering customary rights and respecting traditional practices. Provision of opportunities for leaning and decision making also motivate the communities to

initiate actions and enhance capabilities. 4) For ensuring the effect and sustainability of these measures, local governance arrangements with multi-stakeholders as well as various technical and financial supports in readiness actions will be critical. By applying those measures with respect to CA, an appropriate REDD+ implementation system can be conceptualized and developed.

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Abbreviations

AFOLU	Agriculture, Forestry, and Land Use
A/R	Afforestation and Restoration
BAL	Basic Agrarian Law
BPS	Badan Putsat Statistics (Statistics Office)
CO_2	Carbon Dioxide
CA	Capability Approach
CI	Conservation International
COP	Conference of the Parties to the UNFCCC
CDA	Canonical Discriminant Analysis
CDM	Clean Development Mechanism
CSR	Corporate Social Responsibility
DBH	Diameter at Breast Height
DF	Degraded Forest
ERC	Ecosystem Restoration Concession
FAO	Food and Agriculture Organization
FCPF	Forest Carbon Partnership Facility
FFI	Fauna and Flora International
FG	Forest Garden
FIP	Forest Investment Program
FPIC	Free, Prior and Informed Consent
FORCLIME	Forest and Climate Change Program
GCF	Green Climate Fund
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Corporation for International Cooperation)
GNU	Germany, Norway, and United Kingdom
GPNP	Gunung Palung National Park
IFACS	Indonesia Forest and Climate Support
IJ-REDD+	Indonesia-Japan project for development of REDD+ mechanism
JICA	Japan International Cooperation Agency
MF	Montane Forest
MoEF	Ministry of Environment and Forestry

MoF	Ministry of Forestry
MRV	Measuring, Reporting and Verification
MS	Mangrove and Shrubs
NDC	National Determined Contribution
NFL	New Forestry Law
NTFP	Non-timber Forest Product
NGO	Non-governmental Organization
ODA	Official Development Aid
OA	Open Area
PC	Principal Component
PCA	Principal Component Analysis
PES	Payment for Ecosystem Service
PSF	Peat Swamp Forest
REL	Reference Emission Level
PT	Plantation
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	Reducing Emissions from Deforestation and Forest Degradation and Enhancing Forest Carbon Stocks
SIS	Safeguard Information System
TGHK	Tata Guna Hutan Kesepakatan (Consensus-Based Forest Land Use Planning)
UNFCCC	United Nations Framework Convention on Climate Change
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
USAID	U.S. Agency for International Development
VCS	Verified Carbon Standard
WWF	World Wildlife Fund

Chapter 1. Introduction

1.1. Climate change and forest conservation

While climate change and global warming are critical issues for human beings, forest ecosystem functions such as regulating local climate and storing carbon dioxide (CO_2), an important greenhouse gas (GHG), are also well recognized. The awareness of the role of the forest resources in the global environment has increased after deforestation activities have accelerated by globalization and market demand for timber and agricultural products, especially in the tropics since the 1970s. According to the assessment by Food and Agriculture Organization (FAO, 2015), 129 million ha of net forest area was lost around the world between 1990 and 2015, 0.13% loss each year, particularly in the tropics. Reduction of carbon stocks in forest biomass has been estimated to be approximately 11 gigatons of carbon over the past 25 years (1990-2015). It was mainly caused by the conversion of forest areas to other land uses (agricultural land). In order to take measures against deforestation, various efforts have been made by the developing countries in the form of physical and technical support from multilateral and bilateral agencies and non-governmental organizations (NGOs). Despite those efforts, ongoing tropical deforestation contributes to 18% of annual global

greenhouse gas emissions (IPCC, 2007).

Forest governance changes were promoted in the 1980s and 1990s through the decentralization of forest policies. The role of local communities in forest conservation was recognized by these changes. It was estimated that almost 700 million people rely on forest products for fuel, food, and cash income (Chomiz, 2007). Especially for households in poverty, non-timber forest products (NTFPs) provide one-third to a half of the total household income and act as a daily safety net for local populations (Shackleton et al., 2011). The needs of the local communities for forest resources encouraged the governments to delegate the management role to the locals with a participatory approach. This was also done to reduce the financial burden on the governments (Cronkleton et al., 2008). In addition to the decentralization, forest certification efforts were initiated as a way to avoid illegal logging in concession and other forests, and improve tropical forest management practices. The pressure on the global forest management and the latest recognition of the impact of forest loss on climate change increased the involvement of market actors in forest governance, and motivated international governments to develop the mechanism of carbon funds (Agrawal et al., 2008). These global pressures and expectations led to the initiation of

carbon crediting mechanisms such as the clean development mechanism (CDM) and reducing emissions from deforestation and forest degradation with forest management (REDD+). Financial incentives for mitigating climate change are also being discussed under the United Nations Framework Convention on Climate Change (UNFCCC).

1.2. Progress of international negotiation on REDD+

As the initial international agreement for the reduction of GHG emissions, the Kyoto Protocol was adopted under the UNFCCC in 1997. Based on the principle of "common but differentiated responsibilities", developed countries took a heavier burden on their targets primarily through national measures. The protocol also offered additional means for using market-based mechanisms, CDM and joint venture, to meet the targets on reducing GHG emissions. It was also agreed to include activities on afforestation and reforestation (A/R) as a part of CDM in the Agriculture, Forestry, and Land Use (AFOLU) sector. However, efforts for reducing emissions from deforestation and forest degradation (REDD) were not included in the Kyoto mechanism due to the difficulty in estimating the volume of GHG emissions and absorption; instead, they were discussed in the next UNFCCC as a new post-Kyoto Protocol mechanism, REDD+. Besides that, strict operation guidelines of the A/R CDM were limited to a few middle-income

countries such as China and India. By reviewing that situation in the CDM, REDD+ is expected to be a framework and a mechanism that most developing countries can participate.

The basic ideas of REDD were included in the Bali Road Map and adopted as mitigation measures in the Conference of Parties (COP 13) in 2007. In the Cancun Agreement agreed at COP 16 in 2010, REDD became REDD-plus (REDD+) by the addition of forest management components (UNFCCC, 2010). REDD+ includes the following five activities:

(a) Reducing emissions from deforestation,

(b) Reducing emissions from forest degradation,

(c) Conservation of forest carbon stocks,

(d) Sustainable management of forests,

(e) Enhancement of forest carbon stocks.

REDD+ intends to provide incentives for increasing carbon stocks and allows for emission reduction credits from various forest management practices. Improvements to logging practices, forest fire prevention, afforestation/reforestation, and sustainable

forest management, in addition to forest conservation, became potential credit-generating activities under REDD-plus (UNFCCC, 2010). Practical measures for ensuring long-term mitigation efforts by utilizing carbon credits, and by activities for developing technical capacities and institutional arrangements were encouraged. The measures would begin with strategy development and demonstration activities with capacity building toward achieving result-based goals. Contributing to the sustainability of those activities, the importance and necessity of adequate and predictable financial and technical support including non-carbon benefits were also strengthened in the decisions (UNFCCC, 2015)

Since the activities prioritizing the amount of carbon stock would cause negative social and environmental consequences, the parties are required to develop Safeguard Information System (SIS) or monitoring and reporting the seven social and environmental safeguard items during the REDD+ implementation. The REDD+ safeguards (UNFCCC, 2010) include:

(a) The actions that complement or are consistent with the objectives of national forest programs and relevant international conventions and agreements,

(b) Transparent and effective national forest governance structures, taking into account the national legislation and sovereignty,

(c) Respect for the knowledge and rights of indigenous peoples and members of local communities, by taking into account relevant international obligations, national circumstances and laws, and noting that the United Nations General Assembly has adopted the United Nations Declaration on the Rights of Indigenous Peoples,

(d) The full and effective participation of relevant stakeholders, particularly indigenous peoples and local communities,

(e) The actions are consistent with the conservation of natural forests and biological diversity, ensuring that the actions are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and ecosystem services, and to enhance other social and environmental benefits,

(f) Actions to address the risks of reversals,

(g) Actions to reduce displacement of emissions.

In the COP 19 held in 2013, the Warsaw Framework for REDD+ was adopted. This agreement has provided clarity on a number of important technical issues related to REDD+ implementation such as modalities for measuring, reporting, and verification

(MRV), national forest monitoring systems, forest reference emission levels and/or forest reference levels (REL), measures for drivers of deforestation and forest degradation, and information on safeguards. Even though financing mechanisms were also an important topic, the details would be discussed in the future. At the COP 21 in 2015, parties to the UNFCCC reached an agreement, namely the Paris Agreement. This agreement came into force in November 2016 to strengthen the global collaboration against the threat of climate change by keeping the global temperature rise in this century below 2 degrees Celsius above pre-industrial levels and by encouraging member nations to make efforts to limit the temperature increase even further to 1.5 degrees Celsius (UNFCCC, 2015). The agreement required all member countries to exhibit planning efforts through "nationally determined contributions" (NDCs). Around forty countries have committed to the efforts of utilizing REDD+ as a means of mitigation measures for climate change.

1.3. Preparation for REDD+ implementation

Prior to the agreement on the REDD+ framework and modalities under the UNFCCC, preparation for REDD+ has been conducted in some developing countries that have the potential and forest conservation needs. As a part of readiness in the phased approach,

international organizations started to invest in capacity building and demonstration activities at various locations and scales. A global survey undertaken in 2009 (Cerbu et al., 2011) revealed that there were at least 79 REDD readiness activities, mostly aiming for national capacity building, policy development, or land-cover change monitoring, and 100 demonstration activities for targeting particular sites. While readiness activities were relatively evenly distributed across Africa, Asia, and Latin America, most demonstration activities were concentrated in Asia, especially in Indonesia as the most popular site.

The institutions and actors engaged in REDD+ preparation in developing countries can be divided into three groups even though some supports are a combination of these three groups: 1) project-based technical support for REDD+ demonstration activities in targeted forests or administration areas, 2) readiness REDD+ technical support for capacity building and preparation for national REDD+ strategy and resources, and 3) financial support for national REDD+ actions. Main actors and actions with key modalities of REDD+ implementation are illustrated in Figure 1-1. The support for REDD+ readiness has been provided by various actors in developed countries through multilateral organizations including the United Nations (UN), bilateral organizations

such as the Japan International Cooperation Agency (JICA), NGOs, and private companies. Developing countries can utilize these resources and supports to set up a national REDD+ strategy and develop capacity. Through collaboration and interaction among governments and various stakeholders for REDD+ efforts at the local level, carbon credits benefited as result-based payments are expected to act as positive incentives for continuing the REDD+ activities to achieve sustainable forest management as well as mitigation of climate change.

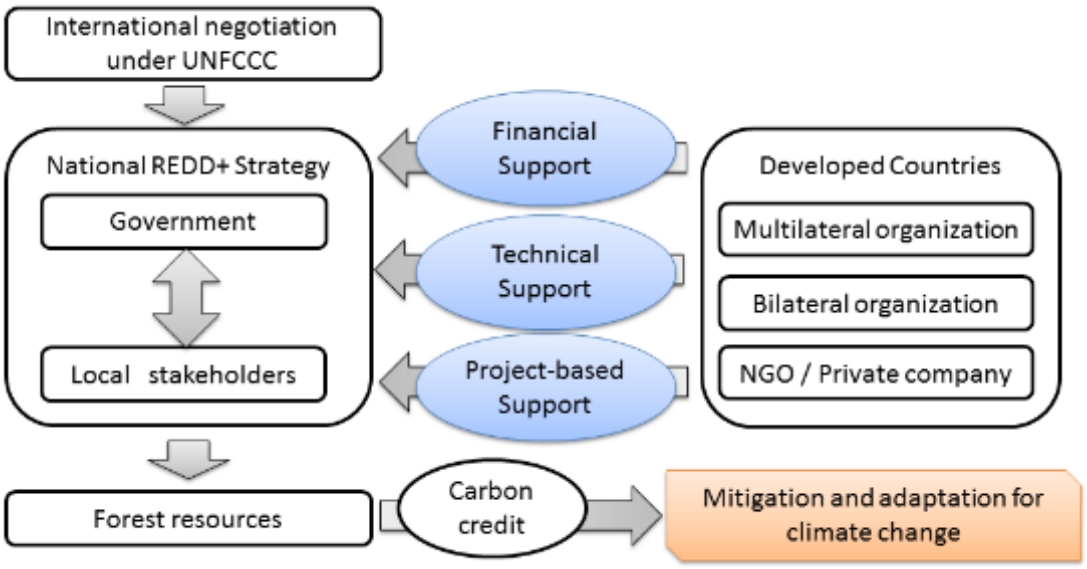


Figure 1-1 Major approach for supporting REDD+ implementation

(Composed by the Author)

Majority of the project-based REDD+ demonstrations are conducted by NGOs, private companies, and bilateral organizations. According to the survey conducted by Cerbu et

al. (2011), the largest NGOs involved in these efforts are World Wildlife Fund (WWF), Conservation International (CI), and Fauna and Flora International (FFI). These NGOs, which globally work for nature conservation, have engaged in climate change mitigation since climate change threatens Earth's biodiversity. Some of the project-based REDD+ activities have succeeded in acquiring finances from private companies as voluntary carbon credits or corporate social responsibility (CSR) practices. For promoting those initiatives, the Verified Carbon Standard (VCS) has taken a remarkable role by developing methodologies and certifying credible efforts all over the world. By September 2016, a total of 1,368 projects, in all mitigation-related sectors, have been registered as validated activities fulfilling the requirements of the methodologies.

The readiness support is mostly provided by multilateral and bilateral organizations as technical cooperation and capacity building for promoting REDD+ actions at the national and sub-national level. Since the REDD+ implementation units for MRV and crediting could be broader administrative boundaries, such as districts or provinces, rather than project-level units such as villages or forest areas, the role of these readiness supports are critical in preparing proper conditions and attracting future REDD+ investment by private sector, which is difficult to engage in policy-related

supports. One of the leading readiness supports, UN-REDD, was launched in 2008 as a collaborative program by three United Nations agencies: Food and Agriculture Organization (FAO), United Nations Development Program (UNDP), and United Nations Environment Program (UNEP). The UN-REDD program has supported over 60 countries for promoting nationally-led REDD+ processes and designing national strategies and actions. Bilateral development organizations such as the German Corporation for International Cooperation (GIZ), the Government of Norway, and JICA also conduct REDD+ readiness supports based on bilateral agreements.

Although financial mechanisms toward result-based REDD+ implementation are still under discussion in the UNFCCC, multilateral and bilateral organizations have already provided financial support for REDD+ readiness. The largest financing for REDD+-related supports from 2006 to 2014 was provided by three countries: Germany, Norway, and United Kingdom (GNU) (Norman & Makhooda, 2014). The GNU is planning to continue to provide support by working with existing REDD+ programs especially in countries having higher potential of GHG reduction such as Brazil and Indonesia (Fujisaki and Yamanoshita, 2016). As a financial multilateral organization, Forest Carbon Partnership Facility (FCPF) through the World Bank has provided the

Readiness Fund for promoting national REDD+ process in 37 countries by 2015. For countries that have made progress in their readiness actions, the Carbon Fund also provided incentives in the form of performance-based payments to stakeholders in REDD+ pilot activities in 14 developing countries. In order to assist similar REDD+ readiness projects, the Forest Investment Program (FIP) was launched in 2008 by multilateral development banks. The FIP has approved or already disbursed grants and low interest loans to 18 projects in 15 developing countries by 2015. In response to the decisions made in COP16, the Green Climate Fund (GCF) is being established and expected to be a core global financial mechanism for facilitating low-emission and climate-resilient development including REDD+.

1.4. Readiness process in Indonesia

Indonesia is one of the countries that implement REDD+ because it has the eighth-largest forest area in the world, the third among the tropical countries following Brazil and the Republic of Congo. It also has extensive peatland forests pooling the largest carbon stock in the tropics. These forests experience a great rate of forest reduction; 684,000 ha of net loss was detected between 2010 and 2015 because of timber extraction and oil palm plantation (Edwards et al., 2012; FAO, 2015). With the three

largest oil palm growing regions: Sumatra, Kalimantan, and Papua, land covered by oil palms reached 7.7 million ha in 2010 and 8.9 million ha in 2015, mostly converted forest areas as illustrated in Figure 1-2 (Gunarso et al., 2013; Write & Rahmanulloh, 2015). Since the Indonesian National Policy Plans include the expansion of palm oil-based biodiesel production and investment in biodiesel plants depending on the increase in market price of crude oil palm, further land conversions to oil palm plantations will occur by deforestation of peatlands in which concession of commercial agriculture has already been issued (OECD-FAO 2008, Wicke et al., 2011). However, the regulations on postponing to grant new licenses for oil palm plantations (Presidential Decree No. 8/2015) can prevent further conversions of forest areas and peat lands. Those drastic changes in local conditions caused by land use-related development make it difficult to identify proper measures for forest management and REDD+ due to complex socio-economic conditions and loss of forest resources rich in carbon stock and biodiversity (Irawan et al., 2013; Eilenberg, 2015).

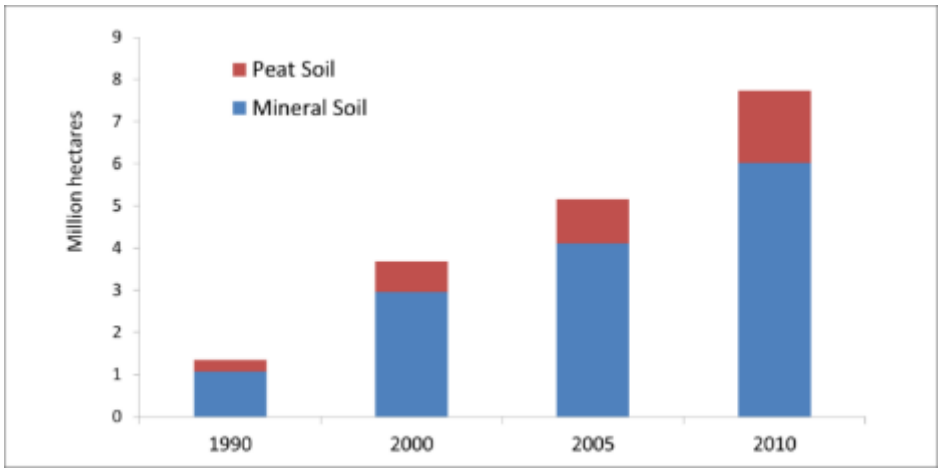


Figure 1-2 Expansion of oil palm plantations between 1990 and 2010 in Sumatra, Kalimantan, and Papua. (Source: Gunarso et al., 2013)

Because of the destruction of its rainforests and carbon-rich peatlands as a leading factor, Indonesia ranks as the world's ninth largest GHG emitter, and is determined to take measures against global warming (Matthews et al., 2014). The Government of Indonesia submitted the National Determined Contribution (NDC) to the UNFCCC in 2015 and is committed to reduce its GHG emissions by 26% compared to the current baseline by 2020 (RoI, 2015). To prepare for the national REDD+ policy and framework, the REDD+ Agency, established by the previous president as a cabinet institution in 2013, took a leading role prior to 2015. After the reorganization of ministries in 2015 under the newly elected president, who integrated the previous REDD+ Agency into the Ministry of Forestry, the newly organized Ministry of Environment and Forestry has undertaken initiatives to draft and enforce REDD+-related national strategies and

policies. In addition to the submission of the NDC, the National Forest Reference Emission Level for REDD+ was also officially submitted to the UNFCCC in 2015. In the same year, a huge forest fire and deadly haze caused an environmental disaster of global proportions. Large areas of tropical forests and peatlands, especially in Sumatra and Kalimantan, burnt out of control in a few months. In response to this disaster, the Government of Indonesia planned to take measures for the prevention of forest fires and the restoration of the peatlands. As a remarkable political action, the Peatland Restoration Agency (BRG) was established in 2016 as a presidential directive (The Government Regulation No. 1/2016).

As part of REDD+ readiness in Indonesia, various policy-related and project-based pilot activities have been implemented with the assistance of international and bilateral organizations. A *Letter of Intent* (LOI) for financial support that was signed between Indonesia and Norway in 2010 facilitated the set-up of the previous REDD+ Task Force and the decision on the moratorium on issuing palm oil licenses in forest areas and peatlands. Furthermore, the financing would also be utilized for promoting the set-up of sub-national financial mechanisms and pilot demonstrations (Luttrell et al., 2011; McNeill, 2015). Besides the support of the Government of Norway, multilateral

programs such as UN-REDD and FIP have been implemented. Various REDD+ demonstrations, mostly mixed with policy supports in provincial and district governments have also been conducted by bilateral agencies, NGOs, and private companies. Further collaboration of these actors will be needed during the transition from the readiness process to national REDD+ actions to tackle with various challenges toward a full implementation of sustainable forest management.

1.5. Main challenges for REDD+ actions at the local level

Since the Paris Agreement entered into force in 2016, the REDD+ readiness and demonstration in developing countries have accelerated. While implementing REDD+ demonstration at the local level, it is important to understand the differences between conventional and REDD+ approaches exemplified in Table 1-1. In the conventional approach, there were time and resource limitations for achieving sustainable forest conservation in project-based activities by Official Development Aid (ODA) and NGOs (Blom et al., 2010; Gibson et al., 2000). To address those limitations, REDD+ intends to target a broader area at a longer time period to deal with multiple stakeholders and direct financing with a result-based approach.

Table 1-1 Differences between conventional and REDD+ approaches

Conventional approach		REDD+ approach
Around 3-5 years	Period	Around 20-40 years
Forest area with buffer zone	Target area	Landscape within jurisdictional boundaries
Particular sector in local (forest-related)	Stakeholder / Counterpart	Various sectors in central and local (rural development-related)
Pilot activity	Main activity	From pilot up to independent operation
In-kind or indirect funding based on plan and performance	Financing	Direct financing based on results in emission reduction
Typical agents and drivers	Target group	Plural agents and drivers
Specific standards and guidelines of each organization	Safeguard	Common information system (Safeguard Information System: SIS)

(Composed by the Author)

For implementing REDD+ demonstrations at the local level, careful considerations and measures are needed to manage various stakeholders or agents in target areas, which are mostly jurisdictional boundaries. In Indonesia, drastic environmental and social changes are caused by ethnic variety and rapid economic growth due to rich natural resources and private investment on oil palm plantations. Those dynamic and complicated conditions make it difficult to identify appropriate targets and measures for the issues of deforestation and forest degradation, ensure safeguards, and achieve sustainability. Based on the on-going REDD+-related discussion (UNFCCC, 2013;

UNFCCC, 2015) and the results of previous studies (Korhonen-Kurki et al., 2012; Minang & van Noordwijk, 2013), the main challenges for REDD+ demonstration activities at the local level can be grouped into three topics: 1) identification of drivers of deforestation and forest degradation, 2) strengthening the role of REDD+ safeguards, and 3) integration of non-carbon benefits into activities for sustainability. Those linkages are illustrated in Figure 1-3. Effective REDD+ actions can be designed and implemented through identification of agents and drivers from various communities in a broad target area. For preventing negative impacts and securing the REDD+ actions, safeguards need to be well utilized. Then, appropriate incentives including non-carbon benefits would be essential to secure sustainability of those actions for the future generations. The details of each challenge are explained as follows.

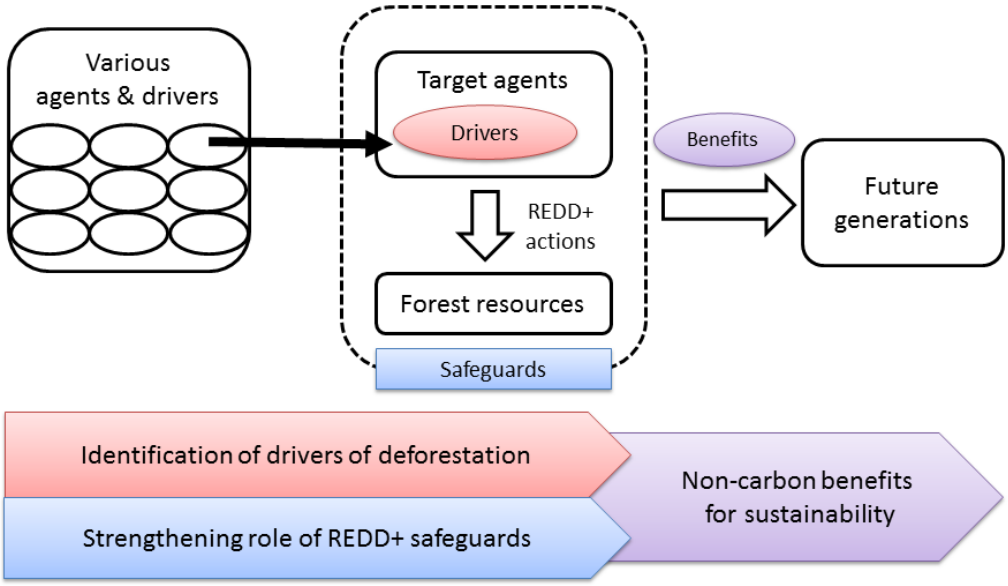


Figure 1-3 Relationships of the main REDD+ challenges considered in the thesis

(Composed by the Author)

1) Identification of drivers of deforestation and forest degradation

The conference of the Parties notes the complexity of the problem, different national circumstances, and multiple drivers of deforestation and forest degradation. It encourages all Parties, relevant organizations, private sector, and other stakeholders to continue their work to address the drivers of deforestation and forest degradation and to share the results of their work on this matter. (Decision 15/CP.19)

In REDD+ implementation, actions to reduce drivers of deforestation and forest

degradation will be essential, as affirmed in Decision 15/CP 19 of the UNFCCC in Warsaw (UNFCCC, 2013). For that purpose, correct identification of agents and drivers of deforestation and forest degradation will be needed to consider effective measures and evaluate those outcomes (Kissinger et al., 2012; Minang et al., 2014). As mentioned above (Chapter 1.3), the VCS, one of the standards for carbon-related verification at the project level, suggests combining several types of surveys and analyses for the identification (Shoch et al., 2011). However, the VCS deals with several drivers at the project level and is thus not sufficient for application in broader jurisdictional boundaries, which involve numerous complicated agents and drivers. Besides that, appropriate ways to understand the interactions of various agents and drivers – including the underlying causes at the target project level – are still limited (Angelsen & Kaimowitz, 1999; Salvini et al., 2014). Measures of proximate factors without considering the underlying causes would minimize the effect of forest management efforts (Buys, 2007). With continuously changing environmental and socio-economic situations, appropriate ways of identifying agents and drivers in local communities need to be proposed.

2) Strengthening the role of REDD+ safeguards

The Conference of the Parties notes that the implementation of the safeguards and the information on how these safeguards are being addressed and respected should take into account the national circumstances and respective capabilities and recognize national sovereignty, legislation, and relevant international obligations and agreements. (Decision 17/CP.21)

The safeguards agreed in the UNFCCC are expected to contribute to multiple benefits without causing negative environmental and social impacts through REDD+ demonstrations and implementations. Each country is required to monitor and report how safeguards are respected and addressed in REDD+ actions according to their national circumstances (Arhin, 2014; UNORCID, 2015). Especially for the social aspect, developing countries face tenure rights related to customary forest use practices (Larson et al., 2013; Sunderlin et al., 2014). Even though the safeguards ask member countries to respect the rights of indigenous people and local communities, the conditions of rights and the characteristics of indigenous people vary across countries. In countries like Indonesia where ethnicity and forest practices are rather diverse, it is quite difficult to identify whose rights and decisions should be respected. A principle of

"Free, Prior, and Informed Consent (FPIC)" should be applied for community involvement, but there are not many examples clarifying how FPIC secures the rights and the active participation of communities (Mahanty & McDermott, 2013). It is also essential that local stakeholders, especially local governments, understand the concept of the safeguards and communicate well with the community and forest users (Sunderlin et al., 2014). Thus, they need to explore how safeguards can play an effective role in improving the capability of local communities through secured rights and positive participation in REDD+.

3) Integration of non-carbon benefits into activities for sustainability

> *The Conference of the Parties recognizes that, in line with their national circumstances and capabilities, developing country Parties seeking support for the integration of non-carbon benefits into activities contributing to the long-term sustainability of those activities, may provide information on, inter alia, the nature, scale, and importance of non-carbon benefits. (Decision 18/CP.21)*

The REDD+ is expected to provide a "carbon benefit" as a benefit to the communities or

forest users to commit to the forest management in the long-run. At the same time, there are concerns that activities prioritizing the amount of carbon stock through REDD+ would underestimate forests and communities in areas with low carbon stock, but abundant precious ecosystems (Putz & Redford, 2009). In response to that, achieving "co-benefits" by adding "non-carbon benefits" such as poverty alleviation and biodiversity conservation are also expected as benefits of the REDD+ actions (Brown et al., 2008). However, in reality, in Indonesia and other countries, forest resources are being converted to other land uses such as farm areas and oil palm plantations. Even most of the local communities using nearby forest resources for traditional practices are inclined to sell or rent their farm land to oil palm companies to acquire instant financial benefits rather than waiting for uncertain carbon benefits (Dixon & Challies, 2015). In addition to that, it is also unclear if sufficient and fair result-based payments will be provided and shared without solving the policy and tenure issues even if REDD+ activities succeeded (Dixon & Challies, 2015; Howson & Kindon, 2015). For instance, the national policy would not allow for distributing the benefits to the communities that do not have legal status for using the forest resources in state forests or national parks (Ituarte-Lima et al., 2014). In that case, it would be difficult for communities to access REDD+ and be motivated to select it only by the expectation of the result-based benefits

(Karsenty & Ongolo, 2012). While it is not certain whether appropriate benefits, either carbon or non-carbon, will be allocated to communities through REDD+ actions, we need to explore what kind of benefits and measures should be taken to refrain people to sell their land and forest resources for acquiring short-term economic returns.

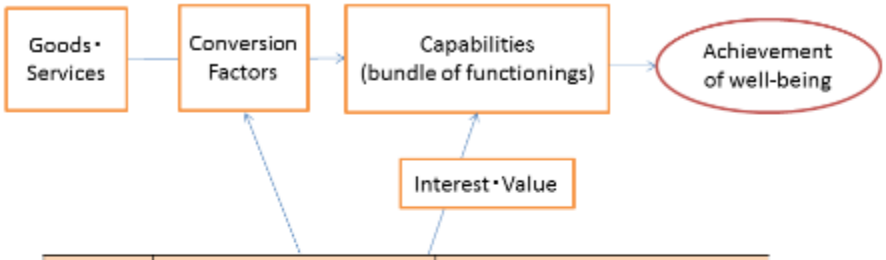
1.6. Capability Approach and human well-being

For analyzing the linkages between the ecosystem services and human well-being - specifically poverty alleviation, previous studies (Fisher et al., 2013; Fisher et al., 2014) compared and improved the existing conceptual frameworks such as "Framework for Ecosystem Services Provision (Rounsevell et al., 2010)', "Millennium Ecosystem Assessment (MEA, 2005)", and "Sustainable Livelihoods (Chambers & Conway, 1992)" These studies pointed out that there are some difficulties in dealing with the social differentiation although the frameworks are effective in visualizing those linkages. The other related studies (Forsyth, 2015; Polishchuk & Rauschmayer, 2012) emphasize that a "capability approach (CA)" is an appropriate framework to analyze ecosystem services in terms of diversified development outcomes, including social dimensions, for human well-being. The CA, developed by Amartya Sen, focuses on 'capabilities', referring to what and how people can achieve meaningful outcomes by using their 'functionings',

signifying the beings and doings' that constitute those outcomes (Forsyth, 2015; Sen, 1992). People's capabilities are constituted by 'functioning sets' that are shaped by 'conversion' of various goods and services and are valuable for the person to the extent that they affect his or her capabilities (Polishchuk & Rauschmayer, 2012; Robeyns, 2005). Within this CA, the ultimate goal of development or human well-being can be expressed as diversifying and enhancing one's capabilities that are influenced by "social and environmental factors" and "personal interest and value".

The specific elements and examples of CA are illustrated in Figure 1-5. People would achieve their well-being by utilizing the capabilities, i.e. the set of functionings, which are converted from various goods and services including forest products and ecosystem services. Various social and environmental factors such as government policies and natural disasters affect capabilities. For example, the development of oil palm plantations on peatland forests would provide sufficient short-term benefits for some local people for selling their land assets and reducing their options for livelihood activities. Thus, a person's overall capability could be weakened even though financial conditions, one aspect of the functionings, was enhanced. On the other hand, other local people can maintain various options for their livelihood by utilizing nearby forest

resources, for small-scale financial benefits such as selling non-timber forest products (NTFP) and promoting eco-tourism. In that case, those people can inherit the opportunities and options including carbon benefits through REDD+, even pass them to the future generations by conserving forest resources and obtaining moderate financial benefits.



Level	Social factors	Environmental factors
Micro	・Customary/Tradition ・Education ・Gender ・Group activities	・Condition of natural resources ・Access to natural resources
Meso	・Public service ・Development activities ・Market	・Natural disaster ・Biodiversity
Macro	・Policy ・National strategy	・Climate change

Figure 1-4 Conceptual diagram on structure of the Capability Approach

(Revised: Robeyns, 2005)

1.7. The purpose of the thesis

In most of the developing countries implementing REDD+, it is expected that all stakeholders take appropriate roles and actions for promoting REDD+ readiness and demonstration. While national programs and international support accelerate the REDD+ process toward a full-implementation, preparation efforts and measures need to be done at the local level in accordance with the socio-economic diversity and local circumstances. Neglecting local conditions in implementing REDD+ actions might have a negative impact on local communities and natural resources. In order to avoid such risks, each country needs to monitor the safeguards. However, there are technical and financial concerns in the sustainability of the implementation of safeguards and measures for deforestation drivers. The purpose of this thesis is to provide a practical REDD+ implementation system ensuring effective safeguards and sustainability through appropriate identification of local conditions. The proposed system will be examined and discussed by applying the CA to the REDD+ potential area, the Gunung Palung National Park (GPNP) in West Kalimantan, Indonesia.

This thesis is composed of seven chapters. After describing the study area and basic methodology (Chapter 2), the findings of four different studies are presented in the

following chapters: the identification of the agents and drivers of deforestation (Chapter 3), characteristics of diversity in communities (Chapter 4), the impact of forest use practices and social safeguards on forest ecosystems (Chapter 5), and the role of local governments in securing safeguards (Chapter 6). Based on the findings, main challenges and policy recommendations are discussed in Chapter 7.

Chapter 2. Study area and methodology

2.1. Oil palm plantation in West Kalimantan

In Indonesia, large tropical forest and peatland remain mostly in Sumatra and Kalimantan. But, the biggest forest loss, around 2.0 to 3.2 million hectare during 2000 to 2010, was observed in Kalimantan, which was attributed mainly to expansion of oil palm plantations (Gunarso et al., 2013). Especially in the West Kalimantan province, 525,000 ha of oil palm were already planted in 2009 (Levang, et al., 2016), and expanded up to 1.82 million ha in 2015 (BPS Kalimantan Barat, 2016). It is expected that the regulation on the moratorium (Presidential Decree No. 8/2015) will mitigate the further land conversions to oil palm plantations. However, there are still concerns that deforestation could occur even in peatland forest in which concessions had already been issued before the regulation entered into force (Koh et al., 2011; OECD-FAO, 2008).

These land use transitions have caused drastic changes in livelihoods and various socio-economic conditions of local communities although it needs the long-term assessment for understanding positive and negative impacts of the oil palm plantations

that enlose complex responses and interactions (Carlson et al., 2012; Rival & Levang, 2014). However, previous studies on impact of oil palm plantations have exhibited concerns on social conflicts and health damage as well as various influences of losing their farm lands and traditional cultures (Li, 2015; Rist et al, 2010; Terauchi et al., 2014).

As a critical social issue triggered by expansions of oil palm plantations, there is a report mentioning that land conflicts are common incidences in the West Kalimantan mostly caused by unwanted land conversions and rejecting oil palm companies, these are mainly generated by unclear forest and land tenures (Levang, et al., 2016; Rival & Levang, 2014). The legal basis of the state control over forest areas in Indonesia has been based on the New Forestry Law (NFL) of 1999. Under the NFL, around 70 % of total land area has been assigned to forest zones under the jurisdiction of MoF (Brockhaus et al., 2012). However, it has generated ambiguity and inconsistencies in the jurisdictional status of land with the Basic Agrarian Law (BAL) of 1960 which had administrated the state control over the all lands in Indonesia. Especially, it caused unclear positions of customary rights for using forest area which was recognized in the BAL, but contested in the NFL (Resosudarmo et al., 2014). Under the ambiguous

situations, customary practices have been continued in some forest areas by people depending on forest resources. And, Consensus-Based Forest Land Use Planning (TGHK) was applied and mapped in the 1980s to classify forest lands in the country by their functions: (1) conservation forest, including national park, for protected areas; (2) protection forest for watershed protection; (3) limited production forest; (4) production forest for commercial logging; and (5) conversion forest for conversion of degraded production forest to agriculture or other uses. Since 1990s, huge of the conversion forest have been converted to oil palm plantation (Brockhaus et al., 2012). These ambiguous and complicated conditions in land tenures have responsible for various types of conflicts largely through unequal power relations among stakeholders claiming legal or customary rights for land and forest areas (Abram et al., 2017; Levang et al., 2016)

2.2. REDD+ in West Kalimantan

While various development activities such as oil palm plantation and mining have been implemented in the West Kalimantan, policy measures for deforestation and climate changes also have been contemplated. For achieving the national targets for reducing 26 % of GHG emission, all of the provincial governments prepared for the Local Action Plans on GHG reduction (RAD-GRK) in 2012. At the same year, the provincial REDD+

Task Force in the West Kalimantan has been established under the Governor's decree. Although the provincial REDD+ strategy and action plan (SRAP) was also prepared, it has not yet reached practical actions and coordination by governments in the central and the local.

The province has hosted some REDD+ projects including the village level carbon pool assessments and ecosystem restaration in the Districts of Ketapang and Kapuas Hulu in collaboration with the Fauna and Flora International (FFI). The Japan International Cooperation Agency (JICA) has implemented the Indonesia-Japan project for the development of REDD+ implementation mechanism (IJ-REDD+) since 2013 as a technical cooperation assistance for institutional setting and various surveys including peatland distributions and REDD+ potential areas. There is also the Forest and Climate Change Program (FORCLIME) supported by the Government of Germany. It is a comprehensive program combining financial supports for readiness in the province and the districts, and technical supports through demonstration activities. The Forest Investment Program (FIP) has also started a grant support for the provincial government to address institutional, technical, and capacity-related barriers for the REDD+ implementation. While preparations and demonstrations are being promoted,

opportunities for information sharing and coordination on the provincial REDD+ actions will be more active.

2.3. Outline of Gunung Palung National Park

A series of studies for this thesis were conducted in the area around the Gunung Palung National Park (GPNP), which covers 108,000 ha of conservation forest (*Hutan Konservasi* in Indonesia), in the West Kalimantan province in Indonesia. The Gunung Palung area was originally registered as a Wildlife Sanctuary in the 1980's, then designated as a National Park in 1990 as a precious ecosystem area enclosing primary, peat swamp and mangrove forests, that provide habitats for Proboscis monkey (*Nasalis larvatus*) and Orangutan (*Pongo pygmaeus*). Annual rainfall in the Kayong Utara district was 2,645 mm in 2013, with seasons of little rain during January to March and August to October (BPS Kyong Utara, 2014).

Currently, around 45,000 people, comprising various ethnic groups such as Malay, Dayak, Javanese, Bugis, Madura, and Chinese, live in 20 villages that share boundaries with the GPNP and locating in two districts—the Ketapang and the Kayong Utara. Each village (*Desa*), a minimum administrative unit, consists of three to five

sub-villages (*Dusun*), generally that have similar ethnic groups and cultures (Figure 2-1). Traditionally, local people have utilized forested areas, where are largely located inside the national park at the present, for collecting durian fruits and other NTFPs, (Figures 2-2 and 2-3).

Figure 2-1　Location of Gunung Palung National Park in West Kalimantan

Figure 2-2　View of Mount Palung and peat swamp forest over Sedahan Jaya village, Kayoung Utara District (Photograph by the Author)

Figure 2-3　Forest garden of durian and banana inside the national park around Sejahtera village, Kayoung Utara District　(Photograph by the Author)

In the 1960s, the government of Indonesia began to issue timber concessions (*Hak Pemanfaatan Hutan*, or HPH) in the West Kalimantan. During that, the logging concession companies hired local villagers and immigrants to work as laborers for illegal loggings around the GPNP. By the late 1980s, the companies closed operations since most of valuable timbers were removed (Hiller et al., 2004; Ravenel, 2004). Because of that, the workers of the concession companies lost jobs and cash income. Owning to loss of livelihoods as well as confusion in the forest management policies under decentralization promoted after stepping down of the president Suharto in 1998, illegal logging came to be active according to joining of unformal institutions and investments from outside (Curran et al., 2004; Ravenel, 2004). Previous studies (Hiller et al., 2008; Ravenel, 2008) have concluded that main causes of the illegal logging were: i) easy access to forest, labor, market, and equipment; and ii) local and national economic factors such as international demand for timbers and local needs for cash income. From 1988 to 2002, almost 25,700 ha of lowland peatland forest within the GPNP were lost attributed mainly to illegal logging (Curran et al., 2004).

Illegal logging has decreased since 2003 owing to strengthened patrolling activities by

the GPNP office in the area even though small-scale community loggings still continued (Ministry of Forestry, 2009; Zamzani, 2008). Currently, in addition to urbanization and population growth, oil palm plantations in the GPNP vicinity increased and created employment for local communities as laborers or production of oil palm at the farm land (Figure 2-4).

Figure 2-4　Development of oil palm plantation by converting natural forest area around the Sempurna village, Ketapang District (Photograph by the Author)

When looking into the historical changes in paddy and oil palm productions and areas in the Ketapang (Figure 2-5) and the Kayong Utara Districts (Figure 2-6), it is relatively clear, especially in the Ketpanag district, that some farmers stopped paddy farming and

converted their cultivation crops to oil palm under a nucleus estate and small holder schemes (*plasma*), which is a form of contract farming with a plantation company. Actually, expansions of oil palm plantation and plasma by farmers are being increased even in the Kayong Utara District according to the interviews with the district staff and the communities.

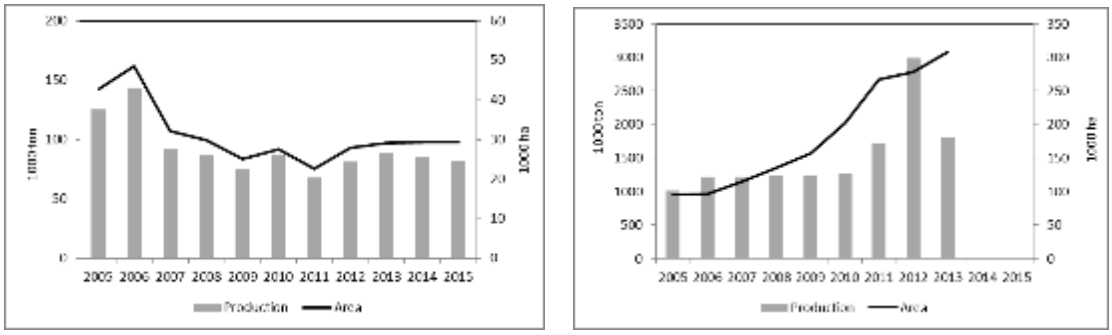


Figure 2-5　Historical change in production and area of paddy (left) and oil palm (right) by farmers in Ketapang District　(Source: BPS Ketapang)

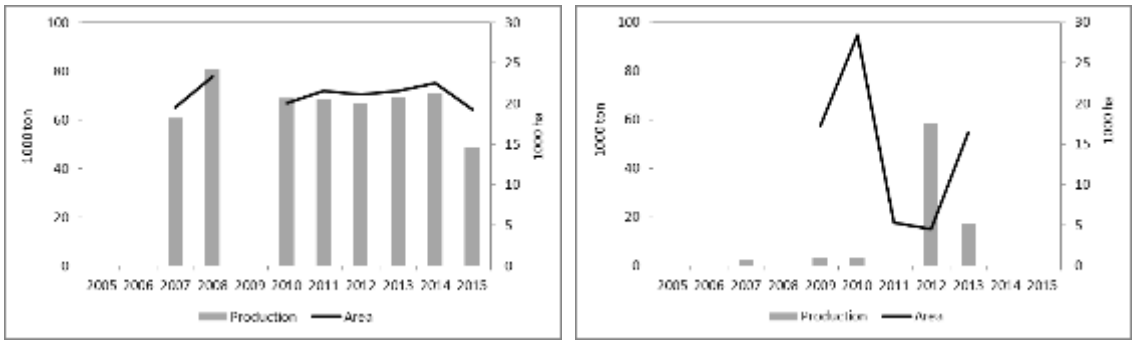


Figure 2-6　Historical change in production and area of paddy (left) and oil palm (right) by farmers in Kayong Utara District　(Source: BPS Kayong Utara)

Under the government regulation No. 98 of 1998, National Parks in Indonesia, that are 534 protected areas including 50 parks covering 28.2 million ha, is designated as natural ecosystems holding certain characteristics and functions. According to the Decree P. 56, each national park has several designated zones, such as “core” and “traditional use”, based on the ecological functions and the socio-economic conditions. It also includes a “special use zone” for accommodating forest uses by local communities residing at the area since before designated as a national park. Designations of the boundaries and the zones without sufficient consultation and recognitions have caused disputes and conflicts with local communities around national parks (Blouch, 2010; Mulyana et al., 2010).

In case of the GPNP, originally certified as the Gunung Palung Wildlife Sanctuary in the 1980’s, main works for the rangers were was to rotate the buffer villages regularly, and monitored forest conditions with some villagers. Wherein traditional forest uses such as durian fruit collection was practiced, the rangers issued permission notices of special uses for the registered villagers. Because illegal logging was rampant when the GPNP office began operation in 1990, their principal duty, mainly by forest police (*Polhut*) which are majority of the GPNP staff, was to patrol illegal activities inside the

GPNP. For supporting livelihoods and well-being of communities around the GPNP, only a few extension staff (*Penyuluh*) have conducted irregular enlightenment activities to conserve habitat of orangutan and forest resources.

Besides to the GPNP office, the district governments have duties to provide public services such as extensions of agricultural skills and technologies, public health, and education over the community people. However, it is quite difficult for the Kayong Utara district government to deliver sufficient service up to the remote areas around the GPNP. Thus, several local NGOs have worked for villages around the GPNP and built good relationships with the communities. One of the active organizations is the Alamat Sehat Lestari (ASRI) which provides medical service and forest conservation activities according to their missions for "health nature everlasting with harmonious balance". The Yayasan Palung (YP) has also provided various conservation activities like environmental education and livelihood supports especially for protecting biodiversity and habitat of orangutan. As REDD+-related activities, the FFI Indonesia has closely worked with pilot villages in the Ketapang District and continued negotiating with the district government to certify for the village forest program (*Hutan Desa*), which is an official scheme to transfer authority on forest use and management to communities

based on an agreed plan and a regulation. In 2013, the *Hutan Desa* was approved for the Manjau sub-village in the Laman Saton village, which is one of buffer villages around the GPNP. After that, the FFI supported the community to acquire for the Plan Vivo Standard as a kind of REDD+-related demonstrations aiming to channel with voluntary carbon funds. The Indonesia Forest and Climate Support (IFACS) supported by the USAID also provided various capacity building and demonstration activities that are mainly livelihoods supports and forest monitoring in target villages. As their remarkable outputs, the Strategic Environment Assessment (SEA) and the voluntary-based stakeholder forum were prepared in the both Ketapang and Kayong Utara districts.

Since 2013, a pilot REDD+ demonstration project, IJ-REDD+, targeting the GPNP has been implemented under the agreement between the Ministry of Environment and Forestry (MoEF) and the JICA. To develop enabling conditions of the REDD+ implementation, the following activities have been conducted by 2016 in collaboration with the GPNP office:

- Partnership building and collaborative activities in the target villages through practical trainings on facilitation skills targeting for the GPNP staff;

- Trainings and workshops on collaborative management and the REDD+ safeguards targeting for the GPNP staff and local stakeholders and communities;
- Preparation for setting up the multi-stakeholder forum for collaborative management of the GPNP landscape as a platform for decision making; and
- Various surveys such as socio-economic survey and forest inventory for compiling a data set which can be utilized for drafting a REDD+ document in the future.

2.4. Socio-economic survey

Socio-economic data for this thesis were collected through questionnaire surveys as well as semi-structured interviews as a part of the activities the IJ-REDD+. The questionnaire surveys and semi-structured interviews were conducted in eleven villages out of the twenty buffer villages around the GPNP. The target villages were selected in accordance with the purpose of each study mainly for extracting socio-economic characteristics of ethnic groups, key livelihood activities and forest use practices. The surveys were carried out by local surveyors and the IJ-REDD+ project staff after confirming their survey skills and ethical considerations through practical trainings and progress monitoring. A key consideration was to administer the survey without creating anxiety in the surveyed households in terms of assigning blame or identifying

those engaged in illegal practices. In advance to conduct the survey, the research plan was consulted and approved by the Ethics Review Committee on Research with Human Subjects of Waseda University (No. 2015-232).

The questionnaire survey for the eleven villages (Figure 2-7) was conducted by attempting to elicit quantitative information, such as types and amounts regarding the five main topics during the latest one year: basic information (family size and ethnicity), assets (livestock and land use), farming conditions (type of crops, productivity, location of farming), collection of non-timber forest products (NTFP; type of NTFP, amount, location of collection), and income structure (amount from on-farm and off-farm activities). Those survey items were selected by referring previous socio-economic-related surveys around the GPNP (Hiller et al., 2004; Lawrence et al., 1998; Zamzani, 2008). Households for the survey were selected by a stratified sampling method, which extracts characteristics of various ethnic groups, farming, and livelihood types by referring to the village profile statistics. For example in the Sedahan Jaya Village, the sample size from the non-Malay households (47 %), such as Javanese and Balinese, is larger than their actual ratio in the population (around 40 % according to the village head) because we adopted a stratified sampling to obtain data for

understanding the characteristics of every ethnic group with sufficient reliability. According to the stratified number of ethnic groups, farming, and livelihood types, those numbers were allocated in advance by referring to the respective village profile. The sample households were selected from households' name lists mentioning ethnic groups and main livelihoods instructed by the village offices and the village heads. From the eleven sample villages, total 870 samples (13.7 %) were selected out of the 6,364 total households in the statistics as listed in Table 2-1 (BPS Kayong Utara, 2014; BPS Ketapang, 2014). After the questionnaire survey, semi-structured interviews which aim to obtain supplemental background information on forest uses and park management were conducted with several informants especially in the Sedahan Jaya and the Sejahtera villages, in which majority of forest users residing. Those surveys and interviews were conducted from June 2014 to March 2015.

Figure 2-7 Location of sample villages around Gunung Palung National Park

Table 2-1 Number of total and sample households in eleven villages

District	Village	Total households	Sample households
Kayong Utara	Simpantiga	426	30
	Sejahtera	543	70
	Pangkalan Buton	1,049	120
	Benawai Agung	638	70
	Sedahan Jaya	661	120
	Gunung Sembilan	349	60
	Panpang Harapan	310	80
	Riam Berasap	445	60
Ketapang	Laman Satong	729	90
	Pangkalan Teluk	837	90
	Sempurna	377	80
	Total	6,364	870

2.5. Data Analysis

In this thesis, multivariate analysis was mainly applied for data obtained from the questionnaire survey. From the point of CA which is consisted with bundle of functionings, it helps to deal with multiple variables such as livelihood activities and assets at the same time. Basically, principal component analysis (PCA) and canonical discriminant analysis (CDA) as a method of multiple regression analysis were used because it is useful to grasp the characteristics of various communities. A CDA is useful for finding a combination of features that separates multiple classes of objects, such as villages and ethnic groups. A PCA is a mathematical procedure that transforms a number of correlated variables into a smaller number of uncorrelated variables called principal components (PCs), wherein each component is a linearly weighted combination of the initial variables. The first principal component (PC) indicates the highest amount of variation in the data. The second and succeeding components, which account for as much of the remaining variability as possible, are completely unrelated to the first component and explain additional variation. As preceding cases have demonstrated, a PCA can be used for identifying factors of forest cover changes, leading to recommendations for technical approaches and policy reforms (Jadin et al., 2013; Soto and Pintó, 2010; Valdivia et al., 2012). In those studies, PCA was used to reduce

the number of variables in a data set from household surveys into smaller numbers of the dimensions of community groups or critical agents (Vyas and Kumaranayake, 2006). From these bases, it was recognized that PCA would be more appropriate for this study for identifying key variable factors that help to analyze and assess capabilities, bundle of functionings, of various community people.

Chapter 3. Identification of agents and drivers of deforestation

3.1. Introduction

Prior to implementing a REDD+ project in target areas, agents and drivers of deforestation and degradation need to be understood so that the necessary targets and activities for forest conservation can be identified (Rudel et al., 2009; UNFCCC, 2013). Such an understanding would also contribute to the design of appropriate REDD+ activities, which should integrate both forest management and poverty reduction by involving livelihood supports and community empowerment for enhancing long-run opportunities and capabilities for well-being (Chhatre et al., 2012; Demals & Hyard, 2014; Tata et al., 2014; Vu et al., 2014). Drivers of deforestation and degradation can be further divided into proximate drivers and underlying causes (Angelsen & Kaimowitz, 1999; Geist & Lambin, 2001). Proximate drivers could include farm expansion and forest use, either legal or illegal, by local people, while underlying causes might be the interaction of various complex influences of government policies, private sector plantations, and the growing demand for forest-derived commodities in the global markets (Geist & Lambin, 2002; Nguon & Kulakowski, 2013). Previous studies (Boucher et al., 2011; Romijn et al., 2013; Rudel et al., 2009; Smit & Wandel, 2006;

Wicke et al., 2011) have verified that for most countries, population growth, poverty, and policy-oriented factors have been the main underlying causes of deforestation, particularly during high deforestation periods. However, certain factors that accelerate deforestation and degradation tend to be difficult to specify because multiple factors – mainly those derived from land use-related development, such as oil palm plantation and timber concession – have interacted in the current situation (Lambin et al., 2001; Lutrell et al., 2014). Some previous researches on identification of deforestation factors have mostly focused on analysis of agents and proximate drivers from the aspect on geographical land use changes (Hosonuma et al., 2012; Vu et al., 2014; Wyman & Stein, 2010). Thus, appropriate ways to understand and integrate the interactions of various agents and drivers – including underlying causes in a target project level – are still limited (Angelsen & Kaimowitz, 1999; Salvini et al., 2014). Not sufficient considering the underlying causes could minimize the impact of initiatives for addressing drivers and forest management on long-term (Buys, 2007; Salvini et al., 2014).

As mentioned above, identification of agents, drivers, and underlying causes is essential for REDD+ interventions in target areas that enclose complex human and natural systems. However, identifying agents and drivers appropriately tends to be difficult

when they are interrelated in a target area. Countries such as Indonesia, which is consisted of various ethnic groups, constitute complex social environment. Even in our study site, Gunung Palung National Park, various ethnic groups such as Malay, Dayak, Javanese, Bugis, Madura, and Chinese, have lived in buffer villages in harmony for years. Furthermore, land use changes also have been ongoing because of development activities, such as oil palm plantation development, illegal logging, mining, and forest fires inside and around the GPNP. These situations cause drastic changes in community, and make it difficult to anticipate how agents and drivers affect and interact in each other. Thus, this study aims to examine an effective way of identifying agents and drivers of deforestation in a community constituted of various ethnic groups and active forest uses. In addition, potential underlying causes and structures of socio-economic diversity in a community will be discussed from the point of capability approach.

3.2. Methodology and data collection

Sedahan Jaya Village was selected from among the buffer villages around the GPNP, based on consultation with the GPNP office, because of priority in conservation and potential for REDD+ owing to accelerated deforestation and forest degradation, which attributes mainly to forest fire, farm land expansion and intensive forest land uses as

community activities. The Sedahan Jaya village consists mainly of the Malay as the most prominent ethnic group, along with a mixture of the Balinese and the Javanese that majority immigrated from Bali Island or East Java in the 1960's to 1990's because of volcanic eruption and transmigration projects by the government.

The questionnaire survey for the Sedahan Jaya village was conducted from June to July 2014 for 120 samples (18.2 %) out of around 661 total households. After the questionnaire survey had been administered, semi-structured interviews were conducted for 40 randomly selected households in the Sedahan Jaya among those who engage in farming and NTFP collection. The interview was conducted from November to December 2014, aiming to obtain supplemental background information – such farming practices, trends in forest uses, and the changes associated with them.

An understanding of the basic characteristics of the ethnic groups and natural resource use was gleaned from the sample data. Subsequently, the statistics analysis proceeded in three steps: 1) conducting canonical discriminant analysis (CDA) for identifying characteristics of main ethnic groups and users of the national park in the Sedahan Jaya, 2) attempting to evaluate factors on drivers of deforestation by applying a

multiple regression analysis ,and 3) conducting principal component analysis (PCA) to extract key variables and socio-economic structures and classifying sample households as a set of principal components.

3.3. Results

Overview of socio-economic characteristics

The results of the questionnaire surveys in the Sedahan Jaya are summarized in terms of the number of engaged households (n) out of the sample total (N) and the mean of the number or volume for each main characteristic: ethnic group, agricultural production, livestock possession, land use inside and outside National Park (NP), collection of NTFPs and income (Table 3-1). The average was calculated based on the number of engaged sample households (n) except for income, which is average of the total sample households (N). In terms of farming practices, paddy rice is the main one. The amount of annual paddy production is 3.0 ton per hectare, this bountiful harvest likely owing to sufficient water resources and irrigation facilities. The villagers cultivate vegetables and fruits in home gardens around their residences. Chickens and pigs are the main livestock, raised mainly by relatively wealth or the Balinese households. These animals graze mostly around houses inside the villages, not inside the national park. Regarding

use of the national park, the forest area is used for farming and forest gardening. Whereas the farming in the national park is mainly for rice cropping, the forest gardens in the Sedahan Jaya Village are for cultivation of sugar palm and banana trees under natural trees as well as collecting NTFPs, such as firewood, durian, and bamboo shoot. Based on the interview survey, the farmers have customary user rights for the durian trees. Users collect durian fruits that fall to the ground naturally rather than by cutting the trees. In order to make it easy to find durian fruits on the ground, the people carry out such minimum management as weeding around the trees. Regarding the income structure, on-farm activities mainly from selling paddy in the Sedahan Jaya seem to be the main source rather than off-farm activities, which are mostly as government employees or temporary income from construction activities.

According to the interview survey, the following three points were cited as noteworthy in relation to land use practices among the ethnic groups: 1) the Malay residents, who had lived there prior to other ethnic groups like the Javanese and the Balinese, were recognized as predominant forest users because they were using the forest area for cultivating tree crops and collecting NTFP as a traditional forest gardening even before it was designated as a national park. This custom may have continued and tends to be

intensive uses compared with the past. 2) Inadequate land for farming is one of the critical issues in the village especially for the Javanese that came to this area in the 1990's. Even though the Balinese also immigrated in the 1960's, they could achieve relatively good paddy production by utilizing their knowledge on irrigation. The average farm area in the Sedahan Jaya is 0.98 ha per household, which will be distributed evenly to children in the growing population. In case children continue farming, it would be difficult to get sufficient production in the limited farm area without expanding to other areas such as the national park. 3) Generally, there are no utilization rules for forest use, including forest gardens. Only 6.7% of households realized that there were any customary rules for NTFP collection. According to the village head, most of the villagers do not have a good recognition of the exact boundary or zoning of the national park, either.

Based on these socio-economic characteristics, the drivers of deforestation and forest degradation are assumed to be farming and forest gardening inside the GPNP. However, it is difficult to identify the characteristics of households that can be engaged as agents of the drivers. Doing so would be especially difficult in the Sedahan Jaya Village using only simple statistics with the mean of each characteristic because multiple ethnic

groups conduct various farming activities and forest use in the same area.

Table 3-1 Overview of socio-economic characteristics in Sedahan Jaya

Socio-economic Attributes		Unit*	Sedahan Jaya (N = 120)	
			n	Mean
Ethnic Group	Malay	Household	64	
	Javanese	Household	21	
	Balinese	Household	27	
	Others	Household	8	
Agricultural Production	Paddy rice	Ton/year	110	3.0
	Home garden	Kg/year	53	301.7
Livestock	Cow	Head	8	0.2
	Pig	Pig	21	0.7
	Chicken	Chicken	67	8.4
Land Use	Farming inside NP	1,000 m^2	10	9.2
	Farming outside NP	1,000 m^2	108	11.0
	Forest garden inside NP	1,000 m^2	25	8.2
	Plantation outside NP	1,000 m^2	11	3.5
Collection of NTFP	Fuelwood	Bundle/year	107	56.8
	Durian	100 kg/year	36	3.7
	Mushroom	Kg/year	13	44.8
	Bamboo shoot	Kg/year	65	32.6
Income	Paddy rice	Million Rupiah/year	108	19.2
	Vegetable	100,000 Rupiah/year	7	0.2
	NTFP	100,000 Rupiah/year	50	16.0
	Total on-farm activities	Million Rupiah/year	112	23.1
	Employment salary	Million Rupiah/year	42	8.2
	Total off-farm activities	Million Rupiah/year	100	14.7

* The unit was used for standardizing figures and preparing for the Figure 3-1.

Identification of agents

In order to explore the link between ethnicity and socio-economic characteristics, a CDA was conducted with a stepwise method for the main ethnic groups in the Sedahan Jaya – Malay, Javanese, Balinese and others – using socio-economic attributes in Table 3-1. The results, at 59.2% of the correct distinction rate, revealed that detailed ethnic groups might be not remarkable factors in helping to distinguish socio-economic characteristics as a means of identifying deforestation agents (Table 3-2).

Table 3-2 Results of CDA on ethnic groups in Sedahan Jaya

Ethnic groups		Predicted group				Total
		Malay	Javanese	Balinese	Others	
Original count	Malay	40	6	4	13	63
		(63.5 %)	(9.5 %)	(6.3 %)	(20.6 %)	(100 %)
	Javanese	3	11	1	9	24
		(12.5 %)	(45.8 %)	(4.2 %)	(37.5 %)	(100 %)
	Balinese	3	2	16	6	27
		(11.1 %)	(7.4 %)	(59.3 %)	(22.2 %)	(100 %)
	Others	1	1	0	4	6
		(16.7 %)	(16.7 %)	(0 %)	(66.7 %)	(100 %)

Positive discrimination rate = 59.2 %

Further CDA on the national park (NP) users who farm and do forest gardening was conducted by using the socio-economic attributes as variables with a stepwise method. Then, we introduced Malay or non-Malay residents as a dummy variable, without

applying detailed ethnic groups. The analysis showed that 90.0% of all sample households were appropriately classified as NP users or non-NP users. The 26 NP users out of 31 households were properly discriminated at 83.9% and the non-NP users at 92.1% (Table 3-3). A calculated structure matrix derived from the CDA, which explains how much each independent variable contributes to distinguishing the two groups, describes the characteristics of the national park users as positive values in the variables 'Malay', 'income from NTFP', and 'amount of durian collection', as well as on-farm activities such as 'production of paddy rice' (Table 3-4). This matrix seems to demonstrate that especially Malay households, which practice farming and are highly depend on NTFPs such as durian, tend to use forest resources in the national park and could be main agents. On the other hand, as the features of non-users, land use outside the national park and off-farm activities exhibit negative values. Thus, households that have sufficient land and off-farm livelihood assets tend not to be such deforestation agents. Based on this understanding of the characteristics of agents, measures to mitigate impact on the national park and forest resources can be considered.

Table 3-3 Results of CDA on national park users in Sedahan Jaya

Independent variable	Total	Discrimination	
		NP users	Non-NP users
NP users	31	26	5
	(100%)	(83.9%)	(16.1%)
Non-NP users	89	7	82
	(100%)	(7.9%)	(92.1%)

Positive discrimination rate = 90.0%

Table 3-4 Structure matrix derived from CDA on national park users

Variables	Function	
	NP users	Non-NP users
Malay	0.51	
Income from NTFP	0.49	
Durian collection	0.37	
Farming outside NP		-0.16
Income from off-farm activity		-0.15
Production of paddy rice	0.13	
Plantation outside NP		-0.12
Production from home garden		-0.06
Fuelwood collection	0.05	
Income from on-farm activity	0.02	

Evaluation of drivers

For evaluating the impact on deforestation by potential agents who depend on forest resources and land in the national park, a multiple regression analysis was administered, employing land use area for farming and forest gardening in the national

park as the dependent variables. By using the socio-economic attributes as the explanatory variables, a stepwise method was applied in the analysis. Although the adjusted coefficient of determination in the results, 0.25, was not very relevant, it allows us to estimate a socio-economic structure that affects the magnitude of impact on the national park (Table 3-5). The extracted four explanatory variables were effective in preparing a regression formula that could evaluate the impact of the national park uses for farming and forest gardening. In particular, 'amount of durian collection' shows a higher t-value as well as 'production of paddy rice', with a positive value. As the negative t-value in the explanatory variables, 'areas of farming' and 'forest garden outside the national park' were extracted. Those variables match with results in the discriminant analysis, which also exhibits that sufficient land use outside the national park would be a feature of non-NP users (see Table 3-4). Thus, it can be assumed that deforestation would be accelerated by an increase in households that intensively use forest area and resources whereas it might be alleviated by promoting effective land use for farming and forest gardening outside the national park.

Table 3-5 Results of multiple regression analysis on use of national park

Explanatory Variables	ß	t	p	Γ
Durian collection	0.53	5.00	**	0.26
Forest garden outside NP	-0.36	-3.33	**	-0.10
Farming outside NP	-0.26	-2.70	**	-0.13
Production of paddy rice	0.21	2.25	*	0.12
Adj. R^2	0.25			
N	120			

ß: Standard partial regression coefficient γ: Correlation coefficient

** $p < 0.01$; * $p < 0.05$

Detecting the socio-economic structure

For identifying socio-economic characteristics and detecting the socio-economic structure of the sample households in the Sedahan Jaya village, the PCA was applied to extract key variables and principle components (PCs). Prior to being subjected to the PCA, units of quantitative variables were standardized (Table 3-1). In the PCA, an appropriate set of variables showing the highest value in the accumulated percentages of variance was explored. Based on the analysis, five principle components (PCs) with 11 independent variables were extracted from the dataset, accounting for 81.4% of the total variance (Table 3-6). These 11 independent variables from livestock, farm production, NTFP collection, and income would be recognized as key factors of the socio-economic characteristics for classifying the sample households in Sedahan Jaya.

From the results of the PCA (Table 3-6), PC 1, 22.6% of the variance, can be interpreted as a type of main livelihood by separating on-farm and off-farm activities, in particular. Even some of the households engaging in off-farm activities derive income from on-farm activities. Thus, the result actually emphasizes full-time farmers and part-time farmers those who garner food and income from various means, including employment and home gardens. PC 2 seems to be related to economic activities by emphasizing households that engage in off-farm activities and farming for receiving more cash income by selling vegetables and fruits from home gardens rather than subsistence products, such as paddy production from full-time farming. PC 3 shows off-farm activities as a positive value while highlighting households that home garden for additional income as a negative value. PC 4 makes it possible to identify households using forest areas, mainly the national park, for farming and forest garden by using the negative coefficient value. Then, PC 5 also seems to relate forest uses with positive values by assisting with dividing between households that engage in stable and complementary income activities. Possessing a cow and collecting NTFPs like durian, shown as negative values, are not stable, but they provide supplemental income. These interpretations of PCs can be used to explore appropriate REDD+ activities at the project level.

Table 3-6 Results of PCA in Sedahan Jaya Village

Extracted variables	Principal Component (PC)				
	1	2	3	4	5
Production in home garden	-0.10	0.32	-0.37	0.01	0.05
Cow possession	0.28	0.21	0.07	0.20	-0.25
Pig possession	0.01	-0.09	-0.08	0.49	0.33
Farming inside national park	0.07	-0.01	-0.01	-0.02	0.07
Forest garden in national park	0.16	0.03	0.03	-0.41	0.35
Durian collection	0.32	0.21	0.06	0.05	-0.05
Income from paddy rice	0.19	-0.06	-0.04	0.42	0.29
Income from vegetables	-0.10	0.33	-0.37	0.01	0.06
Income from NTFP	0.27	0.18	0.07	-0.15	-0.04
Income from employment salary	-0.18	0.28	0.35	0.08	0.14
Income from off-farm activity	-0.18	0.26	0.35	0.11	0.15
% variance	22.6	18.7	16.9	12.9	10.4
Accumulated %		41.2	58.1	71.0	81.4

The use of extracted variables and their PC factor scores for each PC in Table 3-6 enabled identification of the characteristics of households in the scatter plot diagrams (Figure 3-1). Each dot in the diagrams shows sample households and different symbols for ethnic group-Malay or non-Malay- and-NP users or non-NP users- to demonstrate the possibility of difference in characteristics. Contrasting PC 1 (type of main livelihood) and PC 2 (type of economic activity), the households can be classified into three types; I) non-farming, II) forest use, and III) paddy farming. Most of the national park users would be classified as NTFP users, type II, and would be recognized as Malay residents.

This outcome mostly matches with the results in the CDA (Tables 3-3 and 3-4). Thus, it is possible to verify that a part of the Malay community could be main forest users as well as a potential deforestation agent in Sedahan Jaya Village. From these PCA and scatter plot diagrams, we can understand the characteristics of sample households and diversity in community by classifying them, which could help, in turn, with designing effective REDD+ activities.

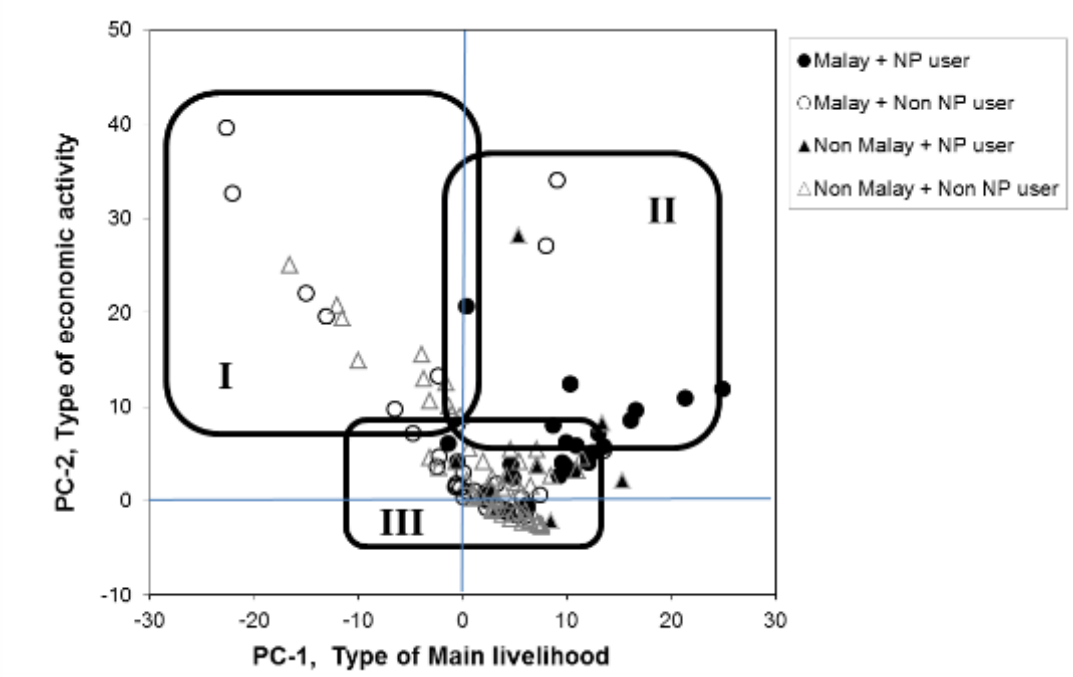


Figure 3-1 Distribution (factor scores) of households in Sedahan Jaya formed by the two-principle component; PC 1 (main livelihood type) and PC 2 (economic activity type), with an indication of types (I-III). The characteristics can be classified as I) non-farming, II) forest use, and III) paddy farming.

3.4. Discussion

Potential of the combined method

Around the GPNP, various ethnic groups and livelihood activities make it difficult to identify agents and drivers of deforestation and forest degradation. In this study, we assumed use of the national park for farming and forest gardening as proximate drivers. Then, features of agents were identified through a structure matrix derived from the discriminant analysis while drivers were evaluated through a multiple regression analysis. Additionally, the socio-economic structure of the sample households through PCA and scatter plot diagrams could assist in understanding the characteristics of sample households. Combining these methods helps to recognize the positioning of potential agents and to understand socio-economic structures that constitute various people in community who have multiple functionings.

In terms of forest conservation activities, it would be difficult to draw at a fundamental and effective solution without approaching the underlying causes of deforestation (Geist & Lambin, 2002; Lambin et al., 2001; Salvini et al., 2014). In the case of the Sedahan Jaya Village, lack of farm land was addressed in the interview. Such information requires the support of interpretation in looking at the results of the statistical analysis,

which implies that sufficient land outside the national park would mitigate drivers. Combining socio-economic surveys and statistical analysis effectively makes it possible to estimate not only agents and proximate drivers but also underlying causes involving various households in an area. However, further study would be needed to verify the appropriateness of these methods in the broader landscape around the GPNP and other areas that have more varied socio-economic characteristics and geographical conditions. Especially in such areas as the nearby oil palm plantation developments, previous surveys have demonstrated that the impact on community livelihoods and socio-economic contexts will be complex and will take time to assess (Carlson et al., 2012; Wicke et al., 2011).

Identification of socio-economic diversity in a community

By using multivariable analysis such as PCA, the sample households in the Sedahan Jaya were classified mainly in three types: I) non-farming, II) forest use, and III) paddy farming (Figure 3-1). Then, a part of the Malay community in Type II could be main forest users and main agents in the Sedahan Jaya village. But the Malay people seem to be scattered in every type and difficult to specify in a particular characteristic. It shows possibility of utilizing multivariable analysis for appropriate understanding of

socio-economic characteristics in a community.

As shown in Table 3- 5 and 3-6, multiple variables such as income and farming area are interrelated for constituting variable households and people in a community. From the point of capability approach (CA), the constitution up to capability can be illustrated (Figure 3-2). The sample households in the Sedahan Jaya utilize their accessible goods and services, such as farm land and forest resources. Then, convert them into their capabilities as a bundle of functionings, such as production of agricultural crops, nursing livestock, and collection of NTFPs. By using a PCA and a scatter plot, it makes possible to identify those key multiple variables, key functionings, in two-dimensional coordinates from principal components as seen in Figure 3-1. Even though each household conducts multiple activities based on their capabilities, the main livelihoods in case of the Sedahan Jaya can be classified into three types; paddy farming, forest use, and off-farm activities. When providing supports or public services as the readiness phase, it would be important to enhance capabilities; options in functionings, through comprehensive activities. By contributing to increase their options in livelihoods, the REDD+ actions can be accessed and recognized by communities as a part of livelihood activities not only for forest conservation.

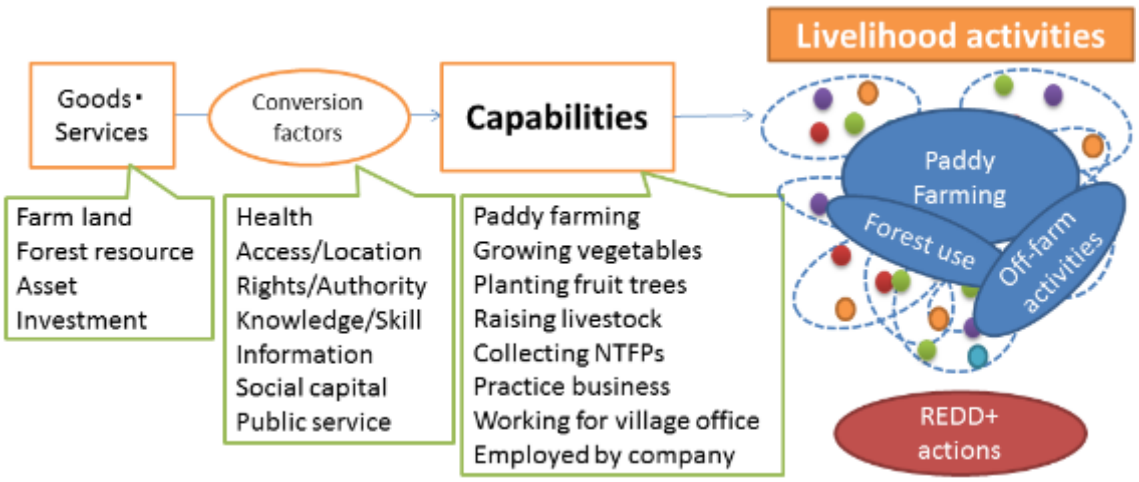


Figure 3-2 Conceptual diagram on structure of capabilities and livelihood activities in Sedahan Jaya village (Composed by the Author)

3.5. Conclusions

This study has attempted to understand socio-economic characteristics in a community; the Sedahan Jaya village, through exploration of main agents of deforestation and forest degradation. For this purpose, combined methods for identifying characteristics in households were examined by employing socio-economic surveys and statistical analyses. Using these methods would assist in effective identification of agents, drivers, and underlying causes even in situations wherein it is necessary to implement integrated measures owing to various people and communities such as in landscape or jurisdiction scale. For considering sustainable forest conservation through REDD+ activities, it will be essential to utilize socio-economic survey for identifying the key

socio-economic characteristics from multiple variables of diverse people. Based on this method, the structure of diversity in a community can be understood from the aspect of Capability Approach, a bundle of functionings. Nevertheless, further studies and verification will be necessary to see the potential of this methodology in broader landscape areas that have various socio-economic and geographical characteristics.

Chapter 4 Identification of the structure of diversity in communities

4.1. Introduction

For implementing the REDD+ at the local level, correct identification of agents and drivers of deforestation and forest degradation will be essential for establishing appropriate targets and actions. To identify specific key agents and drivers, the Verified Carbon Standard (VCS), one of the standards for carbon-related verification, methodology suggests to combine several types of surveys and analyses (Shoch et al., 2011). However, the VCS deals with specific drivers at the project level and is thus not sufficient for applying to a landscape or to broader areas. In order to identify deforestation agents and drivers in such circumstances, a socio-economic survey combined with a multivariate analysis can be effective for extracting critical factors or variables from various potential actors and activities (Vyas & Kumaranayake, 2006). Application of the statistical method in this study is expected to integrate various agents and drivers into a few components or groups as examined in Chapter 3.

As a part of REDD+ readiness in Indonesia, various policy-related and project-based pilot activities have been implemented (Dixon & Challies, 2015; McNeill, 2015).

Because these initiatives of project-level REDD+ under complex socioeconomic conditions will be common challenges in Indonesia and other REDD+ target areas, this study aimed to examine how key socio-economic diversity and structures in plural communities can be identified through identification of drivers and agents of deforestation and their linkages with the socio-economic variables. Through the process, potential of the multivariable analysis was discussed from the point of the Capability Approach (CA).

4.2. Methodology and data

Based on consultation with the GPNP office and after considering the extent of land cover changes determined through field observation and satellite image analysis, as described in the results, six villages out of the 20 surrounding villages were selected for this study. In addition, through interviews with village representatives, it was assumed that ethnicity and geographic characteristics would be closely related with livelihoods and forest uses of the communities. Thus, two of the six villages, which have a relatively large variety of ethnic groups and higher utilization of forest resources, were selected from each of the western, eastern, and southern parts of the GPNP. These villages are Sedahan Jaya and Sejahtera in the western part, Sempurna and Pangkalan Teluk in

the eastern part, and Riam Berasap and Laman Satong in the southern part. Villages in the northern part of GPNP were excluded from the sample because communities in the area currently use few forest resources due to separation by a large river and are largely recruited by oil palm companies. Each village (*desa*), a minimum administrative unit, consisted of three to five sub-villages (*dusun*), which tend to have similar ethnic groups and cultures.

The questionnaire survey for the six villages was conducted for 510 sample households (18.7%) selected from about 2,722 total households as summarized in Table 4-1. For the analysis of the questionnaire survey data, the basic characteristics of the livelihoods and natural resource uses in the six sample villages were compared by means of the collected data. Then, statistical analysis was administrated by using canonical discriminant analysis (CDA), and principal component analysis (PCA).

In order to reveal the situation of deforestation in the six target villages around the GPNP, land cover changes in circular plots with a radius of five kilometers from the center of the sampled village or sub-village were also calculated from remote sensing data (Figure 4-1). For the analysis, satellite imagery of a middle-resolution sensor

(Landsat, in 2000 and 2013) was analyzed to compare land use and land-use changes within each plot. A ground truth survey was also conducted to verify the results of the land-use map derived from the Landsat data.

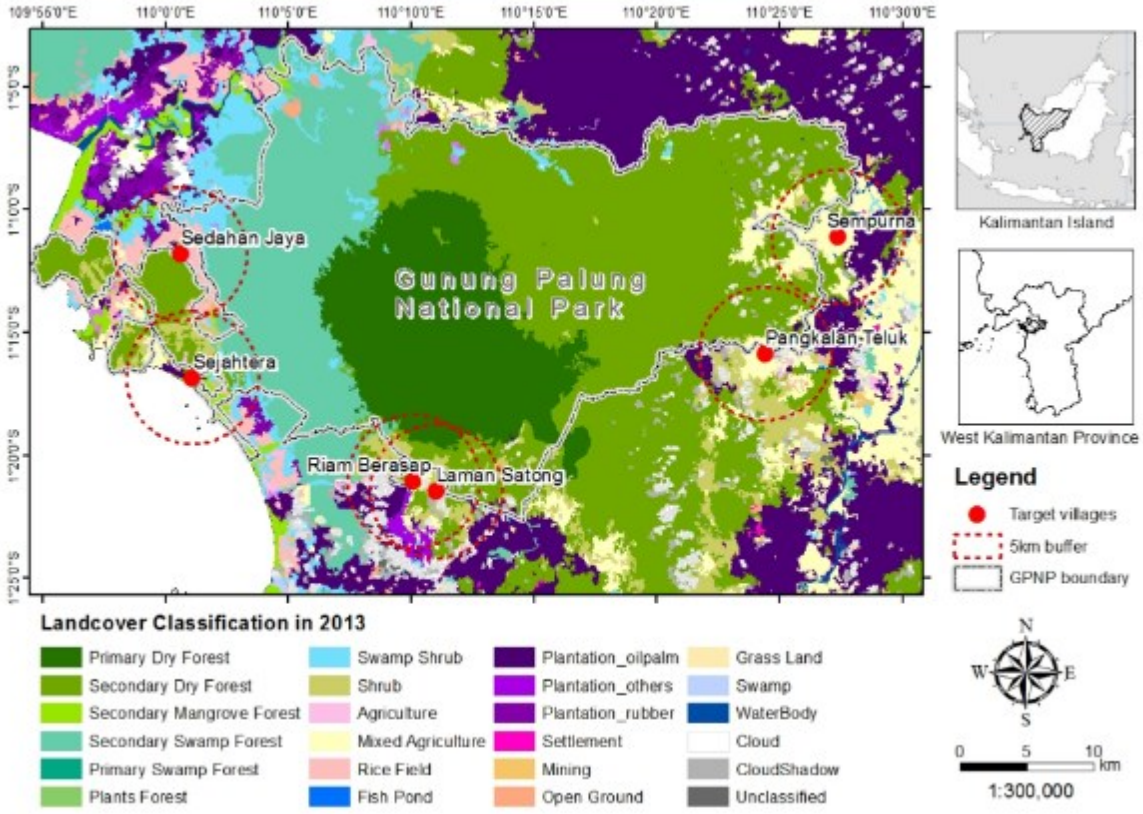


Figure 4-1 Circular plots with radius of five kilometers of the six target villages.

4.3. Results

Land cover changes

Deforestation rate for the target villages was calculated by analyzing the land use change between 2000 and 2013 (Table 4-1). The highest deforestation rate was exhibited

in the villages in the east area, 50.2 % in the Sempurna and 49.3 % in the Pangkalan Teluk. This deforestation was caused mainly by the development of oil palm plantation, which began around 2008 near the villages. Approximately half of the forest area outside the GPNP, which had not been designated as conservation (*hutan konservasi*) or protected (*hutan lindung*) forest by the MoEF, was logged and converted to oil palm plantation. The medium rate, 32.9–36.1 %, of deforestation was seen in the villages in the south. This change also can be attributed largely to oil palm plantation initiated since 2008. However, the change was not as high as that in the east because the villages are located near state forest, such as production forest *(hutan produksi)*, and the GPNP. The lowest deforestation rate occurred in the west area, 11.5 % in the Sejahtera and 0 % in the Sedahan Jaya. Even though there is not yet any development of oil palm plantation around the area, people use the area for farming and as forest gardening (*kebun hutan*). According to the village leader of the Sedahan Jaya village, deforestation and degradation by people in the community might be accelerated due to increasing population and demand for forest resources and farming area. These risks can be estimated as potential drivers or underlying causes of deforestation commonly applicable to the study area.

Table 4-1 Changes of forest area and deforestation rate in the six target villages

Area	Village	Forest area (1000 km2)		Deforestation rate (%)
		2000	2013	
West	Sedahan Jaya	3.66	3.66	0.0
	Sejahtera	2.80	2.48	11.5
East	Sempurna	5.40	2.69	50.2
	Pangkalan Teluk	7.95	4.04	49.3
South	Riam Berasap	5.11	3.31	35.1
	Laman Satong	5.01	3.36	32.9

Overview of socio-economic characteristics

From the questionnaire survey, 19 socio-economic attributes were prepared as a dataset for statistical analysis (Table 4-2). By comparing the means of number or volume for each socioeconomic attribute, features of the six sample villages could be summarized for main ethnic group, main income sources, and ways of using forest area in the national park (Table 4-3). In terms of ethnic groups, the Sedahan Jaya and the Sejahtera villages consist of various ethnic groups, such as Malay, Javanese, Balinese, and Bugis, whereas the other villages are relatively dominated by a single ethnic group, the Malay or the Dayak. In all of the villages, but especially in the Sedahan Jaya, paddy rice agriculture is the main farming activity. Regarding land use, uses of the forest area inside the national park for rice crop farming and forest gardens are especially higher in

the Sejahtera, the Sedahan Jaya, and the Sempurna, although this practice does occur in all villages. Whereas forest gardening in the national park consists of the planting of various NTFP, such as rubber, durian, and banana, among the natural trees, plantation outside of the national park is generally unitary rubber or wood production.

Table 4-2 Socio-economic attributes and units used in the statistical analysis

Socioeconomic Attributes		Unit*
Agricultural Production	Rice cropping	Ton/year
	Home garden	Kg/year
Possession of Livestock	Cow	Head
	Pig	Head
	Chicken	Head
Land Use	Farming inside NP	1,000 m^2
	Farming outside NP	1,000 m^2
	Forest garden inside NP	1,000 m^2
	Plantation outside NP	1,000 m^2
NTFP collection	Fuelwood	Bundle/year
	Durian	100 kg/year
Income	Paddy rice	100,000 Rupiah/year
	Vegetables	100,000 Rupiah/year
	NTFP (excluding rubber)	100,000 Rupiah/year
	Rubber plantation	100,000 Rupiah/year
	Total on-farm activities	100,000 Rupiah/year
	Labor in oil palm plantation	100,000 Rupiah/year
	Employment salary	100,000 Rupiah/year
	Total off-farm activities	100,000 Rupiah/year

* The unit was used for standardizing figures and preparing for the Figure 4-3.

Table 4-3 Main socio-economic features of the six sample villages

Area	Village	Total HH	Sample HH	Main Ethnic Group	Main Income	Use of Forest Area in the National Park
West	Sedahan Jaya	601	120	Malay, Balinese, Javanese	Agriculture	Moderate for NTFP collection and paddy
	Sejahtera	568	70	Malay, Bugis	Employment, Agriculture	Moderate for durian collection
East	Sempurna	377	80	Malay	Rubber, Employment, Oil Palm	High for rubber plantation, paddy and durian collection
	Pangkalan Teluk	341	90	Malay	Employment, Oil Palm, Agriculture	Low
South	Riam Berasap	290	60	Malay	Employment, Oil Palm	Low
	Laman Satong	545	90	Dayak, Malay	Oil Palm, Employment	Moderate for NTFP collection and up-land rice

The results of the interviews conducted in the Sempurna village showed that the boundary of the national park was demarcated without sufficient consideration on the traditional forest uses for rice and rubber cropping prior to designation as the national park. For this reason, approximately half of the households in Sempurna village have conducted activities inside the national park. Collection of NTFP, mainly firewood and durians, occurs mostly inside the national park because of the limited forest resources around the villages. Firewood for cooking is collected by more than half of the households in all of the sample villages. For income structure, on-farm activities are the

main source of income in the Sedahan Jaya and the Sempurna, whereas off-farm income has a higher mean in the other four villages. Especially, the income from on-farm activities is quite low in the Riam Berasap. In most villages, except for the Sedahan Jaya and the Sejahtera in the west area, about 30 to 50 % of the sampled households presently acquire their income by working for oil palm plantations. Generally, they manage an allocated plantation area as a team consisted of four to five villagers, then share the monthly cash payment provided based on the workloads and amount of harvesting in a month.

Examination of ethnic characteristics

In order to examine features for classifying ethnic groups in sample households, a CDA was conducted for the five main ethnic groups, Malay, Dayak, Javanese, Balinese, and Bugis, in the study area. For the CDA, all socioeconomic attributes were used and the process was continued by replacing factors until the highest discrimination rate was attained. Finally, the attributes were narrowed down to eight variables related with land use and income that were closely related to the land use patterns. The extracted result, a 60.6 % overall correct classification, showed that the socioeconomic characteristics of the sample households could not be discriminated well by ethnic group

(Table 4-4). When examining the details of each ethnic group, the Malay people, who occupy majority of the samples, exhibit higher varieties of characteristics compared with other ethnic groups because they are classified correctly not only as the Malay (63.4 %) but also as the Dayak (25.0 %), the Balinese (6.1 %), and the Javanese (5.2%). Some Dayak groups are also classified as the Malay (35.3 %). From the results, it was assumed that characteristics of Malay and Dayak would be similar when compared with other groups.

Table 4-4. Results of CDA on ethnic groups in six villages

Group		Predicted group					Total
		Malay	Dayak	Javanese	Balinese	Bugis	
Original count	Malay	208 (63.4 %)	82 (25.0%)	17 (5.2 %)	20 (6.1 %)	1 (0.3 %)	328 (100 %)
	Dayak	30 (35.3 %)	55 (64.7 %)	0 (0 %)	0 (0 %)	0 (0 %)	85 (100 %)
	Javanese	10 (30.3 %)	4 (12.1 %)	12 (36.4 %)	7 (21.2 %)	0 (0 %)	33 (100 %)
	Balinese	1 (3.7 %)	1 (3.7 %)	4 (14.8 %)	21 (77.8 %)	0 (0 %)	27 (100 %)
	Bugis	16 (72.7 %)	2 (9.1 %)	0 (0 %)	0 (0 %)	4 (18.2 %)	22 (100 %)

Overall rate of correct classification: 60.6 %

These results show that the use of ethnic group is not appropriate for explaining the socioeconomic characteristics of sample households or assigning agents in the area.

During the survey, selected households noted that they had converted their ethnic identity from the Balinese or the Dayak to the Malay due to a change of religious faith from Hindu or Christianity to Islam, which was also observed in previous studies (Nagata, 1974; Reid, 2001). The trend of ethnic homogenization as Islamic Malays will continue even though cultures and customs may vary based on original ethnicity.

Examination of geographic characteristics

To explore the geographic features of the areas, a CDA was conducted by using and replacing all socioeconomic attributes until the highest classification rate (70.2 %) was acquired (Table 4-5). The results showed a higher rate by areas than that obtained by ethnic groups (Table 4-4), which could imply that socioeconomic characteristics are more appropriate for discriminating geographic differences. The south area consisting of the Riam Berasap and the Laman Satong showed the highest correct classification (79.3 %), whereas the east area including the Sempurna and the Pangkalan Teluk showed the lowest (65.9 %). The insufficient discrimination in the east might be attributable to the remarkably high rate of the users inside the national park in the Sempurna, which causes different characteristics compared with the Pangkalan Teluk even in the same (east) area. This implies that use of national park area should be classified not only by

geographic location but also by socioeconomic features of the sample households.

Table 4-5 Results of CDA on geographical areas of six villages

Area		Predicted area			Total
		West	East	South	
Original count	West	127 (66.8 %)	10 (5.3 %)	53 (27.9 %)	190 (100 %)
	East	10 (5.9 %)	112 (65.9 %)	48 (28.2 %)	170 (100 %)
	South	11 (7.3 %)	20 (13.3 %)	119 (79.3 %)	150 (100 %)

Overall rate of correct classification: 70.2 %

Based on the implications of the CDA by area, a further CDA was conducted by extracting the Sempurna as one group and by combining the Pangkalan Teluk and the villages in the south as the same socio-economic type: A) main livelihood from agriculture, the two villages in the west; B) higher use of the national park area, the Sempurna; and C) main income from oil palm plantation, the two villages in the south and the Pangkalan Teluk in the east. The overall correct classification rate of 74.9 % (Table 4-6) was higher than that of the result by area, 70.2 % (Table 4-5). The rate of correct classification for type B, the Sempurna, is a clearly higher rate (76.3 %) than that obtained by combining it with the Pangkalan Teluk, as in Table 4-5 (65.9 %). Even type C shows a slightly higher rate (80.8 %) by adding the Pangkalan Teluk when

compared with the result for the south area (79.3 %; Table 4-5). For the analysis, eight variables of agricultural production, land use, and income were used, and a structure matrix with center of gravity was extracted (Table 4-7). The center of gravity in function 1 corresponds with features of each socioeconomic type such that main livelihood in agriculture (Type A) tends to be high in "production from rice cropping" whereas users of national park (Type B) tends to be high in "income from rubber." Looking at function 2, villages with their main income from oil palm plantation (Type C) show a negative value in the center of gravity as well as in the structure matrix.

Table 4-6 Results of CDA on socio-economic types of six villages

Type		Predicted type			Total
		A	B	C	
Original count	A	127 (66.8 %)	3 (1.6 %)	60 (31.6 %)	130 (100 %)
	B	0 (0.0 %)	61 (76.3 %)	19 (23.8 %)	80 (100 %)
	C	20 (8.3 %)	26 (10.8 %)	194 (80.8 %)	240 (100 %)

Overall rate of correct classification: 74.9 %

A: Main livelihood in agriculture (Sedahan Jaya, Sejahtera)

B: High use of National Park area (Sempurna)

C: Main income from oil palm plantation (Pangkalan Teluk, Riam Berasap, Laman Satong)

Table 4-7 Structure matrix and center of gravity from CDA on socio-economic type

Variable		Function 1	Function 2
Production from rice cropping		-0.49	0.53
Farm area inside National Park		0.37	0.45
Farm area outside National Park		-0.04	0.04
Forest garden inside National Park		0.42	0.55
Plantation outside National Park		-0.09	0.09
Income from NTFP (excluding rubber)		-0.01	0.05
Income from rubber		0.57	0.30
Income from oil palm plantation		0.26	-0.59
Center of gravity	Type A	-1.10	0.49
	Type B	1.93	0.91
	Type C	0.23	-0.69
% variance		70.4	29.6

From these results, classifying the sample households by key socio-economic type was found to be more appropriate compared with using ethnic group or geographic location in the case of the study area. In addition to agricultural practices and forest uses, off-farm income activity by working for oil palm companies is exhibited as one of the types. The households might be recognized as a newly emerging agent after land conversion by oil palm companies.

Extraction of key characteristics in the regions

To assist the results of the CDA and to identify possible agent groups impacting forest

resources and their relationships with socioeconomic characteristics, a PCA with economic variables was applied to the whole sample households in the six villages. Prior to being subjected to the PCA, the units of quantitative variables were standardized (Table 4-2). The PCA extracted four principle components (PCs), which accounted for 71.8% of the total variance (Table 4-8). For the analysis, eight independent variables that exhibited characteristics of agents were selected from the dataset. It can be inferred that these variables are key features showing the socioeconomic characteristics in this study area because these mostly match those used in the CDA (Table 4-7).

Table 4-8 Results of PCA for households in all six villages

Variable	Principal Component			
	1	2	3	4
Production from home garden	0.50	0.11	0.13	0.03
Farm area inside National Park	-0.05	0.45	-0.08	-0.17
Forest garden inside National Park	-0.09	0.46	-0.03	-0.17
Farming area outside National Park	-0.01	0.01	-0.02	0.89
Income from rice cultivation*	0.08	-0.09	-0.64	-0.14
Income from NTFP (excluding rubber)	0.51	0.12	0.06	0.01
Income from rubber	-0.13	0.40	0.08	0.26
Income from oil palm company	-0.07	-0.11	0.60	-0.19
% variance	23.0	20.3	15.6	13.0
Accumulated %		43.3	58.9	71.8

* It is income by selling paddy rice separated with self-consumption.

With regard to the extracted principal components (PCs), PC 1, explaining 23.0 % of the variance, can be interpreted as separating households by main cropping type such as subsistence products including paddy and NTFPs with a positive value and commercial crops such as rubber and oil palm with negative values (Table 4-8). PC 2 makes it possible to identify households dependent on forest area, mainly inside the national park, for farming and agroforestry with a positive value. PC 3 helps to highlight households that conduct on-farm and off-farm activities, and PC 4 seems to emphasize the legality of land use as farming outside the national park has a high positive value while activities inside the national park have relatively high negative values. These implications from each PC, especially those of PC 1, PC 2, and PC 3, match with the main socioeconomic types in the CDA (Table 4-6): agricultural activity, use of the national park, and off-farm activities.

Classification of households

To classify sample households according to key socio-economic characteristics, scatter plot diagrams (Figure 4-2) were prepared by using the extracted variables and their PC factor scores for each PC in Table 4-8. Each dot in the diagram shows sample households and different symbols are used for the different socioeconomic types: A)

main livelihood in agriculture, B) high use of the national park area, and C) main income from oil palm plantation, supporting the results of the CDA (Table 4-6). Contrasting PC 1 (main cropping type such as subsistence products with a positive value and commercial crops with a negative value) as the X-axis with PC 2 (forest use with a positive value) as the Y-axis, the characteristics of the sample households can be separated by quadrant by main livelihoods and forest uses: quadrant 1) conducting forest gardening or home gardening inside or outside of the national park; quadrant 2) rubber tapping mainly inside the national park; quadrant 3) obtaining income by working for an oil palm company; and quadrant 4) main livelihood from rice cropping outside of the national park area. The households in quadrant 2 are recognized as a main agent group of deforestation and degradation because their activities are related with intensive use of sites inside the national park.

Examining the socioeconomic types shown by the symbols, the characteristics in each quadrant mostly match the socioeconomic type, especially for Type A (quadrants 1 and 4) and Type C (quadrant 3). However, there seems to be a mixture of the three socioeconomic types in quadrant 2, a main agent of deforestation in the national park, even though the majority is occupied by Type B. This implies that the agents and

drivers are diverse in a geographic location and not always identified as a set in an area. Similar trends of mixing of the socioeconomic types are seen even in scatters when using the other PCs.

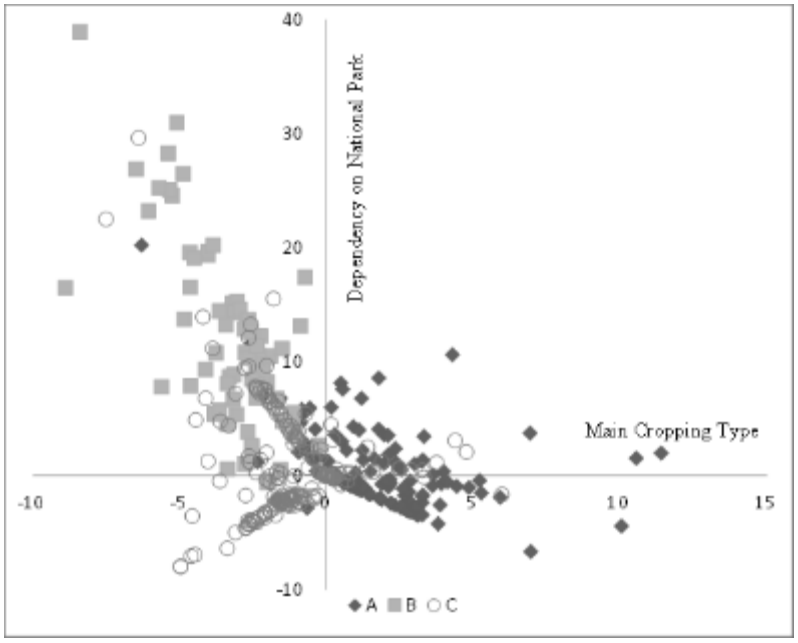


Figure 4-2　Distribution (factor scores) of households in the six villages on two principle components (PCs) by socioeconomic type. PC 1 (main cropping type) is used as the X-axis, and PC 2 (dependency on national park) is used as the Y-axis

Comparison in key socio-economic characteristics

In order to see differences among key socio-economic variables, situation of assets; farm and plantation, and income with Gini coefficient was compared by using average figures of the sample households by village.

The average farming area used inside and outside the national park was varied in villages (Figure 4-3). But it was the largest in the Sedahan Jaya, 1.1 ha, in which more than ninety percent of the households engaged in farming activities. On the other hand, farm land used in the Sejahtera was the smallest, 0.5 ha, even though around seventy percent of the residents engaged in farming and classified as the agricultural livelihoods same as the Sedahan Jaya (Table 4-7). It was also noticeable that households in the Laman Satong and the Pangkalan Teluk, classified as the main income from oil palm plantations, using around 0.8 ha of farm land. Regarding to the location of farm land, remarkable larger portion of farm land inside the national park was seen only in the Sempurna village. The interviews revealed that communities' traditional land use pattern was not fully considered in boundary demarcation when the national park enacted. The similar issues on inadequate farm land and unclear boundaries were pointed out even in other villages.

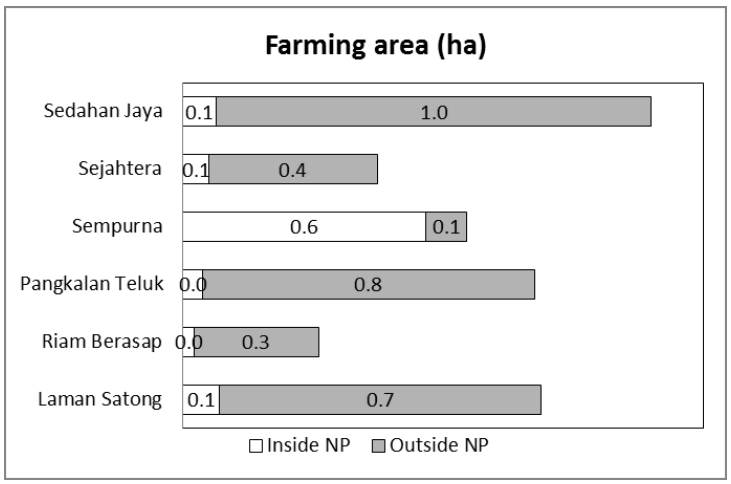


Figure 4-3 Average of farming area used by households in six villages

When looking detailed conditions of forest uses inside the national park (Figure 4-4), the usage in the Sempurna was clearly larger compared with the other villages, which is similar with the farming area as seen in Figure 4-3. The total areas; using for forest garden and plantation, was the largest, 1.3 ha, in the Sempurna among the target villages. The similar trend, larger in forest use area, was also observed in the Laman Satong and the Pangkalan Teluk even though their main livelihoods were off-farm activities by working for oil palm plantations. It means that even if communities come to get larger cash income from oil palm plantations, they still need forest resources like firewood for cooking and NTFPs for domestic self-consume. Several villagers cited that they began to purchase or collect drinking water from outside villages because stream inside the village dried out after conversing their forest to oil palm plantations.

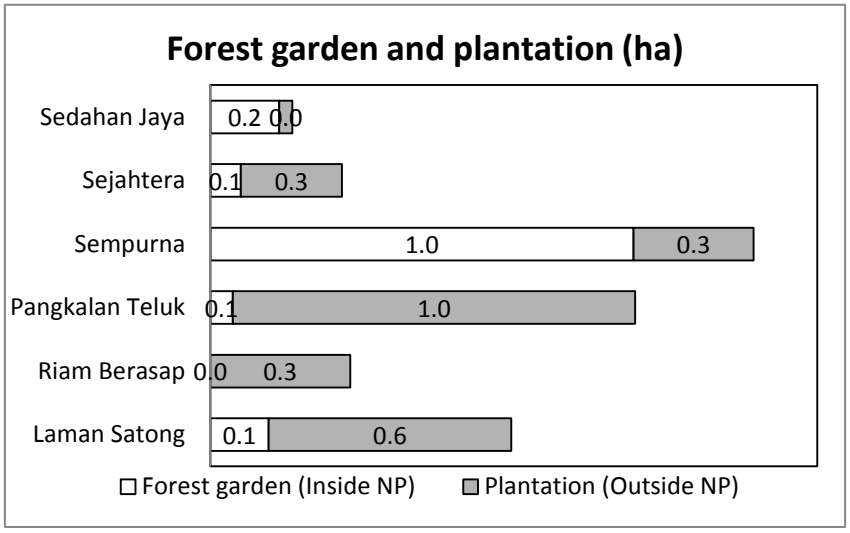


Figure 4-4 Average of forest garden and plantation area used by households in six villages

By comparing the income structures among the villages (Figure 4-5) it presented that average total income in the Sedahana Jaya was the highest, 37 million Rupiah, even though the income will fluctuate by years depending on crop production. Even though the on-farm income was conducted in all the villages, but higher amount in on-farm income rather than from off-farm ones was seen in the Sedahan Jaya and the Sempurna. The total income in the Sejahtera village, higher amount in the off-farm, was the lowest among the villages. According to the interview, the off-farm activities in the Sejahtera were mostly temporary works such as construction, transport, and other various private jobs. By referring to the Gini coefficient (Table 4-9), disparity of acquired income inside the villages can be confirmed. The lowest figure in the Sejahtera, 0.35, helps to estimate

that majority of the households were relatively in low income, but without severe disparity with the others. However, the highest figure, 0.64, in the Pangkalan Teluk, would be caused by large gaps in the income among households who work for oil palm plantations, on-farm activities, and others. The higher Gini coefficient in the Sempurna and the Riam Berasap were also observed, which would be owning to the influences of oil palm plantations.

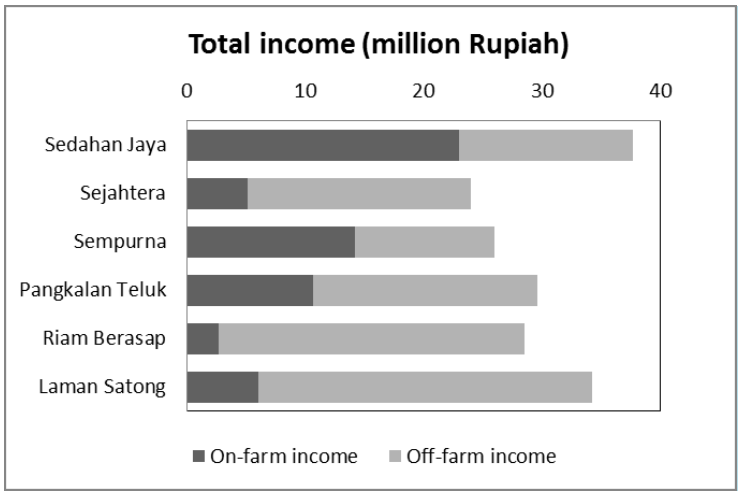


Figure 4-5 Income structure of households in six villages

Table 4-9 Gini coefficient in six villages

Village	Gini
Sedahan Jaya	0.40
Sejahtera	0.35
Sempurna	0.48
Pangkalan Teluk	0.64
Riam Berasap	0.41
Laman Satong	0.40

4.4. Discussion

Identification of socio-economic characteristics by combining methods

In this study, identification of deforestation agents and drivers was examined by combining satellite imaginary and socioeconomic surveys. By using satellite imagery, deforestation area was identified at the macro level as historical land cover changes, such as conversion of forest area to oil palm plantations in the east and south areas of the GPNP (Table 4-1). For further detailed identification, the use of socioeconomic surveys with statistical analyses was shown to be effective. Statistical analysis by CDA could classify the agents effectively by geographic locations but not by ethnic groups (Tables 4-4 and 4-5). Further CDA showed that socio-economic type was even more appropriate for identifying the sample households as the socio-economic types (Table 4-6). By conducting both CDA and PCA, it became possible to understand that extracted eight socio-economic variables would be key characteristics of the target villages, in which various agents and multi-layered drivers existing even in the same village or location. These results explain that complex and diverse socio-economic conditions highlight the relevance of combining several methods, such as satellite imagery and socioeconomic surveys with multivariable analyses, to appropriately identify the

socio-economic characteristics in plural communities.

Drawing scatter diagrams by using the PCA results can assist for clear recognition of interactions among agents, drivers, and underlying causes. When contrasting PC 1 and PC 2, various socio-economic types were seen in a quadrant, such as in the quadrant 2, which represents intensive use of the national park area (Figure 4-2). Such a distribution indicates that various agents associated with multiple socio-economic activities, or drivers, can impact on the land cover in an area. Under such conditions, decomposing into agents, drivers, and underlying causes, as proposed in the VCS methodology (VCS, 2012), can aids recognition of the interactions and targets for interventions. The target level in this study area should be designated for households by the socio-economic types rather than by ethnic groups or geographic locations that various agents and drivers exist in an area, as shown in the scatters (Figure 4-2).

Implications for measures for plural communities in diversity

By utilizing PCA with the scatters, it would assist to consider and design appropriate strategies for the REDD+ readiness. However, even with the combined methods, 74.9 % of the sample households was classified correctly in the socio-economic types by using

the CDA (Table 4-6). The other 25 % of the households were difficult to be classified. It implies that the communities are diverse and dynamic even though the key socio-economic characteristics, such as the extracted eight variables in Table 4-8,can be identified. By looking into each variable, the conditions of diversity and disparity became more remarkable to understand the structures

By comparing the usages in farm and forest areas among the villages (Figures 4-3 and 4-4), it was indicated that even the villages nearby oil palm plantations practice farming and forest gardening. For the households in the Sejahtera, their main income was temporary off-farm activities and supplemented by agricultural production, even though the type was classified that “main livelihood in agriculture” (Table 4-6). From the lowest Gini coefficient in the Sejahtera (Table 4-9), it can be said that the households in the Sejahtera village are less in disparity in income when compared with the other villages. On the other hand, there is disparity in income among communities mainly in the villages nearby oil palm plantations, such as the Pangkalan Teluk, the Riam Berasap, and the Sempurna. Besides that, the oil palm dependent villages still need forest resources for firewood and drinking water despite they get higher cash income from the plantations (Figure 4-4). After converting forest areas to oil palm

plantations, some communities began to access the remaining forest resources in other villages or inside the national park. It explains that loss of forests nearby communities would cause leakage of deforestation and forest degradation in remaining forest resources.

By identifying agents, drivers, and underlying causes such as lack of farm land and forest resources, appropriate measures of sustainable forest management and REDD+ can be considered. Such efforts toward underlying causes and potential agents through appropriate identification of socio-economic characteristics would also be essential in the readiness phase (Pasgaard, 2013; Salvini et al., 2014). At the same time, flexible decision-making and implementation are desirable in the process as socio-economic conditions are diverse and may transform in accordance with development activities and related policies (Agung et al., 2014; Minang et al., 2014). As seen in the target villages, differences in goods and services, such as farm and forest, as well as conversion ability, such as rights and access, cause differences or disparity in livelihoods and well-being among communities, which are constituted of various capability. Since provision of sufficient public care and services for various people seems to be quite difficult, it would be critically important to take comprehensive measures for enhancing

capabilities of various people. Besides that, careful attentions to disparity in capabilities such as access to goods and resources among people need to be taken.

4.5. Conclusion

This study has examined to identify key socio-economic characteristics in plural communities, six villages around the GPNP, by confirming effectiveness of utilizing multivariable analysis attempted in, Chapter 3. For this purpose, satellite imagery analysis and socio-economic surveying were conducted. After recognizing the land cover changes by using the remote sensing analysis, identification of deforestation agents and drivers was examined by statistical analysis applying in the dataset from the socioeconomic survey. The results revealed that there are various deforestation agents and drivers in the study area and that sample households can be discriminated more clearly by socio-economic types than by ethnic groups or geographical locations. An examination of the classifying of various agents by using scatters diagrams from the PCA result implied that the agents and drivers identified do not always match in an area. Rather, various agents associated with multiple socio-economic activities and drivers can influence in the forest and land covers in an area. Such characteristics in plural communities can be identified by using the combined methods with multivariable

analysis examined in this study. By comparing key variables such as farming area and income among the villages, further diverse situations and underlying factors of deforestation were identified. To implement the REDD+ activities under these conditions, comprehensive measures need to be taken to enhance capabilities of various communities. Then, it needs careful attentions to diversity and disparity in income and assets among communities.

Chapter 5. Influence of people's forest use in the forest ecosystem

5.1. Introduction

REDD+ can not only reduce GHG emissions, which can be recognized as a "carbon benefit" but also lead to other "non-carbon benefits" such as alleviating poverty, securing human rights, improving methods of governance, conserving biodiversity, and supporting other environmental services, termed "co-benefits" (Brown et al., 2008). However, there are concerns that activities prioritizing the amount of carbon stock available would have negative consequences for the people living in regions with low carbon stock, but an abundance of precious ecosystems, if the appropriate safeguards were not implemented (Putz & Redford, 2009). Therefore, the parties under the UNFCCC have discussed and proposed to conduct the seven social and environmental safeguards for REDD+ as determined by the Cancun Agreement at COP 16 (UNFCCC, 2010). Each country is required to develop a Safeguard Information System (SIS) for mitigating negative impacts of REDD+ (UNFCCC, 2010).

Appropriate understanding of the links between effects of carbon stock and other non-carbon related benefits (such as biodiversity conservation and forest use rights) are

needed to accomplish co-benefits as well as address the REDD+ safeguards. Some studies conducted on linkages between carbon stocks and biodiversity conservation, revealed that forest management that sustains carbon stock in the long term could have a positive effect on various environmental aspects, such as biodiversity (Norris et al, 2010; Thompson, 2015). However, there is little data assessing social, cultural, and economic impacts of REDD+ implemented in protected areas (Arhin, 2014) due to lack of appropriate methods. Particularly, it is difficult to clarify the relationship between environmental services and forest use by locals, even though traditional rights related to access to forest resources, such as non-timber forest products (NTFPs), have been defined as a social safeguard (Sunderland et al., 2011). For instance, complex interrelations among various social and ecological factors, including policy and tenure, affect forest ecosystems and sustainability of NTFPs species (Ticktin & Shackleton, 2011). Most of the developing countries tend to lack in methodologies and scientific data necessary to assess and promote the co-benefits and the REDD+ safeguards (McGregor et al., 2014).

To implement REDD+ addressing the safeguards in Indonesia, forest governance and tenure arrangements will be critical challenges because the traditional forest use rights

are not allowed legally while approximate 98% of the forest area is under the state control (Agung et al, 2014). In case of the Gunung Palung National Park (GPNP) in West Kalimantan, local people living around the GPNP have maintained a forest garden , known as "*Hutan Kebun*" in Indonesian, as customary practices for collecting NTFPs such as durian and coffee for domestic self-consume and marketing purposes (Salafsky, 1994). Although farming and cultivations inside the national park are prohibited, some forest uses are being continued without sufficient information on the regulations and the zonings in the national park. The similar conditions and issues have been associated with other national parks and conservation forests over Indonesia (Dhiaulhaq, 2015). Thus, examination of forest use practices in the GPNP can provide useful information regarding the REDD+ safeguards by encouraging appropriate understanding and evaluation of the practices.

In instances where there is a lack of data concerning linkages among conservation, forest uses, and carbon stocks, decisions tend to prioritize conservation rather than common practices or safeguards, which concerns stakeholders located around the GPNP. Thus, this study aimed to reveal the impact of forest uses in forest ecosystems through exploring practical implications for promoting REDD+ co-benefits. Based on the

findings, potential socio-economic factors which contribute to differences in forest uses were discussed.

5.2. Methodology and data collection

Socio-economic survey and analysis

Sedahan Jaya and Sejahtera villages around the GPNP were selected as a target for this study because the number of residents that utilize the forest for activities such as forest gardening and plantation is relatively larger than that in other villages. Necessary data for identifying the socio-economic conditions in the two target villages were collected through questionnaire based surveys as well as semi-structured interviews. A total of 120 (20.0%) sample households located in the Sedahan Jaya and 70 (12.3%) in the Sejahtera (BPS Kayong Utara, 2014). In addition to the five main survey sections analyzed in Chapter 3 and Chapter 4, the following three social aspects were inquired: understanding of customary rules, participation in farming group activities, and satisfaction with water and food by giving rankings according to five grade evaluation. After the questionnaire survey was administered, additional questionings on benefits from forest was asked for giving ranking to randomly selected 20 households in each village.

Satellite imagery analysis

In order to clarify the land cover in relation to the forest area in the two villages, shifts in land cover in accessible areas with 10 × 10 km^2, 10,000 ha, in size, were analyzed using remote sensing data. For the analysis, satellite imagery from a middle-range resolution LANDSAT sensor, in 2005 and 2015 was analyzed to compare land cover changes within each area accessed by the two villages. An additional assessment was completed using a high-resolution sensor, SPOT 6, in 2005 and 2015 to verify the results from the LANDSAT TM data. In addition to comparing land cover and forest type situations in the two villages, changes in forest area by the types during the 10 years between 2005 and 2015, were summarized using a matrix. The forest types were classified as forest garden (FG), plantation (PT) mainly with rubber trees, degraded forest (DF), montane forest (MF) situated in mountains, peat swamp forest (PSF), and mangrove and shrubs (MS). In this study, FG was defined as a durian mixed FG inside the national park in the Sedahan Jaya village region, separate from the plantation mainly with rubber and durian trees outside the national park in the Sejahtera area.

Forest plot survey

The forest plot survey was conducted as a collaboration research with Hikichi (2016) around the GPNP. In the two villages, forest plot surveys were conducted in each forest type, except in the MF in the Sejahtera, which is difficult to access. In a 100-m^2 plot randomly selected for each forest type, tree genus, tree height, and diameter at breast height (DBH) were measured for every tree with a DBH greater than 5 cm. For tree identification, knowledgeable villagers accompanied the researchers and assisted during the survey. With the data obtained, mainly the DBH, from the forest plot survey, the volume of sampled trees above ground was calculated using allometric equations. By referring to official guidance on tree biomass estimation in Indonesia (Krisnawati et al., 2012), the equation from Hashimoto et al. (2004) was applied to the survey results in Sedahan Jaya, of which forest was dominated by the *Macaranga spp*. For the data in the Sejahtera village, the equation from Ketterings et al. (2001) was selected since a large part of the forest is dominated by secondary or degraded forests created after fire or logging. By applying the estimated tree biomass for each forest type in analyzed area of changes in each forest type from the satellite imagery, amount of forest biomass changes in 2005 to 2015 were calculated for each village.

5.3. Results

Forest uses by local people

According to the socio-economic survey, the Malay is the main ethnic group in both villages, in addition to a mixture of the Balinese and the Javanese in the Sedahan Jaya and the Bugis in the Sejahtera. Although paddy cropping is the main farming activity in the both villages, some households use forest area mainly for forest gardening or plantations. In the Sedahan Jaya, 30.0% of households engage in forest use mainly as forest gardening, which is mostly located along a slope on the lower side of the MF. A type of agroforestry mainly exists inside the national park, in which 20.8% of sample households participate. Activities include collecting NTFPs, such as durian, sugar palm, and bamboo shoot. On the other hand, outside of the park, the forest use is mainly for PT, and 31.4% of sample households participate in this type of farming, generally located in the degraded area, which is present after forest fires. However, some households collect NTFPs inside the national park.

When the income structures between FG users and all sample households in the both villages (Figure 5-1) was compared, on-farm activities are the primary source of income in the Sedahan Jaya while it is mostly derived from off-farm activities in the Sejahtera.

In the Sedahan Jaya, FG users rely on on-farm activities including the selling of NTFPs (7.5%) for over 80% of income, higher than the average of all sample households in the Sedahan Jaya (61.1%). Similar trends, including a high rate of on-farm income obtained by FG users is observed in the Sejahtera village as well. However, income in the Sejahtera is obtained primarily by PT (22.8%), which is higher than that obtained from paddy farming (10.0%). Because of low paddy production, PT is a key income source in addition to off-farm activities in the Sejahtera.

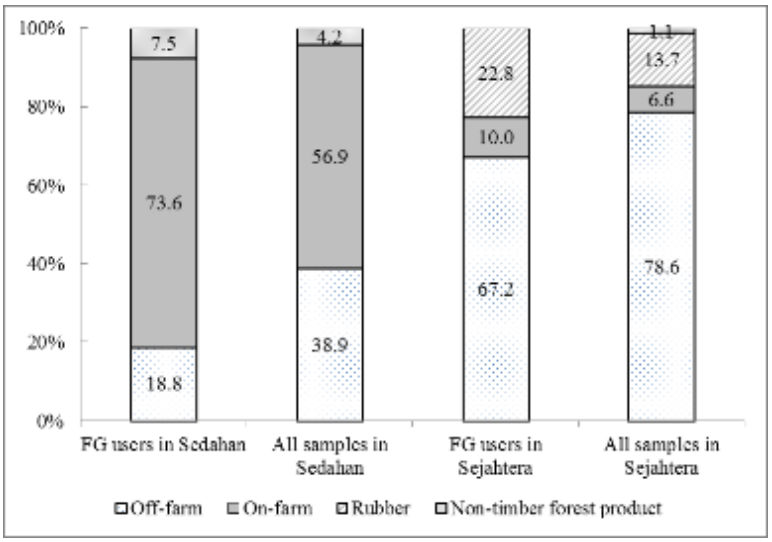


Figure 5-1　Income structure of Forest Garden (FG) users and all sample households in the Sedahan Jaya and Sejahtera villages

Awareness on forest and living condition

For comparing forest ecosystem and living conditions between the two villages, additional questioning was conducted. Regarding the understanding of customary rules,

around 70 percent of the households in the Sedahan Jaya have recognized it especially on conflict management, water use, and agricultural activities. On the other hand, it was only 30 percent in the Sejahtera (Figure 5-2). The rules were mostly related with land uses on farming and rubber plantations. When looking at the participation for farming activities, only twenty percent of the households in the Sejahtera have participated while it was around eighty percent in the Sedahan Jaya. From the results, the communities in the Sedahan Jaya seem to be more familiar with customary rules and group activities than those who in the Sejahtera.

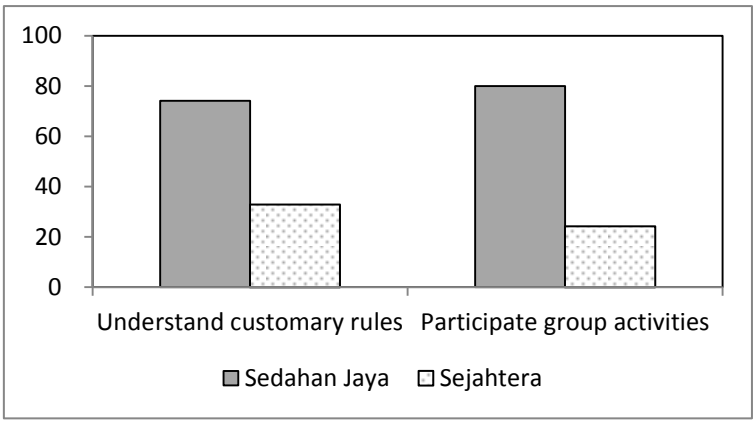


Figure 5-2 Percentage of households recognizes customary rules and participate group activities in the two villages.

Regarding the satisfaction with "volume of water", the responses in the Sejahtera was the highest in "good". However, there was nobody to recognize in "good" but at most in "fair" in the Sejahtera (Figure 5-3). In the both villages, daily life water come from river or stream originated mountains inside the GPNP. Although simple plumbing intake

from the upstream is equipped and distributed to households in the Sedahan Jaya, the communities in the Sejahtera mostly take water directly from river by combining with shallow well water nearby the residential area. The differences in facilities and services can affect in their satisfaction with water resources. The similar trend was also seen in satisfaction with foods. While the households in both villages indicated the highest responses in “fair”, no response in “good” or in “very good” in the Sejahtera. The results explains that there are differences between the villages in satisfaction with water and foods, those are basic needs for daily livings.

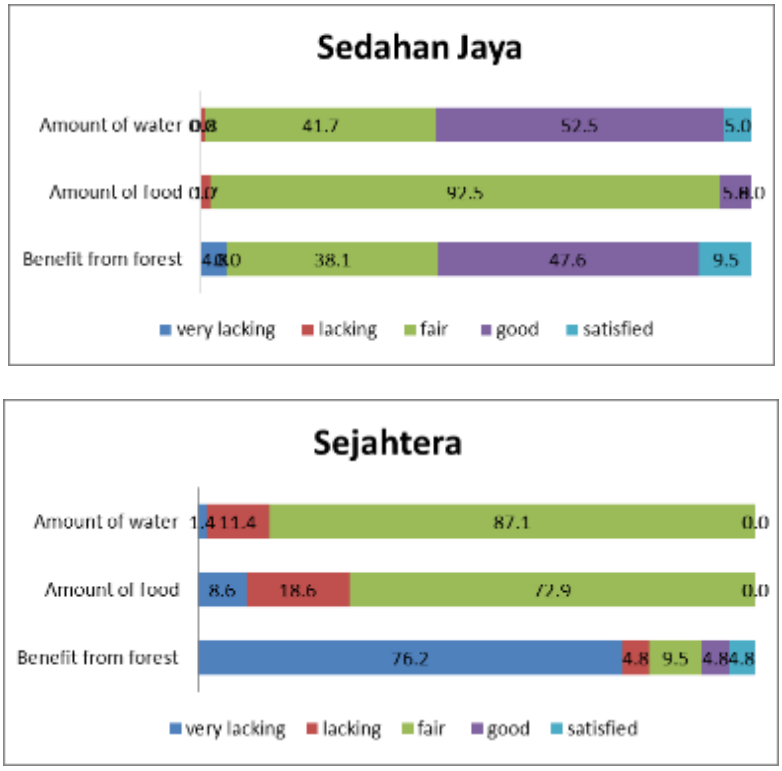


Figure 5-3 Results of giving 5-grade ranking (%) on satisfaction for water, food, and forest benefit in two villages

Regarding to awareness on “benefit from forest”, more than 70 percent of the households in the Sedahan Jaya have appreciated in “fair” or in “good”. However, majority of the households in the Sejahtera responded in “very lacking” in benefit from forests. The result clearly showed that there is difference in the awareness on benefits from forest between the villages.

Overview of land use and forest type

The results of the satellite imagery analysis in 2015 include an overview of land cover and forest type in the Sedahan Jaya and the Sejahtera (Figure 5-4). In the Sedahan Jaya, total residential and farm area expanded north to south between MF in the west, and PSF in the east. We found that FG exists in the edge of MF, close to a residential area. The open and grass area on the edge of PSF was likely caused by a forest fire. In the Sejahtera, residential and farm areas were located along the sea and mangrove forest in the west. In the east region, vast PSF surrounded the village. However, DF, which might have been caused by fires or logging, is visible up to the MF. The PT surrounded by grass implies that the area utilized could have previously been a fired area in the PSF. When comparing the two villages with percentage of area inside the 10,000 ha plot excluding water body, PSF occupied the largest area utilized in the

Sedahan Jaya, 58.4 %, and in Sejahtera, 40.2 % (Figure 5-5). Clear differences between the villages are apparent in the DF and MF. While the MF is larger in the Sedahan Jaya, 21.2 %, a greater DF was found in Sejahtera, 16.5 %. In the villages, FG in the Sedahan Jaya and PT in the Sejahtera functions as a buffer of MF and PSF.

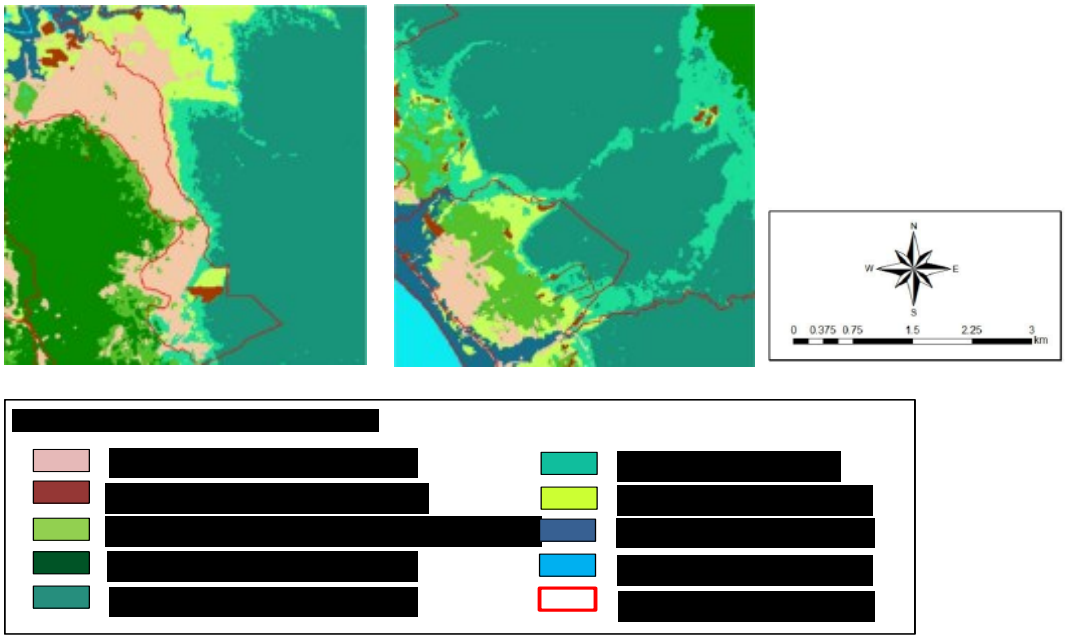


Figure 5-4 Locations of land use and forest types in Sedahan Jaya (left) and Sejahtera (right) based on LANDSAT imagery in 2015.

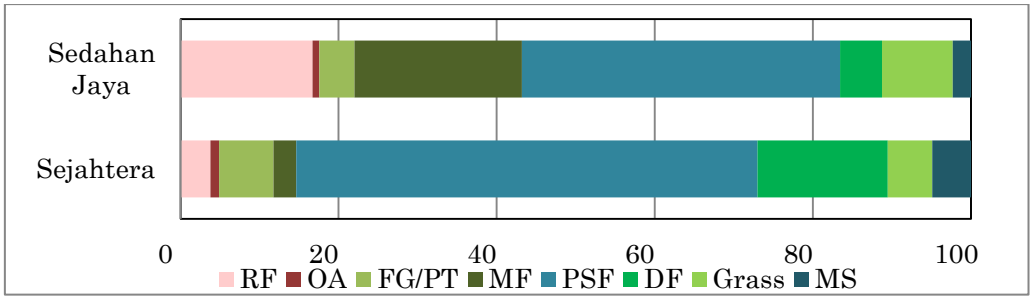


Figure 5-5 Percentage (%) of land cover classification in Sedahan Jaya and Sejahtera. RF: Residence and Farm, OA: Open Area, FG: Forest Garden, PT: Plantation, DF: Degraded Forest, MF: Montane Forest, PSF: Peat Swamp Forest, MS: Mangrove and Shrubs

Using the results of satellite imagery analysis in 2005 and 2015, changes in forest area were summarized and compared in a matrix (Table 5-1). In the Sedahan Jaya, larger forest recovery was observed after a severe forest fire, that lasted from 1997 to 1998, in PSF from DF (194 ha) as well as MF from FG (193 ha). However, there was also a clear increase in residential and farm areas from 711 ha to 1,352 ha. Since a decrease was observed in the OA, from 556 ha to 34 ha, and DF, 602 ha to 449 ha, these areas were converted to residences and farms after being previously devastated. A slight decrease was also observed in FG, which might be due to reduction of households engaging in FG.

In the Sejahtera, it is remarkable that 640 ha of PSF degraded due to frequent forest fires even after severe forest fires in 1997, according to the interviewee. Even though the OA decreased from 148 ha to 78 ha, there was an increase in PT, 502 ha to 649 ha. It can be observed a difference in FG in the Sedahan Jaya, which decreased slightly in area. The DF and OA tended to be used for farming rather than for forest gardening in the Sedahan Jaya, which was converted to PT in the Sejahtera.

Table 5-1 Matrix of land cover and forest area changes between 2005 and 2015 in a) Sedahan Jaya and b) Sejahtera (unit: ha)

a)

Land cover type		2015						
		RF	OA	FG	DF	MF	PSF	**Total**
2005	RF	628	2	38	19	23	-	**711**
	OA	518	1	22	4	9	-	**556**
	FG	80	1	214	19	193	-	**507**
	DF	45	12	3	341	6	194	**602**
	MF	78	3	150	12	1,838	0	**2,082**
	PSF	1	15	1	53	5	3,787	**3,863**
	Total	**1,352**	**34**	**429**	**449**	**2,075**	**3,982**	

b)

Land cover type		2015						
		RF	OA	PT	DF	MF	PSF	**Total**
2005	RF	240	13	76	14	-	-	**343**
	OA	79	17	43	10	-	-	**148**
	PT	13	5	424	59	-	-	**502**
	DF	6	18	92	808	4	314	**1,243**
	MF	-	-	-	34	263	3	**299**
	PSF	4	26	14	640	13	5,369	**6,066**
	Total	**341**	**78**	**649**	**1,566**	**280**	**5,686**	

RF: Residential and Farm area, OA: Open Area, FG: Forest Garden, PT: Plantation, DF: Degraded Forest, MF: Montane Forest, PSF: Peat Swamp Forest

Estimation of forest biomass changes

In the forest plot survey, 699 trees in 48 plots were measured. For each forest type in the two villages, tree density, average DBH, estimated biomass, and main tree genus were summarized (Table 5-2). The biomass was the greatest in PSF while the least is in the DF in both villages. The tree biomass of FG in the Sedahan Jaya (309.4 ton per hectare) is larger than that of DF. The tree density in FG (1,125 trees per hector), was higher than that in MF, 933 trees per hectare. Even though the main tree genera include fruit

trees such as durian, they occupy 33.3% of total sampled trees in FG. From these results, it is apparent that the FG maintains diversity and biomass to some extent. In the case of Sejahtera, the extremely higher rate of *Hevea* involved in PT and *Durio* in durian forest explains why utilization and management are significantly intensive compared with the FG in the Sedahan Jaya.

By assessing forest area for each forest type during 2005 and 2015 (Table 5-1) as well as including results from forest plot survey (Table 5-2), changes in biomass were calculated and compared (Table 5-3). We found that forest biomass in the Sedahan Jaya is in the process of slightly recovering at a rate of 0.04 tons per hector per year even though reduction of area in DF and FG was observed. Since greater increases were observed in PSF which has the largest carbon pool compared with the other forest types, this could be due to efficient recovery after severe forest fire that lasted from 1997 to 1998. On the other hand, tree biomass greatly diminished after 2005 in the Sejahtera, at a rate of 0.83 ton per hectare per year. The slight increase observed in the DF and PT, compared to the dramatic decrease in the PSF, could have been caused by frequent forest fires that took place after the severe forest fire.

Table 5-2. Overview of forest plot survey by forest type in Sedahan Jaya and Sejahtera.

Village/ Forest Type	No. of plot	No. of trees/ha	Mean DBH (cm)	Tree Biomass (ton/ha)	Dominated trees	
					Genus name	% in total
Sedahan Jaya						
Peat Swamp Forest	11	1,773	21.6	483.6	*Palaquium, Macaranga, Shorea*	40.5
Degradation Forest	3	1,433	18.5	157.6	*Macaranga, Pternandra, Syzygim*	88.4
Montane Forest	6	933	29.0	635.2	*Baccaurea, Strombosia, Syzygium*	39.3
Forest Garden	8	1,125	28.8	309.4	*Durio, Lansium, Dimocarpus*	33.3
Sejahtera						
Peat Swamp Forest	10	1,680	22.2	420.7	*Syzygium, Dipterocarpus, Blucia*	39.9
Degradation Forest	4	1,725	14.7	182.9	*Paraquim, Diospyros, Litsea*	33.3
Rubber Plantation	2	2,100	15.8	203.8	*Hevea, Artocarpus*	88.1
Durian Plantation	4	850	63.6	787.1	*Durio, Lansium*	85.3

Table 5-3. Changes of forest biomass between 2005 and 2015 according to forest type in the Sedahan Jaya and Sejahtera villages.

Forest Type	Sedahan Jaya		Sejahtera	
	Area (ha)	Biomass (ton)	Area (ha)	Biomass (ton)
Peat Swamp Forest	118	57,105	-379	-159,519
Degradation Forest	-153	-24,054	323	59,120
Montane Forest	-7	-4,517	-19	-12,178
Forest Garden/Rubber Plantation	-78	-24,088	147	29,966
Changes in the plot (ton/10,000 ha)		4,446		-82,610
Total (ton/ha/year)		0.04		-0.83

5.4. Discussion

Differences in forest use observed according to community

In this study, land use and forest ecosystem between two villages were compared by

assessing the socio-economic characteristics and the forest structures. Especially with respect to the forest gardening, differences were observed in relation to management and farming practices, even though more than 30% of sample households engage in farming in both villages. The forest in the Sedahan Jaya is mostly used for collecting NTFPs, such as durian and sugar palm, by using traditional FG practices, while in the Sejahtera, the forest serves a relatively commercial purpose for producing income in a PT. This difference is remarkable when the income structure is accounted for (Figure 5-1). In the Sedahan Jaya, on-farm activities account for majority of their income, and NTFPs complements 7.5% of the income especially for households that use FG. On the other hand, PT accounts for 22.8% of total income obtained by FG users when off-farm activities are the main source of income. This suggests that NTFPs obtained from FG in the Sedahan Jaya functions as a safety net to make up for shortages in domestic commodities and on-farm income, as is apparent in other areas that are also distantly located from markets (Shackleton et al., 2011). However, the forest uses in the Sejahtera was mainly designated for PT and functioned as a means of cash income same as the off-farm activities.

The roles and functions of FG differed in villages in accordance with the traditional

practices, income structures, and available land and forest areas. Furthermore, the land use changed over the years according to the market trends and natural phenomena such as forest fires. As an overall current trend, farming practices has become more intensive and commercially driven, leading to the expansion of land for using specific tree crops such as rubber in the Sejahtera.

Influence on forest biomass and structure

Using satellite imagery and forest plot surveys, impact on forest ecosystem by village use and management could be deduced. While forest biomass in the Sedahan Jaya tended to recover from severe forest, it has been reduced in the Sejahtera by expansion of land degradation due to frequent forest fires mainly in PSF. A part of the area in the degraded forest was often converted to PT (Table 5-1). Regular uses and maintenance of the rubber trees would be expected to prevent forest fires. However, the recent slump in rubber market piece discourages majority of the villagers to continue rubber tapping, leading to a decrease in PT. These situations can cause further risk of forest fires and reduction in forest biomass as well as carbon stocks. Although it is difficult to identify the precise cause of forest fires, the forest area and biomass in the Sedahan Jaya often recovered even after severe forest fires. Thus, it can be inferred that a type of forest

management awareness based on traditional practices and daily use would affect differences in fire prevention and forest recovery compared with that implemented in the Sejahtera, where the main forest use is commercially driven and involves more intensive plantations. This assumption can be supported by the result of differences in understanding on the customary rules (Figure 5-2) and awareness of benefits from forests (Figure 5-3).

The results of forest plot survey provide a clearer understanding of forest use and its influence on forest biomass according to various types of use. In the both villages, PSF have a higher tree density with larger trees that can be used as timber. Therefore, PSF would be expected to maintain a higher biomass by forest fire prevention and logging. On the other hand, DF is composed of smaller sized trees such as *Macaranga spp,* a pioneer species that is present after fires. Since these forests located in buffer areas between residential areas and forests with large biomass such as PSF and MF, rehabilitation of these deteriorated areas is a key for future park management. While forest use in Sejahtera is biased depending on forest structure with management focused on durian and rubber trees, FG in the Sedahan Jaya is relatively similar in diversity and biomass in both PSF and MF. This suggests that appropriate practices

such as forest gardening in the Sedahan Jaya can contribute not only to the maintenance of biomass but also to prevent forest fires.

Implications for co-benefits and awareness of forest

By exploring both socio-economic and ecological impacts of forest utilization in this study, it was identified that differences in forest gardening practices that could be related to forest biomass and structure. Those differences; traditional- or commercial-oriented, would be linked with experiences in utilizing natural resources such as NTFPs and water as the customary in communities. Higher recognitions and respects of customary rules with active group activities in the Sedahan Jaya can be related with satisfaction in living and awareness on forest management (Figures 5-3 and 5-4). Those various factors help to constitute a part of individual and common value on forest resources (Figure 5-6). Those findings are important to consider when determining the co-benefit to the carbon pool and community livelihoods, as well as promote awareness of forest management among stakeholders. At the same time, further studies and preparations related to social and environmental safeguards are needed to promote appropriate decision makings.

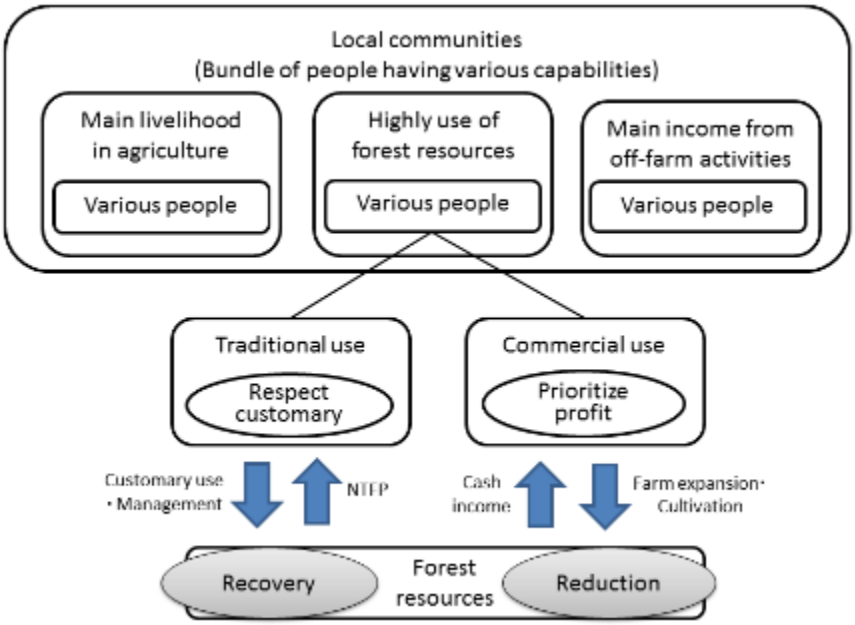


Figure 5-6　Conceptual diagram on local communities with differences in uses of forest resources and their impacts.　(Composed by the Author)

Regarding social aspects, the ambiguous tenure situations for customary FG practices such as those in the Sedahan Jaya, which are not clearly permitted in the national park, need to be considered. While approximately 30% of households engage in FG maintenance and make a living through on-farm activities, which include selling NTFPs, loss of forest access could force villagers into difficult situations or poverty. These restrictive measures could inhibit sustainable park management by worsening trust between the national park staff and villagers and promoting intense illegal activities inside forest area. Similar attention should also be paid to the Sejahtera since PT tends to be expanded in areas of degraded forests, which occur after fires. If no

rehabilitation or monitoring were conducted, it would be quite difficult to expect any enhancement in forest biomass or carbon stock in the areas. Since similar issues have been observed in other forest areas in Indonesia, appropriate measures and decision makings are needed and should involve communities and local stakeholders (Sunderlin et al., 2014).

5.5. Conclusion

In this study, questionnaire surveys with semi-structured interviews, satellite imagery analyses, and forest plot surveys were conducted in the two villages near the GPNP in order to reveal the impact of forest uses in forest ecosystems by exploring practical implications for promoting co-benefits. Using socio-economic surveys, differences in forest use were identified by assessing engagement and income structures among the households. Further comparison of changes in forest area and biomass revealed that frequent forest fires in the Sejahtera region affected the recovery of biomass while the biomass in the Sedahan Jaya tended to recover after 2005, even following the severe forest fire that took place from 1997 to 1998. These differences in forest biomass are affected by socio-economic factors such as expectations and awareness related with forest resources. Results from the forest plot survey identified clear differences in

diversity and biomass according to forest type. The most prominent findings were that a part of forest gardening practices in the Sedahan Jaya were characterized by utilizing plants, which spanned a relatively large genus diversity and biomass. We found that appropriate actions based on awareness of customary and forest resources could minimize impacts on forest ecosystems. These practical results could lead to better decisions by the national park office in respect to management activities, such as zoning revisions and respect for customary rights. Furthermore, both socio-economic and natural environmental aspects of this study will have useful implications for co-benefit activities, which promote forest biomass and community livelihoods contributing to addressing REDD+ safeguards. However, additional studies are required to clarify the effect on other aspects of the ecosystem such as biodiversity, water conservation, as well as climate change mitigation.

Chapter 6. The role of government in diversified socio-economic situations

6.1. Introduction

For preparation and implementation of the REDD+ mechanism in developing countries, a governance system, which administrates policies and various services, take an important role (Angelsen et al., 2009; Brockhaus et al, 2014; Lemos & Agrawal, 2006). Previous studies (Agung et al., 2014; Luttrell et al., 2014; Mulyani & Jepson, 2013) recommended that the process of establishing the REDD+ mechanism in Indonesia is an opportunity for improving governance which embraces accountability, public participation, and legal reform. As a measure for promoting good governance and mitigating negative impacts of REDD+, member countries agreed on the REDD+ safeguards to respect rights and full participation of local communities in accordance with the Cancun Agreement in COP 16 (Baraloto et al., 2014; Chhatre et al., 2012; Putz & Redford, 2009; UNFCCC, 2010;).

Regarding an issue on the park management, there are issues on boundaries and zonings around the GPNP. Prior to be designated as 90,000 ha of a wildlife sanctuary in 1984 and as a national park in 1990, local people have traditionally used forest area

mainly for collecting non-timber forest products (NTFP) such as durian, bamboo shoot and banana. Salafsky (1994) defined the practice as "Forest Gardens (*Kebun Hutan*)" which are a variant of the traditional home garden that had been developed by the local communities in response to the development of new economic markets. Even after the GPNP office demarcated the park boundaries in 1984 and the zonings in 2011, the forest gardening practices were yet continued. In addition to that, large scale of illegal logging activities came to be active in the 1990's, and decreased around 2003 as an effect of strict patrol activities by the GPNP office. Currently, even though the traditional forest garden practices have been continued, expansions of oil palm plantations in the GPNP vicinity tend to be significant. Even though the local communities are hired as laborers, huge farm and forest areas, where had been used by the local communities, were converted to oil palm plantations.

While the socio-economic conditions around the GPNP have changed with a variety of development activities, the GPNP office continued patrolling activities as their main task. For achieving REDD+ with the safeguards, it needs verification if the current role of the GPNP office is appropriate to collaborate with stakeholders. Thus, this study aimed to explore an appropriate role of the governments especially the GPNP office to

ensure enabling conditions of REDD+ with the safeguards in accordance with changes in socio-economic conditions at the local level.

6.2. Methodology and data collection

According to consultation with the GPNP office through a preliminary field survey, the villages (*Desa*) in the Sukadana sub-district (*Kacamatan*) was selected as the target area because there are relatively large numbers of households have practiced agriculture activities and forest uses. In the sub-district, population growth was around 2.6 % between 2010 and 2013 (BPS Kayong Utara, 2014). Even though there are totally ten villages in the Sukadana sub-district, the eight villages were targeted for the questionnaire survey excluding two villages, Sutera and Harapan Mulia, those are nearby a town and rare in forest uses.

The questionnaire survey was implemented to elicit quantitative information on livelihoods and forest uses. From the eight sample villages, the total 610 samples (13.8 %) were selected out of 4,421 total households (BPS Kayong Utara, 2014). Following the questionnaire survey, semi-structured interviews aiming to obtain supplemental background information on the forest use practices and the park

management were done with forest users and the GPNP office staff, and local NGO staff. Additionally, progress of the IJ-REDD+ activities in the Tanjung Gunung sub-village, Sejahtera village was periodically observed and recorded. These surveys and interviews were conducted from October 2014 to March 2015.

The sample data was analyzed to understand features of the sample households through comparing the characteristics of livelihoods and forest uses. Subsequently, the statistics proceeded in three steps: 1) conducting canonical discriminant analysis (CDA) by a stepwise method to exam relevant classification of the forest use type, 2) exploring income structure of the sample households by forest use and farming types, and 3) attempting a multiple regression analysis to identify the key socio-economic factors attributing to expand farming inside the national park by applying "area of farming inside the national park" was used as an independent variable.

6.3. Results

Over view of socio-economic characteristics

The results of the questionnaire surveys in eight villages in the Sukadana sub-district are summarized in terms of the number of engaged households (n) out of the sample

total (N) and the mean of the number or volume for each main characteristic (Table 6-1). The average is calculated based on the number of engaged sample households (n) except for income, which is average of the total sample households (N).

Table 6-1 Socio-economic characteristic of sample households in Sukadana sub-district

Socio-economic attributes		Unit	Sukadana Sub-district (N = 610)	
Ethnic Group	Malay	Household	398	
	Madura	Household	58	
	Bugis	Household	54	
	Javanese	Household	46	
	Balinese	Household	27	
	Others	Household	27	
Agricultural Production	Paddy rice	Ton/year	408	1.4
	Home garden	Kg/year	114	295.2
Livestock	Cow	Head	72	2.5
	Pig	Head	25	4.9
	Chicken	Head	333	12.1
Land Use	Farming area inside NP	1,000 m^2	54	6.9
	Farming area outside NP	1,000 m^2	376	6.9
	Forest use area inside NP	1,000 m^2	114	7.6
	Forest use area outside NP	1,000 m^2	119	7.4
Collection of NTFP	Fuelwood	Bundle/year	498	79.4
	Durian	100 kg/year	149	5.2
Income	Paddy rice	Million Rupiah/year	379	6.9
	Vegetables	100,000 Rupiah/year	76	5.2
	NTFP (excluding rubber)	100,000 Rupiah/year	166	13.3
	Rubber	100,000 Rupiah/year	87	11.7
	Total from on-farm activities	Million Rupiah/year	497	11.9
	Employment salary	Million Rupiah/year	337	10.7
	Total from off-farm activities	Million Rupiah/year	542	17.8
	Total income	Million Rupiah/year	610	30.1

The majority of ethnic groups was the Malay followed by the Madura, the Bugis, the Javanese and the Balinese. The main farm activity was paddy cropping, engaged by 67 % of the total sample households, with 1.4 tons per hectare of the annual production. Some villagers also cultivate vegetables and fruits at their home gardens. While chickens are the typical livestock for the communities, cows and pigs are raised by a part of the wealth and the Balinese. Regarding the land use, almost 70 % of the households own farming area, and 12.5 % of them use land inside the national park for farming. Around 40 % of the households conduct forest gardening inside or outside the national park. Whereas farming inside the national park is mainly for rice cropping, the forest uses are particularly for cultivating sugar palm and banana as well as collecting NTFPs, such as firewood, durian, and bamboo shoot. Additionally, over 80 % of the households still collect firewoods mainly for cooking. In terms of the income structure, the average income from off-farm activities, 17.8 million Indonesia Rupiah, is slightly higher than that from on-farm activities, 11.9 million Indonesia Rupiah. Among those households, 27.3 % of them get their income from NTFPs selling while 14.3 % of them are from rubber production.

Changes in forest use practices

Since before the previous study have been conducted by Salafsky (1994), the local communities, especially the Malay or the Dayak, have utilized the forests mainly for collecting naturally dropped durian fruits. According to a former nature conservation staff worked for the Gunung Palung Wildlife Sanctuary in the 1980's, the traditional forest use for durian collection and minimum weeding was only practiced in the Benawai Agung, a part of that separated from the Sedahan Jaya in 1998, and the Sejahtera villages located in the current Sukadana sub-district. There were no cultivations of tree crops such as coffee and rubber inside the sanctuary. The staff issued a permission notice on durian collecting for the decades of registered households respectively. The durian trees were inherited by the ancestors and named for each tree. During fruiting seasons, family

members used to stay together inside the forest and enjoyed playing traditional music, *Senggayung* in the Malay language, to pray for good fruiting.

The previous study in the Benawai Agung village (Salafsky, 1994) revealed that the forest gardening was engaged by mostly 80 % of the households by diverse ways in accordance with market access and cash demand. The forest gardening practices were

categorized in the four types: 1) durian/mixed fruit forest gardens, 2) new durian/coffee forest gardens, 3) rubber or sugar palm forest gardens, and 4) small plantations or orchards. Because of natural disasters and socio-economic changes, these forest gardening practices and main tree species have been changed. Not only tree crops but vegetables and spices were also cultivated in the forests. Although the forests were designated as the national park in 1990, most of the traditional users did not recognize well about the regulations and the boundaries.

When the severe forest fires occurred in 1997 and 1998 around the Sedahan Mountain where was in active for forest gardening, almost all coffee and rubber trees were burned out. Since then, uses of fire for farming inside the forest was strictly prohibited by both the district and the national park office. In addition to that, dropped market value of coffee bean discouraged the communities to cultivate coffee trees. But, rubber plantings have expanded in degraded peat swamp forests outside the national park. However, other forest fires around the Sejahtera village especially in 2004 and 2013 damaged the rubber trees. Additionally, drops in market prices made communities to abandon the rubber plantations.

In the current, the forest gardening for durian fruits and sugar palm have been implemented mainly by the Malay residents those who inherited durian trees. They recognize customary user rights for these durian trees, but not for land. Rubber plantations mostly outside the national park still exist but come to rarely to be managed after drops in market price. The communities who have practiced rubber plantations explore alternative income sources even inside the national park. However, some of them convert the rubber to farm or expand farming into forest area even inside the national park. These changes make difficult to understand the conditions of the forest uses and their impact on forest conservation.

Categorizing forest use practices

Out of the total samples, 233 households (38.2 %), practice forest gardening either inside or outside the national park. In this study, forest uses by communities were categorized in the three types: I) non forest users, and forest users II) inside or III) outside the national park. By the forest use type, socio-economic characteristics of users in the sample households were compared and summarized in Table 6-2. The Malays those who have practiced traditional forest gardening seem to have the privileges in forest uses in terms of the higher engagement ratio in the Malay and low in the

immigrants seen in Type II. The communities, Type II, also exhibit larger area of forest garden and farm areas compared with the other two types. In the both forest users, Type II and III, the majorities engage in paddy cropping. However, there is difference in the forest use more clearly in the main activities that Type II shows higher rate; NTFP collection in Type II (65,8 %) and rubber plantations in Type III (45.8 %). Additionally, the average of total income is the lowest in the Type II, 26.1 million Indonesia Rupiah. It explains that domestic uses of NTFP by the forest users, mostly the Malays in Type II, bear a role of safety net for the people low in cash income.

Table 6-2 Socio-economic conditions by forest use type

Forest Use Type	N	Malay (%)	Immigrant (%)	Land Asset		On-farm Activities			Total Income (Million Rp.)	
				FG area (ha)	Farm area (ha)	Paddy (%)	NTFP (%)	Rubber (%)	Average	S.D.
I. Non User	377	62.9	30.5	-	0.71	56.2	14.9	5.0	30.9	31.9
II. Inside NP	114	91.2	17.5	0.76	0.73	71.1	65.8	8.8	26.1	15.6
III. Outside NP	119	47.9	19.3	0.74	0.64	72.3	29.4	48.7	31.0	27.0

FG: Forest gardening, Rp.: Indonesia Rupiah

Results of the canonical discriminant analysis (CDA) on relevance of categorizing in the three forest use types exhibited 71.3 % of the overall correct classification (Table 6-3).

Although the rate in Type I showed high discrimination of 86.2 %, these of Type II and Type III were lower, 45.6 % and 48.7 % respectively, due to misclassification as Type I, 49.1 % and 38.7 %. It implies that some forest users have similar characteristics with the households in Type I. From the structure matrix derived from the CDA, the features of the forest users can be inferred by the types (Table 6-4). The higher positive value in the Function 1, "farming area inside national park" and "income from NTFP" explains the features of the households in Type II which has positive figure in the center of gravity (Table 6-3). On the other hand, the positive figures in the Function 2, "income from rubber" and "durian collection", exhibit the features of Type III which is in positive value in the center of gravity.

Table 6-3 Result of CDA on forest gardening types

Type		Predicted type			Total
		I	II	III	
Original count	I	325	25	27	377
		(86.2 %)	(6.6 %)	(7.2 %)	(100 %)
	II	56	52	6	114
		(49.1 %)	(45.6 %)	(5.3 %)	(100 %)
	III	46	15	58	119
		(38.7 %)	(12.6 %)	(48.7 %)	(100 %)

Overall rate of correct classification: 71.3 %

Table 6-4 Structure matrix derived from CDA on forest gardening types

Variables		Function 1	Function 2
Farming area inside national park		0.74	0.28
Farming area outside national part		-0.07	-0.03
Durian collection		0.21	0.60
Income from NTFP (excluding rubber)		0.34	0.35
Income from rubber		-0.44	0.67
Production of paddy rice		0.09	-0.04
Production in home garden		-0.17	0.18
Center of gravity	Type I	-0.08	-0.30
	Type II	0.82	0.34
	Type III	-0.55	0.63
% variance		79.9	20.0

The income structures, percentage of on- and off-farm incomes, by the forest use types was illustrated in Figure 6-1. The on-farm income was further divided into the forest-related ones, NTFP and rubber, and other agriculture related ones. While the off-farm income exhibits 65.6 % of the total income in the non-forest garden users (Type I), it is almost half of the forest users (Types II and II). Even though majority of the forest users (Types II and III) engage in paddy cropping (Table 6-2), the on-farm income limited to a half of the total. It implies that most of the communities conduct off-farm activities for cash income as well as cropping for self-consume. The income from, 13.0 % and 17.8 % respectively, also plays an important role in the total income. While the total income of the forest users inside the national park (Type II) is the lowest among the

types, availability of NTFP would be essential for them. It corresponds with the result presented in the structure matrix (Table 6-4), which shows “income from NTFP” as a key characteristic of Type II.

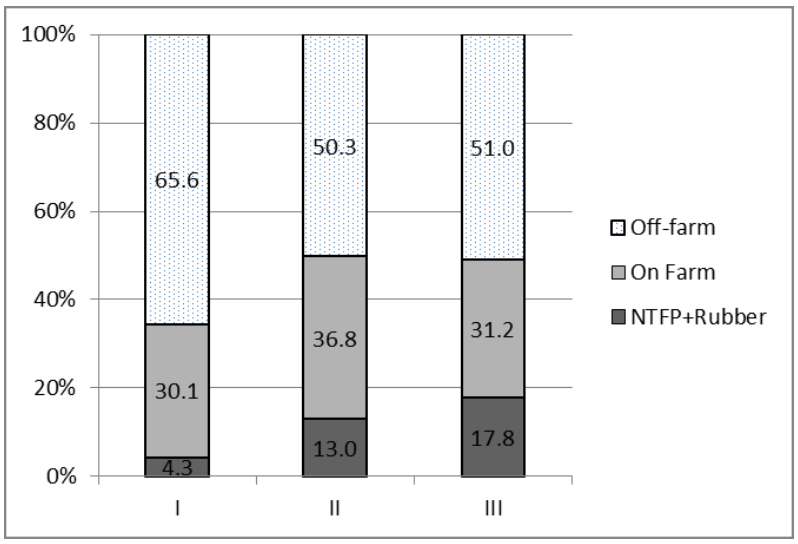


Figure 6-1　Income structure by forest gardening type in Sukadana sub-district

Farming inside the national park

In order to understand relationships between “income from NTFP” and “farming inside the national park” as seen in the structure matrix of the households in Type II (Table 6-4), differences in farming types were explored. According to interview with the forest users, there are typically the four types of farming practices inside the national park nearby the Sukadana sub-district: 1) both new immigrants and native residents start to

open new farmland into forests, 2) some of the Malay or the Dayak practice traditional shifting cultivation even inside the national park, 3) non-Malay communities purchase the customary user rights of forest uses, forest gardens, from the Malays, and 4) some of the Malays, those who have practiced forest gardening, convert to farming at their forest gardens. In the interview, most of the forest users mentioned that lack of farming area in the villages must be the underlying causes of encroaching on forests. Besides that, it will be accelerated when the forest users cannot get sufficient food and cash income.

The socio-economic conditions of the communities those who practice farming inside the national park, 54 households, was compared with that of all farming households and all samples (Table 6-5). The percentage of the Malay is higher in the households farming in the national park, 87.0 %. From the result of larger forest gardens and farms seems also higher, it is expected that the Malays have privileges for land asset in the area. Majority of the households farming inside the national park, 85.2 %, engage in paddy cropping. However, their average total income, 24.0 million Rupiah, is slightly lower than the households conducting forest gardening inside the national park, 26.1 million Rupiah (Table 6-2). It would imply that the households those who are low in cash income and

highly dependent in self-sufficiency tend to expand farm lands even over the national park.

Table 6-5 Socio-economic conditions by farming type

Households	N	Malay (%)	Immigrant (%)	Land Asset		On-farm Activities			Total Income (Million Rp.)	
				FG area (ha)	Farm area (ha)	Paddy (%)	NTFP (%)	Rubber (%)	Average	S.D.
Farming in NP	54	87.0	25.9	0.92	0.83	85.2	44.4	16.7	24.0	12.0
All Farming	423	61.9	25.1	0.74	0.70	87.0	29.8	16.8	28.1	21.6
All samples	610	65.2	25.9	0.76	0.70	62.1	27.2	14.3	30.1	28.6

Looking into the income structured by the farming types shows more clearly that the households farming inside the national park depending on on-farm activities for the income (Figure 6-2). Especially, the percentage of income from NTFP and rubber, 13.2 %, is higher. It implies that the forest use plays as a safety net for their livelihoods when their on-farm income is insufficient. In case of unstable and poor in income, they compensate those lacks by expanding farm land.

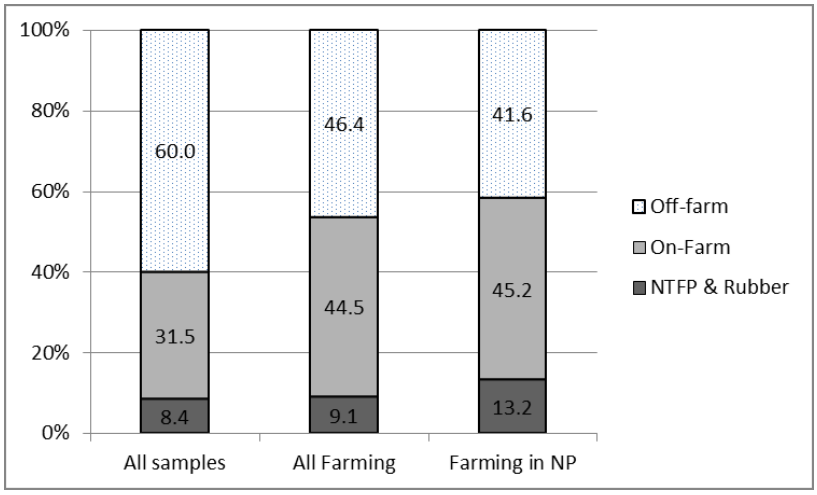


Figure 6-2　Income structure by farming types in Sukadana sub-district

To confirm characteristics of the households expanding farm land inside the national park, a multiple regression analysis was administered by employing farm area inside the national park as the dependent variables. By using the socio-economic attributes as the explanatory variables, a stepwise method was applied in the analysis. Although the adjusted coefficient of determination in the results, 0.26, was not very relevant, it helps to estimate a socio-economic structure that attracts encroachment into the national park (Table 6-6).　The extracted three explanatory variables were effective in preparing a regression formula that could quantify impact of farming inside the national park. Particularly, “forest use area inside the national park” shows a higher positive t-value as well as “production of paddy rice”. As the negative t-value in the explanatory variables, “farming area outside the national park” was extracted.　Those variables

match with results in the discriminant analysis, Type II in Table 6-3, which conducts forest gardening inside the national park. It can be assumed that farm expansion would be accelerated by households frequently access and use forest resources, such as collecting NTFP, whereas it might be alleviated by promoting effective land use or improving productivity in the current farmland outside the national park.

Table 6-6 Results of multiple regression analysis on farming inside national park

Explanatory Variables	ß	t	p	γ
Forest use area inside national park	0.43	10.20	**	0.46
Farming area outside national park	-0.26	-5.35	**	-0.24
Production of paddy rice	0.15	3.23	**	0.02
Adj. R^2	0.26			
N	423			

ß: Standard partial regression coefficient γ: Correlation coefficient

** $p<0.01$

Changes in the park management activities

When communities nearby the national park have changed their forest use practices, the GPNP office has conducted park management activities since the 1990. According to the GPNP office, most of the field staff have not recognized exactly where tha park boundaries which was demarcated in 1984. The park boundary demarcation is in responsible of the Forest Area Development Bureau (BPKH), which has divisions in

each province and a role of managing geographic data of the all conservation forests over Indonesia. Thus, the GIS experts in the GPNP office does not possess the map data due to inefficient information sharing across the organizations. Besides that, almost all park staff have not been updated on the locations and related regulations of park zonings allocated in 2011. It can be a main reason why the park staff are reluctant to talk with communities about the park boundaries and zonings. When patrols of illegal logging activities were severe in 1995 to 2005, the park staff did not have much problems to conduct their management activities without proper regulations. However, unchanged patrolling duties tend to cause gaps with needs and interests of communities and local stakeholders around the GPNP.

The several communities also mentioned in the interview that most of the residents do not recognize the exact park boundaries and zonings even though the park staff regularly visit the villages for patrolling. There was a remarkable incidence on gaps in recognition of the boundaries in 2014, that the district public work office in Kayong Utara approved to construct irrigation facilities inside mangrove forest area based on their recognition on the park boundary. When employed labors started to cut the mangrove, the GPNP office claimed that the area is inside the national park and

prohibited to conduct the constructions. Because this kind of development activities come to be active around the GPNP, miscommunication and insufficient information sharing on the correct park boundaries and zonings cause further confusions and conflicts among local stakeholders. Regarding the strict patrol by the GPNP office, some communities expressed concerns and dissatisfaction that sufficient explanation and information sharing should be done rather than the patrols. Some NGO staff also pointed out the similar concerns and expectation for the GPNP office to be open for sharing and collaborating with the stakeholders.

Under these situations, the IJ-REDD+ project have conducted a series of trainings on facilitation skills for the GPNP staff in the field. The main purpose was to encourage the park staff to build trust with communities through collaborative learnings and exploration for locally-available resources. In case of the Tanjung Gunung sub-village in the Sejahtera village, the national park staff was reluctant to visit there and communicate with the communities due to conflicts with some of the residents engaging in loggings as their main livelihoods. However, the several park staff, trained in the facilitation skills, started to visit even as private to dialogue with the communities. Through the process, the staff succeeded in building cordial friendship with alomst all of

the residents including the leader of loggers (Figure 6-3). As a result of that, eleven voluntary groups, which aim to improve the livelihoods, were established as their own initiatives. The groups initiated various activities such as organic farming, tree planting, and duck breeding without any external material and financial supports, but only for technical supports by the local governments and NGOs (Figure 6-4). Before the facilitation activities started, 75 males had engaged in illegal logging inside the GPNP. However, approximate 30 people have joined in the group activities and began to collaborate for improving their livelihoods.

Figure 6-3　Park staff conduct facilitative dialogue with ex-leaders of illegal loggings in the Tanjung Gunung sub-village　(Photograph by the Author)

Figure 6-4　A female group in the Tanjung Gunung has initiated to grow medicinal plants　(Photograph by the Author)

By getting experiences on trust building as seen in the Tanjung Gunung, the GPNP office has changed their attitudes in communication with other communities and stakeholders. As a remarkable progress, the office started to lead preparations for the multi-stakeholder forum since 2015, and also collaborate with communities for solving issues on the park boundaries.

6.4. Discussion

Changes in the forest use practices by communities

From the results combining the questionnaires and the interview surveys, the details of forest use conditions were clarified. Around forty percent of the households have practiced forest gardening either inside or outside the national park (Tables 6-1 and 6-2). And, the income from forest products, mainly NTFPs and rubbers, reached almost twenty percent of the total income (Figure 6-1). As explained in this study (Tables 6-2 and 6-3), the current forest use practices can be categorized into the two types: 1) durian and mixed fruit forest gardens to collect NTFPs inside the national park according to the traditional practices, and 2) intensive rubber plantations for getting cash income outside the national park. From the income structures, the households practicing forest gardening inside the national park (Type II) are lower in the total income acquired mainly from on-farm activities (Figure 6-1). This result implies that NTFPs from forests work as their safety net for mitigating vulnerability in livelihoods by compensating the unstable on-farm productions and cash income.

However, these forest uses are dynamic in response to various environmental and socio-economic conditions the development including development of new economic

markets as defined by Salafsky (1994). Even though some communities engaged in the traditional durian collection in the 1980's, the forest uses came to be more diverse and intensive in the 1990's. Because of the economic situations and forest fires, coffee plantations are rarely conducted, and rubber plantations are disregarded due to drops in the market price. Furthermore, after designation of the national park in 1990, some communities have refrained from using forest resources. In the structure matrix obtained from the CDA, "farming area inside the national park" was extracted as a key factor of forest users inside the national park (Table 6-4). The characteristics of forest users, low in cash income and highly dependent on on-farm activities, matches with that of communities practicing farming inside the national park (Figure 6-3). It implies that communities those who depend on on-farm activities and forest resources are inclined to expand farm land over forests in case they cannot get enough production from the current farm land. The result of the multiple regression analysis explain that "farming area outside the national park" work as a suppressor of expanding farm land inside the national park (Table 6-6). It means that lack of farm lands will accelerate encroachment and intensive use of forest area in response with the on-going changes in socio-economic conditions at the local. These dynamics make various agents and drivers exist and interact in an area.

Implications for park management

While the socio-economic conditions and forest uses change around the national park, it would be important that management activities be appropriate in accordance with those changes. Even after the severe illegal loggings reduced, the GPNP office has continued patrolling without appropriate communication and information sharing with the communities. Such attitudes have caused distrust and confusions with local stakeholders. It needs to consider that some illegal loggings were forced to acquire foods and cash for their families under inadequate farm lands and unstable income (Figures 6-1 and 6-2, Table 6-6). Under the dynamic socio-economic conditions around the national park, the GPNP office is expected to take more effective roles by collaborating with communities. These experiences are applicable to the other national parks and forest areas as a commonly observed challenge over the country.

Potential of local governance

Most of the GPNP staff did not recognize exactly on the park boundaries and the related regulations. The similar cases, mainly caused by ambiguous and complicated forest and land tenure conditions, can be seen in the other national parks and forest areas in

Indonesia (Brockhaus et al., 2012; Kusters et al., 2007; Resosudarmo et al., 2013; Yasmi et al., 2006). If an area was designated as a conservation forest such as a national park, it is typical that boundary conflicts occur as seen in the GPNP. And, if an area was a conversion forest, it would be converted to oil palm plantations or other commercial crops through inappropriate procedures for legal license and clearance on tenures (Levang et al., 2016; Setiawan et al., 2016). Even nearby the GPNP, there were disputes and complaints of communities that farm and forest lands have been cleared and converted to oil palm plantations without sufficient explanations and agreements. It can be typical incidences that the forest governance in Indonesia involves distrust and conflicts with local communities. It will be a critical risk for achieving the effective REDD+ and the safeguards.

As measures for the risks, collaboration under governance would be effective to adapt and deal with various issues on natural resource management (Lemos & Agrawal, 2006; Schultz et al., 2015). To promote collaborations, mutual trust building through dialogues and learnings as seen in the Tanujung Gunung sub-village would be essential. Outsiders or third parties can assist not only for technical supports but also for building bridges among stakeholders. By setting up a local governance as a platform for

collaborative management, local stakeholders and communities can be encourage to tackle with a variety of issues regarding to natural resource management and land tenures (Berkes, 2009). To enhance capabilities of communities through the learning process will also contribute to address the REDD+ safeguards for effective and sustainable ways.

6.5. Conclusion

In order to discuss an appropriate role of the management activities in accordance with dynamic changes in community livelihoods and forest uses, the questionnaire surveys, targeting for the 610 households in the eight villages, and the semi-structured interviews were conducted. The results of the CDA made possible to classify the households by the three types of forest use practices. Then, the income structures were compared by the forest use and farming types. Additionally, characteristics of the households expanding farm land inside the national park were explored by using the multiple regression analysis. These results explained that the households, insufficient in income and farming areas, tend to expand farming area. The response to the interviews also supported the trends that traditional forest uses have been converted to farming-focused practices. In spite of those changes in the forest uses and conditions,

the GPNP office has continued patrolling and caused distrust of communities. These conditions can be common in the forest sectors in Indonesia. To achieve the REDD+ actions by addressing the safeguards, it is expected that the governments take appropriate interventions and collaboration with stakeholders at the local level. In case of the communities in the Tanjung Gunung sub-village, the efforts for trust building by the GPNP staff inspired the initiatives of group activities and reduction of loggers. These actions under the local governance supports by outsiders or third parties will be effective for enhancing capabilities of communities enabling REDD+ by addressing the safeguards in accordance with changes at the local level.

Chapter 7. Overall discussions and conclusions

The objective of this thesis was to provide a practical REDD+ implications system ensuring safeguards and sustainability at the local level. By using the socio-economic data obtained from the target villages around the GPNP, several methods including multivariate analysis were applied by using Capability Approach (CA). In this chapter, after summarizing the main findings of the four studies (Chapter 7.1), the practical measures for the main challenges introduced in Chapter 1.4 are discussed (Chapter 7.2) followed by policy recommendations (Chapter 7.3), future research plans (Chapter 7.4), and significance of the thesis (Chapter 7.5).

7.1. Summary of findings

In Chapter 3, appropriate ways of identifying the agents and drivers of deforestation were explored through a socio-economic survey in a sample village, which has several ethnic groups practicing farming and forestry for their livelihood. The canonical discriminant analysis (CDA) and principle component analysis (PCA) were used to extract key socio-economic characteristics and categorize households. Although the households could be simply divided into two groups as forest users and non-forest users, they were also categorized by the main livelihood activities. The sample households

perform multiple activities in their own “capability” that is defined as a combination of eleven key socio-economic variables, or functionings, extracted from the PCA. The results imply that various agents and drivers of deforestation exist in the same community and the structure of diversity in these communities can be explained by multivariate analysis.

Based on the findings in Chapter 3, a similar multivariable analysis method was applied to six villages located across the GPNP, in Chapter 4. The sample households could not be categorized by their ethnic groups and geographic features. Although the categorization by socio-economic activities showed the highest classification rate, there were some households that could not be classified correctly because socio-economic characteristics in real-world circumstances are too complicated to identify completely. The distribution of the sample households by three socio-economic characteristics can be visualized by drawing a scatter plot diagram using the extracted variables from the PCA. It would be difficult to identify the diverse conditions at the local level only by using macro-level data such as satellite imagery or regional statistics. Additionally, comparisons of the key variables or functionings, such as income and asset, revealed that there are disparities among households and villages potentially caused by

development activities, mainly oil palm plantations, and policies related to park boundaries and land tenures. The comparisons also explain the underlying causes of deforestation and forest degradation such as excessive forest use and farm expansions.

In order to determine the influence of forest use on forest biomass, or carbon pool, the conditions of the two villages, which are different in types of forest uses even though they are both located in the same sub-district, were compared in Chapter 5. Relatively diverse tree species and biomass were conserved in one of the villages, which continued the traditional ways of forest gardening practices. On the other hand, the expansion of degraded forest and rubber plantation was observed in the other village practicing mainly commercial rubber growing. Estimating the changes of forest biomass in ten years revealed clear differences between the villages. It can be deduced that the differences in communal experiences of utilizing natural resources affected in the awareness on customary rules and benefits from forests. It would indicate an importance of cultural aspect such as traditional practices in forest management and conservation.

The changes in forest use practices were explored in Chapter 6 through a socio-economic

survey in eight villages located in the same district which is active in forest use. The practices tended to be diverse but were more commercially-oriented even though they could be classified as "forest gardening inside the national park" and "plantation outside the national park". Those forest use practices by communities have changed by environmental and socio-economic factors at times. As a response to these changes, appropriate measures for management should be taken by governments. In case of the GPNP office, patrolling without sufficient recognition and communication at the park boundary have caused distrust by the nearby communities. With the support of the outsiders for partnership building and collaborative management, communities have initiated actions using their own resources. The findings imply that trust building and local governance would be effective in enhancing the capabilities of local communities and accommodating the changes in local conditions which would facilitate the implementation of REDD+ and safeguards.

7.2. Practical measures for main challenges

Based on the findings of the four studies, measures for the main challenges for REDD+ implementation at the local level are discussed as follows:

1) Identification of the drivers of deforestation and forest degradation

As explained in Chapters 3 and 4, the studied communities consist of various people performing multiple activities that could not be classified by ethnic groups or geographical features. A variety of potential agents and drivers of deforestation exists inside a community and an area when implementing REDD+ actions. By utilizing multivariable analysis and scatter plot diagrams, the structures of diversity in these communities and underlying causes of deforestation could be identified to some extent. Since the factors are diverse and complicated, comprehensive measures need to be taken to enhance peoples' capabilities.

2) Strengthening role of REDD+ safeguards

The REDD+ safeguards under the UNFCCC are limited in reporting the negative impacts of REDD+ actions. Under the situations that diverse communities and agents facing disparity in income and assets as seen in Chapters 3 and 4, it would be difficult to care for and monitor all of them equally and fairly from both social and environment aspects. Thus, it would be more appropriate to recognize the safeguards as a process of activities and capacity building for communities and local governance as discussed in Chapter 6. Especially for the social safeguards, securing the rights and land tenures is

a key issue to encourage the community's participation and trust since insecure and ambiguous rights are common challenges in Indonesia and other developing countries. Followed by the positive participation and collaborative actions, local communities can enhance their capabilities step-by-step toward REDD+ implementation as illustrated in the conceptual diagram in Figure 7.1.

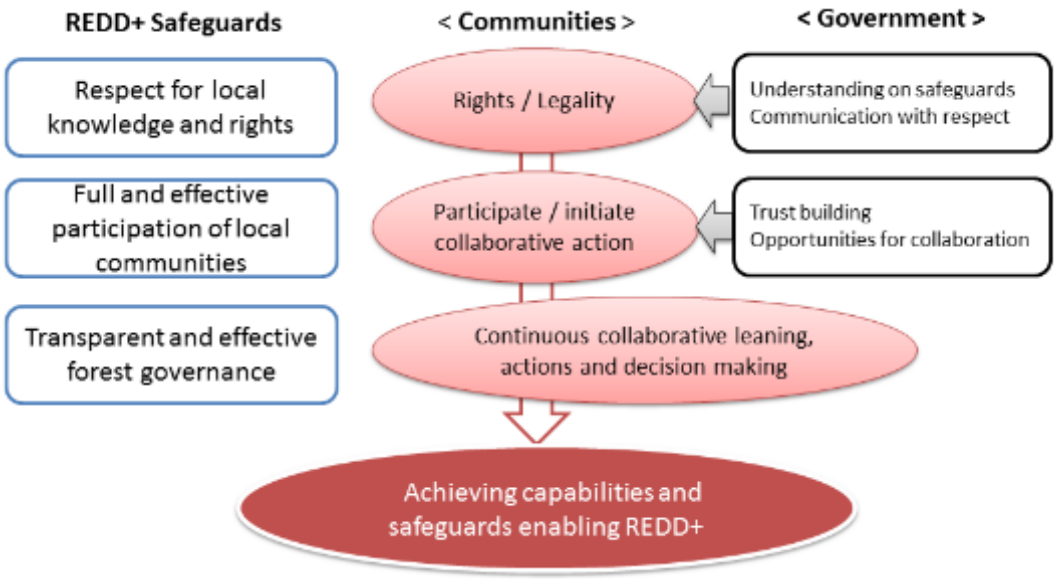


Figure 7-1 Phased approach for achieving capabilities and safeguards enabling REDD+

(Composed by the Author)

a) Respect for the knowledge and rights of communities

Through sufficient understanding of the principle of the safeguards, local governments can take proper actions and communicate well with the community for respecting their

customary rights and exploring mutual solutions to the problems. Vulnerable populations and minorities (females, ethnic groups, and loggers) need extra attention since they have difficulty in participating in and accessing public services. Besides that, ways of legalizing customary tenures and practices should be explored for encouraging the communities to challenge various issues such as forest management and other land tenure-related issues such as oil palm plantations. As potential activities, revisions of park boundaries and zoning through a participatory approach can be considered. It is also important for communities and stakeholders to gather information on and learn together about the practices and their impacts in the field through monitoring the forests and safeguards (MacFarquhar & Goodman, 2015).

b) Full and effective participation of relevant stakeholders

Benefiting from the information gained through mutual trust and communication, community members can access and participate in collaborative activities and decision making in forest management and rural development. For encouraging active participation, it is essential to provide opportunities that community members can join and develop a sense of ownership for forest management and REDD+ actions.

c) Arrangements for transparent and effective forest governance

In order to implement continuous REDD+ activities through a) and b), it is essential to support communities under transparent and effective governance. Communities as well as government officials can strengthen their capabilities for dealing with various challenges and making decisions on REDD+ by continuing the learning process and improving relationships among stakeholders.

3) Integration of non-carbon benefits for sustainability

The results in Chapter 5 showed that the traditional forest use practices have potential of managing forest resources with less impact on ecosystems and biomass. The results revealed the amount of carbon pool recovered from forest loss by severe fires in the past. While there are various types of sources of income and forest use activities in an area, such practices can be encouraged as a model of co-benefits activities. However, it would be difficult for the traditional practitioners to acquire REDD+ benefits since they do not possess legal rights for forest use under the regulations of national parks in Indonesia. While forest use practices are commercially-directed for cash income as seen in Chapter 6, customary uses will be declined without proper respect and understanding. By

securing customary rights and solving ambiguous tenure issues as a type of non-carbon benefits, community members can be motivated to initiate collaborative and sustainable actions by utilizing locally-available resources as seen in Chapter 6.

For effective and sustainable implementation of the first three measures, an additional measure; "local governance for readiness supports", should also be discussed.

4) Collaboration under local governance for readiness supports

REDD+ demonstrations at the local level seem to be similar to the conventional project-based approach by ODA and NGOs, but they differ in targeting scales and stakeholders as described in Chapter 1.5. As the main features of the REDD+ approach, REDD+ would cover broader target groups and various deforestation drivers. In accordance with the diverse communities, it is essential to take comprehensive measures for enhancing functionings and capabilities (Sen, 2001). In case of the GPNP, potential measures will vary across communities and include various technical trainings, introduction of alternative sources of income, and some forest-related activities such as eco-tourism and environmental education. Besides, political and institutional approaches for solving issues pertaining to insufficient farm lands should

be considered to address the underlying causes of the issues. Since it is difficult to deal with a broad range of measures by several organizations, it would be effective to encourage collaborations among local stakeholders as discussed in Chapter 6.

By involving various stakeholders such as local governments, private companies, and communities, local governance can work not only on park management and but also on multiple challenges such as conflicts on oil palm plantations. These issues should be handled by multi-stakeholders, and negotiating tenure issues commonly occurred in Indonesia should be performed by skilled mediators or a third party (McCarthy 2004; Yasmi et al., 2006). By addressing potential risks and uncertainties such as conflicts on tenures, investment in REDD+ can be an attractive market base for official and private finances (Dixon & Challies, 2015). At the same time, the collaboration on tenure issues would contribute to mutual learning and respect for land uses and the impacts of oil palm plantations, which can lead to enhanced capabilities of communities to secure rights and access REDD+ benefits. If communities could access and achieve REDD+ in the future, they need to handle the carbon benefits provided as result-based payments. For sharing and managing those benefits with various stakeholders, local governance can act as a platform for decision making and process monitoring in a transparent way.

While implementing the REDD+ demonstrations in the field, it is common to have conflicts or trust issues between government organizations and communities. Improving the relationships supports collaborative learning and actions toward REDD+ benefits as discussed in Chapter 6. In case of the GPNP, the IJ-REDD+ project has built mutual trust between the national park staff and community members as an outsider. It is useful for outsiders or third parties to take a role of building bridges among stakeholders. At the same time, outsiders should also support the implementation of comprehensive activities as a member of local governance. By taking a stepwise approach to securing rights and participation, communities can enhance the capabilities for enabling REDD+. Thus, it is important to provide technical and financial support for those readiness actions that include comprehensive capacity building and governance practices. In order to ensure sustainability of various measures and safeguards, supports for the readiness actions are essential prior to motivating the stakeholders for result-based payments.

Based on the above-mentioned potential measures for challenges in REDD+ demonstrations, an ideal implementation structure is illustrated as a conceptual

diagram in Figure 7.2. By considering the real-world condition in communities, which are a mixture of people and households those who have a variety of capabilities, governments and outsiders provide technical and financial support and services. As a basis of the local governance, it is essential to build trust among stakeholders through connections with third parties. By collaborating under the local governance, comprehensive actions for securing rights and participation can be promoted step-by-step. The continuous process of decision making contributes to enhancing capabilities of community members and addressing safeguards that would pass forest resources and REDD+ benefits to the future generations.

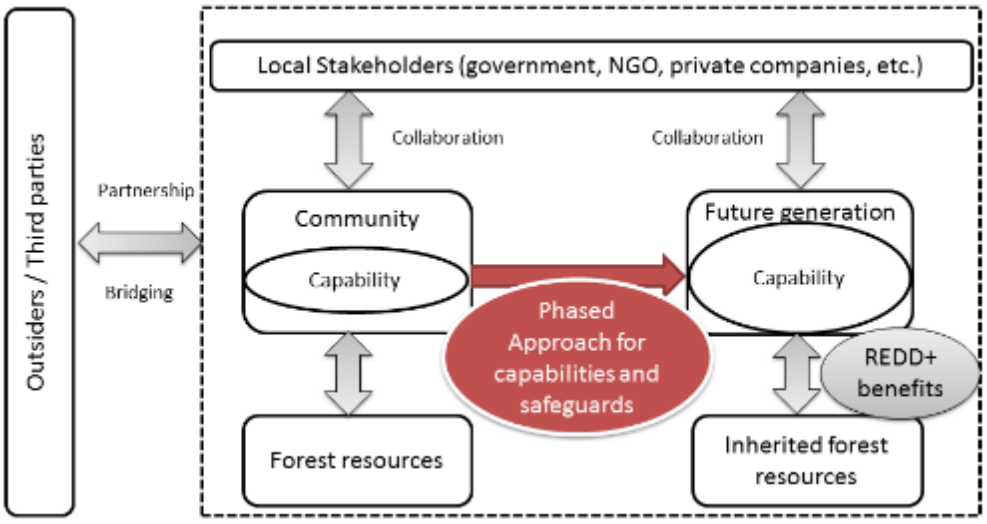


Figure 7-2 Conceptual diagram on ideal REDD+ implementation structure at the local level

(Composed by the Author)

7.3. Policy recommendations

To promote effective REDD+ implementation at the local level, the following policy recommendations are presented based on the findings and implications from the four studies.

1) In order to enhance the capabilities of diverse communities, comprehensive supports and activities on forest management, and safeguards should be promoted based on the understanding of diversity in local communities. To facilitate actions toward REDD+, local stakeholders need to collaborate for effective preparation and implementation in accordance with local conditions.

2) The REDD+ safeguards are effective to act as a process of enhancing capabilities through secured rights and participation. Rather than limiting that role into monitoring and reporting, more sustainable REDD+ processes can be achieved by recognizing it as a basic prerequisite and step for enabling the communities to access and make decisions on REDD+. When implementing the safeguard-related activities, governments should understand and regard the safeguard principles as their regular mission and task.

3) To encourage communities to have sufficient understanding and capabilities for REDD+ implementation, readiness activities at the local level are very important. In order to ensure effectiveness and sustainability of forest management and REDD+ actions, further technical and financial supports as non-carbon benefits and performance-based payments should be considered.

7.4. Future research

Potential future research is expected to extend the findings of this thesis, such as the use of multivariable analysis and capability approach over other forest areas inside and outside Indonesia. The effectiveness of the methods for identifying the agents and drivers in diverse communities needs to be verified and supported by applying the methods in other socio-economic situations. Further research should be conducted to understand the impact of forest use by local people on forest ecosystem services such as water resources, biodiversity, and cultural services. Such studies would provide the implications of recognizing the importance of non-carbon benefits. By expanding the potential of both carbon and non-carbon benefits in the REDD+ mechanism, sustainable forest management in the tropics, which is difficult to attain by project-based efforts with ODA, can be achieved along with climate change mitigation.

7.5. Significance of the thesis

Previous activities for tropical forest conservation implemented under the UNFCCC have caused concerns about excluding rural people without securing legal standing from forest areas. Such approaches could not achieve sustainability even though they enabled forest conservation in the short term. For this thesis, practical ways for securing the rights and participation of the community in the decision-making process to manage forest resources were studied. Through the analysis of socio-economic data by using an aspect of CA, this study shows that the enhancement of community well-being and capabilities has a significant impact on forest conservation. These practical findings from the study indicate that the approach of human science can contribute to developing solutions for global environmental issues, such as the protection of tropical forests to mitigate global warming.

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Appendix

No. _____

Household Survey Questionnaire

Date: / /

Name of Interviewer:	Name of Interviewee:
Starting time	Ending time

PREFACE

We are staffs from NGO working in collaboration with Gunung Palung National Park office and currently doing household surveys of GPNP surroundings.

We are interviewing the society surroundings the National Park. You are not forced to participate if you do not want to. This interview requires approximately one and half hours or two hours and I will record your answers. There is no correct or wrong answer. You may stop at anytime and decide to not answer the question. There is no punishment if you quit the interview, and will be a reward at the end of the interview.

We want to inform you that all the information given is confidential. It means that your name will not be written in a report and we will not inform to the government or anybody else regarding your private answers. After we study the research, we will compile and analys the infomation to consider the improviment for conditions National Park surrounding area.

By answering the questions of this study might not directly impact you, but we hope this study will share the benefit public condition in the future. We expect you to enjoy the conversation with the interviewer and share your opinions to us.

Please kindly consider and decide whether you are able to join or not. If you decide to participate, please inform me and we will start the interview.

1. Basic information

1) Village name:_____ Sub-Village Name:_____Neighbor Group: _____

2) Age_____ Sex_____

3) Relationship with Household head: □1.itself or _____ (Selecting the number from below)

4) Accompanying persons(Selecting the number, specify the relationship) _____ _____ _____

2. Father	3. Mother	4. Husband	5.Wife	6. Daughter	7. Son	8. Grandparent
9.Grandchild	10. Nephew	11. Niece	12. Uncle	13. Aunt	14.Others[specify]	

5) Personal Information

1	Ethnic Group	□1. Dayak □2.Javanese □3. Melayu □4.Balinise □5.Chinise □6. Bugis □7.Madura □8.Others( )
2	Religion	□1. Islam □2.Christian □3.Catholic □4.Hindu □5.Bhuddhist □6.Others( )
3	Previous living place	□1. Born here -> Skip the question No.4 □2. Migrated from other place-> Please ask the reason at question 4 District( ) Village( ) When( )
4	Reason of migration	1) □1.Need land □2.Seeking New job □4.Coming with families □5.Marriage □6.Government Policy-Transmigration □7. Other Government Policy[ ] □8.Others( ) 2) Migration year( )

6) Family member:

Number of families [Living together]	
Number of families [Absentee (Living outside)]	
Total	

Appendix

Family Member living together

No	Relationship	Sex	Age	Education	Main Occupation	Other Occupation	Birth Place [District] & [Village]
1		□1.M □2.F					[ ]& [ ]
2		□1.M □2.F					[ ]& [ ]
3		□1.M □2.F					[ ]& [ ]
4		□1.M □2.F					[ ]& [ ]
5		□1.M □2.F					[ ]& [ ]
6		□1.M □2.F					[ ]& [ ]
7		□1.M □2.F					[ ]& [ ]
8		□1.M □2.F					[ ]& [ ]

Relationship
1. Father
2. Mother
3. Husband
4. Wife
5. Daughter
6. Son
7. Grandparent
8. Grandchild
9. Nephew,Niece
10. Uncle, Aunt
11. Uncertain
12. Others

Education
1. SD
2. SMP
3. SMK
4. Non-education
5. Uncertain
6. Others
-> Specify

Occupation
1. Farming on own land
2. Farming on rented land
3. Wage labor
4. Logger
5. Self employed business
6. Student
7. Housewife
8. Government officer
9. Uncertain
10. Others-> Specify

2. Household assets

1) Utility

Category	
1. Water source 1) Drinking water Multiple	□1.Water Supply □2.Well □3.River water □4.Water from forest area □5.Botteled water □6.Others[ ] □7.Uncertain
2) Water for general use Multiple	□1.Water Supply □2.Well □3.River water □4.Water from forest area □5.Botteled water □6.Others[ ] □7.Uncertain
2. Energy supply sources 1) Energy for lighting Multiple	□1.Generator set □2.Solar energy □3.Kerocene □4.Electricity from grid □5.Others[ ]□6.Uncertain
2) Energy for cooking Multiple	□1.Fuel wood □2.Charcoal □3.Electricity □4.Propane gas □5.Kerocene □6.Others[ ] □7.Uncertain

Appendix

1) Main materials of the house	
1) Floor	□1.Cement □2.Wood □3.Bamboo □4.Tile □5.Others[ ] □6.Uncertain
2) Wall	□1.Brock(Batako) □2.Cement □3.Wood □4.Bamboo □5.Others[ ] □6.Uncertain
3) Roof	□1.Leaves/ grasses □2.Zinc/ tin □3.Roof tile □4.Bamboo □5.Asbestos □6.Others[ ] □6.Uncertain

2) Transportation (Working)

Category	a. Number Owned	b. First procuring year	Category	a. Number Owned	b. First procuring year
1. Automobile			2. Boat		
3. Truck			4. Boat engine		
5. Motorcycle			6. Bicycle		
7. Others					

-If they don't have any transportation way, please put number "0"

3) Electrical Goods(Working)

Category	a. Number Owned	b. First installing year	Category	a. Number Owned	b. First installing year
1. Generator			2. TV		
3. Satellite antenna			4. Computer		
5. Regular phone(land line)			6. Mobile phone		
7. AC			8. Others [ ]		

If they don't have any electrical good, please put number "0"

4) Total number of livestock: If they don't have any livestock, please put number "0"

Category	1) Number Owned	2) Owner Code below	3) Grazing Place Code below
1. Buffalo		□1, □2, □3 □4[ ]	□1, □2, □3, □4, □5, □6[ ]
2. Cow		□1, □2, □3 □4[ ]	□1, □2, □3, □4, □5, □6[ ]
3. Pig		□1, □2, □3 □4[ ]	□1, □2, □3, □4, □5, □6[ ]
4. Chicken		□1, □2, □3 □4[ ]	□1, □2, □3, □4, □5, □6[ ]
5. Duck		□1, □2, □3 □4[ ]	□1, □2, □3, □4, □5, □6[ ]
6. Fish		□1, □2, □3 □4[ ]	□1, □2, □3, □4, □5, □6[ ]
7. Others[ ]		□1, □2, □3 □4[ ]	□1, □2, □3, □4, □5, □6[ ]
Total Value	Rp.	-	-

2). Owner
1. Own 2. Group 3.Community 4. Others[specify]

3) .Grazing Place
1. Forest 2. Fallow 3. Surrounding a residential area (Home garden) 4.Farming area 5. In the cage or tied 6. Others[specify]

Appendix

5) Land Assets

Area of land used and owned by the household

*the detail of agricultural land use shall be asked in other parts.

Category	Area and location	Total Area	Total No. of plot	Land Category [Code]
1. Settlements	□1. None			
	□2. Inside NP	ha		□1, □2, □3, □4, □5[ ]
	□3. Outside NP	ha		□1, □2, □3, □4, □5[ ]
	□4. Inside HL	ha		□1, □2, □3, □4, □5[ ]
	□5. Unknown	ha		□1, □2, □3, □4, □5[ ]
	□6. Others	ha		□1, □2, □3, □4, □5[ ]
2. Farming Area	□1. None			
	□2. Inside NP	ha		□1, □2, □3, □4, □5[ ]
	□3. Outside NP	ha		□1, □2, □3, □4, □5[ ]
	□4. Inside HL	ha		□1, □2, □3, □4, □5[ ]
	□5. Unknown	ha		□1, □2, □3, □4, □5[ ]
	□6. Others	ha		□1, □2, □3, □4, □5[ ]
3. Plantation [ ]	□1. None			
	□2. Inside NP	ha		□1, □2, □3, □4, □5[ ]
	□3. Outside NP	ha		□1, □2, □3, □4, □5[ ]
	□4. Inside HL	ha		□1, □2, □3, □4, □5[ ]
	□5. Unknown	ha		□1, □2, □3, □4, □5[ ]
	□6. Others	ha		□1, □2, □3, □4, □5[ ]
4. Agroforestry (Mix planted area)	□1. None			
	□2. Inside NP	ha		□1, □2, □3, □4, □5[ ]
	□3. Outside NP	ha		□1, □2, □3, □4, □5[ ]
	□4. Inside HL	ha		□1, □2, □3, □4, □5[ ]
	□5. Unknown	ha		□1, □2, □3, □4, □5[ ]
	□6. Others	ha		□1, □2, □3, □4, □5[ ]
5. Others [ ]	□1. Inside NP □2. Outside NP □3. Inside HL □4. Unknown	ha		□1, □2, □3, □4, □5[ ]

If they don't have any area, please choose "None"

Land Category Code
1.Private land, 2.Rented Land, 3.Government land: Category[Specify], 4.Communual land
5. Others [Specify]

Appendix

3. Living conditions

Satisfaction about living conditions	Level of appreciation 1-Low 2-Middle Low 3-Middle 4-Middle High 5-High	Reasons
1. Amount of water volume for daily use	1 2 3 4 5	
2. Quality of water volume for daily life use	1 2 3 4 5	
3. Amount of water volume for drinking water		
4. Quality of water volume for drinking water	1 2 3 4 5	
5. Sufficiency of amount of food for daily life	1 2 3 4 5	
6. Sufficiency of amount of crop productivities	1 2 3 4 5	
7. Situation of entertainment	1 2 3 4 5	
8. Situation of health service	1 2 3 4 5	
9. Situation of education for your family	1 2 3 4 5	
10. Situation of transportation	1 2 3 4 5	
11. Accessibility to road for vehicles	1 2 3 4 5 [ ] m	
12. How often do you go outside village?	times/ month	
13. How do you go to outside village?	□1.By bike □2.By bicycle □3.By public vehicle, □4.By walk □5.Others( )	

4. Natural resource usage

1. Changing in frequency of natural resource usage

[Ranking: 0:1:Few 1-5times/year, 2:Mifddle :10-20 times/year 3:Many: Over20times/year]

Activities	Location	2000-2004	2005-2009	2010-2013
1. Fuel wood collection	A: Inside NP			
	B: Outside NP			
	C: Uncertain			
2. Timber wood collection	A: Inside NP			
	B: Outside NP			
	C: Uncertain			
3. NTFP collection Fuel wood collection	A: Inside NP			
	B: Outside NP			
	C: Uncertain			
4. Logging	A: Inside NP			
	B: Outside NP			
	C: Uncertain			
5. Animal hunting	A: Inside NP			
	B: Outside NP			
	C: Uncertain			

Appendix

2. Natural resource usage in 2013

Type of Resource and Activity in 2013	Level of appreciation	
A) Fuel wood collection	Collecting	□1.Yes □2.No
	1.Frequency	_____ times/ year
	2.Total amount	_____bundle/ year
	3.Place	□1.Natural forest, □2.Plantation □3.Home garden
	4.Area located	□1.Inside NP, □2.Outside NP □3.Inside HL, □4. Uncertain
	5.Resource type	□1.Cutting living tree, □2.Dead tree □3 Collecting branches
	6.Purpose	□1. Domestic use, □2.Selling □3. Both
A) Timber collection	Collecting	□1.Yes □2.No
	1.Frequency	_____ times/ year
	2.Total amount	_____kg/ year
	3.Place	□1.Natural forest, □2.Plantation □3.Home garden □4. Uncertain
	4.Area located	□1.Inside NP, □2.Outside NP □3.Inside HL,
	5.Resource type	□1.Cutting living tree, □2.Dead tree □3 Collecting branches
	6.Purpose	□1. Domestic use, □2.Selling □3. Both
B) NTFP collection NTFP	Collecting □1.Yes □2.No ->Skip next question What kinds of NTFP are collecting? □1.Durian □2.Mushroom □3.Banana □4.Honey □5.Rattan □6.Bamboo shoot □7. Medicine □8. Others( )	
1. Frequency 2. Total amount 3. Place 4. Area located 5. Purpose Mushroom Banana Honey Rattan Damar Bamboo shoot	1) Durian 1._____/ year 2._____kg/year 3.□1.Natural forest, □2.Plantation □3.Home garden 4.□1.Inside NP, □2.Outside NP □3.Inside HL □4. Uncertain 5.□1. Domestic use □2.Selling □3. Both 2) Species(_____) 1._____/ year 2._____kg/year 3.□1.Natural forest, □2.Plantation □3.Home garden 4.□1.Inside NP, □2.Outside NP □3.Inside HL □4. Uncertain 5.□1. Domestic use □2.Selling □3. Both 3) Species(_____) 1._____/ year 2._____kg/year 3.□1.Natural forest, □2.Plantation □3.Home garden 4.□1.Inside NP, □2.Outside NP □3.Inside HL □4. Uncertain 5.□1. Domestic use □2.Selling □3. Both	
D. Animal hunting 1. 2. 3. 4.	1. □1.Yes □2.No->Skip next question 2. Frequency : _____times/ year 3. Total amount: _____heads/year 4. Place: □1.Natural forest, □2.Plantation □3.Home garden 5. Area located □1.Inside NP, □2.Outside NP □3.Inside HL □4. Uncertain 6. Purpose □1. Domestic use, □2.Selling □3. Both	

Appendix

5. Expenditure in 2013

Total expenditure per one year Rp._____

If they don't expense any money, please put number "0"

A) Household expenditure			
Category	**Annual Expenditure**	**whom**	**Note**
1. Food	Rp.		
2. Energy	Rp.	-	
3. Drinking water	Rp.	-	
4. Water for daily use	Rp.		
5. Telephone	Rp.	-	
6. Clothes	Rp.	-	
7. Health	Rp.	-	
8. Education	Rp.	-	
9. Transportation/ Travel	Rp.	-	
10. Wage for labor	Rp.	-	
B) On-farm expenditure			
Category	**Annual Expenditure**	**Whom**	
1. Buying seeds/ seedlings	Rp.	□1, □2, □3, □4,□5,□6	
2. Buying agricultural tools	Rp.	□1, □2, □3, □4,□5,□6	
3. Buying materials(fertilizer/ insecticide etc)	Rp.	□1, □2, □3, □4,□5,□6	
4. Planting/ Maintain trees a) Oil Palm b) Rubber c) Other	a) Rp. b) Rp. c) Rp.	a) □1, □2, □3, □4,□5,□6 b) □1, □2, □3, □4,□5,□6 c) □1, □2, □3, □4,□5,□6	
5. Grazing livestock			
6. Others[ ]	Rp.	□1, □2, □3, □4,□5,□6	
C) Taxes and loan		Whom	
Category	**Annual Expenditure**	**whom**	
1. Loan repayment	Rp.	□1, □2, □3, □4,□5,□6	
2. Tax payment	Rp.	□1, □2, □3, □4,□5,□6	
3. Remittance to family	Rp.	□1, □2, □3, □4,□5,□6	
4. Saving	Rp.	□1, □2, □3, □4,□5,□6	
5. Others[ ]	Rp.	□1, □2, □3, □4,□5,□6	
D) Social life		Whom	
Category	**Annual Expenditure**	**whom**	
1. Donation for social events (wedding, funeral,others)	[Rp.]	□1, □2, □3, □4,□5,□6	

Whom
Code: 1. Villager 2.Market 3.Middleman 4.Company 5. Outside of village 6.Bank

Appendix

6. Annual Income (in 2013)

Total income per year Rp.

If they don't earn any income, please put number "0"

Category	Annual Income	whom	Note
[On-farm income]			
1. Cash Crops			
1) Wetland rice	Rp.	□1, □2, □3, □4,□5,□6	
2) Dry upland rice	Rp.	□1, □2, □3, □4,□5,□6	
3) Other vegetables	Rp.	□1, □2, □3, □4,□5,□6	
2. Live stock	Rp.	□1, □2, □3, □4,□5,□6	
3. Selling games of hunting	Rp.	□1, □2, □3, □4,□5,□6	
4. Selling NTFP	Rp.	□1, □2, □3, □4,□5,□6	
5. Selling Fuel Woods	Rp.	□1, □2, □3, □4,□5,□6	
6. Selling Timber	Rp.	□1, □2, □3, □4,□5,□6	
7. Selling Rubber	Rp.	□1, □2, □3, □4,□5,□6	
[Off-farm income]			
Category	**Annual Income**	**Whom**	
1. Employment **(Permanent)**			
1) Labor: Oil palm plantation	Rp.		
2) Labor: Farming	Rp.		
3) Labor: Mining	Rp.		
4) Others[ ]	Rp.		
2. Employment **(Temporary)**			
1) Labor: Oil palm plantation	Rp.		
2) Labor: Farming	Rp.		
3) Labor: Mining	Rp.		
4) Labor: Going away to working			
5) Others[ ]	Rp.		
3. Private Business	Rp.		
4. Loan/ Borrowing	Rp.	□1, □2, □3, □4,□5,□6	
5. Remittance from family	Rp.		
6. Others[ ]	Rp.		

Whom Code: 1. Villager 2.Market 3.Middleman 4.Company 5. Outside of village 6.Bank

Appendix

7. Annual Crop Production

Code for Cropping Pattern:				
1. Corn	2.Cassava	3. Wet land paddy	4. Dry land paddy	
5. Soybean	6. Coconut palm	7. Durian	8. Banana	
9. Leaf vegetables	10. Rubber	11. Oil palm	12. Coffee	13. Others (Specify)

1. Major crops planted (Code)

Type of agriculture		Plot1	Plot2	Plot3
1. Shifting cultivation Engaging? □1.Yes □2.No	1.Production (Code)	1.	1.	1.
	2.Area	2. Ha	2. Ha	2. Ha
	3.Production	3. Kg	3. Kg	3. Kg
	4.Consumption	4. □1.Sell □2.Domestic □3.Both	4. □1.Sell □2.Domestic □3.Both	4. □1.Sell □2.Domestic □3.Both
	5.Unit price	5. Rp./kg[ ]	5. Rp./kg[ ]	5. Rp./kg[ ]
2. Fixed farm Engaging? □1.Yes □2.No	1.Production (Code)	1.	1.	1.
	2.Area	2. Ha	2. Ha	2. Ha
	3.Production	3. Kg	3. Kg	3. Kg
	4.Consumption	4. □1.Sell □2.Domestic □3.Both	4. □1.Sell □2.Domestic □3.Both	4. □1.Sell □2.Domestic □3.Both
	5.Unit price	5. Rp./kg[ ]	5. Rp./kg[ ]	5. Rp./kg[ ]
3. Home garden Engaging? □1.Yes □2.No	1.Production (Code)	1.	1.	1.
	2.Area	2. Ha	2. Ha	2. Ha
	3.Production	3. Kg	3. Kg	3. Kg
	4.Consumption	4. □1.Sell □2.Domestic □3.Both	4. □1.Sell □2.Domestic □3.Both	4. □1.Sell □2.Domestic □3.Both
	5.Unit price	5. Rp./kg[ ]	5. Rp./kg[ ]	5. Rp./kg[ ]

2. History of crops planted / harvesting (Code) in 10 years

(Please check the column with "✓")

Item (code)	2000-2004			2005-2009			2010-2013		
	Out NP	In NP	None	Out NP	In NP	None	Out NP	In NP	None
Sample) 3				✓	✓		✓		
Shifting cultivation									
Fixed farming									

Appendix

8. History of engaged activities and events in the village in past 11 years (1998-2013) (after moving the present place)

Please put "✓" activities they engaged

1. Activities	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Reason of changing or quitting the activities
Example)Logging				✓	✓	✓							Lost a logging area
a. Logging individual													
b. Logging company													
c. Dry upland rice (Shifting cultivation)													
d. Wetland paddy rice cultivation													
e. Installing irrigation systems													
f. NTFP Collection													
g. Hunting													
h. Wage labor (Farming)													
i. Wage labor (Oil palm farm)													
j. Wage labor (Mining company)													
k. Oil palm plantation (Individual)													
l. Rubber plantation (Individual)													
m. Others[ ]													

Events history in the village in past 15years: Please encode the frequency [Low 1 ・ 2 ・ 3 High]

2. Events	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Example						3	3	3			1	1				
a. Forest fire																
b. Introduction oil palm plantation																
c. Migration from out side																
d. Others[ ]																

Appendix

9. Current Land Use in 2012/2013

Type of Land	1.Use	2.No. of locations used	(a) Land owned and used by the HH			(b) Land rented/ borrowed from others		
	(Yes/ No)	Total No. of Plots used	1.No. of plot	2.Ave Area per plot	3.Land Category [Code]	1.No. of plot	2.Ave Area per plot	3.Land Category [Code]
A. Cultivated								
Example	Y / N	3	2	0.5Ha	5	1	0.5Ha	3
A1.Home Garden	Y / N			Ha			Ha	
A2.Wetland Paddy	Y / N			Ha			Ha	
A3.Upland dry paddy	Y / N			Ha			Ha	
A4. Shifting cultivation Vegetables	Y / N			Ha			Ha	
A5. Agroforestry (Mix Planting)	Y / N			Ha			Ha	
A6. Palm Plantation (Own farm)	Y / N			Ha			Ha	
A7. Rubber Plantation	Y / N			Ha			Ha	
B. Un-cultivated								
B1.Currently unused but kept for shifting cultivation*(Fallow)	Y / N			Ha			Ha	
B2.NTFP Collection	Y / N			-			-	
Others ( )	Y / N			Ha			Ha	

Land Category Code:
1.Inside NP 2. Outside NP 3.HL 3. HP 4. APL 5. Village 6.Communual land
7.Others [ ] 8. Uncertain

Appendix

10. Group activities of the village

1.	**Village Customary Rule**		
1)	Do you know customary rule in the village ?	□1. Yes □2. No	
2)	What are the contents of the customary rules? (Multiple)	□1. Natural resource management(NTFP) □2. Forest management □3. Land use/ tenure management □4. Conflict management □5. Financial management □6. Water resource use □7. Farming Practice □8. Others[ ]	
2.	**Group activities of village**		
1)	Do you know practicing group activities in the village? (Multiple)	□1. Natural resource management □2.Social events (wedding, funeral, etc...) □3. House construction □4. Group farming □5. Religious □6. Coopa/ Credit Union □7. Others[ ]	
2)	Do you participate the activities in the village? (Multiple)	□1. Natural resource management □2.Social events (wedding, funeral, etc...) □3. House construction □4. Group farming □5. Religious □6. Coopa/ Credit Union □7. Others	
3)	What is your purpose of the participating the activities?	□1. To access income resources □2. To ensure labor resources □3. To collect / share information □4. To communicate with the others □5. Others[ ].	

Appendix

11. Please answer the following alternative livelihoods you have interesting in and making ranks No.1 to 5.

Alternative Activities
1. Commercial cropping
2. Wetland paddy rice farming
3. Dry upland rice farming
4. Shifting cultivation(vegetables)
5. Raising livestock
6. Hunting animals
7. Trading
8. Labour
9. Planting fruit trees
10. Handy crafts
11. Planting industrial trees: Oil palm,
12. Planting industrial trees: Rubber trees.
13. Fishery
14. Fish culture
15. Logging
16. Tour guide
17. Others: [ ]

No.1 :
No.2 :
No.3 :
No.4 :
No.5 :

Appendix

12. During past 10 years (2003-2013) what kinds of supports from government / NGO provided on your family

12-1 Have you receive any support from outsider?
☐. Yes -> Please continue to answer the column below ☐2. No

12-2 Detail information of supports from outsiders

1.Organizations and program name	2.Target Multiple	3.Contents Multiple	3. Approach Multiple	5.Period	6.Satisfaction
□1. Central Gv □2. District Gv. □3. NGO □4. Private company □5. Others ->specify ( )	□1. Man □2. Woman □3. Children □4 Family members □5. Others □6. Others	□1. Healthcare □2. Natural resource management □3. Agriculture technical □4. Forest management □5. Plantation □6. Capacity Building □7 Business training. □8.Others[ ]	□1. Providing information □2. Providing materials □3. Training □4. Workshop □5. Financial support □6. Loan □7 Others [ ]		1. Satisfaction Low 1 2 3 4 5 High 2. Usefulness Low 1 2 3 4 5 High 3. Sustainability Low 1 2 3 4 5 High
□1. Central Gv □2. District Gv. □3. NGO □4. Private company □5. Others ->specify ( )	□1. Man □2. Woman □3. Children □4 Family members □5. Others □6. Others	□1. Healthcare □2. Natural resource management □3. Agriculture technical □4. Forest management □5. Plantation □6. Capacity Building □7 Business training.	□1. Providing information □2. Providing materials □3. Training □4. Workshop □5. Financial support □6. Loan □7 Others		1. Satisfaction Low 1 2 3 4 5 High 2. Usefulness Low 1 2 3 4 5 High 3. Sustainability

Appendix

		□8.Others[ ]	[ ]		Low 1 2 3 4 5 High
□1. Central Gv □2. District Gv.. □3. NGO □4. Private company □5. Others ->specify ( )	□1. Man □2. Woman □3. Children □4 Family members □5. Others □6. Others	□1. Healthcare □2. Natural resource management □3. Agriculture technical □4. Forest management □5. Plantation □6. Capacity Building □7 Business training. □8.Others[ ]	□1. Providing information □2. Providing materials □3. Training □4. Workshop □5. Financial support □6. Loan □7 Others [ ]		1. Satisfaction Low 1 2 3 4 5 High 2. Usefulness Low 1 2 3 4 5 High 3. Sustainability Low 1 2 3 4 5 High