Local perspectives towards REDD+ projects across different forest management regimes: the case of Indonesia

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THESIS DECLARATION

I, **Ari Rakatama**, certify that:

This thesis has been substantially accomplished during enrolment in the degree of Doctor of Philosophy of The University of Western Australia, UWA School of Agriculture and Environment: (Agricultural and Resource Economics).

This thesis does not contain material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution.

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ABSTRACT

Reducing Emission from Deforestation and Forest Degradation - Plus (REDD+) is perceived as an important climate change mitigation policy to reduce greenhouse gases (GHG) emissions from the forestry sector which contributes around 12-15% of global GHG emissions. However, a sound understanding of the socio-ecological complexity is required to achieve GHG emissions reduction goals while co-benefiting local people through REDD+ schemes. Knowledge of social, economic and institutional factors that affect REDD+ implementation and how these factors are inter-connected is crucial for this understanding.

The primary objective of this research is to contribute towards the understanding of what would be the preferred approaches for REDD+ implementation from local people's perspectives with a focus on forest management regimes and the local contexts. The novelty of this research is that it contributes knowledge on how contextual differences in REDD+ implementation can influence household's perception of, participation in, and preference for REDD+ projects.

This study stands on a general framework to analyse the sustainability of social-ecological systems that is adapted to REDD+ implementation contexts. Household surveys were conducted in three REDD+ project areas in Indonesia that have been managed under three different forest management regimes (private, government, and community). Respondents were divided into two groups based on their participation in REDD+ projects – REDD+ participants and non-participants, and sampled randomly. The study utilised quantitative and qualitative techniques to generate and analyse the data, including focus group discussion, discrete choice experiment, latent class analysis, and structural equation modelling.

The costs and benefits of REDD+ were categorised into three types for the survey purposes – social, economic and environmental. We found that in comparison to REDD+

benefits, the perceived REDD+ costs have a stronger and negative influence on households' support for REDD+ projects. Added restrictions on forest livelihoods under REDD+ projects is the biggest concern of local households; however, involving local households in decision-making and distributing REDD+ benefit for community projects could create a supportive environment for such projects. Among three types of perceived benefits (social, economic and environmental), only environmental benefits are strongly associated with households' support for REDD+.

Current practices of REDD+ also have heterogeneous impacts on perceived benefits and public preferences across forest management regimes. We found that respondents in community and government regimes are the most supportive for REDD+ projects whereas those in private regime are the least supportive. Female respondents from households with larger family size and limited land ownership are likely to support REDD+ projects more than the male respondents. The results of the latent class analysis indicated that there are three distinct classes of REDD+ households -supporters, indifferent group and opponents. Forest management regime is a key determinant in separating these classes. These findings would be useful to design REDD+ policy and more targeted REDD+ projects in the future.

We suggest that addressing appropriately REDD+ costs and benefits is important. Perceived costs of REDD+ should be avoided first. Then, environmental benefits of REDD+ should be promoted more, and REDD+ monetary benefits should be used to fund community projects. Contextualization of REDD+ projects to specific forest management regime is also crucial. Community forests should be prioritised to implement the REDD+ scheme, while private forest should be the last priority. Different REDD+ strategies should be implemented in different forest regime. Another policy recommendation is identifying and targeting potential REDD+ supporters. REDD+ should target the supporter groups with certain socioeconomic profiles to participate. Last, distributing sufficient, transparent and factual information about REDD+, through local organisations is essential for its success in the future.

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AARES	:	Australasian Agricultural and Resource Economics Society
ANOVA	:	Analysis of Variance
ARC	:	Australian Research Council
ASC	:	Alternative Specific Constant
BIC	:	Bayesian Information Criterion
BPS	:	*Badan Pusat Statistik* (Statistical Bureau)
CAIC	:	Consistent *Akaike* Information Criterion
CCB	:	Climate, Community & Biodiversity
CLM	:	Conditional Logit Model
CO2	:	Carbon Dioxide
COP	:	Conference of the Parties
CoV	:	Coefficient of Variation
DCE	:	Discrete Choice Experiment
EAAERE	:	East Asian Association of Environmental and Resource Economics
ERC	:	Ecosystem Restoration Concession
FGD	:	Focus Group Discussion
GHG	:	Greenhouse Gases
GoI	:	Government of Indonesia
GSEM	:	Generalised Structural Equation Model
Ha	:	Hectare
IDR	:	Indonesian Rupiah
IID	:	Independently and Identically Distributed
IIED	:	International Institute for Environment and Development
LCM	:	Latent Class Model
LPDP	:	*Lembaga Pengelola Dana Pendidikan* (Indonesia Endowment Fund for Education)
LR	:	Likelihood Ratio
ML	:	Maximum Likelihood
MMNL	:	Mixed Multinomial Logistic
MNL	:	Multinomial Logit Model
MoE	:	Ministry of Environment

MoEF	:	Ministry of Environment and Forestry
MoF	:	Ministry of Forestry
MRV	:	Measurement, Reporting and Verification
NR	:	Natural Resources
OMED	:	Orthogonal Main-Effect Design
PES	:	Payment for Environmental Services
PWSE	:	Probability-Weighted Sample Enumeration
RED	:	Reducing Emissions from Deforestation
REDD	:	Reducing Emissions from Deforestation in Developing Countries
REDD+	:	Reducing Emissions from Deforestation and Forest Degradation Plus
RUM	:	Random Utility Model
SAGE	:	School of Agricultural and Resource Economics
SALCM	:	Scale Adjusted Latent Class Model
SD	:	Standard Deviation
SE	:	Standard Error
SEM	:	Structural Equation Model
tCO2e	:	Ton of Carbon Dioxide Equivalent
UNEP	:	United Nations Environment Programme
UNFCCC	:	United Nations Framework Convention on Climate Change
USD	:	United States Dollar
UWA	:	University of Western Australia
VCS	:	Verified Carbon Standard

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AUTHORSHIP DECLARATION

This thesis contains work that has been published and material prepared for publication. The bibliographical details of the published and unpublished material, their location in the thesis, and the candidate's contribution to the material relative to that of the co-authors are as follows:

Chapter 2: Rakatama, A., Pandit, R., Ma, C., Iftekhar, S. (2017) The costs and benefits of REDD+: A review of the literature.

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- Student's contribution*: 75% which includes conceptualisation, data analysis and writing*

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- Student's contribution*: 80% which includes conceptualisation, data analysis and writing*

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The undersigned supervisors certify that the student statements regarding his and the co-authors' contribution to each of the works listed above are correct.

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Co-author's signature (Sayed Iftekhar): ______[redacted]______ Date: 28/06/2018

CHAPTER 1
Introduction

1.1. Background

As a natural resource, forest is not only an ecosystem but also a complex social-ecological system. Ostrom (2009) indicates that knowledge within this complex system and how they are connected is crucial in the governance processes to achieve sustainability outcomes. Social, economic, and institutional contexts influence how different variables in the system interact and affect the outcomes of forest governance. Formal institutions (i.e. management regimes, rules) and informal institutions (i.e. incentives, cultures) would shape the human actions in governing the resources (North, 1990). Therefore, different institutions in forest governance will interact differently with other variables and result in different outcomes.

The adverse impacts of climate change on ecological processes, food production, human health and wellbeing, biodiversity, economic growth, and social order have made the climate change a significant global issue (Field et al., 2014). Deforestation and forest degradation contribute around 12-15% of global greenhouse gas (GHG) emissions that cause climate change (Van der Werf et al., 2009). Therefore, Reducing Emission from Deforestation and Forest Degradation - Plus (REDD+) is perceived as a potentially effective and efficient option to adapt and mitigate climate change (Angelsen et al., 2012). REDD+ aims to reduce, stop and reserve emissions from forestry sector by providing economic incentives for conserving, replanting and using forest sustainably in developing countries (UN-REDD, 2017a).

Being the third largest tropical rainforest country with around 120 million hectares of forest area (MoEF, 2017g), Indonesia is an important country from the implementation perspective of REDD+. About 63% of total emission in Indonesia comes from forestry sector (i.e. deforestation and forest degradation caused by the conversion of forest land to agriculture, unsustainable logging and mining) (Indrarto et al., 2012; MoE, 2010). Around 613,000 hectares of Indonesian forests were deforested and degraded every year from 2009 to 2012 (MoF, 2014c). Indonesia has shown a strong commitment to REDD+ implementation since forestry sector plays a vital role to realise the national GHG emissions reduction target. Of the national target of 29% GHG emissions reduction (from business as usual) before 2030, over 59% of this target is stated to be achieved from forestry sector (GoI, 2016). Therefore, REDD+ becomes an important instrument to fulfil national GHG emissions reduction commitment.

At the national level, formulation of REDD+ implementation guidelines was completed in 2008 to provide a regulatory and legal framework. There are several regulations issued by the Ministry of Forestry to guide REDD+ implementation, including demonstration activities (MoF, 2008c), benefit-sharing, location, proponents (MoF, 2009a; MoF, 2009b), the creation of new forest concession called Ecosystem Restoration Concession (ERC) (MoF, 2008b; MoF, 2010; MoF, 2012b) and establishing a forest carbon project (MoF, 2012a). Most currently, Ministry of Environment and Forestry issues several regulations to guide REDD+ implementation, including the procedures of REDD+ implementation (MoEF, 2017e), national registry system (MoEF, 2017d), measurement, reporting and verification (MoEF, 2017b), national GHG inventory (MoEF, 2017c), and trading for certified emission reduction (MoF, 2014b). These regulations then provide different contexts in REDD+ implementation in Indonesia that potentially have different implications on REDD+ costs and benefits as well as preferences, perceptions, and supports towards REDD+ projects.

While locally, at least 66 REDD+ projects have been implemented in Indonesia in different settings since 2008. These projects are distributed in all five major islands and two small islands (UN-REDD, 2015) as indicated in Figure 1.1. Regarding the number of REDD+ projects, Indonesia is the second largest country after Brazil (CIFOR, 2017). Also in 2008, the government invited the private sector to develop and invest in REDD+ projects through the creation of a new forest concession scheme called Ecosystem Restoration (ER).

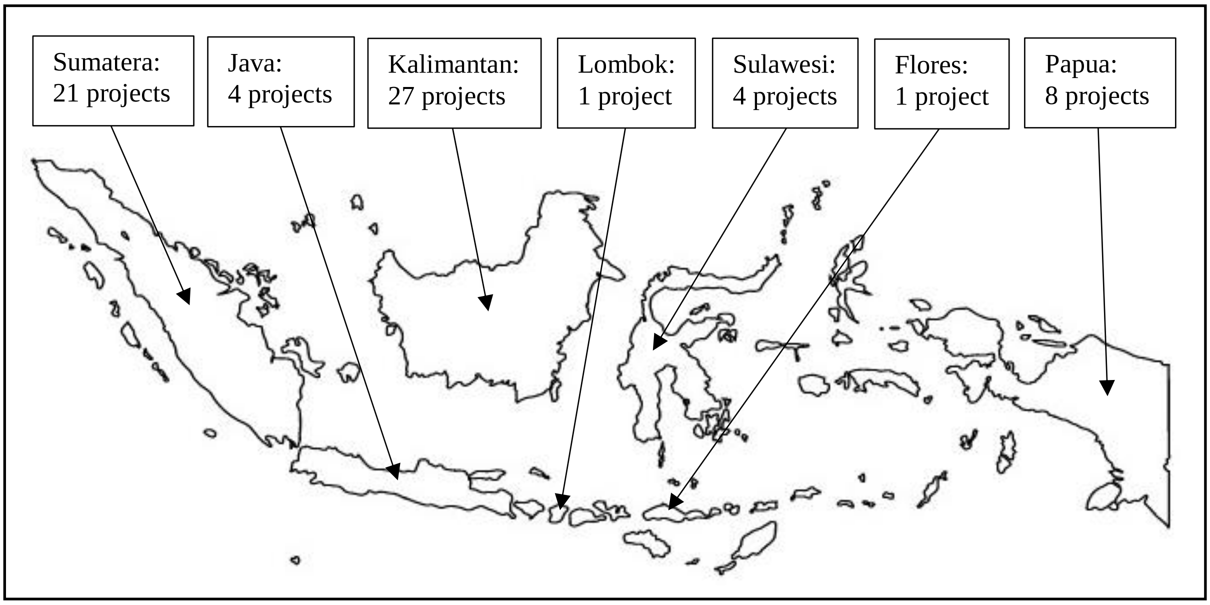

Figure 1.1. The distribution of REDD+ projects in Indonesia. Source: UN-REDD (2015)

1.2. Problems and research questions

Understanding of factors affecting local preferences and support towards REDD+ implementation is crucial to the success of this emerging instrument. In a democratic country like Indonesia, securing support from the local community means securing political support from parliament and bureaucracy which is vital in REDD+ implementation (Luttrell et al., 2014). Their involvement in REDD+ projects can contribute significantly to achieve long-term goals of the projects (Harvey et al., 2010). Most literature implicitly indicates some key factors affecting REDD+ implementation, but do not explicitly discuss whether and to what extent these factors separately or jointly influence preferences, perceptions, and support of the local community towards REDD+ under different REDD+ implementation contexts. In general, the factors that affect REDD+ implementation include forest governance (Larson et al., 2012; Resosudarmo et al., 2014), REDD+ benefits (Howell, 2014b; Skidmore et al., 2014), socioeconomic conditions and forest dependency of local people (Castillo and Armenia, 2016; St-Laurent et al., 2013b), and local experience (Eilenberg, 2015; Mulyani and Jepson, 2015).

This study explores how contextual differences in REDD+ implementation can influence preferences, perceptions, and support of the local community towards REDD+. One of the most remarkable contextual differences is the forest management regime, i.e. under which regime the REDD+ projects are being implemented – private, government and community. Different forest regime means different legal activities that can be conducted by the local community in that forest (GoI, 1999; GoI, 2011; MoF, 2008a). This situation has direct implications for REDD+ specific opportunity costs and forest tenure specific arrangements. Besides forest zones, differences in forest management regimes can also influence REDD+ benefits. For example, there are different benefit sharing mechanisms for different permit holders or developers of REDD+ projects (MoF, 2009b). Such differences are well expected to affect preferences and supports of the local community towards REDD+ projects.

The main research questions in this study are:

1. What are the different costs and benefits of REDD+ examined in the literature and what factors affect these costs and benefits?
2. What are the different perceived benefits and costs of REDD+ projects among local households and how these perceived benefits and costs, along with their socioeconomic characteristics and institutional structure of forest management influence their perception towards REDD+ projects?
3. How and whether the preferences of the local households for REDD+ projects differ by forest management regime and other socioeconomic contexts, including the current REDD+ intervention?

4. How and whether the local households are segmented into different groups based on their preferences towards REDD+, and how to utilise this segmentation to design more targeted REDD+ policies?
5. How could improved understanding of local households' perception, preference and segmentation towards REDD+ projects improve future REDD+ policy?

1.3. Significance and contribution

From an economic point of view, costs and benefits of REDD+ projects are predicted as the primary drivers that shape local preferences and supports for such scheme. The potential of REDD+ to adequately compensate the opportunity cost of local forest users is one of the main reasons why this idea is increasingly popular, and it is supposed to be the win-win approach to reduce emission from forestry sector while empowering local people (Brown et al., 2008). Although several studies discuss and calculate REDD+ costs (Fosci, 2013; Gallemore et al., 2015) and benefits (Howson and Kindon, 2015; Luttrell et al., 2012), they are based on aggregate analysis without considering preferences and aspirations of the local community in different REDD+ implementation contexts simultaneously. There is a limited understanding of how REDD+ costs and benefits are currently perceived at the local level. Also, there is a gap of knowledge on how to maximise REDD+ benefits while minimising the costs at the local level.

The main contribution of this research is in generating knowledge on how contextual differences in REDD+ implementation can influence preferences, perceptions, and support of local communities towards REDD+ projects. By considering preferences and aspirations of the local community in REDD+ implementation, this study will also fill the gap of knowledge about perceived REDD+ costs and benefits at the local level, and suggest solutions on how to maximise REDD+ benefits while minimising the costs through targeted approaches. In the end, the research will contribute to improved understanding of what would be the appropriate REDD+ implementation strategies for different forest management regimes in Indonesia and similar contexts elsewhere.

1.4. Conceptual framework

Knowledge of social, economic and institutional variables and their relationships which potentially affect REDD+ implementation is crucial to the success of REDD+ schemes. Thus, to provide a better understanding of this complex system, this study utilised a general framework of social-ecological systems advanced by Ostrom (2009) with modifications for REDD+ implementation context in Indonesia. This framework is chosen after comparing ten established frameworks for analysing social-ecological systems (Binder et al., 2013). Ostrom's framework is relevant for examining sustainability in forest management since the framework conceptualises the ecological system (forest) from an anthropocentric perspective as a resource system (Binder et al., 2013). The derived framework focuses on interactive processes among subsystems in different social, economic and institutional contexts pertaining to REDD+ implementation (Figure 1.1).

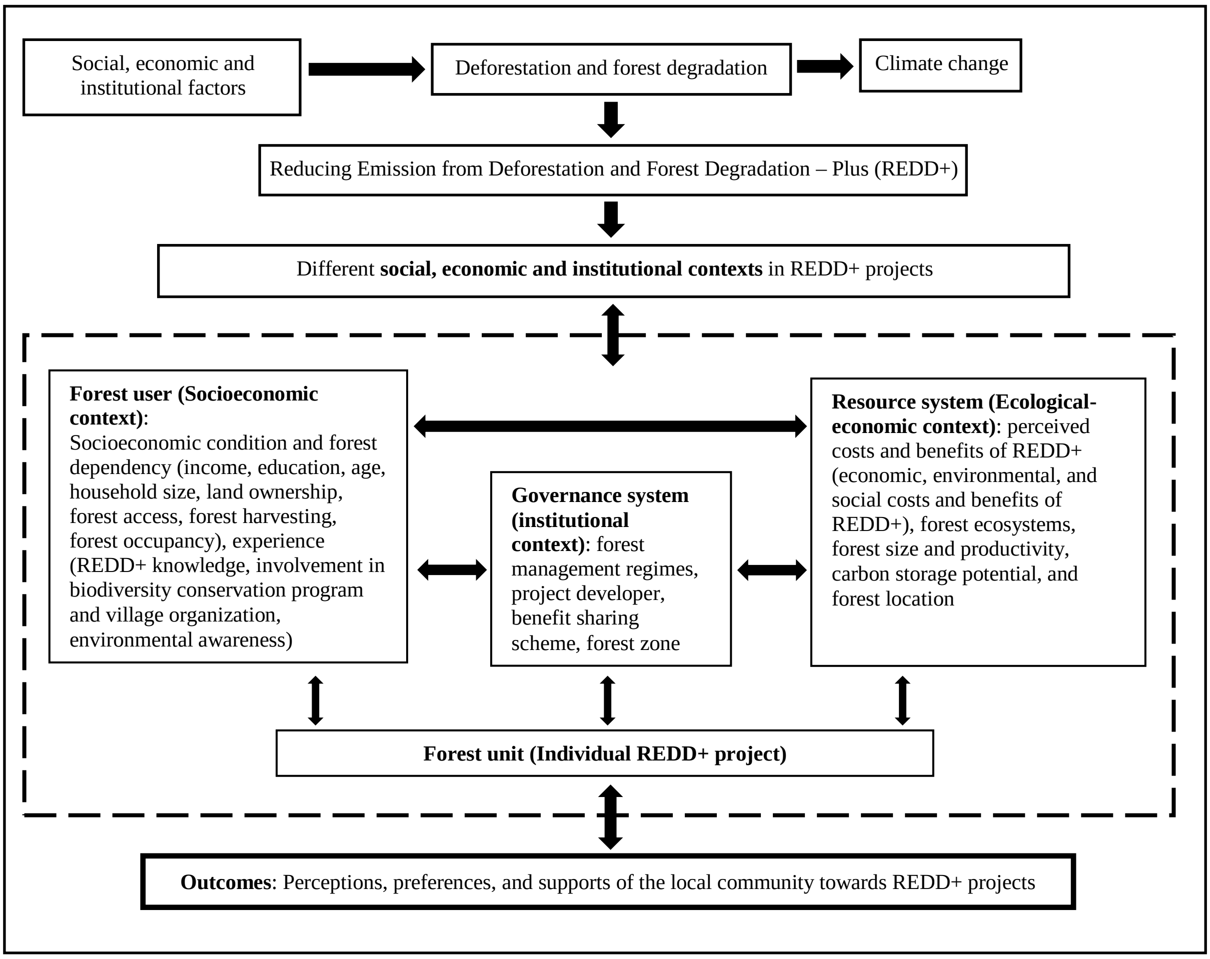

Figure 1.2. A conceptual framework for analysing REDD+ implementation from a social-ecological perspective

1.4.1. Governance system

Governance system-related factors in REDD+ implementation include forest management regimes, project developer, benefit sharing scheme, and forest zone. One of the contextual differences in REDD+ implementation is the various benefit sharing mechanisms across the forest management regimes and project proponents (developers): government, community, or private sector (MoF, 2009b). This would result in a different sense of ownership from the perspectives of the local community. This finding is congruent with studies showing that community empowerment programs within REDD+ projects would affect REDD+ implementation (Larson et al., 2012; Resosudarmo et al., 2014).

Similar to differences in benefit sharing, differences in forest zone where REDD+ is implemented will lead to differences in forest management regime thereby on REDD+ opportunity cost. This critical factor could significantly influence preference and support for a given REDD+ project. In Indonesia, the local community may have three levels of interest in forests, based on legally allowed commercial activities in the forest zones (GoI, 1999; GoI, 2011; MoF, 2008a). Firstly, the local community has a low level of interest in the forests that provide very limited access for them, such as in nature reserve, wildlife reserve, and national park (core and wilderness zone). Secondly, they have a medium level of interest in the accessible forests for essential activities such as forest product harvesting, farming, and hunting. This forest zone includes national park (utilisation zone), forest park, nature-park, hunting-park, protection forest and production forest. Thirdly, the local community has a high level of interest in state-owned forests that are fully managed by the community or indigenous people such as indigenous forests and village forests.

Institutions shape human action (North, 1990). Thus, formal and informal institutions with which REDD+ projects are implemented will determine the responses of the local community. This theory shows that different institutions in REDD+ implementation will interact differently with other factors/variables, which may result in different REDD+ outcomes.

1.4.2. Forest user

In forest user subsystem, socioeconomic condition of the local community is a major determinant of REDD+ implementation. Other relevant variables are the household location from the forest, number of forest users in the REDD+ project, the importance of the forest to households, REDD+ knowledge, and forest use history. Other studies have also indicated that socioeconomic conditions and forest dependency of local people including income, education, age, household size, land holding, forest access, forest harvesting, and forest occupancy are some of the main determinants of REDD+ implementation (Castillo and Armenia, 2016; St-Laurent et al., 2013b).

Another important influencing factor is household/respondents' experience including REDD+ knowledge, involvement in conservation projects and village organisations, and environmental awareness (Eilenberg, 2015; Mulyani and Jepson, 2015). Lawlor et al. (2010) indicate that involvement of the local community in REDD+ implementation will provide positive impacts on forests and local community itself. However, the local community needs to understand how REDD+ projects would be organised, be administered, and affect their livelihood including costs and benefits as well as rights, responsibilities, and risks related to their involvement (Resosudarmo et al., 2012).

1.4.3. Resource system and forest unit

In REDD+ context, critical factors within resource system include forest ecosystems, forest size and productivity, carbon storage potential, and forest location. In this subsystem, economic, environmental, and social costs and benefits of REDD+ are among the important determinants for REDD+ implementation (Howell, 2014b; Skidmore et al., 2014). Meanwhile, the subsystem of forest unit refers to the individual REDD+ project that has project-specific characteristics.

1.5. REDD+ costs and benefits from local perspectives

To fulfil REDD+ goals, we need to have a better understanding of preferences, perceptions and supporting behaviour of the local community towards different REDD+ implementation contexts. The implementation context must incentivise local community by recovering all REDD+ costs while offering additional benefits. Therefore, analysing REDD+ costs and benefits from local perspectives is a requirement to provide policy-relevant suggestions for designing and implementing successful REDD+ schemes.

On costs, Wertz-Kanounnikoff (2008) describes two types of REDD+ costs: opportunity costs and transaction costs. The opportunity costs relate to foregone revenues from the land and forest use that include the losses of income from forest products, and land uses because of REDD+ implementation. Forest provides essential goods for subsistence and commercial purposes, land for other uses, and environmental services. Thus, conserving forest for REDD+ activity may affect access of the local community to those forest products and become the opportunity costs from their perspective which are the biggest part of REDD+ costs (Boucher, 2008; Pagiola and Bosquet, 2009). Other costs are transaction costs associated with the initiation and implementation of REDD+, which covers all expenditures to participate in a REDD+ scheme such as measurement, monitoring, capacity building, planning, brokerage, verification, certification, and insurance. Nevertheless, Pagiola and Bosquet (2009) differentiate implementation costs from transaction costs. The former costs cover the costs for realising actions to reduce emissions in REDD+ implementation. The examples of these costs include the costs associated with planting, maintaining, and conserving the forest.

From benefit side, most literature defines REDD+ benefits only on the monetary basis (Lindhjem et al., 2010; Peskett, 2011) based on the concept of payments for environmental services. Wunder (2008) translates this concept as a transaction of a clear environmental service from a buyer who is benefited by the services to a provider who ensures the availability of the service. However, Luttrell et al. (2012) describe the wide-ranging benefits of REDD+ beyond the monetary benefits that include indirect benefits arising from REDD+ implementation. From local perspectives, direct benefits from REDD+ would include the benefits obtained from selling carbon credits, working in REDD+ related activities, and engaging in community empowerment programs from REDD+ projects developers. Meanwhile, indirect benefits from REDD+ cover all benefits from forest products harvesting, land and forest use activities, infrastructure provisions, and environmental services that occur only after REDD+ implementation. Both benefits can arise as monetary benefits that can be measured through market approaches and non-monetary benefits that can only be quantified by non-market approaches.

Apart from carbon benefit, REDD+ is also expected to deliver other co-benefits including the availability of environmental services such as water, and non-timber forest products such as herbal medicine and fuelwood (UNFCCC, 2015). REDD+ also provides opportunities for new protected forest establishment (Macdonald et al., 2011), offers fresh funding for forest and biodiversity conservation (Venter et al., 2009a; Alexander et al., 2011), and critical habitat restoration (Alexander et al., 2011).

Furthermore, understanding households' preferences towards REDD+ are also important to obtain a social license and to ensure the success REDD+ implementation (Bong et al., 2016; Godden and Tehan, 2016; Moonen et al., 2016). Households' preferences for REDD+ might be influenced by forest management regime that could affect their access to the forest and perceived costs and benefits of REDD+ projects. Therefore, a Discrete Choice Experiment (DCE) approach was used in this thesis. In Payment for Environmental Services (PES) schemes, which is the similar form of REDD+ scheme, DCE has been widely involved to analyse households' preferences for PES contract design (Balderas Torres et al., 2013; Costedoat et al., 2016; Raes et al., 2017). In addition, specifically for REDD+ context, this thesis contributes to the knowledge of how DCE could reveal households' preferences for REDD+ design under different forest management regimes and implementation contexts.

Another determinant of households' preferences towards REDD+ are the experiences of participation in current REDD+ activities. However, it is difficult for households to express their preferences towards current REDD+ projects because of limited experience and information about REDD+ projects (Atmadja and Sills, 2016). Therefore, DCE approach that presents scenarios of hypothetical REDD+ designs to respondents is a good method to address insufficiency of experience and information about REDD+ projects.

1.6. Organisation of thesis

This thesis is comprised of seven chapters and 14 appendices. A diagram informing the thesis structure and how each chapter is linked to the other chapters is presented in Figure 1.3. Furthermore, the thesis organisation is presented in Table 1.1.

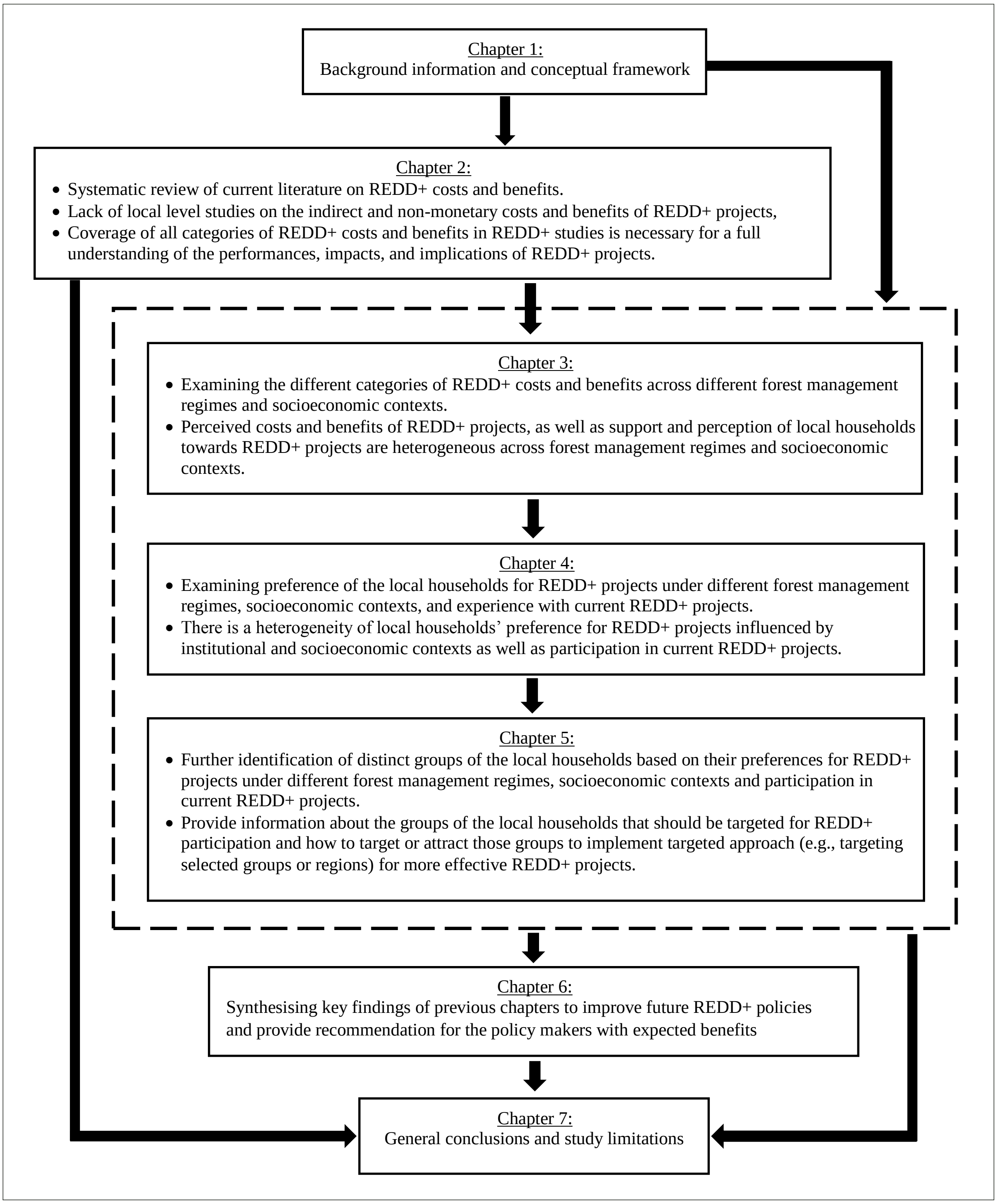

Figure 1.3. Thesis structure and how each chapter is linked to the other chapters.

Table 1.1. Organisation of thesis

Part of thesis	Description	Data used	Method used
Chapter 1	Providing background information, addressed problems and research questions, significances and contributions, conceptual frameworks, and literature review of REDD+ costs and benefits from local perspectives.	Literature	Descriptive
Chapter 2	What are the costs and benefits of REDD+ and what factors affect these costs and benefits, including estimation approach and study context?	Literature	Systematic review
Chapter 3	What costs and benefits of REDD+ projects are perceived by the local households and how perceived costs and benefits, institutional and socioeconomic characteristics could influence their perception towards REDD+ projects?	Household surveys and FGD	Structural equation modelling
Chapter 4	How preferences of the local households for REDD+ projects differ across institutional and socioeconomic contexts and how current REDD+ intervention affects their preferences?	Household surveys and FGD	Mixed multinomial logit modelling
Chapter 5	How the local households are segmented into different groups based on their preferences towards REDD+, and how to utilise this segmentation to design more targeted REDD+ policies?	Household surveys and FGD	Scale adjusted latent class modelling
Chapter 6	How could improved understanding of local households' perception, preference and segmentation towards REDD+ projects improve REDD+ policy?	Key findings from the previous chapters	Synthesising previous chapters
Chapter 7	Conclusions of this thesis presenting addressed research questions and key findings, and the study limitations.	Key findings from the previous chapters	Descriptive

CHAPTER 2

The costs and benefits of REDD+: A review of the literature

This paper has been published as:

Rakatama, A., Pandit, R., Ma, C., Iftekhar, S. (2017) The costs and benefits of REDD+: A review of the literature. *Forest Policy and Economics* 75: 103-111.

Abstract

The costs and benefits of the Reducing Emissions from Deforestation and Forest Degradation (REDD+) projects are often reported in isolation. There is a lack of comprehensive understanding of the types of REDD+ costs and benefits reported in the literature. In this paper, we conducted a review of 60 different REDD+ costs and benefits studies. We found that no single study covers all categories of costs and benefits in a comparable form. A total of 56 comparable estimates were available for opportunity costs, 21 for transaction and implementation costs, 23 for total costs, and only four for direct monetary benefits. We found that, on average, the total REDD+ cost ($24.87/tCO2e) was 2.23 times higher than the opportunity cost and the opportunity cost was 3.28 times higher than the transaction and implementation costs. Costs estimates among studies vary widely based on estimation approach used and the scale of the studies. We noted that future REDD+ costs and benefits studies should provide estimates of all relevant costs and benefits, and the distribution of these costs and benefits among project stakeholders. These findings have implications for REDD+ project design and implementation.

Keywords: REDD+, opportunity cost, transaction cost, implementation cost, direct benefit, estimation approach

2.1. Introduction

Climate change is a global problem. It negatively impacts ecological processes, food production, human health and wellbeing, biodiversity, economic growth, and social order (Field et al., 2014). Deforestation and forest degradation contribute to about 12% (6–17%) of anthropogenic CO2 emissions, which is a significant causative of climate change (Van der Werf et al., 2009). Reducing Emissions from Deforestation and Forest Degradation (REDD+), along with conservation and enhancement of forest carbon stocks, and sustainable forest management is being increasingly recognised as an essential climate change mitigation strategy within the United Nations Framework Convention on Climate Change (UNFCCC).

REDD+ aims to reduce, stop, and reverse emissions from the forestry sector by providing economic incentives to developing countries to manage forests sustainably (UNFCCC, 2010; UNFCCC, 2011), and to avoid forest conversion to other land uses (Parker et al., 2009). REDD+ is considered a low-cost option to mitigate climate change compared to other options, such as renewable energy programmes (Angelsen and McNeill, 2012). It is low-cost because it has a lower opportunity cost and its implementation does not require new technology and long-term research (Hope and Castilla-Rubio, 2008). While the details of the REDD+ mechanism are still being negotiated under UNFCCC (UNFCCC, 2015), various bilateral, corporate, government, and non-governmental agencies are already supporting and implementing REDD+ projects (UNDP, 2015). For example, over 300 projects across 64 countries have been funded ($258 million) and implemented under the United Nations REDD Program (Sills et al., 2014; UN-REDD, 2017b). Even though the implementation of REDD+ is getting traction, there is still limited understanding of the types and determinants of the estimated costs and benefits in different implementation contexts. A consistent approach to incorporate and estimate REDD+ costs and benefits is essential for proper evaluation and design of REDD+ projects.

Costs and benefits of REDD+ projects vary depending on the geographical, ecological, institutional and socio-economic circumstances of the project (Fosci, 2013). Additionally, the estimated costs and benefits for the same project could vary based on the components of costs and benefits that are included and how those estimates are derived (estimation approach). For example, Stern (2007) estimated the costs of avoided (global) deforestation and concluded that the avoided deforestation would be more economical than a range of other emissions mitigation options. However, this avoided deforestation cost estimate has been criticised because it excluded implementation and transaction costs (Dang Phan et al., 2014), which are essential throughout the REDD+ project cycle, including the establishment of the project, maintaining carbon storage and avoiding leakage in the long run.

REDD+ has different categories of costs (i.e., opportunity, implementation and transaction costs) and benefits (i.e., direct and indirect as well as monetary and non-monetary). While opportunity cost is the most critical cost category, the implementation and transaction costs could also be decisive in determining the cost-effectiveness of REDD+ projects in situations where these costs are relatively high. Direct monetary benefits are the most commonly estimated benefits in REDD+ projects, however indirect monetary benefits and non-monetary benefits could also be equally important to understand the overall benefits of REDD+ projects. These non-dominant forms of costs and benefits must be considered in the REDD+ project design to ensure the best investments are made. To date, there has been no systematic review of REDD+ studies that examine the different categories of costs and benefits. It is also unclear to what extent and level of rigour these costs and benefits categories have been incorporated into the empirical literature. An improved understanding of these costs and benefits is necessary for national policymakers, project developers, local communities and governments to make better and informed decisions. It is crucial for the policymakers and project developers to know the distribution of REDD+ costs and benefits among project stakeholders, particularly among local communities, and what factors affect these costs and benefits, including estimation approach and study context. This understanding is essential for equitable sharing of these costs and benefits at the local level (Loft et al., 2014). At the global and regional level, understanding the variations in costs and benefits is necessary to ensure a more efficient and equitable distribution of REDD+ funds and projects (Dang Phan et al., 2014). This review fills these gaps in the literature by systematically examining the existing studies to improve our understanding of REDD+ costs and benefits by focusing on: a) categories of costs and benefits that have been estimated in the existing studies, b) estimation approaches used and their pros and cons, and c) the determinants of costs and benefits estimates including the geographical scope of studies – local, national and international.

Evolution of REDD+ terminology, categories of REDD+ costs and benefits, and the estimation approaches of such costs and benefits are described in Section 2.2. The inclusion criteria to identify relevant studies and the analytical framework to assess REDD+ studies are described in Section 3. Results and discussion of the review are presented in Section 4 with a focus on REDD+ costs and benefits estimates and their distribution among stakeholders by costs and benefits categories, estimation approaches, study location and scope, and other influential factors. Section 5 presents the concluding thoughts with the 'lessons learned' for a way forward in estimating REDD+ costs and benefits.

2.2. REDD+, costs and benefits, and estimation approaches

2.2.1. The evolution of REDD+ terminology

Literature has witnessed a gradual development in the use of REDD+ related terms. Earlier studies used a variety of terms to represent mitigation of carbon emissions from the forestry sector, including 'emissions mitigation from forestry sector' (Makundi and Okiting'ati, 1995), 'reducing emissions by forest conservation' (Kremen et al., 2000) and 'mitigation by enhancing and maintaining carbon sink' (Boer, 2001). The term 'Reducing Emissions from Deforestation (RED)' was first used by Osafo (2005) and Silva-Chávez (2005). This term was in parallel to the first discussion of this idea at the Eleventh Session of the Conference of the Parties (COP 11) of the UNFCCC in Montreal. RED was referred as 'REDD' (Reducing Emissions from Deforestation in Developing Countries) in the submissions by the governments of Papua New Guinea and Costa Rica to COP 11 (i.e., agenda item # 6) (UNFCCC, 2005) and used in most studies published from 2005 to 2009.

In 2007, COP 13 developed a Bali Action Plan and proposed an enhanced scheme called Reducing Emissions from Deforestation and Forest Degradation in developing countries. It encompassed the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries. In 2010, during COP 16, REDD became REDD – Plus (REDD+). Figure 2.1 shows the number of studies published annually using different terminology from 1995 to 2015. It depicts the substantial increase in publications of REDD+ studies after COP 13 and demonstrates that the term REDD+ did not appear in papers until after COP 16 in 2010 (e.g., Bond (2010)). The evolution of REDD+ terminology is continuing. REDD+ is sometimes referred to as REDD++ where the second '+' refers to the variant of the program that considers low carbon but high biodiversity land.

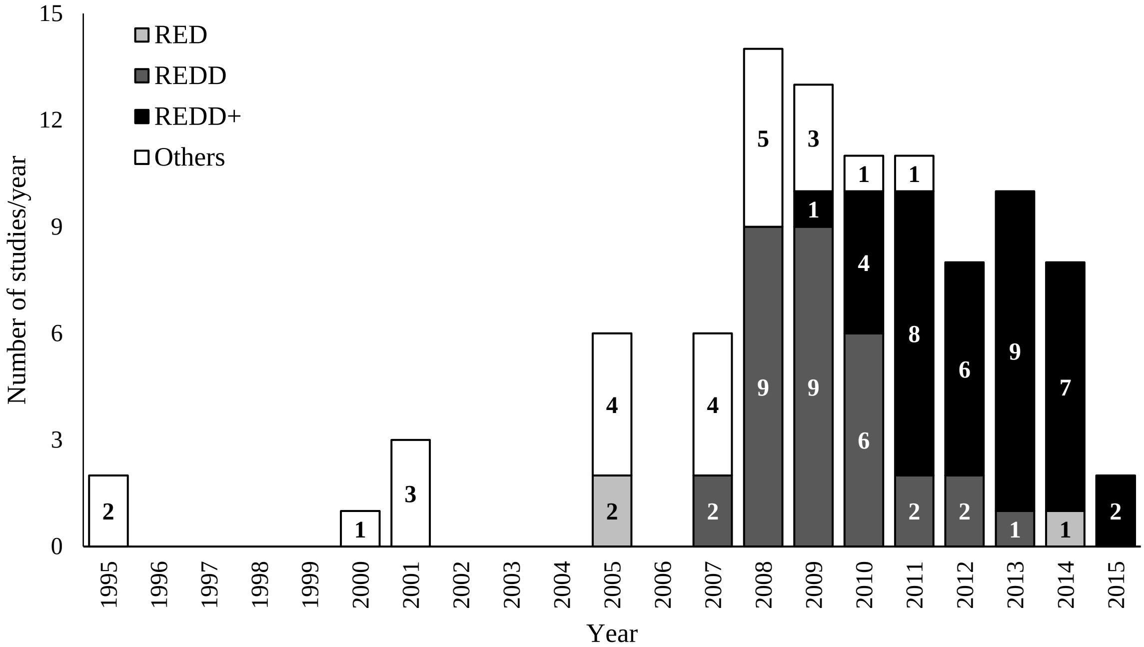

Figure 2.1. Number of studies per year and the evolution of REDD+ terminology

2.2.2. REDD+ costs and benefits categories

REDD+ costs are broadly grouped into three categories: opportunity costs, implementation costs and transaction costs. The *opportunity costs* related to foregone revenues from substitute land and forest use due to REDD+ implementation (White and Minang, 2011). For example, forgone revenues for conserving forest under REDD+ scheme include loss of income from timber logging, fuel-wood production, timber plantation, palm oil plantation, subsistence agriculture, soybean agriculture, maize mono-cropping, pasture, and ranching (Irawan et al., 2014; Ndjondo et al., 2014).

The *implementation costs* refer to the upfront and ongoing expenses in running a REDD+ scheme (White and Minang, 2011). These costs can be divided into two parts: 1) expenditure items that are indirectly associated with REDD+ activities, such as planning, administration, and management (Deveny et al., 2009), research, capacity building, governance reforms, and developing alternative livelihoods for local people (White and Minang, 2011); and 2) expenditure items required to realise the implementation of REDD+, such as infrastructure, human labour and machinery used to plant, maintain, and conserve forest (Deveny et al., 2009).

The *transaction costs* are associated with ensuring transparency and credibility of the scheme (White and Minang, 2011), which cover all expenditures necessary to connect buyers and sellers to make an economic exchange (Bond et al., 2009). Specifically, transaction costs could include costs for negotiation and enforcement of contracts, measurement, monitoring, reporting and verification of outcomes (Merger et al., 2012), and certification (Deveny et al., 2009).

Luttrell et al. (2013) classified REDD+ benefits into four categories: direct monetary benefits, indirect monetary benefits, direct non-monetary benefits, and indirect non-monetary benefits. *Direct monetary benefits* include all payments, shares, incentives, and subsidies related to REDD+ activities. For example, receiving payment or a share from selling carbon credit, paid employment in REDD+ related activities, and incentive or subsidy from donor or government. *Indirect monetary benefits* include all increased income and decreased costs of forest use activities that occur only because of REDD+ implementation. *Direct non-monetary benefits* include all social benefits for stakeholders that are difficult to express in monetary values, such as increased skill, knowledge and capacity of the local community, clarity on forest/land tenure, strengthened local community rights and participation. *Indirect non-monetary benefits* include all intangible ecosystem-based benefits, such as water availability and recreation opportunities.

2.2.3. REDD+ costs and benefits estimation approaches

Approaches to estimate REDD+ costs and benefits vary among studies. Table 2.1 presents the main approaches to REDD+ costs and benefits estimation with typical input data, advantages and disadvantages. Local-empirical, global-empirical, and global simulation models have been used to estimate REDD+ costs (Boucher, 2008). The *local-empirical* model is based on a field survey of a local area. In this model, the cost per ton of carbon dioxide or equivalent ($/tCO2e) is obtained by dividing the costs estimate of a specific area ($/ha) by the carbon density (ton/ ha) (Boucher, 2008). The *global-empirical* modelling approach is based on global aggregation of local-empirical estimates, ignoring carbon density variations in different areas (Boucher, 2008). In this model, the cost per ton of carbon dioxide or equivalent ($/tCO2e) is derived from global area based costs ($/ha) and global carbon density values (ton/ ha). However, if carbon density data is unavailable, costs estimates are reported on per area basis ($/ha). The *global simulation* model estimates the REDD+ supply curves (i.e., carbon abatement supply curve) by simulating the responses of relevant economic sectors to carbon prices compared to a baseline scenario (Bond et al., 2009).

With regards to benefits, two main approaches have been used to calculate direct monetary benefits: supply estimation and demand estimation (Eliasch, 2008). With *supply estimation*, area-specific carbon density and potential CO2 emission reduction from forest sectors are first estimated and then multiplied by carbon credit prices to get benefits per ton ($/tCO2e). *Demand estimation* approach involves estimating the availability of finance for REDD+ implementation from all possible sources such as carbon markets, donors and governments. Information is gathered mainly from secondary data and benefits are mostly expressed as total annual benefits ($/year).

Table 2.1. Approaches to REDD+ costs and benefits estimation.

Attribute	**Cost estimation approaches**			**Benefit estimation approaches**	
	Local-empirical	**Global-empirical**	**Global simulation**	**Supply-based**	**Demand-based**
Geographical scale	Local & national	Global & regional	Global	Mostly local & national	Local, national or global
Input data source	Primary data on alternative land use; local/national carbon density	Local-empirical estimates; global/regional carbon density	Secondary data from relevant sectors such as forestry, agriculture, and energy; carbon credit prices; baseline scenario	Carbon density; potential emissions reduction; carbon credit prices	Funding data available from carbon market, donor and governments
Cost or benefit estimation basis	Empirical study (in $/tCO2e)	Aggregation of local empirical studies (in $/tCO2e)	Global modelling (in $/tCO2e)	CO2 emissions reductions, benefit per ton (in $/tCO2e)	Funding available for emissions abatement, benefit per year (in $/year)
Advantages	Accurate and reliable for specific area; consider location specific factors	Based on accurate and reliable empirical studies	Considers emissions reduction target; considers impacts of increasing land productivity; considers interactions within and among sectors	Accurate and reliable for specific area; considers location specific factors	Can be combined with other data, such as population and forest area to transform into preferred unit
Disadvantages	Difficult to generalise or extrapolate to other places; ignores future changes in population, technology, prices, and market feedbacks (Bond et al., 2009).	Ignores carbon density variation among places (Boucher, 2008); ignores market effects and interactions	Based on secondary data only; ignores location-specific factors	Cannot be generalised to other places	Only based on secondary data
Example studies	Araya and Hofstad (2014), Ndjondo et al. (2014)	Strassburg et al. (2009), Grieg-Gran (2008)	Overmars et al. (2012), Eliasch (2008)	Bottazzi et al. (2013), Kindermann et al. (2008)	Hoang et al. (2013), Deveny et al. (2009)

2.3. An analytical framework to compare costs and benefits

Literature published before October 2015 was considered to conduct this review. The REDD+ studies identified for use in this review had a focus on at least one of the following four inclusion criteria: 1) different types of costs and/or benefits, 2) estimation approaches of costs and/or benefits, 3) distribution of costs and/or benefits, and 4) factors affecting the variations of costs and/or benefits.

Relevant databases were searched – Google Scholar, EconLit, Science Direct, Willey Online Library, Web of Science, and Scopus – using keywords and their combinations to identify candidate studies. The keywords used for the literature search included: REDD cost, REDD benefit, REDD economics, REDD financing, forest carbon cost, forest carbon benefit, forest carbon economy, forest carbon financing, and the opportunity cost of deforestation, cost/benefit of preventing deforestation, and cost/benefit of tropical land conservation[1].

Assessment criteria (Table 2.2) were developed to review each of the identified studies, based on the inclusion criteria described earlier and a brief review of REDD+ costs and benefits categories and the estimation approaches presented in Section 2.2.

Table 2.2. Assessment criteria to review REDD+ costs and benefits

Assessment criteria	**REDD+ costs**	**REDD+ benefits**
Costs or benefits categories (what was estimated?); comprehensiveness: estimates and their distribution	Opportunity costs; implementation costs; transaction costs	Direct monetary benefits; direct non-monetary benefits; indirect monetary benefits; other indirect benefits
Estimation approaches/models (how was it estimated?)	Local-empirical, global-empirical, global-simulation	CO2 emissions supply approach, CO2 emissions demand approach
Influential factors or contexts (what affects the estimates?)	What factors were identified that could affect the cost estimates?	What factors were identified that could affect the benefit estimates?
The geographical scope of the study and the forest types (where was it studied? And in what forest types?)	Local, national, global; type of forests	Local, national, global; type of forests

[1] We thank one of the anonymous reviewers for suggesting the last three key words.

Following the keywords search, a total of 334 studies published between 1995 and 2015 were identified as candidate studies. Robustly, the entire texts of all 334 studies were skimmed and perused to assess their suitability for an in-depth review. This process yielded a total of 92 studies that fulfilled at least one of the four inclusion criteria.

Each study was reviewed in detail and the following aspects were systematically recorded: geographical location and study scale; sample size; respondents; type and magnitude of costs estimates – opportunity costs, transaction costs, implementation costs; type and magnitude of benefit estimates – monetary/non-monetary benefits, direct/indirect benefits; costs/benefits estimation approaches/methods, costs/benefits distributional aspects, factors affecting costs/benefits estimates, alternative land use, emission reduction target, forest type, carbon density, and forest governance.

Various estimates of REDD+ costs and benefits are available in the reviewed papers. Most reviewed papers have reported estimates in US dollars, except two – Enkvist et al. (2007) in Euro and Heres et al. (2013) in Brazilian Real. However, most of these studies did not indicate whether exchange rate or purchasing power parity was used to convert local currencies to US dollars. In fact, only Tomich et al. (2005) indicated that an exchange rate was used to convert the local currency. Thus, for these two particular studies, an exchange rate was used to convert the local currency to US dollars. The choice of conversion metrics – exchange rate or purchasing power parity – would affect the reported estimates but wouldn't have any significant impact on the range of estimates discussed in this paper.

In cases where the estimate is given in a range, rather than a point estimate, an average was calculated. The estimates from studies of different years were converted to US dollar estimates and then adjusted for 2015 US dollar using inflation calculator (http://www.bls.gov/data/inflation_calculator.htm) to generate comparable estimates. The original and converted individual estimates for opportunity costs, transaction and implementation costs, total costs, and direct monetary benefits are provided in Appendix 2.1. Finally, summary statistics are calculated using available comparable estimates in $/tCO2e.

2.4. Results and discussion

2.4.1. REDD+ costs and benefits estimates and their distribution

Not all 92 studies provided REDD+ costs and benefits estimates. A total of 39, 15, and 12 studies provided estimates for opportunity costs, total costs, and benefits, respectively. The studies that provided estimates for opportunity costs and total costs were mutually exclusive, i.e., if a study reported opportunity costs, it did not report total costs and vice versa. However, the benefits, transaction and implementation costs were mutually inclusive to studies reporting the opportunity costs, except for two cases. In those two cases, benefits and total costs were reported (e.g., Bottazzi et al. (2013); Karky and Skutsch (2010)). On the other hand, some studies provided more than one estimate for the same costs or benefits category. After these were considered, a total of 60 unique studies were analysed (Appendix 2.1). Figure 2.2 depicts the individual estimates for comparable studies, and a statistical summary of these estimates are given in Table 2.3.

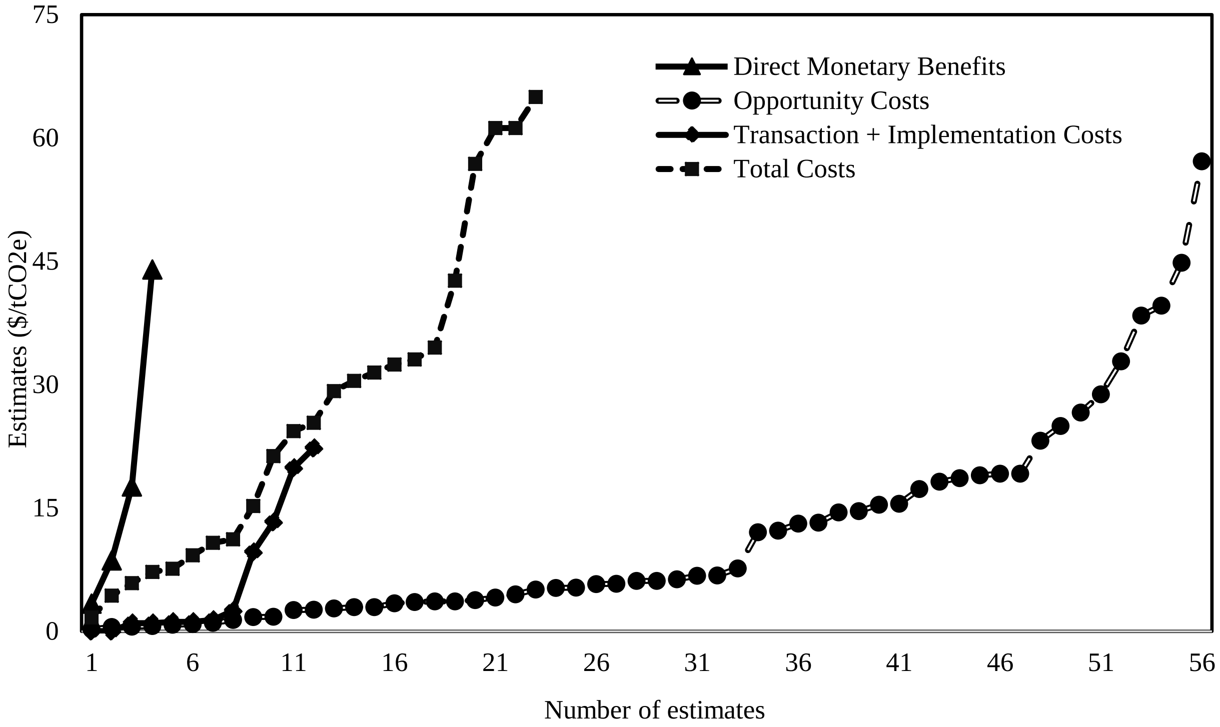

Figure 2.2. Individual estimates of REDD+ costs and benefits by categories

Table 2.3. Summary estimates of REDD+ costs and benefits ($/tCO2e)

Description[a]	**Opportunity costs**[a]	**Transaction & implementation costs**[a]	**Total costs**[a]	**Direct monetary benefits**[a]
Mean	11.13	3.39	24.87	17.37
Standard deviation	11.99	5.12	19.02	14.59
Minimum	0.26	0.03	1.65	3.26
Maximum	56.37	20.93	64.08	41.28
Coefficient of variation	1.08	1.51	0.76	0.84
# of comparable estimates	56	21	23	4
Total # of estimates	67	23	28	15
# of comparable studies	30	12	11	4
Total # of unique studies	39	14	15	12

[a] The cost and benefit estimates in all form of presentations (tables, figures and text) are presented based on 2015 USD for comparison purposes.

The results showed that most of the costs estimates have only focused on the opportunity costs and didn't consider other cost categories. For example, there were 56 comparable estimates ($/tCO2e) available for opportunity costs, whereas the number of comparable estimates was only 21 for the transaction and implementation costs, and 23 for total costs (i.e., all costs reported together). It is also evident from the table that some studies did not provide any comparable estimates (i.e., they reported the costs and benefits in other forms such as $/year or $/ha), whereas some studies provided more than one comparable estimates. For opportunity costs and total costs, one study provided two costs estimates on average.

Only three studies specifically estimated the implementation costs, i.e., Merger et al. (2012); UNEP (2011); Nauclér and Enkvist (2009). Of these three studies, the comparable estimates were only available for one, i.e., $4.65 to $12.59/tCO2e (Merger et al., 2012). While the inclusion of implementation and transaction costs in REDD+ studies became more prevalent from 2008, the unique estimates of these costs were still rare. In fact, these estimates were virtually non-existent for implementation costs. For transaction costs, except in a few cases, e.g., Wertz-Kanounnikoff (2008), it was often given as joint transaction and implementation costs or some other variants. For example, transaction and implementation costs were referred to by various names, such as administrative costs (Deveny et al., 2009), mechanism costs (Hoare et al., 2008), and management costs (Irawan et al., 2013) in existing studies. This example showed a serious lack of information on implementation and transaction costs, either individually or collectively. This condition leads to under-reporting of total costs and consequently over-estimation of the cost-effectiveness of REDD+ projects (Fosci, 2013).

A closer look at the available estimates revealed that average total cost was 2.23 times greater than the average opportunity cost estimate which is 3.28 times higher than the average transaction and implementation costs. This finding is supported by existing literature. It is suggested that implementation and transaction costs are substantially lower than the opportunity costs for REDD+ projects (Boucher, 2008; Deveny et al., 2009). For example, Boucher (2008) indicated that around 80% of total REDD+ costs are opportunity costs and 20% are transaction and implementation costs. Similarly, Deveny et al. (2009) indicated that at the project level transaction and implementation costs are on average 13% of REDD+ costs.

At a national level, Potvin et al. (2008) indicated that the transaction and administration costs are about 25% of REDD+ project costs in Panama. The total costs estimates have a smaller dispersion than the other two costs estimates as shown by the lower coefficient of variation. This finding suggests that total costs estimates may be less sensitive to variations in estimation method or geographical location of the REDD+ projects.

Although some studies estimated REDD+ benefits, the number is far less than studies that estimated REDD+ costs. Table 2.3 shows only four out of 12 studies (i.e., four out of 15 estimates) estimated the direct monetary benefits of REDD+ in a comparable form, at a range of \$3.26/tCO2e to \$41.28/tCO2e. Of the other eight studies, six estimated the direct benefits in \$/year, and two estimated it in \$/ha. The use of units other than \$/tCO2e created challenges when identifying efficient projects from a CO_2 emissions abatement perspective. Furthermore, no comparable estimate of non-monetary and indirect benefits of REDD+ was available in the literature. However, without providing any empirical estimates, some studies mentioned indirect and non-monetary benefits of REDD+ in the form of maintaining environmental services (Howson and Kindon, 2015), increasing non-timber forest products (Luttrell et al., 2012), supporting biodiversity conservation (Andersen et al., 2012), sustaining forest management (Hoang et al., 2013), reducing local poverty (Kowler et al., 2014), developing local capacity (Peskett, 2011), securing land tenure (Larson et al., 2013), and maintaining cultural and social heritage (Howson and Kindon, 2015).

One of the reasons for the sheer lack of estimates for non-monetary and indirect benefits of REDD+ could be the difficulty in obtaining expertise on non-market valuation approaches. Another reason is the unavailability of environmental and biodiversity benefits data on the scale of these studies, which is quite limited at this stage of REDD+ implementation. However, ignoring the value of non-monetary and indirect benefits of REDD+ in the total benefit estimates would lower the cost-effectiveness of REDD+ (Pagiola and Bosquet, 2009).

The distribution of REDD+ costs and benefits among stakeholders was not commonly reported in the reviewed studies. Only a handful of studies indicated distribution of REDD+ costs and benefits among stakeholders (Appendix 2.2), including Antinori and Sathaye (2007); Deveny et al. (2009); MoF (2009b); Karky and Skutsch (2010); Andersen et al. (2012); Luttrell et al. (2012); Irawan et al. (2014). As expected, depending on the study context, the distribution of costs or benefits are uneven among stakeholders across studies. For example, on the distribution of costs, Karky and Skutsch (2010) reported that local community bears higher costs compared to other stakeholders in Nepal, while Irawan et al. (2014) indicated that the government and private sector share a relatively equal proportion of opportunity costs in Indonesia. On the distributions of benefits, Deveny et al. (2009) suggested that private companies, governments, and local communities in developing countries gain most benefits from REDD+, while Andersen et al. (2012) indicated that households and rural people are expected to be most benefited from REDD+. MoF (2009b) indicated a distribution range of direct monetary benefit in Indonesia for three key stakeholders: 10%–50% for government, 20%–70% for the local community, and 20%–60% for project developer.

2.4.2. Estimation approaches and REDD+ costs and benefits

Various approaches have been used to estimate REDD+ costs and benefits in the reviewed papers. A summary of different costs estimates based on estimation approaches is provided in Table 2.4.

Table 2.4. Summary of different categories of REDD+ costs ($/tCO2e) by estimation approach.

Cost category	Estimation approach	Mean	Std. deviation	Min.	Max.	CoV	# of estimates
Opportunity cost	Local empirical	11.69	12.62	0.26	56.37	1.08	46
	Global empirical	3.32	2.07	0.73	5.72	0.62	5
	Global simulation	13.76	8.27	3.85	27.04	0.60	5
Transaction & implementation costs[a]	Local empirical	3.46	5.76	1.10	20.93	0.67	12
	Global empirical	1.15	0.94	0.03	2.33	0.81	3
	Global simulation	3.43	4.53	0.03	12.34	1.32	5
Total cost	Local empirical	22.21	18.78	2.31	57.16	0.85	11
	Global simulation	24.61	24.19	1.65	64.08	0.98	5
	Meta-analysis	29.25	13.65	7.51	56.07	0.47	7

[a] One more estimate for transaction and implementation cost is estimated through meta-analysis, i.e., $9.03/tCO2e (Wertz-Kanounnikoff, 2008).

Based on estimation approach, the global empirical approach provided the lowest cost estimates for both average opportunity cost and average transaction and implementation costs per tCO2e. There were no reviewed studies that used global empirical approach for the total cost, but a sizable number of total cost estimates were derived from meta-analysis. The local empirical approach produced the lowest average total cost per tCO2e. However, a closer look at the costs estimates showed a substantial difference in average cost by estimation approach for opportunity costs and transaction and implementation costs compared to total costs. Global empirical approach generated the lowest estimates for opportunity costs and transaction and implementation costs, but not for total costs. For example, average opportunity costs per tCO2e are 3.5 times and 4.1 times higher for local empirical and global simulation approaches compared to global empirical approach, respectively. Similarly, for the transaction and implementation costs, both the average costs estimates from local empirical and global simulation approaches are about three times higher than the estimate from the global empirical approach. On the contrary, average total costs estimates per tCO2e are fairly close among the estimation approaches, i.e., 1.1 and 1.3 times higher by global simulation and meta-analysis compared to local empirical approach.

The global simulation approach (also referred as a top-down approach) typically resulted in higher estimates of REDD+ costs compared to local empirical approach (also referred to as bottom-up approach) (Boucher, 2008; Lubowski and Rose, 2013). We found this evidence in our review of average opportunity costs and average total costs, but not for the average transaction and implementation costs. The reason is that global simulation approach takes into account the effects of market feedbacks (Lubowski and Rose, 2013), impacts of increasing land productivity in future, and intra- and inter-sector interactions (Kindermann et al., 2008; Sohngen et al., 2008). Market feedbacks occur because decreases in deforestation will reduce timber harvesting and land conversion to agriculture which subsequently reduce commodity supply and increases the price of commodities, implying higher opportunity costs of REDD+ (Lubowski, 2008). Strassburg et al. (2009) generalised local empirical studies on a global scale and reported total costs of \$8.44/tCO2e, which is still lower than the opportunity costs (\$11.01–\$23.12/tCO2e) reported by Kindermann et al. (2008) from a global simulation study.

Another reason for a higher costs estimates from the global simulation approach is the use of CO2 emissions reduction targets. Higher reduction targets typically resulted in higher costs estimates. Eliminating deforestation entirely from 90% to 100% will require much higher funding (Boucher, 2008) due to higher marginal reduction cost at substantially higher levels of reductions. For example, the estimate of opportunity cost was doubled when the emission reduction target increased from 94% to 100% for the Brazilian Amazon forest (Nepstad et al., 2007). Similar findings were also documented in Blaser and Robledo (2007); Enkvist et al. (2007); and Hope and Castilla-Rubio (2008).

Using a different but closely related cost estimation approach to Boucher (2008); Dang Phan et al. (2014) reported REDD+ costs from a review of 32 studies. They reported that on average modelling approach (similar to global simulation by Boucher) yields a higher estimate of REDD+ costs (\$64.08/tCO2e) compared to the option ranking (\$24.03/tCO2e) and averaging ($15.02/tCO2e) approaches (which are similar to local empirical approach by Boucher).

On the benefits side, only four estimates are comparable of which three were derived by supply estimation and one by demand estimation approaches. Based on the supply estimation, the direct monetary benefits of REDD+ range from $3.36/tCO2e (Karky and Skutsch, 2010) to $8.43/tCO2e (Bottazzi et al., 2013) to $16.51/tCO2e (Kindermann et al., 2008). It appears that the estimated benefit of REDD+ is higher based on demand estimation approach ($41.28/tCO2e, Boucher (2008)) compared to supply estimation approach.

However, it should be noted that regardless of the chosen estimation approach, the estimates of benefits were woefully inadequate. Even when the estimates are available, they are not comparable because of inconsistent measurement units and limited sample size. Similar is the case with transaction and implementation costs. This finding suggests that there is an essential gap in the literature on the availability of comparable estimates for monetary benefits, transaction costs, and implementation costs.

2.4.3. Geographical location, study scale and REDD+ costs and benefits

Based on the review, we noted that REDD+ costs and benefits studies are conducted in over 25 countries at varying scales from local to national, and global. Of the 60 studies that provided estimates of the REDD+ costs and benefits, the descriptive statistics for comparable opportunity costs ($/tCO2e) by study region and scale are given in Table 2.5.

Table 2.5. Opportunity cost estimates of REDD+ by study location and scale ($/tCO2e)

	Location			**Scale**		
	Africa	**Latin America**	**Asia**	**Local**	**National**	**Global**
Mean	13.68	4.56	14.11	14.58	9.83	8.54
Standard deviation	13.57	3.37	13.52	13.54	11.62	7.97
Minimum	1.00	0.47	0.26	0.56	0.26	0.73
Maximum	39.05	13.58	56.37	56.37	43.48	27.04
CoV	0.99	0.74	0.96	0.93	1.18	0.93
# of estimates	9	13	26	18	28	10

The average opportunity cost estimate is lowest in Latin America and similar in Asia and Africa. Compared to Latin America, the opportunity cost per tCO2e is about three times higher for Africa and Asia. The variation in costs estimates is also lowest in Latin America compared to the other two regions. Our findings partially support the arguments made in the literature on the distribution of costs across regions. The emissions reduction costs in Latin America were found to be higher than that in Africa but lower than that in South East Asia (Enkvist et al., 2007; Sathaye et al., 2011). Using the global simulation approach, Overmars et al. (2012) reported that the total cost of REDD+ is lowest in Africa ($0–$3.3/tCO2e), slightly higher in South and Central America ($2.06–$9.29/tCO2e), and substantially higher in Southeast Asia ($20.65–$61.94/tCO2e). At a country level, the most number of REDD+ costs and benefits estimates available in these three regions include three for Tanzania, nine for Brazil, and 22 for Indonesia. It is interesting to note that despite Papua New Guinea and Costa Rica being advocates of the REDD+ scheme, and having the ability to push this concept into the COP 11 (2005) agenda in Montreal, only two unique estimates on opportunity costs of REDD+ for Papua New Guinea (i.e., Hunt (2010)) and none for Costa Rica were found in this review.

The scale of the study could also influence the costs estimates. A closer look at Table 2.5 shows that opportunity costs estimates of local studies are the highest, on average, followed by estimates from national and global scale studies. Compared to the estimates of local studies, the estimates of national and global scale studies are about 25% and 40% lower. Dang Phan et al. (2014) also found a similar pattern of results for local and national scale studies, but not for global studies, i.e. the average costs for local, national and global studies are $30.04/tCO2e, $7.51/tCO2e, and $56.07/tCO2e, respectively.

The differences in REDD+ costs estimates, particularly the opportunity costs, across the study locations and scales are partly due to the differences in alternative land use, including land productivity and scarcity. The more profitable the alternative land use is, the higher the opportunity cost of a REDD+ project. For example, in Brazil the estimated range of opportunity costs is \$0–\$1.22/tCO2e, \$0–\$3.31/tCO2e, \$2.76–\$3.76/tCO2e and \$4.31–\$6.74/tCO2e if the alternative land use is subsistence agriculture, ranching, soybean agriculture, and timber production, respectively (Olsen and Bishop, 2009). In Indonesia, the range of costs is \$0–\$1.69/tCO2e, \$4.22–\$8.79/tCO2e and \$0.55–\$21.65/tCO2e if the alternative land use is subsistence agriculture, logging, and palm oil plantations, respectively (Olsen and Bishop, 2009). In another Indonesian study, Wulan (2012) reported a continuum of opportunity costs from\$5.16 to \$18.38/tCO2e, the highest for logging and lowest for paddy field, clove, cocoa, and coconut plantation as alternative land use. Dang Phan et al. (2014) showed that opportunity cost is highest on land with rubber and palm oil plantations (\$34.04/tCO2e), followed by cropping (\$31.04/tCO2e), animal farming (\$25.03/tCO2e) and logging (\$21.02/tCO2e). Therefore, the wide range of opportunity cost estimates across regions and scales of studies is due to the availability of next best alternative land use.

2.4.4. Forest types, carbon density, governance and REDD+ costs and benefits

REDD+ costs estimates could vary by forest types and carbon density (Olsen and Bishop, 2009) and by forest governance arrangement (Dissanayake et al., 2015b). The opportunity costs of palm oil plantation in Indonesia are found to be higher on mineral soil forests (\$10.88–\$36.94/tCO2e) than on peat soil forests (\$1.80–\$5.15/tCO2e) (Venter et al., 2009b). Likewise, REDD+ costs from agricultural rent and forest rent in montane forest (\$1/tCO2e) is substantially lower than in degraded *miombo* woodlands (\$39.05/tCO2e) in Tanzania (Araya and Hofstad, 2014). As an example of forest governance arrangement, REDD+ projects are implemented in three levels of governance structure in Indonesia (i.e., private company, government, and community), which have different benefit sharing mechanisms (MoF, 2009b), affecting the distribution of benefits to different stakeholders. Differences in forest governance structure also influence the opportunity costs of REDD+, affecting the cost-effectiveness of

REDD+ projects. There is also interdependency among some of the factors, which could affect costs and benefits estimates. For example, the geographical location could strongly influence land uses, forest types and carbon density.

2.4.5. Other factors

The REDD+ costs and benefits related literature has also indicated a variety of other factors influencing the costs and benefits estimates. These factors include: expected price of carbon credits and the amount of deforestation reduced (Bond, 2010; Deveny et al., 2009); the type of sequestration activity (Bosetti and Rose, 2011); carbon accounting method, time horizon, and agriculture share in an economy (Dang Phan et al., 2014); access to markets, capital and infrastructure (Howson and Kindon, 2015; Olsen and Bishop, 2009); the design of payment mechanisms (Borner and Wunder, 2008; Wertz-Kanounnikoff, 2008); expectations about labour and discount rate (Araya and Hofstad, 2014); social relationship and REDD+ knowledge (Howson and Kindon, 2015); local context (Bond, 2010; Olsen and Bishop, 2009); agricultural/forestry commodity prices (Bond, 2010); population (Andersen et al., 2012); comparative advantage at local level (Wulan, 2012); national capacities and strategies (Lubowski, 2008), and; history of forest use (Coad et al., 2008). There are insufficient studies to compare the costs estimates for all of these factors. Nevertheless, these factors are not less important to determine REDD+ costs and benefits.

2.5. Lessons learned and concluded thoughts

Based on the review of relevant REDD+ studies, we found a few lessons for future REDD+ costs and benefits studies. First, there is a lack of comprehensive coverage of all relevant cost categories. While the opportunity cost was the most substantial cost, it was not the sole determinant of REDD+ projects. The rarity of transaction and implementation costs covered in REDD+ studies is problematic. As pointed out by Fosci (2013), this situation is inflating the cost-effectiveness of REDD+ projects, leading to less than optimal allocation of REDD+ resources. Future studies should accommodate all three relevant cost categories (opportunity, transaction and implementation) to account for the actual cost of REDD+. Estimation of individual cost category is essential not only to understand the specific cost in a given context but also to estimate total costs if needed. However, the other way around is not possible because the total costs estimates cannot be accurately disaggregated into opportunity, transaction and implementation costs.

Second, the complete picture of REDD+ benefits was missing in the literature as indirect and non-monetary benefits of REDD+ were virtually non-existence. There was a sheer lack of benefits estimates in the published literature even for direct monetary benefits. Even where benefits were reported, the units were different, e. g., $/year vs. $/ha, making comparison impossible. Both monetary and non-monetary benefits should be part of the REDD+ benefits estimations in the future. In the context of increased importance placed on biodiversity conservation and ecosystem services provided by forests, these co-benefits of REDD+ should be reflected in future REDD+ studies.

Third, from a REDD+ costs estimation point of view, the local empirical approach has been popularly used in the literature for both opportunity costs and total costs estimation. However, the costs estimates from different estimation methods were substantially different. For example, studies using global simulation approach tended to estimate higher REDD+ costs and benefits and used global or regional perspectives (Deveny et al., 2009), while estimates from local empirical or global empirical approaches were smaller as they use local or national perspectives (Dissanayake et al., 2015b). Therefore, while evaluating the REDD+ costs or benefits estimates, the estimation approach used and the assumptions behind it should be carefully considered.

Fourth, apart from differences in estimation approaches, REDD+ costs and benefits estimates are affected by study location and scale. We found that the average opportunity cost of REDD+ was lowest in Latin America and highest in Asia. Similarly, the opportunity costs were lowest for studies that were global in scale and highest for studies that were local in scale. This finding will have important implications on using existing estimates of REDD+ project costs as reference points for new projects proposed at a different scale and in a different location.

Fifth, there were only a few studies on the distribution of REDD+ costs and benefits. Some of the existing research highlighted that the distribution of costs and benefits between different layers of government and local people might be one of the critical factors of the success (or failure) of REDD+ projects in the future. For example, it was difficult to distribute financial benefits of REDD+ due to the difficulty to separate the contributions from each type of stakeholders (Skutsch et al., 2013). However, when the implementation of REDD+ projects progresses in the future, more research on the distribution of REDD+ costs and benefits is required to ensure equitable sharing of costs and benefits among stakeholders (Loft et al., 2014). Furthermore, a better understanding of costs and benefits distribution among stakeholders will influence REDD+ project designs, particularly the benefits sharing mechanism and carbon price. Therefore, future REDD+ studies should incorporate distributional issues of REDD+ costs and benefits among different stakeholders.

In summary, to provide comprehensive estimates of REDD+ costs and benefits for a fair comparison of cost-effective CO2 emissions reduction options at local, national and global levels, we recommend that future REDD+ costs and benefits studies should include following aspects: 1) estimates of all types of costs associated with REDD+, including transaction and implementation costs; 2) estimates of all types of benefits arising from REDD+, including non-monetary and indirect benefits; 3) expressing costs and benefits estimates in a comparable unit, i.e., \$/tCO2e; 4) clear integration of contextual factors (geographical location and scale of study, estimation approach, forest types/governance structure, market forces and other influential factors) into costs and benefits estimates; 5) distributional aspect of REDD+ costs and benefits among all stakeholders for a fair sharing of its net benefits. These inclusions and considerations in future studies would provide robust and comprehensive estimates of REDD+ costs and benefits, which in turn help to design REDD+ projects to achieve project objectives cost-effectively.

Bridging section 1: From the literature on REDD+ costs and benefits to the perceived REDD+ costs and benefits on the ground

The previous chapter presented a comprehensive analysis of the REDD+ costs and benefits with a special focus on the parts that are missed in the current literature. The chapter reviewed and identified lack of local level studies on non-monetary and indirect costs and benefits of REDD+ projects. Such information is necessary for a full understanding of the performances, impacts, and implications of REDD+ projects and should be reflected in the future REDD+ studies. Therefore, the next chapter would examine the different categories of costs and benefits of REDD+ projects perceived by the local households. REDD+ costs and benefits would be segmented into three categories (economic, environmental, and social) within two-time dimensions (present and future). How perceived costs and benefits differ across forest management regimes and other institutional and socioeconomic contexts, and how they influence the support and perception of the local households towards REDD+ projects would also be examined in the next chapter.

CHAPTER 3

Perceived costs and benefits of REDD+ projects under different forest management regimes in Indonesia

This paper has been submitted as:

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Abstract

Although Reducing Emissions from Deforestation and Forest Degradation (REDD+) projects have been extensively trialled, the costs and benefits perceived by households are not fully understood. We examined the costs and benefits perceived by households under private, government, and community forest regimes in Indonesia. We analyse interrelationships of households' perception towards REDD+ with perceived costs and benefits, forest management regimes, and socioeconomic characteristics using Structural Equation Modelling (SEM). In comparison to REDD+ benefits, our findings indicate that perceived REDD+ costs by households have a stronger and negative influence on their support for REDD+ projects. Among three types of perceived benefits (social, economic and environmental), only environmental benefits are strongly associated with households' support for REDD+. The perceived environmental and future benefits of REDD+ projects under community forest regime are higher than private and government regimes. Therefore, future REDD+ projects under community forest regime are more likely to be accepted. This information would be useful to design future REDD+ policy.

Keywords: REDD+ perception, structural equation, path analysis, forest regime, Indonesia, REDD+ politics

3.1. Introduction

Reducing emissions from forestry sector is an important strategy to mitigate climate change as this sector is the second largest global greenhouse gas (GHG) emitter. Therefore, Reducing Emissions from Deforestation and Forest Degradation (REDD+) mechanism has been created to provide financial incentives to local communities and governments in developing countries for avoiding deforestation and forest degradation. In other words, REDD+ aims to improve the environment while providing financial incentives for local development and livelihood improvements (Angelsen, 2008; UN-REDD, 2017a). So far, approximately $10 billion has been spent (IIED, 2015; Norman and Nakhooda, 2014) to pilot over 300 REDD+ projects in 64 countries, implemented under different types of forest management regimes involving socioeconomically heterogeneous communities (Sills et al., 2014; UN-REDD, 2017b). However, the full range of costs and benefits of REDD+ projects perceived by participating households are not well understood. In particular, how differences in individual and institutional contexts, including forest management regimes in which such REDD+ projects have been implemented, influence costs and benefits perceived by REDD+ participants (Bayrak and Marafa, 2016).

This paper aims to answer how the local households perceive costs and benefits of REDD+ projects under different forest management regimes – private, community and government - in Indonesia. It also aims to explore how perceived costs and benefits, as well as forest management regimes and participant’s socioeconomic characteristics, could influence the perception towards REDD+ projects. Finally, we present some suggestions on designing REDD+ policy and projects inline with the perceived costs and benefits of REDD+.

The perceived costs and benefits of REDD+ projects need to be understood since they could influence people's support for REDD+ projects (Lawlor et al., 2013). Households in REDD+ project areas would be the most affected by the project and could affect the implementation of such projects (Angelsen and McNeill, 2012). Therefore, ensuring positive perception and involvement of local households in implementing REDD+ projects are essential to obtain social licences to operate and also to achieve long-term project goals (Hawthorne et al., 2016; Kim et al., 2016; Loaiza et al., 2016).

The data to understand perceived costs and benefits of REDD+ projects was collected through face-to-face interviews with the decision-makers in the households in Kalimantan, Indonesia from three different REDD+ projects implemented in three different forest management regimes (private, government, and community). Indonesia is an excellent case for studying perceived costs and benefits of REDD+ projects because it is the third largest tropical rainforest nation (MoEF, 2017g) and the forestry sector in Indonesia is one of the primary contributors of GHG emission (Margono et al., 2014). Also, Indonesia has a relatively long experience (about ten years) of REDD+ project implementation (Sills et al., 2014). We divided perceived costs and benefits of REDD+ projects into three categories (economic, environmental, and social) and for two time periods (present and future). We used generalised structural equation modelling (GSEM) technique to understand the factors affecting households' perception towards REDD+ projects.

Our results indicate heterogeneity of perceived costs and benefits of REDD+ under different forest management regimes and between households with different socioeconomic characteristics. We found that the households' perception of economic and environmental benefits of REDD+ are highest in private and community-based forest management regime, respectively. We also found that the environmental benefit is the only benefit category significantly associated with household support for REDD+ projects. Conversely, economic and social costs are significantly associated with the negative perception of households towards REDD+ projects. These results are useful to design appropriate REDD+ projects in different implementation contexts. We organise the rest of the paper as follows. Section 2 presents the literature on factors affecting households' perception towards REDD+ as well as perceived costs and benefits. Section 3 introduces the methodology, and section 4 presents the primary results, followed by discussions in section 5. The last section concludes the paper.

3.2. Factors affecting households' perception of REDD+ projects

There are four categories of costs and benefits of REDD+ projects at the household level: livelihood, environmental, socio-cultural, and institutional (Bayrak and Marafa, 2016). These costs and benefits perceived by the households would determine their perception towards and participation in REDD+ projects. Literature indicates that the value of monetary benefits is the main determinant for the positive perception of households' towards REDD+ projects (Appiah et al., 2016; Bong et al., 2016; Komba and Muchapondwa, 2016). The value of financial benefits together with the arrangement of benefit distribution to various stakeholders, the term of REDD+ commitment, and restriction on forest-based livelihoods are important attributes that may shape households' preference for REDD+ projects (Dissanayake et al., 2015a; Dissanayake et al., 2015b). However, other literature suggests that non-monetary benefits would be required to ensure the positive perception of households towards REDD+ projects (Busch et al., 2012; Howell, 2014a; Resosudarmo et al., 2012). Furthermore, St-Laurent et al. (2013b) indicate that potential negative impacts of REDD+ projects explained by households are the biggest obstacles to implement such projects. So, there are multiple factors which could affect households' perception towards REDD+ projects.

Some factors might influence perceived costs and benefits as well as indirectly foster households' perception towards REDD+ projects, which include institutional factors such as forest management regime (Araya and Hofstad, 2016; Pandit et al., 2017), access rights to forest-based livelihoods (Broegaard et al., 2017), local empowerment programs (Larson et al., 2012; Resosudarmo et al., 2014), benefit sharing arrangements (Jaung and Bae, 2012; Luttrell et al., 2012), and participation in REDD+ decision-making process (Appiah et al., 2016; Bong et al., 2016; Komba and Muchapondwa, 2016). In Indonesian context, differences in forest management regime mean differences in other institutional aspects including access rights to forest-based livelihoods and benefit sharing arrangements[2] (GoI, 1999; GoI, 2011; MoF, 2008a; MoF, 2009b). Furthermore, Castillo and Armenia (2016) indicate several socioeconomic factors such as income level and occupation. Other factors affecting perception towards REDD+ include education of respondents (St-Laurent et al., 2013b), level of forest dependency (Sutta et al., 2014), knowledges and experiences in current REDD+ projects, Payment for Environmental Services (PES) schemes, and conservation programs (Blom et al., 2010; Howell, 2014a) as well as participation in village organization (Castillo and Armenia, 2016; St-Laurent et al., 2013b).

Based on this set of literature, we hypothesise that perceived costs and benefits of REDD+ determine households' perception towards the REDD+ projects. Furthermore, perceived costs and benefits depend on forest management regimes and socioeconomic characteristics of households where such projects have been implemented. Figure 3.1 shows the conceptual framework of casual relationships among households' perception towards REDD+, perceived costs and benefits, forest management regimes, and socioeconomic factors.

[2] See Appendix 3.1 for more information on forest management regime, access rights to forest-based livelihoods and benefit-sharing arrangements for REDD+ projects.

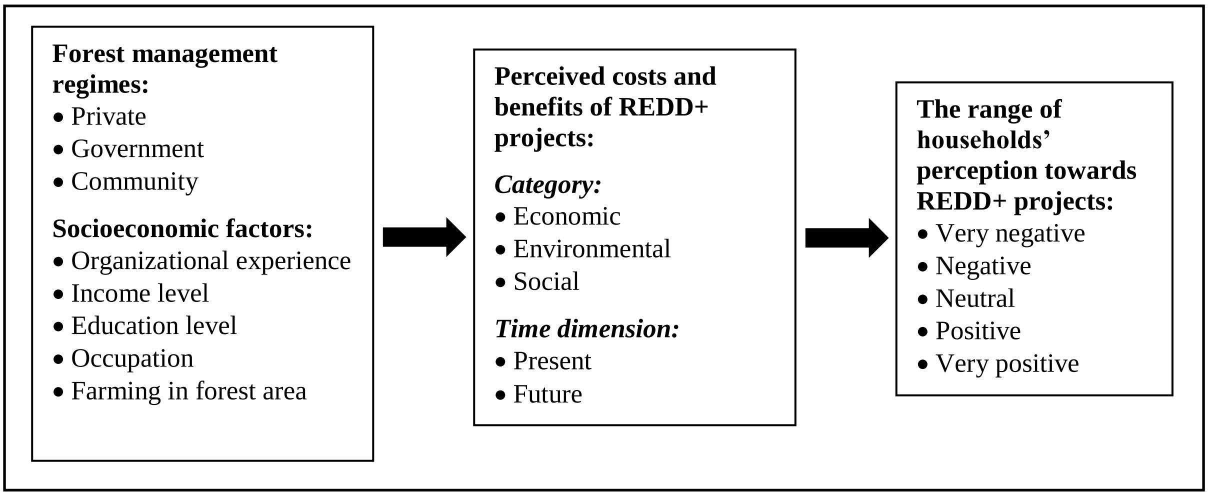

Figure 3.1. Conceptual framework

3.3. Methodology

3.3.1. Households' surveys

To minimise potential bias generated due to location differences, we purposively chose three REDD+ pilot projects on the same island (Kalimantan) in Indonesia. These three projects are different in forest management regimes (private, government, community) and REDD+ implementation contexts[3], so we could examine the differences in perceived REDD+ costs and benefits under a range of contexts. A total of 12 participating villages surrounding the three REDD+ projects were selected randomly as the target villages for household surveys.

The draft of the questionnaire was prepared and refined through focus group discussions (FGDs). Three FGDs with local households (29 participants in total) were conducted to gather information on the expectations and concerns about REDD+ projects, forestry issues, and feedback on the survey design. To minimise selection bias on participant selection, we also invited representatives of different stakeholder groups as participants of the FGDs (i.e. ordinary households, community leaders, government officers, and REDD+ project developers). The

[3] See Appendix 3.2 for more information on the REDD+ project sites.

final survey was carried out from March to June 2016. The respondents were selected randomly from the target villages. Each household was represented by one decision-making respondent only who could be the father, the mother, or any adult household member. A total of 14 local enumerators with at least 12 years of formal education were hired to assist in data collection by minimising language and cultural barriers. To minimise potential errors that could be introduced by a large number of enumerators, all enumerators were trained on survey implementation process for consistency before they independently conduct face-to-face interviews with household decision makers. We obtained consents from local governments and local community leaders before conducting such surveys. In total, there are 268 respondents distributed across the three REDD+ projects. Table 3.1 shows the number of villages, FGD participants, enumerators and respondents in each REDD+ project.

Table 3.1. Number of villages, FGD participants, enumerators and respondents in each REDD+ project site

Site	No. of villages	No. FGD participants	No. of enumerators	No. of respondents
Site 1 (private)	5	15	3	100
Site 2 (government)	3	5	4	63
Site 3 (community)	4	9	7	105
Total Number	12	29	14	268

3.3.2. Variables

We asked respondents about their perceived costs and benefits of the REDD+ project using open-ended questions. We also asked whether they have already realised the costs and benefits of REDD+ or expect to realise them in the future. The responses to perceived costs and benefits were grouped into three categories (economic, environmental, and social) and in two temporal dimensions (present and future). Table 3.2 shows typical respondents' responses towards perceived costs and benefits of REDD+ projects. Table 3.3 presents the variables included in the models and their coding.

Table 3.2. Category of perceived costs and benefits, and typical responses to each category

Category of costs and benefits	**Selected responses to demonstrate the category of costs and benefits**
Economic benefit	Working for REDD+ activities; receiving financial aids; receiving non-financial aids such as diesel machine, solar lamp, water filter, etc.; maintaining availability of forest products such as fruits, rattan, bamboo, vegetables, fuelwood, seeds, etc.; obtaining financial benefits from carbon trading; providing income from ecotourism; building infrastructures such as village office, bridges, etc.
Environmental benefit	Restoring ecosystem; reducing disaster risks such as forest fire, landslide, flooding, drought, etc.; maintaining the availability of clean water, fresh air, and pleasant climate; conserving wildlife and the habitat.
Social benefit	Providing resources of funding teachers for schools; capacity building for the local households; providing clear regulation for logging; securing the customary right for the next generation; securing land/ forest tenure; reducing illegal activities such as illegal logging and hunting; empowering women.
Economic cost	Restricting forest-based livelihood such as fishing, hunting, farming, logging, etc.; limiting access for collecting non-timber forest products such as fuelwood; receiving unfair benefit share from carbon trading; limiting the economic development of the village.
Environmental cost	Reducing wildlife diversity; drying some parts of the forest and increasing the risk of forest fire.
Social cost	Generating conflicts and mistrust among community members because of some reasons such as unfair distribution of benefits and employment for REDD+ activities, no transparency in carbon trading scheme, avoiding households' participation in REDD+ decision making, and failing to fulfil the commitments for realising community empowerment programs.

Table 3.3. Variables included in the models

Variables	Coding
Households' perception	1 = Very negative; 2 = Negative; 3 = Neutral; 4 = Positive; 5 = Very positive
Perceived economic benefits	0 = No; 1 = Yes
Perceived environmental benefits	0 = No; 1 = Yes
Perceived social benefits	0 = No; 1 = Yes
Perceived current benefits	0 = No; 1 = Yes
Perceived future benefits	0 = No; 1 = Yes
Perceived economic costs	0 = No; 1 = Yes
Perceived environmental costs	0 = No; 1 = Yes
Perceived social costs	0 = No; 1 = Yes
Perceived current costs	0 = No; 1 = Yes
Perceived future costs	0 = No; 1 = Yes
Forest management regimes	1 = private; 2 = government; 3 = community (base variable)
Organizational experience	0 = inexperienced with village or community organization; 1 = experienced
Income level	Total income (million IDR/year) or (thousand USD/year)
Years of formal education	1 = 0 – 6 years; 2 = 7 – 11 years; 3 = 12 years or more
Occupation	0 = Does not base on non-natural resources (i.e., labour, trader, employee); 1 = Based on natural resources (i.e., fisherman, farmer, hunter)
Farming in forest area	0 = No; 1 = Yes

3.3.3. Modelling approach

We used structural equation model (SEM) which allows complex modelling of correlated multivariate data to reveal interrelationships among variables (Ramlall, 2016). SEM is more potent than regression analysis in controlling measurement errors, dealing with multiple dependent variables, and analysing complex relationships (Fabrigar et al., 2010). SEM has been used to investigate the interrelationships between forest dependence and community well-being in the past (Parkins et al., 2003). In the REDD+ project context, the SEM study by Dong-hwan (2016) investigated the interrelationships between community/ place attachment and support for a REDD+ project implemented in Indonesian peatland.

The two core elements of SEM are a structural model that captures the causal relationship between the endogenous and the exogenous variables, and a measurement model that shows the relationship between dependent variables and the observed variables. While measurement model relates the latent variables to the observed variables, structural equation focuses on the relationship between independent and dependent variables, and the effects of independent variables on dependent variables (Anderson and Gerbing, 1988). In particular, this study uses a path analysis under structural models (Ramlall, 2016) where endogenous variables ($\boldsymbol{F}^*_i$) are the sum of parameter vectors of mediating variables ($\boldsymbol{M}^*_i$), exogenous variables ($\boldsymbol{F}_i$) and residual term (d_i) (Equation 3.1).

$$F_i^* = \beta_i M_i^* + \tau_i F_i + d_i \qquad (Eq.3.1)$$

Where: i = respondent 1 to respondent 268
β = coefficient of mediating variables
τ = coefficient of exogenous variables

An endogenous variable in this study is households' perception towards REDD+ while mediating variables include perceived economic, environmental, and social costs and benefits as well as perceived present and future costs and benefits of REDD+ projects. Furthermore, exogenous variables are forest management regimes, respondents' organisational experience, income level, years of formal education, occupation, and farming activities in the forest.

Following standard practices in conducting SEM analysis, we started from developing a theoretical/ conceptual model and tested the specified model by performing interrelationship analysis among the variables. Before this process, we conducted data screening to remove outliers. We use the maximum likelihood technique (Equation 3.2) in the estimation process because it is consistent and asymptotically efficient (Ramlall, 2016).

$$ML = \ln|C| - \ln|S| + trSC^{-1} - \mathrm{M} \qquad (Eq.3.2)$$

Where: ML = maximum likelihood; ln = natural logarithm; C = actual covariance matrix; S = covariance matrix implied by the model; tr = trace (sum of the diagonal elements); | | = determinant (index of generalized variance) of a matrix.

We analysed the data in STATA 14. Because the responses of our conceptual models are multinomial with the assumption of logit distribution, we used generalised SEM as the best approach for executing the models using *gsem, mlogit* command (StataCorp, 2013). Under the multinomial logistic model, the probability of each outcome is (Equation 3.3):

$$\Pr(y = i) = \exp(X_i\beta_i)/(1 + \sum_{i=1}^{n}\exp(X_i\beta_i)) \qquad (Eq.3.3)$$

Where X_i is a vector of explanatory variables and β_i is the vector of associated coefficients. We also analysed the responses using one-way ANOVA to test any significant differences in respondents' profile across villages and forest management regimes.

3.3.4. Data summary

About 27% of respondents have organisational experience, mostly at the village level, with average income level around IDR 36,000,000 (USD 2,804) per year. On average, respondents have 0 to 6 years of formal education. Around 68% of respondents work in natural resource-based occupations as fishermen, farmers, hunters, and loggers. Most of the respondents have no farming activity inside forest area. Based on one-way ANOVA test, respondents' profiles are significantly different at 1% across villages, and forest management regimes (private, government, and community)[4]. Table 3.4 presents details on respondents' characteristics by forest management regime.

[4] Except for *Education level* that is not significantly different at 1% across villages and forest management regimes

Table 3.4. Respondents' characteristics by REDD+ projects

Respondents' characteristics	Full Sample (mean or percentage)	Sub-samples (mean or percentage) by forest management regimes and significance of one-way ANOVA test			
		Private	Government	Community	Sig
Experienced with local organisations	27%	35%	35%	15%	***
Total income in a million IDR/year (thousand USD/year)	35.95 ($2.80)	29.55 ($2.30)	49.49 ($3.86)	33.85 ($2.64)	***
Education level:					
1 : 0 – 6 years	67.55%	70.71%	68.85%	63.81%	
2 : 7 – 11 years	15.09%	11.11%	18.03%	17.14%	
3 : > 12 years	17.36%	18.18%	13.11%	19.05%	
Natural resources based Occupation	67.92%	72%	92.06%	49.02%	***
Farming in forest area	34.33%	0%	0%	87.62%	***

*** $p < 0.01$

3.4. Results

We organise the results section into two parts. First, we present summary statistics of perceived costs and benefits. Second, we show the results of generalised SEM analysis.

3.4.1. Summary statistics of perceived costs and benefits

About 66% of respondents perceived some benefits from REDD+ projects. About 42% and 32% of respondents perceive economic benefits and environmental benefits, respectively. However, only 4% of respondents perceive social benefits. 10% of respondents perceive both economic and environmental benefits at the same time. Regarding benefits over time, about 58% and 25% of respondents perceived REDD+ benefits at present and expected in the future, respectively. Furthermore, 18% of respondents perceive present as well as expected future benefits.

On the other hand, 34% of respondents perceived costs of REDD+. Economic costs are perceived by 28% of respondents, while only 1% and 6% of respondents perceived environmental and social costs, respectively. Only 1% of respondents perceive both economic and social costs at the same time. Similar pattern as in the case of benefits is observed for perceived REDD+ costs overtime, i.e. about 26% 14% of respondents perceived REDD+ costs at present and expected in the future, respectively. Only 6% of respondents perceive present REDD+ as well as expected future REDD+ costs.

Our data indicate that only a few respondents perceive multiple costs and benefits of REDD+ projects, suggesting that awareness of REDD+ costs and benefits are still poor among the respondents. Table 3.5 presents more comprehensive results on the percentage of perceived costs and benefits by their respective categories and time (present vs. future).

Table 3.5. Percentage of perceived costs and benefits by categories and time

Benefits	**% of respondents**	**Costs**	**% of respondents**
Perceive benefits	66.04	Perceive costs	33.58
Categories		Categories	
Economic benefits	41.79	Economic costs	27.99
Environmental benefits	32.46	Environmental costs	1.49
Social benefits	3.73	Social costs	5.97
Economic & environmental	9.70	Economic & environmental	0.37
Economic & social	1.87	Economic & social	1.49
Environmental & social	1.87	Environmental & social	0.37
Perceive all benefit categories	1.11	Perceive all cost categories	0.37
Time dimensions		Time dimensions	
Present benefits	57.84	Present costs	26.12
Future benefits	26.12	Future costs	13.81
Perceive at all time	17.91	Perceive at all time	6.34

Table 3.6 presents a cross-tabulation between perceived costs and benefits by their categories and time. There are around 13% of respondents who perceive economic benefits as well as economic costs. Also, 12% of respondents perceive both environmental benefits and economic costs. Meanwhile, only 4% of respondents perceive economic benefits and social costs at the same time. We found small percentages for other combinations of cost and benefit categories.

On the temporal basis, about 19% of respondents perceive both costs and benefits at present, while only about 6% of them perceive both costs and benefits in the future. About 10% of respondents perceive present benefits but are worried about the future costs of REDD+. In contrast, 9% of respondents believe in future REDD+ benefits but perceive that it has costs at present.

Table 3.6. Cross-tabulation between perceived costs and benefits by categories and time

Benefits	**Costs**				
	Economic	**Environmental**	**Social**	**No perceived cost**	**Total responses**
Economic	12.69%	1.12%	4.10%	24.25%	113
Environmental	11.57%	0.75%	0.75%	19.40%	87
Social	1.87%	0.37%	0.75%	1.12%	11
No perceived benefit	6.72%	0.37%	1.12%	0%	22
Total responses	88	7	18	120	233
	Present costs	**Future costs**		**No perceived cost**	**Total responses**
Present benefits	18.66%	10.45%		33.96%	169
Future benefits	8.96%	5.60%		15.67%	81
No perceived benefit	5.60%	1.87%		0%	20
Total responses	89	48		133	270

Note: % of total respondents who have mentioned the categories and time dimensions of costs and benefits

3.4.2. Results on generalised SEM

Table 3.7 present a set of generalised SEM results on the interrelationships between categories of perceived REDD+ costs and benefits, and households' perception towards REDD+, forest management regimes, and socioeconomic characteristics. Furthermore, Figure 3.2 shows a path diagram representing interrelationship structures among those variables based on the results from Table 3.7.

Table 3.7. GSEM results on the interrelationships between categories of perceived REDD+ costs and benefits, and households' perception towards REDD+, forest management regimes, and socioeconomic characteristics

Categories of perceived costs and benefits	**Perception towards REDD+ [a)]**							
	Negative		**Neutral**		**Positive**		**Very positive**	
	Coef.	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***
Economic benefits	1.85		2.00		2.46		2.05	
Environmental benefits	-0.88		0.54		2.62	*	3.76	**
Social benefits	-21.38		0.03		0.55		0.57	
Economic costs	1.67		-2.78	**	-2.54	*	-2.45	*
Environmental costs	21.14		-1.39		20.36		22.48	
Social costs	0.48		-3.52	*	-5.09	**	-23.45	
No. of observation	268							

Institutional and individual factors	**Categories of perceived benefits**						**Categories of perceived costs**					
	Economic		**Environmental**		**Social**		**Economic**		**Environmental**		**Social**	
	Coef.	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***
Private regime [b)]	2.92	**	-4.70	**	-0.60		-0.23		-1.06		19.78	
Government regime [b)]	1.24		-2.57	**	-1.21		0.39		-2.17		17.91	
Organizational. experience	0.49		1.26	**	1.17	*	-0.23		16.42		0.61	
Income level	0.10		0.08		-0.15		0.03		0.39		0.05	
Education level 2 [c)]	0.62		0.63		0.86		0.41		-16.73		1.27	
Education level 3 [c)]	0.28		0.71		0.24		0.87	*	-14.78		1.30	*
Natural resource-based occupation	0.39		0.40		-0.17		-0.51		16.78		0.67	
Farming in forest area	-0.89		-0.87		-0.18		-0.61		-14.15		0.12	
No. of observation	261											
Log-likelihood	-717.37											

[a)] Base variable is '*Very negative*'; [b)] Base variable is '*Community*'; [c)] Base variable is '*Education level 1*';
* $p < 0.05$, ** $p < 0.01$

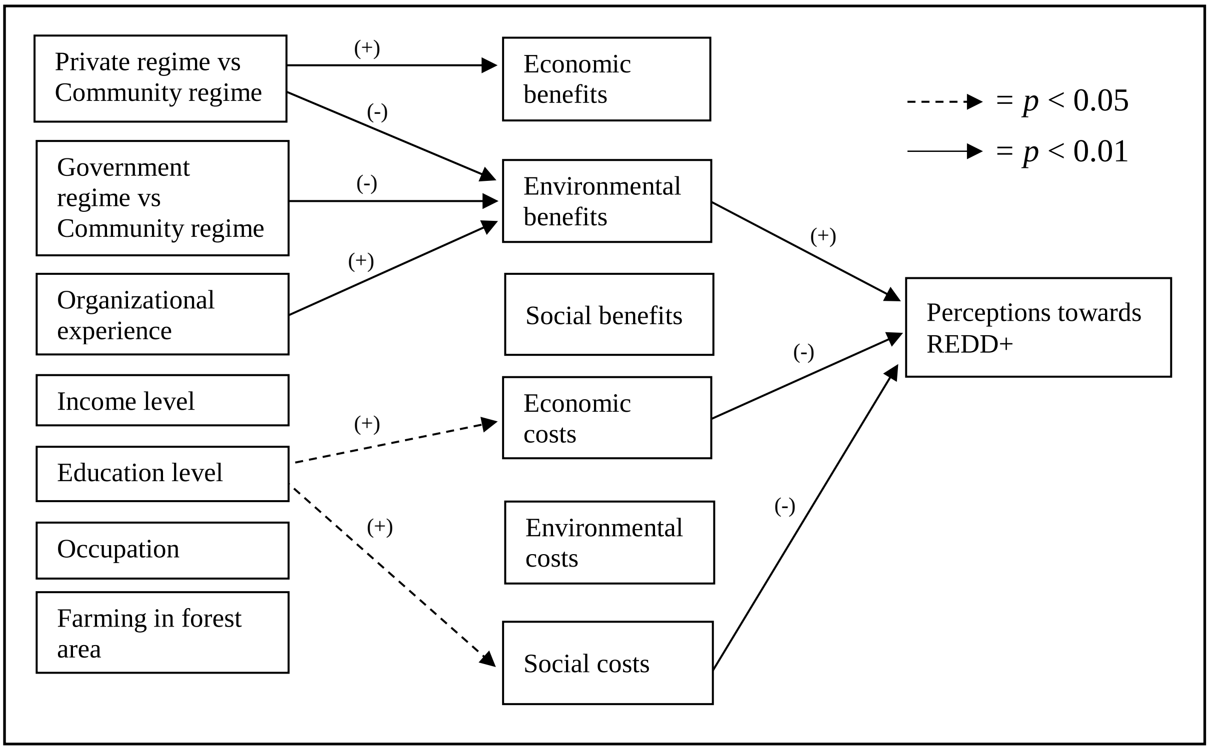

Figure 3.2. A path diagram representing interrelationship structures between institutional and individual factors, categories of REDD+ costs and benefits, and perception towards REDD+

The results indicate that respondents in private regime perceive higher economic but lower environmental benefits compared to the respondents in community regime. Similarly, respondents in government regime perceive lower environmental benefits compared to the respondents in community regime. We also found that respondents with experience in a local organisation perceive higher environmental benefits than inexperienced respondents. However, well-educated respondents (12 years or more of formal education) perceive more economic and social costs compared to less-educated respondents (0 – 6 years of formal education). Overall, environmental benefits are associated with positive perception towards REDD+, while economic and social costs are associated with negative perception towards REDD+. This situation indicates the need for REDD+ implementation to focus on avoiding economic and social costs while delivering environmental benefits to the local community.

Table 3.8 presents another set of generalised SEM results on the interrelationships between temporal aspects of perceived REDD+ costs and benefits (present and future) and households' perception towards REDD+, forest management regimes, and socioeconomic characteristics. Based on these results, Figure 3.3 illustrates the interrelationships among those variables as a path diagram.

Table 3.8. GSEM results on the interrelationships between temporal dimensions of perceived REDD+ costs and benefits and households' perception towards REDD+, forest management regimes, and socioeconomic characteristics

Time dimensions of perceived costs and benefits	**Perception towards REDD+** [a)]							
	Negative		**Neutral**		**Positive**		**Very positive**	
	Coef.	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***
Current benefits	0.81		1.35		2.22	*	3.06	**
Future benefits	-2.46		1.59		2.96		3.61	*
Current costs	2.69		-3.32	**	-2.31	*	-2.23	*
Future costs	1.15		-2.28		-2.96	*	-2.92	*
No. of observation	268							

Institutional and individual factors	**Time dimensions of perceived benefits**				**Time dimensions of perceived costs**			
	Current		**Future**		**Current**		**Future**	
	Coef.	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***	***Coef.***	***Sig.***
Private regime [b)]	-0.24		-3.19	**	-0.55		1.41	
Government regime [b)]	-1.50		-3.71	**	0.18		-0.97	
Organizational. experience	0.85	*	1.48		0.23		-0.20	
Income level	0.07		-0.01		0.05		0.13	
Education level 2 [c)]	0.23		1.25	**	0.42		0.10	
Education level 3 [c)]	0.57		0.71		0.73	*	1.20	**
Natural resource-based occupation	0.49		0.43		-0.13		-0.21	
Farming in forest area	-1.83	*	-0.10		-0.95		0.67	
No. of observation	261							
Log-likelihood	-742.57							

[a)] Base variable is '*Very negative*'; [b)] Base variable is '*Community*'; [c)] Base variable is '*Education level 1*';
* $p < 0.05$, ** $p < 0.01$

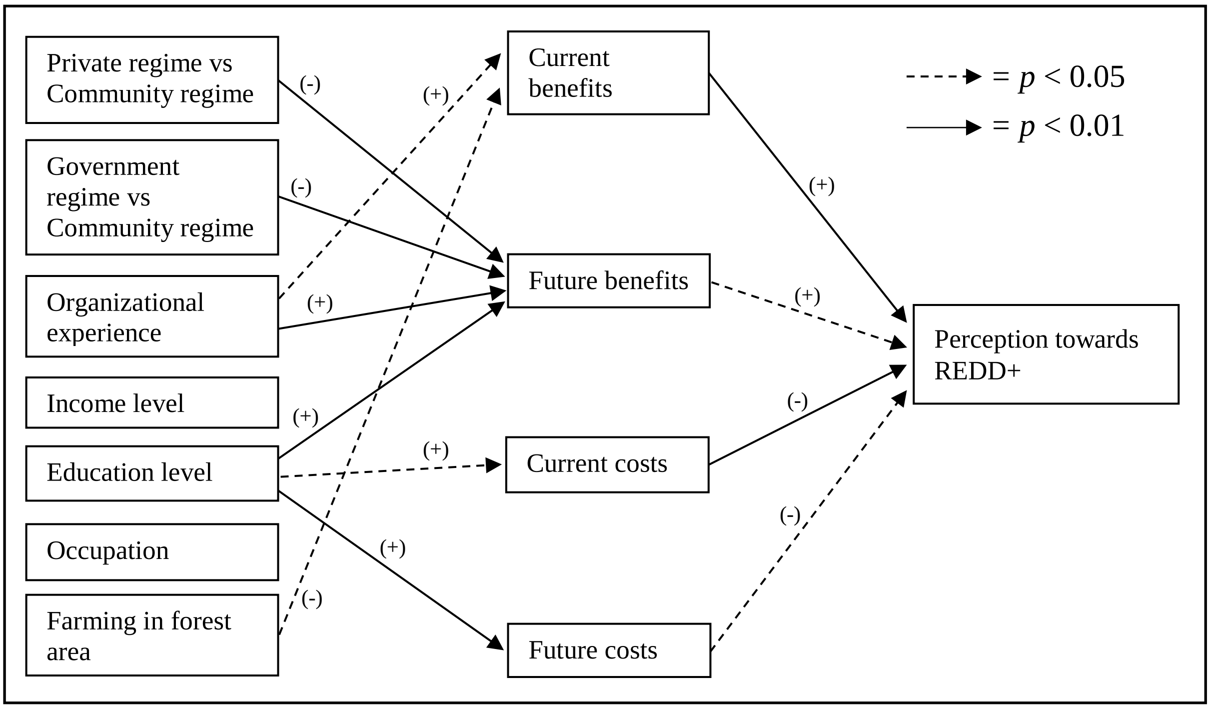

Figure 3.3. A path diagram representing interrelationship structures between individual and institutional factors, temporal dimensions of REDD+ costs and benefits, and perception towards REDD+

The results indicate that respondents in private and government regimes perceive lower future benefits compared to the respondents in community regime. Compared to the respondents without any experience in local organisation, respondents with some experience perceive higher benefits of REDD+, both at present and in the future. This finding is consistent with the previous model presented in Table 3.7. We found that moderately-educated respondents (7 – 11 years of formal education) perceive more future benefits compared to less-educated respondents. Meanwhile, well-educated respondents perceive more costs, both at present and in the future, compared to less-educated respondents. Respondents who farm in forest area perceive less current benefits of REDD+. Moreover, current and future benefits are associated with positive perception towards REDD+, while current and future costs are associated with the negative perception. This finding indicates that temporal dimension is influential in shaping positive and negative perception towards REDD+.

3.5. Discussions

3.5.1. Avoiding perceived costs should be an essential element of the REDD+ mechanism

We found that avoiding perceived costs is more important than perceived benefits for further implementation of REDD+. Our modelling results indicate that there are two categories of perceived costs (*economic and social costs*) that influence household perception towards REDD+ negatively, but only one category of perceived benefits affects REDD+ perception positively. Furthermore, we found that respondents who do not perceive any REDD+ costs will be at least *neutral* for REDD+ implementation. They would have *positive* and *very positive perception* if they perceive REDD+ benefits.

This finding is consistent with the literature indicating that the most prominent concern of the local households is not the benefits that they would obtain from REDD+, but the restrictions on forest-based livelihood that would be in place under REDD+ implementation (Resosudarmo et al., 2012). Although REDD+ might be financially beneficial, restrictions on forest-based livelihood might decrease income and increase costs of living of the local households (Brimont et al., 2015). For example, we found that households in our study areas are highly dependent on forest products, such as timber from surrounding forest for building materials and fuelwood. Any restrictions to access those forest products means extra economic costs to households for obtaining the products from other places. Most importantly, this situation could generate social costs that are intangible and difficult to measure, associated with conflicts among community members or between REDD+ project management and the local households (Dressler et al., 2012; St-Laurent et al., 2013b).

The implication of this finding is that perceived costs of REDD+ should be classified or addressed first before discussing perceived benefits with the households. The future success of REDD+ implementation would depend on the efforts to anticipate perceived economic and social costs by avoiding or limiting the number of new restrictions on forest-based livelihood in implementing REDD+.

3.5.2. Perceived environmental benefits would generate positive perception towards REDD+

The environmental benefit is the only category of perceived benefit that is significantly associated with support for REDD+. Interestingly, we found that perceived economic benefits of REDD+ will not influence support to a REDD+ project. It contradicts with the findings of other studies which suggest that economic benefits are the primary drivers for positive perceptions of households towards REDD+ (Appiah et al., 2016; Beyene et al., 2016; Komba and Muchapondwa, 2016). This contradiction may be contextual to our study areas but reinforces the point that financial payment may not be a sufficient condition to ensure support for REDD+ projects.

Another implication of our finding is that implementing REDD+ as a performance-based program for carbon sequestration might be challenging. Considering limited funding available for REDD+ and uncertainty of the private sector involvement in financing REDD+ (Angelsen, 2017; Angelsen et al., 2017), future economic benefits of REDD+ might be less attractive compared to the opportunity costs, i.e. other economic activities and opportunities that can be pursued instead of REDD+ projects such as the expansion of palm oil plantation. However, eliciting or sharing the environmental benefits of REDD+ could increase environmental awareness of the local households that might then increase their support for REDD+ projects. Therefore, ensuring that local households understand the environmental benefits of the REDD+ project is essential for its success.

It has been argued that environmental benefits perceived by the local households not be comprehensively studied in the existing literature (Rakatama et al., 2017). Our findings based on both focus group discussions and field observations come to the same conclusion that environmental benefits of REDD+ were not sufficiently promoted to the local households by the REDD+ project proponents. Therefore, there is a need for REDD+ studies to explore what types of environmental benefits that should be promoted in REDD+ projects and how those affect REDD+ implementation. It is also important to emphasize that the ability of REDD+ to bring forest conservation benefits to local households is one of the main reasons for their positive perception towards REDD+ projects in Indonesia and many other countries - Brazil, Cameroon, and Tanzania (Resosudarmo et al., 2012).

3.5.3. Socioeconomic characteristics influence perceived costs and benefits of REDD+

Experience with local organisations positively influence perceived environmental and future benefits. This experience would increase positive perception towards REDD+ because respondents involved in local organisations would obtain frequent update and accurate information about REDD+. Castillo and Armenia (2016) showed that membership in local organisations is associated with high participation in REDD+ activities. A study by St-Laurent et al. (2013b) demonstrated that local organisation has a strategic position to ensure further success of REDD+ implementation because the members of local organisation tend to have a united voice for REDD+ that could be either supportive or opposing to REDD+. Therefore, local organisations should be positioned as the information centre for REDD+ implementation. Also, promoting memberships to local organisations could be a part of the successful REDD+ implementation strategy.

A study in Nepal by Pandit (2018) indicates that less-educated respondents are unlikely to adopt REDD+ due to financial burden and high dependency on forest resources. However, we found that well-educated respondents (12 years or more of formal education) perceived more REDD+ costs than less-educated respondents (0 – 6 years of formal education), and this influenced their perception negatively towards REDD+. Through focus group discussions and further interviews, we found that the critical views of well-educated respondents to the REDD+

projects are potentially the reasons behind such a finding. Therefore, there is a need to deliver credible and factual information about REDD+ benefits to households. Using local organisations to provide such information could be a useful strategy.

Respondents who do not farm in forest area perceive more REDD+ benefits than those who farm in the forest. These former respondents typically plant on private land or have other non-farm income sources. Therefore, they have less dependency on forest and face fewer REDD+ restrictions. Our finding might not be congruent with another study in Indonesia indicating that security of forest tenure might not affect the effectiveness of REDD+ projects (Resosudarmo et al., 2014). Moreover, our finding has an implication for further REDD+ policy to deliver more REDD+ benefits for another group which is a forest-dependent group that farm in the forest area. Forest-dependent group under REDD+ projects tend to be the poorest group among different forest-dependent communities (Skutsch et al., 2017) and the most affected group by the negative impacts of climate change (Angelsen and Dokken, 2018). Therefore, 'pro-poor' strategy would help REDD+ to achieve its essential goal of poverty reduction and climate adaptation among people living nearby the forests (Leggett and Lovell, 2012).

3.5.4. Different REDD+ strategies in different forest management regimes would be desirable

Although all forests in Indonesia are state-owned, the government delegates its authority to private sector and community to manage specific forest areas under long-term contract (more than 25 years), based on ecological values, forest allocations[5] and functions (GoI, 1999). Implementing REDD+ strategy based on forest management regime is practical since it has clear boundaries and entitlements. We found heterogeneity of perceived benefits in different

[5] See Appendix 3.3 for more information on forest allocations in Indonesia.

forest management regimes. For example, respondents in private and government regimes perceive higher economic benefits than community regime, but respondents in community regime perceive higher environmental benefits than the other regimes. This condition indicates a need to adopt a different focus on further REDD+ strategy in different forest management regimes (Table 3.9).

Table 3.9. Different strategies for REDD+ implementation under different forest management regimes

Forest management regimes	Relative comparisons of perceived benefits [a)]	Focus on further REDD+ strategy
Private regime	• Higher economic benefits compared to community regime • Lower environmental and expected future benefits compared to community regime	Ensuring the local households perceive environmental and future benefits of REDD+.
Government regime	• Lower environmental and expected future benefits compared to community regime	Ensuring the local households perceive environmental and future benefits of REDD+.
Community regime	• Lower economic benefits compared to the private regime • Higher environmental and expected future benefits compared to private and government regime	Ensuring the local households perceive economic benefits of REDD+.

[a)] We exclude perceived costs from this analysis since there is no significant coefficient for the relationships between forest management regimes and the categories and temporal dimensions of perceived costs.

Furthermore, we found that respondents in community regime are most likely to support REDD+ because they perceive the most environmental and future benefits of REDD+ that affect their perception towards REDD+ positively, indicating that REDD+ would be more acceptable in community regime rather than in private and government regimes. Our finding supports the earlier studies indicating that the community forest is an essential part of REDD+ implementation (Pandit, 2018; Skutsch and McCall, 2012). However, in Indonesian context, only less than 2% of the total state forests are under community regime[6] (MoEF, 2017a), thus

[6] See Appendix 3.3 for more information on forest management regimes in Indonesia.

indicating a need to expand forest areas under community regime as well as encouraging the establishment of future REDD+ projects in community forests.

3.6. Conclusions

This study delivers new insights on perceptions of costs and benefits of current REDD+ projects in Indonesia from the perspectives of local households. By assessing types and timing of perceived REDD+ costs and benefits under different forest management regimes among socioeconomically heterogeneous households, we found some useful results to help in designing future REDD+ policy and projects.

Avoiding or reducing perceived costs of REDD+ is most crucial to ensure genuine and long-term support for REDD+ projects. Therefore, the REDD+ implementation approach should avert costs perceived by the local households. Second, there is a finding that perceived environmental benefit is more potent than economic benefit for boosting positive perception towards REDD+ projects. Thus, in term of delivering REDD+ benefits, there is a need for policy shifting from only enhancing economic-benefit to also ensuring environmental benefits of REDD+ at local levels. Third, forests under community management need to be prioritised to implement REDD+ scheme because the perceived environmental and future benefits of REDD+ projects under community regime are higher than private and government regimes. Hence, REDD+ projects would likely to be more successful in community forests. Last, distributing valid information about REDD+ benefits through local organisation would be an effective way to engage local stakeholders in implementing REDD+ projects. Based on these findings, REDD+ can be viewed as an effort for environmental improvement and local development.

We recognise that this study relies on the data gathered from the three types of forest management regimes within the same island in Indonesia (Kalimantan). Although this would minimise bias generated by location differences, the findings might not be equally applicable to different areas with different situations. Therefore, similar nature of additional studies from different areas is needed to provide comparable information for a better understanding of the impacts of current REDD+ projects from the local households' perspectives. Such a broad base understanding would benefit REDD+ policy design and practices in the future.

Bridging section 2: From the heterogeneity of perceived REDD+ costs and benefits to the heterogeneity of households' preferences toward REDD+ projects under different forest management regimes

The previous chapter indicated that there are significant differences in REDD+ costs and benefits perceived by the local households across different forest management regimes and socioeconomic contexts. Such variations caused a heterogeneity in support of the local households towards REDD+ projects. For example, perceived environmental and future benefits of a REDD+ project under community regime were higher than under private and government regimes. Hence, REDD+ projects would likely to be more successful in community forests because of higher support and positive perception of the local households. The next chapter will examine preference of the local households for REDD+ projects under different forest management regimes, socioeconomic contexts, and experience with current REDD+ projects. Using a choice experiment data set, in the context of a hypothetical REDD+ contract, the chapter will identify the most and the least concerned attributes among the following five attributes (*Benefit, Distribution, Duration, Restriction*, and *Participation*). Such information would be useful to improve future REDD+ policy.

CHAPTER 4

Household preference for REDD+ projects under different forest management regimes: The case of Indonesia

This paper is under revision as:

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Abstract

Successful implementation of Reducing Emissions from Deforestation and Forest Degradation (REDD+) projects depends on active support and participation by local households. It has been suggested that households' support for REDD+ could be influenced by their socio-economic conditions, their experience with REDD+ projects and local forest management regimes. However, there has been little information about the effect of such contextual factors on public preference for REDD+ projects. Using a choice experiment survey in Indonesia, this paper examines heterogeneity on household preferences for REDD+ projects among three distinct forest management regimes: private, government, and community. We found that respondents in community regime are the most supportive for REDD+ projects whereas those in private regime are the least supportive. Current REDD+ interventions also have heterogeneous impacts on household preferences across forest management regimes. Added restrictions on forest-dependent livelihoods under REDD+ projects is the biggest concern of participating households; however, we note that involving households in decision-making and distributing REDD+ benefit for community projects could create a supportive environment for REDD+ projects. Female respondents from households with larger family size and limited land

ownership are more likely to support REDD+ projects. These findings provide useful insights to design more targeted REDD+ projects.

Keywords: REDD+, choice experiment, preference, community, forest regime, Indonesia

4.1. Introduction

REDD+ is a global initiative to mitigate climate change by reducing emissions from deforestation and forest degradation as well as by promoting biodiversity conservation, sustainable forest management and forest carbon enhancement in developing countries (UN-REDD, 2017a). Specifically, REDD+ aims to reduce greenhouse gases (GHGs) emissions by providing direct financial incentives from carbon emitters (e.g., developed countries and companies) to developing countries and local communities to implement sustainable forest management. It is fundamentally a payment for environmental services (PES) scheme that would sustain forest while benefiting the local households (Clements and Milner‐Gulland, 2015).

A PES scheme could attract the participation of the local households if it is designed with due consideration to local cultural, economic, organisational, and political conditions (Miranda et al., 2006). Participation of local households may increase if they are involved in designing a scheme that offers flexible contracts and combines PES with integrated conservation and development projects (Raes et al., 2017). It is also necessary to allow sufficient payment to cover opportunity cost from forgone revenue by sustaining the environmental services (Robert and Stenger, 2013). Households may have a strong preference for certain features of a PES scheme which would influence their participation in the scheme (Petheram and Campbell, 2010). Therefore, understanding preference heterogeneity of the local households and the relationship with particular socio-economic and individual characteristic is important to find potential target households or regions for successful implementation of a PES scheme (Beharry-Borg et al., 2013).

The present study aims to examine households' preferences for REDD+ projects under three distinct forest management schemes. Specifically, we examine how preferences for REDD+ projects differ across three distinct forest management regimes (i.e., private, government, community), and how current REDD+ intervention affects household preferences. We hypothesise that in addition to household characteristics, forest management regimes and REDD+ participation status may also have a significant influence on household's preference for REDD+ projects.

Among other factors such as supportive national and local legislation, availability of alternative livelihood opportunities for households, the success – reduced emissions within a timeframe and effective stakeholder engagement – of REDD+ implementation depends crucially on the local contexts (i.e., forest management regimes, households' dependency on forests for livelihoods as well as experience in pilot projects) (Atela et al., 2015). However, only a few studies have examined the role of different forest management regimes and household experience with REDD+ projects in shaping household preference for REDD+ projects. This paper thus contributes to an improved understanding of the impact of such contextual differences that is important to ensure support and involvement of local households for effective implementation of REDD+ under different forest management regimes.

We use a discrete choice experiment (DCE) approach, which becomes an increasingly popular tool to understand people's preferences for different contract design features of PES schemes (Balderas Torres et al., 2013; Costedoat et al., 2016; Raes et al., 2017). However, there are only a few studies that have applied DCE in REDD+ contexts. For example, DCE is shown to be a reliable ex-ante method to reveal local household's preference for REDD+ projects (Rakotonarivo et al., 2017). Using the DCE, Dissanayake et al. (2015a; 2015b) examined local households' preference for various attributes of REDD+ contract on community forests in Ethiopia and Nepal. The present paper, however, contributes to the knowledge of another aspect of PES design – that is, preferences for REDD+ projects under different forest management regimes and implementation contexts.

It is widely recognised that understanding and accommodating heterogeneous local preferences in REDD+ design and implementation are crucial to the success of this emerging instrument (Bong et al., 2016; Godden and Tehan, 2016; Moonen et al., 2016). Specifically, households' preference for REDD+ design could be influenced by forest management regime because it could affect their access to the forest as well as the benefits they receive from REDD+ projects. In some places, there is a tension that REDD+ projects could weaken rather than strengthen tenure security and access rights to forests and livelihood options of local households (Broegaard et al., 2017). In such cases, REDD+ projects should be designed and implemented based on the preferences of the local households (Sikor et al., 2017). The support and involvement of local households can contribute significantly to obtain social licences to operate for REDD+ projects (Hawthorne et al., 2016; Kim et al., 2016; Loaiza et al., 2016).

Furthermore, the previous and current participation of households in REDD+ pilot projects could positively or negatively influence their support for such projects in the future. Recent studies indicate that the level of benefit and benefit-sharing arrangements, participation in decision-making process, community interactions, socioeconomic condition, households' dependency on forest, the duration of REDD+ contract, restriction on forest livelihoods as well as local experience and knowledge about REDD+ are all important determinants of household preferences for REDD+ projects (Appiah et al., 2016; Bong et al., 2016; Komba and Muchapondwa, 2016).

We examine the case of REDD+ projects in Indonesia. As the third largest tropical rainforest nation (MoEF, 2017a), as well as a major contributor to global greenhouse gases

(GHG) emissions from forestry sector (Margono et al., 2014), Indonesia, provides an excellent case for studying the heterogeneity of household preferences for REDD+ projects across varying contexts, including forest management regimes. For other countries having a similar setting to Indonesia, lessons learned from this paper could be useful to design and to implement REDD+ policy by considering contextual differences.

The rest of the paper is organised as follows. Section 2 introduces current REDD+ status and issues in Indonesia, and its various forest allocations and management regimes. Section 3 describes the empirical approach including the study area, sampling strategy, data collection, survey instrument, experimental design and model specifications. Section 4 presents the main results, followed by the discussion. The last section concludes the paper.

4.2. REDD+ and Forest Management Regimes in Indonesia

4.2.1. The Current State of REDD+ Projects in Indonesia

Indonesia is the third largest tropical rainforest country with around 121 million hectares of forests (MoEF, 2017g; MoEF, 2017a). About 63% of total GHG emissions in Indonesia come from forestry sector (MoE, 2010) through deforestation and forest degradation, including conversion of forest land to agriculture, unsustainable logging, and mining (Indrarto et al., 2012). Around 613,000 ha of Indonesian forests were deforested and degraded each year from 2009 to 2012 (MoF, 2014c). Deforestation in Indonesia during the 2001-2012 period was lower than the previous period (1990-2000) with the major drivers of forest conversion ranged from logging and forest burning, subsistence agriculture, palm oil expansion, plantation forest and mining (Wijaya et al., 2015). Agriculture and subsistence logging are the main forest-based livelihoods. Furthermore, working as labour for palm oil estate, plantation forest, and mining is common among the local population.

Indonesia has shown a strong commitment to REDD+ implementation as its forestry sector plays an important role to achieve the national reduction target on GHG emissions. Of the national target of 29% GHG emissions reduction (from business as usual) by 2030, over 59% of this target is to be achieved from the forestry sector (GoI, 2016). Thus, REDD+ is widely considered as an important instrument to fulfil this national commitment. Perhaps, more importantly, REDD+ is expected to invite an influx of funding to the country.

Starting from 2008, Indonesia is among the first countries which introduced REDD+ implementation guidelines at the national level to provide the regulatory and legal framework (MoF, 2008c; MoF, 2008b; MoF, 2009a; MoF, 2009b). Most currently, there are several regulations issued by the Ministry of Environment and Forestry to guide REDD+ implementation, including the procedures of REDD+ implementation (MoEF, 2017e), national registry system (MoEF, 2017d), measurement, reporting and verification (MoEF, 2017b), national GHG inventory (MoEF, 2017c), and trading for certified emissions reduction (MoF, 2014b).

REDD+ implementation is moving from national to sub-national and project levels. Since the inception of REDD+ in 2008, it has been piloted through at least 66 projects in Indonesia (UN-REDD, 2015; Enrici and Hubacek, 2018), which indicates Indonesia's active engagement in REDD+ implementation with the second largest share of REDD+ projects in the world after Brazil (CIFOR, 2017). Funded by the public and private finance, REDD+ projects were initiated by various parties including the government, conservation NGO, local community, and private sector. The private sector was invited to develop and invest in REDD+ projects since the inception, through the creation of a new forest concession scheme called Ecosystem Restoration (ER) (MoF, 2008b; MoF, 2014a). Several REDD+ projects have already been involved in voluntary carbon schemes (Kawai et al., 2017). Most of the REDD+ projects aim to sell carbon credits in the voluntary carbon market for either funding forest conservation programs or making a profit (Kawai et al., 2017). However, some of the projects are also initiated to secure forest right and land tenure for the local community (Enrici and Hubacek, 2018).

Following uncertainty in REDD+ funding mechanism at the global level (Fletcher et al., 2016; Lund et al., 2017), the implementation of REDD+ projects at the local level is also facing many challenges. REDD+ projects in Indonesia are also struggling to find long-term funding (Enrici and Hubacek, 2018) since current REDD+ funding mainly comes from aid agencies, not from the private sector and carbon market (Angelsen, 2017; Angelsen et al., 2017). By 2018, there is only one project in Indonesia that is funded by voluntary carbon market (Enrici and Hubacek, 2018). Furthermore, Kawai et al. (2017) indicate several problems on the implementation of REDD+ projects in Indonesia including the delays and complexities for obtaining licenses and approvals from the authority, insufficient technical and institutional capabilities, conflict over forest rights and land tenure, and low support and participation from the local community. The latest problem is the main discussion of this study.

4.2.2. Forest management regimes in Indonesia

All forests in Indonesia, except private entitlements, are declared as state forests by the government (GoI, 1999). The forests cover around 70% land area in Indonesia and are grouped into three broad categories: production forests (54%), protection forests (24%) and conservation forests (22%) (MoEF, 2017g; MoEF, 2017a). Production forests produce forest-based products. Protection forests are allocated to protect life support system such as hydrological cycle, prevent flooding, control erosion, prevent saltwater intrusion, and maintain soil fertility. Allocated conservation areas preserve the diversity of plants, animals and the ecosystem (GoI, 1999).

While most conservation forests are managed by the government, many parts of protection and production forests are managed by companies and communities under forest concessions issued by the government. Until 2017, companies manage around 41 million ha, a substantially higher amount than the number of state forests managed by communities, just about 1.8 million hectares (MoEF, 2017a). However, the government released its target to increase forest areas under community regimes to 4.7 million hectares by 2019, and to 12.7 million hectares by 2021 (MoEF, 2017f). An overview of state forest allocations and management regimes in Indonesia is presented in Table 4.1.

Table 4.1. State forest allocations and management regimes in Indonesia

Forest allocations	**Area (Million Hectares)**	**Area (%)**	**Management Regimes**	**Area (Million Hectares)**	**Area (%)**
Conservation forests	22.10	18.32	Government	78.42	65.01
Protection forest	29.68	24.60	State and Private Companies	40.46	33.54
Production forest	68.85	57.08	Community	1.75	1.45
Total forests	120.63	100.00	Total forests	120.63	100.00

Source: (MoEF, 2017a; MoEF, 2017f; MoEF, 2017g)

Under the three forest management regimes, the local households have different levels of legal rights or access to the forests (GoI, 1999; GoI, 2011; MoF, 2008a). Forests under government management regimes having high conservation values (i.e., nature reserves, wildlife reserves, as well as core and wilderness zones of national parks) typically allow limited access to the local households. People could access the forest area for educational and research purposes, but not to engage in forest-based livelihoods. The government is the only entity that manages this type of state forests.

There are some forms of government managed forests that allow essential and small-scale livelihood activities for the local households such as farming, fishing and collecting forest-based products. These forests include other conservation areas such as utilisation zone of national parks, forest parks, natural parks, and hunting parks. Other forest types are protection forests and production forests that can be managed by government and private entities under certain concessions. In these forests, the local households are allowed to make a livelihood from the forests for subsistence and small-scale business.

The community entity can also manage protection and production forests under certain concessions such as *Hutan Desa* (Village forest), *Hutan Kemasyarakatan* (Community forest), *Hutan Adat* (Indigenous forest). Forests under community management regime allow for the highest level of household access. Apart from traditional forest-based livelihood, subsistence logging is also allowed in this type of forest under the specific regulation for forest sustainability. Table 4.2 presents typical forest types under various allocations and management schemes with different levels of legal access and a permitted set of activities by the local households.

Table 4.2. Levels of legal forest access by the local households in Indonesia

Forest management regimes	Government	State and Private Companies	Community
State forest allocations	Conservation area	Conservation area, protection forest and production forest	Protection forest and production forest
Typical forest concession / authority	Nature reserve, wildlife reserve, and national park (core and wilderness zone)	National park (utilisation zone), forest park, natural park, hunting park, ecosystem restoration, industrial forest plantation, natural forest concession	Village forests, and community forests, customary forests
Access by local households	Very limited access	Accessible for basic and small-scale livelihoods	Fully managed by community
Typically allowed activities	Research, education	Research, education, farming, fishing, collecting forest-based products	Research, education, farming, fishing, collecting forest-based products, subsistence logging

Sources: (GoI, 1999; GoI, 2011; MoF, 2008a)

However, there is an inconsistency between forest regulation on paper and the realities on the ground. For example, collecting fuelwood by illegally cutting down small trees for subsistence purposes in conservation forest are tolerated by the forest authorities for humanitarian reasons and due to lack of monitoring capacity of the forest authorities

(Rakatama, 2016). The contradiction between the legal and de facto use of forest resources among local households happen under all forest management regimes. This is reflected in the loss of forest cover across different forest management regimes due to agriculture, logging and land clearing (MoE, 2010).

4.3. Methodology

4.3.1. Study area and sampling strategy

REDD+ projects are currently implemented under all three forest management regimes in Indonesia. We purposively chose three study sites at the Kalimantan island[7] which has both REDD+ participating and non-participating villages across all three forest management regimes: government, private and community (Table 4.3)[8]. This allows us to examine and compare household preferences for REDD+ under three different forest management regimes. REDD+ projects are not in operation in all the villages in a given site. In all three sites, we proportionally selected REDD+ participating villages (as treatment groups) and non-participating villages (as control groups)[9] to conduct the choice experiments. Such sampling allows us to explore the impact of experience and participation in previous or current REDD+ projects on household preferences.

[7] Full human ethics approval was granted by the Human Ethics Office at the University of Western Australia.

[8] Further description of each REDD+ project included in this study is presented in Appendix 4.1.

[9] REDD+ non-participating villages are villages surrounding the REDD+ projects but do not receive any intervention or benefits yet from the REDD+ projects. Therefore, most of the villagers have some knowledge on REDD+ activities from the other villagers living in the nearby participating villages.

Table 4.3. Characteristics of chosen DCE sites

Characteristics	Site 1	Site 2	Site 3
Forest regime	Private company	Government	Community
Project proponent and developer	Private company	Government with NGO supports	Community with NGO supports
Benefit sharing[*]	20% government, 20% community, 60% developer	50% government, 20% community, 30% developer	20% government, 50% community, 30% developer
Forest allocations	Production and protection forest	Conservation area	Production forest
Concession scheme [**]	Ecosystem restoration	National park	Village forest
Community access	For basic and small-scale livelihoods only	Very limited	Fully managed by community
Study area	The entire area under Ecosystem Restoration license	Some area of National Park under the REDD+ project only	The entire area under Village Forest license
Location	Kalimantan	Kalimantan	Kalimantan

Sources: (GoI, 1999; GoI, 2011; MoF, 2008a; MoF, 2009b); [*] from selling carbon credit; [**] Concession scheme is a certain permit issued by the government to manage state-owned forests.

Random sampling was used to choose respondents at the household level. We sampled roughly equal number of households in each of the three forest management regimes. For each household, we interviewed one respondent only that could either be the father, the mother, or any adult household member. To minimise bias due to hesitation and influences from others, all interviews were conducted on a one-to-one basis. The numbers of villages and total households surveyed on each site and type of village are presented in Table 4.4.

Table 4.4. Sample characteristics of chosen DCE sites

Site	**REDD+ participating villages**		**REDD+ non-participating villages**		**Total**	
	No. of villages	**No. of Households**	**No. of villages**	**No. of Households**	**No. of villages**	**No. of Households**
Site 1 (private)	5	100	2	50	7	150
Site 2 (government)	3	63	1	89	4	152
Site 3 (community)	4	105	2	53	6	158
Total	12	268	5	192	17	460

Given the population size on the chosen sites, our final sample of 460 completed household responses is far larger than the minimum required size suggested by Yamane

(1967)[10] and is well within the range recommended by Bateman et al. (2002) and Mitchell and Carson (1989). Table 4.5 lists the population, minimum sample size and actual sample size for all three sites.

Table 4.5. Minimum and actual sample size by site

Site	**No. of villages**	**Population (No. of households)[a)]**	**Minimum sample size[b)]**	**Actual sample size**
Site 1 (private)	7	810	89	150
Site 2 (government)	4	1752	95	152
Site 3 (community)	6	826	89	158
Total	17	3388	273	460

[a)] Sources: (BPS.Ketapang, 2016; BPS.Palangkaraya, 2016; BPS.Seruyan, 2016b; BPS.Seruyan, 2016a; BPS.Seruyan, 2016c); The population sizes are the number of households (not individuals) of the 17 REDD+ villages included in this study.
[b)] Based on Yamane (1967)

4.3.2. Data collection

To minimise language barriers, we recruited and trained 14 qualified local enumerators (with at least 12 years of formal education and some level of prior survey experience) to conduct choice experiment survey. All enumerators were local, living in the surrounding areas of the chosen sites. They also had rich experience and knowledge about the sites and communities, safer routes in the area, local languages, and cultural expectations. We provided two days of training for all enumerators on the general background of the research and the technical aspects of household survey and survey implementation.

We firstly conducted six face-to-face focus group discussions (FGD), with 39 participants in total, before implementing the actual survey in each site and village. The FGDs aimed to understand local forest livelihoods and institutional settings as well as expectations

[10] According to Yamane (1967), the minimum sample size is given by: $n = \frac{N}{(Nd^2)+1}$, where *n*, *N* and *d* represent sample size, group population size and precision. Given the population sizes on three chosen sites, the minimum sample sizes for 95% of confidence interval and 10% of precision are 89, 95 and 89, respectively.

and concerns about REDD+ projects. The FGDs were also used to make the local people aware about the choice experiment survey, and to improve the overall design of the survey including the reasonable ranges of attribute levels. To minimise bias, we invited all stakeholder representatives in the FGD including villagers, community leaders, government officers, and REDD+ project developers[11]. We have implemented three pre-testings (piloting) of the choice experiment questionnaire among 24 households to develop clarity and improve the questionnaire for actual survey. The FGDs and formal face-to-face surveys were conducted from March to June of 2016.

4.3.3. The survey instrument and experimental design

A discrete choice experiment (DCE) was designed to analyse household preferences for REED+ on the chosen sites, representing three forest management regimes in Indonesia. The DCE method is grounded on the characteristics theory of demand, welfare theory and consumer theory (Lancaster, 1966) as well as random utility theory (Luce, 1959; McFadden, 1974). The technique was further developed by Louviere and Hensher (1983) and Louviere and Woodworth (1983) for marketing and transportation studies. The first application of DCE in environmental studies was found in Adamowicz et al. (1994). Presently, DCE has been applied to analyse public preference for a large variety of environmental goods, including specifically the preference for PES schemes (Costedoat et al., 2016; Raes et al., 2017) and REDD+ contracts (Dissanayake et al., 2015a; Dissanayake et al., 2015b).

The core part of a DCE consists of some choice sets where the respondents state their preference for hypothetical alternative goods or services with different attributes at different levels. A set of pre-selected attributes describes the alternative goods. The attributes are presented at different levels to identify the impact of variation in the value of attributes on

[11] Details about the number of local enumerators, sites, villages and participants involved in the FGDs are provided in the Appendix 4.2

respondents' preferences. Given a choice task, the respondent compares the alternative goods presented and chooses the one that provides the highest utility.

Information gathered from expert advice, focus groups and pre-testings is crucial for experimental design (Hoyos, 2010). We first selected a preliminary list of attributes and levels based on existing literature. This was then followed by several rounds of expert consultations, six focus group discussion, and three pre-testings to receive feedback on the survey instruments to refine it for the research purpose. Table 4.6 presents the final set of attributes and the levels.

Table 4.6. Attributes and levels

Attributes	**Description**	**Levels***
Benefit	Total REDD+ financial benefit (IDR/household/year) entitled to the community	No benefit**, 500000#, 1000000#, 1500000#
Distribution	Distribution of total entitled REDD+ benefit between households and community projects.	No benefit distribution**, all to community projects, half to community projects and half to households, all to households
Duration	Duration of REDD+ contract.	No contract**, 2 years, 4 years, 6 years
Restriction	Added restriction on logging and hunting under REDD+ contract	No added restriction^, 50% added restriction, 100% added restriction
Participation	Participation of local households in REDD+ related decision-making.	No^, Yes

*All attribute levels are effect coded; **Only appeared in opt-out option; #Equal to $39, $78, $117 respectively[12]; ^Appeared in opt-out and REDD+ options

The five attributes are essential parts of a REDD+ contract and important determinants of public preferences for REDD+ projects (Dissanayake et al., 2015a; Dissanayake et al., 2015b). Apart from FGD, we used pictures and props (posters and diagrams) to explain appropriately the basic concept of REDD+ as well as all attributes and their levels to the respondents. The *Benefit* is the rate of REDD+ financial benefit entitled to the community measured at per household basis per year. The actual rate received by each household also

[12] For this study, we used http://www.xe.com/ to convert Indonesian Rupiah to US Dollar in March 2016

depends on the *Distribution* attribute which defines how *Benefit* should be distributed to each household and community. The distribution of benefit to the community can be used for public projects including infrastructures, educational, health and economic program which would be beneficial to the whole community.

Duration is the term of commitment in years for a REDD+ contract[13]. The *Restriction* is defined as an additional restriction on logging[14] and hunting as a consequence of REDD+ implementation, apart from the current level of restriction or common practices. Logging and hunting are the two forms of common restrictions under REDD+ pilot projects that could affect household livelihoods. In the field, we explained to all respondents that there would be MRV (measurement, reporting and verification) activities to ensure compliance with added restrictions. We also explained to the respondents that *Participation* of local households in the decision-making of REDD+ project is also possible in a proposed REDD+ scheme[15].

Respondents should be fully aware of the survey content and, if not done properly. In our study context, REDD+ has been in operation, and some respondents are familiar with nature of the scheme. For those who have not been exposed to REDD+, we tried to develop familiarity of REDD+ with respondents through consultation in survey design and pre-testing of the questionnaire. We also incorporated a cheap talk script to mitigate potential hypothetical bias

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[13] *Duration* of 2 to 6 years are used because the current REDD+ pilot projects studied are within this contract duration with the local households. Therefore this is closer to the reality and could reduce hypothetical bias. However, in actual practice the project duration could be greater than 20 years. Hence, not considering the longer duration might be one of the limitations of our study.

[14] In the field, we explained to the respondents and FGD participants that logging *Restrictions* is not only logging for building materials, but also forest clearing for agriculture and fuel-wood extraction in REDD+ areas.

[15] Participation is participation of local households in REDD+ related activities and decision-making, and participating households are households surrounding the REDD+ projects that involve in REDD+ related activities.

(Fifer et al., 2014; Hensher, 2010). The cheap talk ended with a question asking whether or not the respondent understood the talk[16]. We also asked some follow up questions to assess whether the survey was complicated or not for the respondents. From the scale of 0 (very difficult) to 10 (very easy) in answering the questionnaire, the average response of the respondents is at 7.2. That means most of the respondents could answer the questionnaire confidently.

Local languages were used in the actual talks, but the English version of the introductory talk is as follows:

> "In a choice set, we will ask you to choose one between two options of REDD+ contract. You may choose *No REDD+* if you do not like the two options. We will ask you to answer six choice sets. Please be aware that all attribute levels in presented REDD+ contracts are hypothetical. However, your answers could influence the research results and associated policy recommendations, and this might affect the terms of real REDD+ contract that would be implemented further. Therefore, please answer these questions as if you face the real situation. Do you understand and agree with this?"

Figure 4.1. The script of the introductory *cheap talk*

The design of the survey used a rotation design based on the Orthogonal Main-Effect Design (OMEDs) using the *support.CEs* package of *R* software (Aizaki et al., 2014), with 18 choice sets, blocked into three groups of six[17]. However, the actual questionnaires were translated and presented in the local language. Each respondent was asked to answer one block of six choice sets, each containing two alternative REDD+ options and one alternative for opting out of REDD+. The last section of the survey instrument collects information about respondents' household characteristics.

[16] If respondents answered "No" to the ending questions of the *cheap talk*, we would re-explain the REDD+ concepts, attributes and levels, and the *cheap talk* until they answered "Yes". Then, we could conduct the interview.

[17] An example of a choice set in English is presented in Appendix 4.3.

4.3.4. Model specifications

We analyse the data using mixed multinomial logistic (MMNL) model which is commonly used in analysing DCE data. The model is chosen to allow for heterogeneity of preferences across respondents. The preferences are allowed to be different among respondents but remain constant across the choice sets for each (Carlsson et al., 2003; Hensher et al., 2005; Train, 2009). We assume that the utility (U_{jit}) received by individual *j* from option *i* in the choice set *t* is:

$$U_{jit} = a_{ji} + \beta_j X_{jit} + \varepsilon_{jit} \qquad (Eq.4.1)$$

Where a_{ji} is an alternative specific constant (ASC) characterising intrinsic preferences for a specific option, X_{jit} is a vector of non-stochastic explanatory variables and β_j is the vector of associated coefficients. We let all attributes enter as categorical rather than continuous variables to capture potential non-linear effects (Bateman et al., 2002; Greene, 2003) and all categorical attributes are effect coded to be able to identify the baseline and Alternative Specific Constant (ASC) effects (Bech and Gyrd - Hansen, 2005). The first two alternatives in each choice set are REDD+ options and are thus considered closer substitutes for each other than for the opt-out alternative (de Blaeij et al., 2007; Haaijer et al., 2001). We included a random ASC for the opt-out alternative and allowed individual and context-specific characteristics to influence the alternative specific preferences by interacting the characteristic variables with the ASC in various model specifications.

The random disturbance ε_{jit} is assumed to be independently and identically distributed (IID) following a Gumbel distribution. We also assume that the probability density function of β_j is $f(\beta|\Omega)$, where Ω is the parameter of the distribution. $L_j(\beta_j)$ is the logit conditional choice probability of option *i* for individual *j* in the choice set *t*, and given by:

$$L_j(\beta_j) = \prod_t \frac{\exp(\alpha_{ji} + \beta_j X_{jit})}{\sum \exp(\alpha_{ji} + \beta_j X_{jit})} \qquad (Eq.4.2)$$

The unconditional choice probability for individual j is simply the integral of conditional choice probability over the density of β_j :

$$P_j(\Omega) = \int L_j(\beta) f(\beta|\Omega) d\beta \qquad (Eq.4.3)$$

However, because there is no closed formula for the above integral, the unconditional probability P_j is simulated by drawing R random drawings of β, β_r, from $f(\beta|\Omega)$ and averaged the results to get:

$$\tilde{P}_j(\Omega) = \frac{1}{R} \sum_{r \in R} L_j(\beta_r) \qquad (Eq.4.4)$$

4.3.5. Household characteristics

Table 4.7 provides the definitions and summary statistics of all demographic variables for the full sample and sub-samples by research site and REDD+ participation status. On average, 68% of respondents were male. As a comparison, the samples in Dissanayake et al. (2015a) and Dissanayake et al. (2015b) had 90% and 81.2% male respondents, respectively. Table 4.7 shows that the average age of household head is about 41 years with small differences between sub-samples. Average household size is about 4-5 persons.

It appears that respondents in the community forest management regime live farther away from forests and have substantially larger private land ownership than those in private and government forest regimes. On average, respondents in REDD+ participating villages are more experienced with village and community organisations than those from non-participating villages. Interviews through FGDs reveal that respondents with REDD+ experience are more critical about REDD+ projects, irrespective of forest regimes. There are concerns that REDD+

may stimulate conflicts due to unfair benefit distribution and restrictions on forest-dependent livelihoods.

Sample households in the government managed forest regime have significantly higher household income compared to the households from the other two forest regimes (i.e. private and community). Given that households in the government forest regime have lowest land ownership, the higher household income in this forest management regime is less likely to be generated from private-land-based activities. In fact, around 58% of total household income in the government managed forest regime is generated from forest-based activities[18], which is significantly higher than the percentage of forest-based income in the private (20%) and the community (5%) forest regimes[19].

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[18] Forest-based activities are all economic/livelihood activities running in forest area under REDD+ projects, such as fishing, logging, bird-catching, hunting, and collecting non-timber forest products including *jelutung* sap (*Dyera costulata*), *gemor* bark (*Alseodaphne sp.*), fuel-wood, *purun* (wild grass), rattan, bamboo, *gaharu* (aloes or eaglewood), daffodils, fruits and vegetables, etc.

[19] Calculation of forest-based income are based on readily calculated monetary value only (i.e., from the sales of the forest products).

Table 4.7. Definitions and summary statistics of demographic variables

Variables	Definition	Full Sample		Sub-samples (Mean Only) and the p-value of one-way ANOVA test						
		Mean	**S.D.**	**Private**	**Government**	**Community**	**p-value**	**REDD+ participating**	**REDD+ non-participating**	**p-value**
male	1 if respondent is male and 0 if female	0.68	0.47	0.76	0.64	0.63	0.00	0.68	0.67	0.12
age	Age of household head (years)	41.45	12.35	39.45	42.09	42.74	0.00	41.81	40.95	0.00
hhmember	Number of household members (persons)	4.15	1.70	3.85	4.99	3.63	0.00	3.97	4.41	0.00
distance	Distance to forest (kilometres)	1.76	1.99	1.75	1.16	2.33	0.00	1.98	1.44	0.00
land	Size of land ownership (hectares)	1.83	4.11	1.59	0.28	3.19	0.00	1.93	1.67	0.01
experienced	1 if respondent is experienced with village or community organization and 0 if inexperienced	0.24	0.43	0.30	0.26	0.16	0.00	0.27	0.19	0.00
income	Total income (non-forest + forest based) (million IDR/year) or (thousand USD/year)	36.94 ($2.88)	30.67 ($2.39)	34.29 ($2.67)	42.57 ($3.32)	34.20 ($2.67)	0.00	35.95 ($2.80)	38.38 ($2.99)	0.00
perfincome	Percentage of forest-based income (%)	27.07	39.44	19.58	58.24	4.86	0.00	24.82	30.31	0.00

4.4. Results

Table 4.8 presents results from five different mixed MNL specifications. In addition to the chosen attributes, Model 1A estimates a random Alternative Specific Constant capturing an average preference for the opt-out option (ASC_{optout}). Model 2A then examines the heterogeneity in respondents' preference for the opt-out option across various forest management regimes and REDD+ participation status. Model 3 further explores the preference heterogeneity by adding interactions between the ASC_{optout} and household characteristics[20]. As shown in Table 4.8, Model 3 has a slightly smaller number of observations as some respondents did not provide information for all household characteristics. Model 1B and 2B have the same model specifications as Model 1A and 2A respectively, but use the restricted sample as in Model 3.

[20] Given the number of attributes, socio-economic and attitudinal variables, a large number of possible models could be estimated. We observed distinguishable differences in overall preferences for REDD+ across different management regimes and REDD+ participation status in the FGD. We have chosen to model socio-economic and contextual variables as shifters of inherent preferences for REDD+ options. Results from alternative models with additional interaction terms of attribute variables and contextual variables are provided in the Appendix 4.4.

Table 4.8. Mixed MNL regression results

Variables^	Model 1A		Model 2A		Model 3		Model 1B		Model 2B	
	Mean	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Total Benefit#										
1,000,000	0.17**		0.17**		0.18**		0.18**		0.18**	
1,500,000	0.18**		0.17**		0.18**		0.18**		0.18**	
Distribution#										
Half to households	0.04		0.04		0.06		0.07		0.06	
All to households	-0.14**		-0.14**		-0.15**		-0.14**		-0.15**	
Duration#										
4 years	0.03		0.03		0.01		0.01		0.01	
6 years	0.03		0.03		0.03		0.03		0.03	
Restriction#										
50% added restriction	-0.32**		-0.32**		-0.39**		-0.39**		-0.39**	
100% added restriction	-0.37**		-0.37**		-0.45**		-0.45**		-0.46**	
Participation#	0.24**		0.24**		0.24**		0.24**		0.24**	
ASC_{optout}	-2.02**	1.64**	-3.99**	0.40	-6.59**	-0.06	-1.95**	1.55**	-3.94**	0.31
Site & Village#										
Private & Non-REDD+			2.97**	0.87**	3.13**	0.62			2.92**	-0.80*
Private & REDD+			3.56**	0.03	3.64**	0.001			3.45**	0.01
Government & Non-REDD+			1.36*	2.35**	2.57**	-1.95**			1.48	-2.62**
Government & REDD+			2.13**	1.16**	2.50**	0.01			2.08**	1.22**
Community & Non-REDD+			-0.08	2.82**	0.24	-2.51**			0.38	1.92**
Male					0.56*	0.05				
Age					-0.0001	-0.003				
Hhmember					-0.17*	0.05				
Distance (logged)					-0.05	-0.02				
Land (logged)					0.10*	0.001				
Experienced					0.10	-0.07				
Income (logged)					0.22	-0.01				
Fincome					-0.17	1.16**				
Log likelihood	-2385.97		-2300.60		-1950.12		-2043.00		-1965.98	
Observations	8106		8106		6987		6987		6987	

Baselines are *500,000; All to community; 2 years; No added restriction; No participation; Community & REDD+* respectively;
* $p < 0.05$, ** $p < 0.01$; ^ Normal distribution is used as a distributional assumption

Among the five attributes describing the REDD+ options, *Total benefit*, *Distribution*, *Restriction* and *Participation* appear to have significant impacts on household's preference, while *Duration* is not statistically significant. Respondents prefer higher total financial benefit from REDD+ projects; however, a likelihood ratio (LR) test shows no statistically significant difference between the preference for IDR 1,000,000 (USD 78)/household/year and IDR 1,500,000 (USD 117) /household/year. Respondents also seem to have a strong preference for allocating part or all of the benefit to local households for communal works rather than to individual households. The negative coefficient on *Restriction* shows that respondents prefer less additional restriction on forest-based livelihoods, such as logging and hunting. Likewise, they prefer active participation in forest-related decision-making that is likely to have impacts on livelihoods. These results are quite robust to alternative model specifications shown in Table 4.8.

The negative and significant ASC_{optout} in Model 1A shows that respondents have a stronger preference, *ceteris paribus*, for REDD+ alternatives than the opt-out option. This indicates overall positive attitude among respondents towards implementing REDD+ projects in these areas. However, there is substantial heterogeneity in the preference across different forest management regimes (private, government, community) and REDD+ participation status (REDD+ participating and non-participating villages). In Model 2A we add three-way interactions between the ASC_{optout}, forest management regime and REDD+ participation status. The ASC_{optout} now captures baseline preference for the opt-out option by households in REDD+ participating villages in the community forest management scheme. Coefficients on the other five interaction terms are interpreted as changes from the baseline preference. LR tests show that all interactions are significantly different from each other. Model 2A further shows that respondents from private and government regimes have stronger preferences for the opt-out option than those from the community regime. Also, participation in REDD+ piloting projects seems to have very different impacts on respondent's attitude towards REDD+ alternatives at sites under different forest management regimes[21]. Specifically, participation in REDD+ piloting has a negative impact on public support for REDD+ alternatives in privately managed forests. This is indicated by statistically larger coefficients of "Private & REDD+" than those of "Private & Non-REDD+". However, participation in REDD+ piloting in community forest seems to have no significant impact on public support for REDD+ projects[22].

Table 4.7 reveals substantial variations in household characteristics among survey respondents. Model 3 in Table 4.8 further controls for this heterogeneity in household characteristics by adding interactions between the ASC_{optout} and household characteristics. Because not all respondents provided information about all household characteristics, Model 3 has a smaller number of observations. We found that higher preference for REDD+ alternatives is associated with females, households with larger family size and smaller private land ownership. Even after controlling for individual heterogeneity, our previous findings on the impacts of forest management regimes and REDD+ participation status generally hold. As a robustness check, we rerun Model 1A and 2A on this restricted sample and present the results as Model 1B and 2B. Our previous findings associated with Model 1A and 2A are also robust.

[21] There may be a concern that the siting of existing REDD+ projects is endogenous. As shown in Table 4.4, there are REDD+ projects participating villages and non-participating villages in all three regimes such that siting of REDD+ projects across regimes is less likely to be influenced by regime-specific household preferences. Endogeneity can also arise if siting within the same regime is influenced by household preferences. However, REDD+ contract is a contract between the forest manager as the REDD+ project proponent and the buyer of carbon credit. The siting of REDD+ projects is mostly based on forest functions, as well as ecological and biodiversity values of the forests (GoI, 1999; GoI, 2011a; MoF, 2008a; MoF, 2008b; MoF, 2009b; MoF, 2010; MoF, 2012b).

[22] Respondents from REDD+ participating and non-participating villages may have rather different interpretations of the opt-out option given the differences in their status quos. In the Appendix 4.4, we provide additional results estimated using the two sub-samples: respondents from REDD+ participating villages and those from non-participating villages. Overall, we observe substantial differences between the REDD+ participating and non-participating villages in the preferences for REDD+ attributes (*Total Benefit, Distribution, Restriction* and *Participation*) across forest management regimes.

Using estimates from Model 3, we have simulated the marginal effects of changes in all significant REDD+ attribute levels, contextual variables and household characteristics on the probability of choosing REDD+ alternatives. As shown in Table 4.9, we define the marginal change as: 1) a change from the least to the most REDD+ favourable value for REDD+ attributes; 2) a change towards the most REDD+ favourable context (i.e. Community-REDD+) for contextual variables; 3) a unit change towards the more REDD+ favourable values for household characteristics. The marginal effect is simulated as the change in the sum of the probability of choosing the two REDD+ alternatives. As suggested by Louviere et al. (2000) we use the probability-weighted sample enumeration (PWSE) rather than sample average or "naïve pooling" to simulate these marginal effects. Choice probabilities are calculated using the posterior individual-specific parameters (Train, 2009).

Table 4.9. Marginal Effects

Simulation	Marginal Changes[#]	Marginal Effects[^] (%)
1	Total Benefit: 500,000 to 1,500,000	4
2	Distribution: Households to Community projects	3
3	Restriction: 100% to 0% restriction	10
4	Participation: No to Yes	5
5	All significant attributes: Least preferred to Most preferred	22
6	Site-Village: Private-Non REDD+ to Community-REDD+	17
7	Site-Village: Private-REDD+ to Community-REDD+	25
8	Site-Village: Government-Non REDD+ to Community-REDD+	11
9	Site-Village: Government-REDD+ to Community-REDD+	10
10	Gender: Male to Female	6
11	Household member: 1 unit increase from the mean	2
12	Land ownership: 1 unit reduction from the mean	1

[#] Simulation 1 ~ 5: marginal change is defined as a change from the least preferred to the most preferred attribute value; Simulation 6 ~ 9: marginal change is defined as a change towards the most REDD+ favourable context (i.e. Community-REDD+); Simulation 10 ~ 12: marginal change is defined as a change towards a more REDD+ favourable value; [^] Change in the sum of the probabilities of choosing the REDD+ alternatives.

Among the significant REDD+ attributes, *Restriction* appears to be the most crucial attribute presenting the highest marginal effect, followed by *Participation*, *Total benefit* and *Distribution*. If we change the levels of all significant attributes from the least to the most preferred levels, there will be an increase of 22 percentage points in the probability of choosing REDD+ alternatives. Among household characteristics, gender presents the largest marginal effects with female respondents supporting REDD+ more than male respondents.

By far the largest marginal effects come from contextual differences. The probability of choosing REDD+ alternatives by households from REDD+ participating villages in community forest regime is 10 to 25 percentage points higher than those in other contexts. Overall, we found support for REDD+ is highest in community forest regime followed by government forest regime and private forest regime. Not only do households in the private forest regime show the lowest support for REDD+, experience with current REDD+ in private forest regime further reduces the support. This is indicated by the sharp difference in the marginal effects of Simulation 6 and Simulation 7.

4.5. Discussions

4.5.1. Restrictions on logging and hunting

We found that restrictions that affect forest-dependent livelihoods are the biggest barrier to REDD+ adoption in REDD+ project design, while the financial benefit is not the main concern. Forest-based livelihood activities contribute substantially to the household income of local households. Through FGDs, we also found that households in all study areas are highly dependent on surrounding forest for forest products, such as timber/ logs for building materials and fuelwood. In the field, we found that currently, households tend to assume that REDD+ financial benefit is an aid without any commitment to forest conservation.

> *"This village is situated in a remote area where is no road, and we rely on the water transportation only, it is difficult and expensive to bring in building materials from other places. Therefore, this surrounding forest is the only source for us". (FGD participant)*

In the interviews, however, we explained clearly what the benefits and obligations of REDD+ are. This is congruent with the literature suggesting that REDD+ projects are viewed similar to previous forest management programs and seen as aids for the local households without clarity on restrictions and obligations (Lund et al., 2017). Less concern on REDD+ benefits among the respondents might also be caused by the experience of REDD+ or similar conservation projects that promised too much and failed to fulfil households' expectations in the past. Also, the amount offered in the REDD+ scenario was too small, perhaps, compared to other alternative options such as earning from employment in palm oil industry.

Results from our analysis contradict the findings from some other non-DCE studies on REDD+, where scholars found that financial compensation is the most important attribute of REDD+ projects (Appiah et al., 2016; Beyene et al., 2016; Komba and Muchapondwa, 2016). This contradiction raises doubt about the role of financial payment to encourage participation in REDD+ projects. It also implies that realising REDD+ as a performance-based program for carbon sequestration would be challenging because the REDD+ payment may not be attractive to the local households.

Therefore, avoiding or limiting the extent of added restrictions in implementing REDD+ projects would be a strategy to increase support for REDD+ among rural households. Compensating added restrictions on forest-based livelihoods by simply increasing REDD+ financial benefit would not be much helpful to boost support for REDD+ projects. However, biological impacts of such strategy that might occur (i.e., decrease in forest cover and biodiversity) need to be studied further as well as be minimised and controlled. Hence, if added restrictions are unavoidable, REDD+ project policies should encourage participation of local households in decision-making alongside distributing benefits for community projects as they may be able to secure better support from local households. Also, support for REDD+ might increase when households are informed and realise the co-benefits of REDD+ other than monetary benefits, such as waters and nutrients that forests provide for agricultural activities.

4.5.2. REDD+ benefit distribution

Household's preference to distribute REDD+ benefit for community projects rather than individual households may appear surprising, but consistent with what we found on project sites during FGDs. Current REDD+ payment is only based on forest carbon services without taking into account non-carbon services of forest (Ojea et al., 2016). Many respondents think that current REDD+ payment is too small to be distributed to each household and is perhaps more useful to pool the funds for community projects that would generate public benefits for all households[23].

> *"What we can do with IDR 600,000 (USD 46.8) per year? Nothing, right? Perhaps, that would be useful if it is put together for community projects to benefit everyone". (Respondent 1)*

The FGDs also revealed that in private and government-managed forest regimes, respondents prefer to use the REDD+ payment for building infrastructures in the village such as roads, bridges, and community buildings whereas in community managed forest, funds collected from REDD+ project are typically managed jointly for activities that could enhance local economy such as poultry, farming and/or handicraft industry. The forms of community projects are decided through public consultation and community forum. Although it is difficult to reach an agreement of all community members, forms of community projects that have most supporters will be chosen to be implemented.

Our finding is encouraging given that recent literature has shown that distributing REDD+ benefits through community funds for rural development activities within the forest

[23] For example, we found current REDD+ financial benefit in community forest management regime is around IDR 600,000 (USD 46.8) /household/ year.

area is a part of pro-poor policy in Mexico (Skutsch et al., 2017) as well as indirectly increasing carbon sequestration and involving wide range of local stakeholders (Skutsch et al., 2014). On the other hand, Chomba et al. (2016) suggested that distributing benefit for each actor could lead to inequality in benefit sharing and result in disputes.

A comparative study of five REDD+ countries indicates that current strategies on benefit distribution do not guarantee effectiveness, efficiency and equitability in the long term for the success of REDD+ implementation (Dunlop and Corbera, 2016). Although the decision to distribute REDD+ benefits depends on economic feasibility, local institutional capacity, and governance structures, the decision process should be consultative and participatory such that household preferences are accommodated in the decisions (Mohammed, 2011). Moreover, household's preference for REDD+ benefit distribution can be context specific and varies across countries. For example, a study in Nepal indicates household preferences for community projects (Dissanayake et al., 2015b) while in Ethiopia such preference is for distributing the benefits directly to households (Dissanayake et al., 2015a).

In the Indonesian context, our results show that integrating REDD+ financial benefits into broader activities for community empowerment could potentially have multiplier or spill-over effects beyond REDD+ projects. In the future, this would stimulate household's recognition of the additional benefits of REDD+ projects and increase support for REDD+ projects.

4.5.3. Preferences across management regimes

We have found that respondents in community regime have a greater support for REDD+ projects than respondents in private and government regimes. This may be explained by the fact that households are typically more involved in REDD+ activities in community forest regime than other regimes and thus perceive a lower chance of potential conflicts with external stakeholders. Within broader forest management context, community forest regime has been shown to be most effective in sustaining forest in other parts of the world (Loaiza et al., 2016; Ostrom, 2012). Community forest management has reduced degradation and stabilised forested landscapes while supporting local livelihoods (Pandit and Bevilacqua, 2011; Pelletier et al., 2016). In the context of REDD+ implementation, community managed forests can play an important role (Skutsch and McCall, 2012) by bringing effectiveness, efficiency and fairness (Agrawal and Angelsen, 2009) as well as minimising transaction costs in the implementation process (Chhatre et al., 2012).

However, community regime is not without problems. There is also literature arguing that forest management under community regime may not necessarily perform better than other regimes. For example, inequality in the distribution of forest benefit among individual households from community forests could result in internal conflicts among forest users (Oyono et al., 2005), particularly in the poorest group (Malla, 2000). Therefore, further REDD+ studies focused on community forest regime should also pay close attention to distributional aspects of costs and benefits (Rakatama et al., 2017). Some scholars argue that social, economic, and power heterogeneity among community members could also lead to the failure of community managed forest (Pradhan and Patra, 2013) leading to forest degradation (Pérez-Cirera and Lovett, 2006). Some are even concerned that REDD+ may disturb well-functioning community-based forest management systems (Bluffstone et al., 2013).

Within the Indonesian context, revitalising forest management regimes is therefore important for national REDD+ strategy since community currently manages only about 1.5% of Indonesian state-owned forests (MoEF, 2017a). Policy reforms, particularly in forestry and land tenure sector, is one of the keys to future success in REDD+ implementation (Angelsen, 2016). The government could promote community forest management in state forests by recognising management rights of the local households under clear regulations and concession permits such as village forest and community forest. Currently, the government is targeting for additional 3.9% and 10.6% of state forests to be classified as community forests by 2019 and 2021, respectively, in the form of Social Forestry schemes (MoEF, 2017f). Although this is an ambitious target, this is an encouraging step to ensure government recognition of the community rights over the forest carbon. Apart from the state-owned forests under community management regime, there might be private forests (non-state forests owned by the community) that also should be encouraged to join REDD+ projects.

To reduce internal conflicts within the community, the government should be careful in issuing concession for community forest management. There are quite many migrant communities in Kalimantan that also need forests for their livelihood and contribute to the local development. Also, there is a complicated tenure and local community issues in Kalimantan. Therefore, the rights and tenure issues could influence the community's preferences. Also, there might be heterogeneity of preferences between indigenous and migrant community toward REDD+ projects that could be an important topic for further studies.

Among the three forest management regimes, public support for REDD+ is the lowest in private regime, and it goes even lower after villages have experienced REDD+ intervention. We found through FGDs that REDD+ programs are typically enforced rather than implemented on a voluntary basis under the private regime. The practice not only leads to conflicts between local households and forest authority but also gives rise to widespread concern that the private/ government enforced programs would put strict restrictions on forest-based livelihoods. Additionally, there is a tendency of local households to assume that private entities, as profit-oriented organisations, may take advantage of REDD+ programs. FGDs also show that to secure support from local households, early REDD+ programs under private forest management regimes promised unrealistically high financial benefit and contribution to local economies. As these programs failed to fulfil their promise, local household's attitude towards REDD+ project also changed.

“We doubt that this REDD+ project would bring real benefits for us. We heard about this from 4 years ago, and they offered many programs to improve our livelihoods. However, that is not realised yet or only for certain people who close to the village leaders.” (Respondent 2)

This aligns with the current literature suggesting that avoiding bombastic promise and providing credible funding are crucial to support long-term agreements under REDD+ projects and to generate trust among REDD+ stakeholders (Angelsen, 2017). Furthermore, the genuine involvement of local household in REDD+ projects would ensure effective implementation and continuity of the REDD+ projects (Hawthorne et al., 2016; Kim et al., 2016; Loaiza et al., 2016). In broader forest management context, forest conservation program requires the high cost to protect forest boundaries and generates extensive conflict with the local households under the private regime (Ostrom and Nagendra, 2006).

REDD+ under private forest management regime is more challenging than government and community managed forest regimes, and requires a better communication approach to the understanding of households and their needs. Although studied REDD+ project in private regime has conducted Free, Prior and Informed Consent (FPIC) to fulfil the requirements of Verified Carbon Standard (VCS) certification, this might be not adequate to deliver factual and credible information about REDD+. It is crucial to inform the households that REDD+ program would not impose added restrictions that affect livelihoods without adequate compensation. In other words, REDD+ program should focus on creating alternatives for forest-based livelihood activities before enforcing restrictions. Furthermore, in REDD+ decision-making processes, involving representatives of households is important to ensure ownership of the decisions at the local level which in turn facilitate implementation of activities in the field.

4.5.4. Preference across household groups

Regression and simulation results indicate that support for REDD+ projects is higher among households with more member (larger household) and small landholding. Larger households have a stronger intention to protect forests for the livelihoods of their descendants, and thus a positive attitude towards REDD+ projects. Larger households may also have more opportunities to benefit from REDD+ projects, particularly if REDD+ funds are mostly used for community projects. Furthermore, respondents with smaller private land are more supportive to REDD+ because they have higher employment rate in REDD+ projects and they are the main target group for community empowerment program under REDD+ projects. Involving households in REDD+ activities, such as forest monitoring and carbon measurement, would create job opportunities for them while increasing their participation in the program (Hawthorne et al., 2016).

Lastly, female respondents are more supportive to REDD+ projects, while male respondents are more critical and sceptical. This finding is consistent with what we found through FGDs. Community empowerment programs funded by REDD+ benefits are more likely to target women and poorer households with smaller private land ownership. This suggests a promising way forward for REDD+ improvement by incentivising the poorest and the most vulnerable group within local communities (Visseren-Hamakers et al., 2012).

> *"We are lucky and happy to be involved in this training program sponsored by the REDD+ project. We could use skills of creating handicraft to produce our products. Hopefully, we would also get help on financial and marketing matters." (Female respondent)*

4.6. Conclusions

This study contributes to the emerging literature on REDD+ by investigating the heterogeneity of household preferences across different forest management regimes, participation status, and household characteristics in Indonesia. We found that the households in community regime are most supportive to REDD+ compared to the households living in other forest management regimes in Indonesia. Meanwhile, respondents in privately managed forest regime showed the least support for REDD+. We also found that higher support for REDD+ comes from female respondents, as well as households with more member and holding a smaller area of land. We acknowledge that despite our attempt to make the survey instrument as applied as possible through focus group discussion and piloting, the results might have some influence of the hypothetical aspect of the choice experiment questions, including the duration considered which could be much longer for REDD+ implementation.

Nevertheless, in broader contexts, our findings have important implications for how future REDD+ policies should be designed and implemented in other parts of the world facing a similar situation to Indonesia. For example, implementing REDD+ project in community managed forest areas might be more successful than targeting other management regimes. Similarly, there is a strong preference for disbursement of funds in community-managed funds, which indicates that the potential attractiveness of such payment vehicle. However, how REDD+'s indirect and non-financial benefits should be distributed to encourage local support for REDD+ remained an unanswered question for further research. Finally, agencies should be aware of the heterogeneity of the impact of people's experiences. In the present analysis, experience with REDD+ projects seems to have significant impacts on household preference in private or government managed forests but not in community forests. Better knowledge about such heterogeneity can help facilitate initial adoption and ensure sustained success of REDD+ projects.

Bridging section 3: From the heterogeneity of households' preferences toward REDD+ projects to the identification of distinct groups of the local households based on their preferences under different forest management regimes

The previous chapter examined how the preference of local households for REDD+ projects, using five attributes of hypothetical REDD+ contracts (*Benefit, Distribution, Duration, Restriction*, and *Participation*) in choice experiment surveys. It indicated that there is a heterogeneity of local households' preference for REDD+ projects influenced by institutional and socioeconomic contexts as well as participation in current REDD+ projects. Most of the respondents tend to support REDD+. However, the biggest concern of the local households is not the financial benefit of a REDD+ project that would be obtained, but the restriction on forest-based livelihood imposed under REDD+ implementation. The next chapter will further identify distinct groups of the local households based on their preferences for REDD+ projects under different forest management regimes, socioeconomic contexts and participation in current REDD+ projects. It will also provide information about the groups of the local households that should be targeted for REDD+ participation. Such information would be useful to implement targeted approach (e.g., targeting selected groups or regions) to make REDD+ projects more effective.

CHAPTER 5

How to design more effective REDD+ projects? Importance of targeted approach in Indonesia

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Abstract

Reducing Emissions from Deforestation and Forest Degradation (REDD+) has been piloted in several developing countries. Limited funding available for REDD+ suggests that there is a need to adopt targeted approach (e.g., targeting selected groups or regions) to make REDD+ projects more effective. However, there is no clear understanding of how targeting could be done based on households' preferences for various design features of a REDD+ policy. Using choice experiment data obtained from two groups of households (project participants and outsiders) belonging to three types of forest management regimes (private, government and community) in Indonesia, this paper aims to identify classes of households that have similar preferences towards REDD+ design features. The scale adjusted latent class analysis indicates that there are four classes of households: (1) supporters emphasising household benefits, (2) supporters emphasising community projects, (3) indifferent group objecting restrictions, and (4) opponents demanding monetary benefits. We also found that forest management regime is a key determinant in separating these classes. Our results suggest that REDD+ projects are likely to be more accepted by households in the community and government forest management regime. Such information will be useful to develop more targeted REDD+ projects for different classes of households and forest management regimes.

Keywords: REDD+, latent class, choice experiment, targeted approach, Indonesia

5.1. Introduction

Strategies to mitigate climate change should involve emission reduction efforts from forestry sector as it is the second largest contributor to global greenhouse gas (GHG) emissions. This motivated the creation of Reducing Emissions from Deforestation and Forest Degradation (REDD+) mechanism which provides financial incentives to local communities and governments in developing countries for avoiding deforestation and forest degradation by implementing sustainable forest management practices (UN-REDD, 2017a). So far, approximately $10 billion has been mobilised (IIED, 2015; Norman and Nakhooda, 2014) in piloting REDD+ among more than 300 projects in 64 countries (Sills et al., 2014; UN-REDD, 2017b). However, current stage of REDD+ implementation is facing many challenges including inefficiency of REDD+ projects on the ground and poor government policy to support its implementation (Fletcher et al., 2016; Lund et al., 2017). Current REDD+ funding mainly comes from aid agencies (Angelsen, 2017; Angelsen et al., 2017), which is far lower than the suggested amount, US$10–15 billion per year to reduce current global deforestation rate by half (Stern, 2007). Therefore, it is crucial to ensure that limited funding for REDD+ is appropriately utilised by adopting a targeted approach in REDD+ implementation to enhance efficiency and effectiveness of REDD+ projects.

Understanding REDD+ implementation context is a first step towards adopting a targeted approach. This paper aims to examine whether and how contextual differences (i.e., forest management regimes, past experiences on REDD+ activities and individual characteristics) influence households' preferences towards REDD+, and to identify classes of households based on their preferences. This information would be useful to answer such questions as which group should be targeted and how to target those groups.

This paper offers new insights in formulating a REDD+ strategy which would be sensitive to targeted groups and forest management regimes. Households surrounding forest area are at the centre of REDD+ implementation (Angelsen and McNeill, 2012) that could have different perspectives and interests on REDD+ (Pandit et al., 2017). In other words, preference towards REDD+ is likely to be different among members of the same community, given their individual characteristics. Thus, creating an effective, efficient, and equitable long-term strategy for REDD+ implementation is difficult without understanding potential preference heterogeneity among households (St-Laurent et al., 2013a). This understanding allows to identify latent household groups with different preferences towards REDD+ and to obtain support and involvement of targeted groups for effective implementation of REDD+.

Furthermore, this study explains how forest management regimes and socio-demography could influence preference heterogeneity towards REDD+. Because REDD+ could limit household access to the forest, there is a tension that some REDD+ schemes could weaken rather than strengthen tenure security and access rights to forest-based livelihoods for households (Broegaard et al., 2017). Households' preference towards REDD+ could also be influenced by forest dependency and socio-demography (Sutta et al., 2014). Therefore, consideration of forest management and socioeconomic conditions are critical for REDD+ implementation (Araya and Hofstad, 2016; Pandit et al., 2017).

Past experiences of participation in REDD+ activities could also influence individuals' preference towards REDD+. However, in many REDD+ projects, households are not able to express their preference towards REDD+ due to lack of experience and information about REDD+ projects (Atmadja and Sills, 2016). This paper, therefore, examines households' preferences towards REDD+ by analysing a dataset gathered from discrete choice experiment (DCE) surveys that present hypothetical REDD+ contract scenarios to respondents. Furthermore, the application of scale adjusted latent class modelling (SALCM) in this study makes it possible to reveal latent groups based on their preferences towards the hypothetical REDD+ contracts, as well as to identify the probability and membership for each group to understand the influences of contextual differences in the preference heterogeneity towards REDD+ projects.

DCE surveys and FGDs were conducted in three REDD+ pilot projects under different forest management regimes (private, government, and community) in Kalimantan, Indonesia, one of the forefront countries for REDD+ implementation. Indonesia is the third largest tropical rainforest nation (MoEF, 2017g) as well as a major emitter of GHG from forestry sector (Margono et al., 2014). Thus, it provides an excellent case for studying preference heterogeneity towards REDD+. Results from this study bring new perspectives on how households are segmented into different groups based on their preferences towards REDD+, and how to utilise this segmentation to design more targeted REDD+ policies. The rest of the paper is organised as follows. Section 5.2 introduces the empirical methods, and section 5.3 presents the primary results, followed by the discussions in section 5.4. The last section concludes the paper.

5.2. Methodology

5.2.1. Discrete choice experiment

We purposively chose three REDD+ pilot projects[24] as the study sites based on their differences in REDD+ implementation contexts[25]. A total of 17 participating and non-participating villages surrounding the three REDD+ pilot projects[26] were selected randomly as target villages for household surveys.

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[24] We anonymize the names and exact locations of REDD+ projects and villages to fulfil research ethic requirements granted by the Human Ethics Office at the University of Western Australia.

[25] See Appendix 3.2 for more information on REDD+ project sites.

[26] See Appendix 5.1 for more information on village samples.

The draft questionnaire was prepared and refined through focus group discussions (FGDs) and pilot testing. Six FGDs attended by 39 participants were conducted to gather information on local REDD+ and forestry issues as well as feedbacks on choice experiment designs including attributes and levels. The final survey was carried out from March to June 2016. The respondents were selected randomly from the target villages. Individual respondent was an adult member of a household. Some local enumerators (14) were hired to assist data collection[27]. The enumerators were adequately trained before the survey. Consents of the local governments and local community leaders were obtained before conducting the surveys. In total, complete responses were collected from 460 respondents, who were distributed almost equally across the three REDD+ projects[28].

Each respondent was presented with six choice sets (questions) and asked to choose only one option in each choice set. A choice set included two options for hypothetical REDD+ contracts and an opt-out option. Attributes and the levels were decided based on literature, expert interviews, and FGDs. Table 5.1 presents the final set of attributes and the levels that were used in the survey.

[27] See Appendix 4.2 for more information on FGDs and local enumerators.
[28] See Appendix 5.2 for more information on respondent sizes.

Table 5.1. Attributes and levels for DCE surveys

Attributes and Description	Levels			
	Opt-out option (No REDD+)	**Randomise for option 1 and option 2**		
	1	**2**	**3**	**4**
Benefit. A hypothetical financial value of the rate of REDD+ benefit entitled to the community measured at per household basis (IDR/household/year). The benefit is received by the community at this rate, but it does not mean that each household is directly receiving the same level.	No benefit* (0)	500,000[#]	1,000,000[#]	1,500,000[#]
Distribution. Sharing of received REDD+ benefit among individual households and community projects, i.e. building infrastructures, educational, health and economic program which would be beneficial to every member of the community.	No benefit distribution to community projects and households*	All to community projects	Half to community projects and half to households	All to households
Duration. The duration of commitment for a REDD+ contract that must be obeyed.	No contract*	2 years	4 years	6 years
Added restriction. Added restriction or reduction to half of the current practices. Current restrictions, depend on forest allocations and management regimes, are still imposed even though without REDD+ implementation. Monitoring of added restriction is essential in REDD+ implementation	No added restriction^		Reduction of current restriction by half	Full restriction
Participation. Whether participation of households in the decision-making of REDD+ project will be the part of REDD+ scheme or not.	No^		Yes	

* Only appeared in the opt-out option; [#] Equal to $39, $78, $117 respectively[29];

^ Appeared in opt-out and REDD+ options

[29] All conversions of Indonesian Rupiah to US Dollar in this study are based on http://www.xe.com/ in March 2016.

To cover and randomise all levels of attributes, 18 choice sets were arranged and divided into three blocks using a rotation design based on the orthogonal main-effect design (OMEDs) of *support.CEs* package in *R* software (Aizaki et al., 2014). Each hypothetical REDD+ contract has a different profile of attribute levels among the 18 choice sets, and each respondent was only asked to answer one block consisting of six choice sets. All survey instruments were presented in the local language[30].

To reduce potential hypothetical bias, a *cheap talk* in the local language[31] was conducted before each interview to ensure that respondents understood how they should answer the questions (Fifer et al., 2014). Each respondent was interviewed individually to avoid influences from other respondents.

5.2.2. Modelling approach

We specify a series of models that guide the synthesis of respondents' preference towards REDD+ projects. We started with the standard discrete choice model and finally developed scale adjusted latent class model by specifying the joint estimation of scale and preference heterogeneity.

5.2.2.1. Discrete choice model

Discrete choice model is grounded on the random utility model (RUM) underlying the assumption that a respondent considers some alternatives and chooses the alternative that results in the highest expected utility at any given choice situation (McFadden, 1974). The utility (*U*) of respondent *i* to choose alternative *j* given the vectors (*V*) of contract attributes is:

$$U_i = V(x_{ij}) + \varepsilon_{ij} \qquad (Eq.5.1)$$

[30] An example of a choice set in English can be found in Appendix 4.3.
[31] The English version of the introductory talk is presented in Appendix 5.3.

Where $V(x_{ij})$ is the indirect utility function of choosing alternative *j* and ε_{ij} is the error variance that captures the impact of all unobserved factors affecting respondents' choice. The probability (*P*) of alternative *j* in choice situation *t* will be chosen by respondent *i* is equal to the probability of the utility gained from its choice greater than the utility from choosing all other alternatives $(k \in K)$. The specification of this probability function is:

$$P_{ijt} = P\left\{V_{ijt} + \varepsilon_{ijt} \geq V_{ikt} + \varepsilon_{ikt}; j \neq k, \forall k \in K\right\} \qquad (Eq.5.2)$$

Eq.5.2 can be estimated as a conditional logit model (CLM) or multinomial logit model (MNL), depending on the distribution of the error term and assumption that the error terms are independently and identically drawn from an extreme value distribution (McFadden, 1974). The choice probabilities can be estimated by substituting alternative attributes into the deterministic portion of the utility function as follows:

$$P_{ijt} = \frac{\exp(\beta x_{ijt})}{\sum_{k=1}^{K} \exp(\beta x_{ijt})} \qquad (Eq.5.3)$$

Where β is a vector of parameters not specific to the utility function, *x* is the attribute vector, and *K* is the total number of alternatives. *Eq*.5.3 assumes that respondents have a common preference for all contract attributes, which is very restrictive. Therefore, Boxall and Adamowicz (2002) indicate the need to calculate preference heterogeneity by using latent class model (LCM).

5.2.2.2. Standard Latent Class Model

Latent Class Models were introduced by Lazarsfeld et al. (1968) to understand preference heterogeneity and to identify different classes within a community. LCM is considered as a simple and reliable method to study preference differences because it uses semi-parametric approach and has no constraint imposed by predefined specifications (Shen, 2009). In LCM, it is possible to include individual characteristics and local contexts without any interactions to explore preference heterogeneity (Liao et al., 2015).

LCM assumes that individuals belong to different latent classes with specific parameters. The likelihood of individuals belonging to a particular class is a probabilistic function that is influenced by individual preferences, individual characteristics and local contexts (Olaru et al., 2011). The probability of respondent *i* to choose alternative *j* in choice-set *J* at choice situation *t* conditional on belonging to class *c* is:

$$P_{ijt} \mid c = \frac{\exp(\beta_c x_{ijt})}{\sum_{i=1}^{J} \exp(\beta_c x_{ijt})} \qquad (Eq.5.4)$$

LCM assumes that class membership of an individual is unidentified. However, data on individual characteristics and local contexts can be modelled to observe latent constructs and to estimate the probability of class membership within the community. The probability for respondent *i* belongs to class *c* is a general logit choice function of the form:

$$P_{ic} = \frac{\exp(\theta_c z_i)}{\sum_{c=1}^{C} \exp(\theta_c z_i)} \qquad (Eq.5.5)$$
$$c = 1, 2.........., C, \theta_c = 0$$

Eq.5.5 assumes that z_i are covariates with latent class membership including individual characteristics and local contexts. θ_c are parameter estimates for class membership (Greene and Hensher, 2003).

5.2.2.3. Scale Adjusted Latent Class Model

This study implements a scale adjusted latent class model (SALCM). This model enables simultaneous estimation of the scale and preference parameter (Magidson and Vermunt, 2007) and is reliable to examine heterogeneity in the error variance (Burton et al., 2017), which the standard latent class model may ignore. SALCM could group respondents based on similar preferences for REDD+ while taking into account differences in variability. The random utility of alternative j for respondent i depends on the latent preference class $c = 1....C$ and the unobserved scale parameter $\lambda_d, d = 1.....D$. For identification, one scale parameter is normalised to 1, and the rest of the scale parameter estimates are ratios of the reference scale class (Magidson and Vermunt, 2007). The probability of respondent *i* choosing alternative *j*, in choice situation *t*, conditioning on latent class *c* and scale class *d* is:

$$P_{ijt} \mid c, d = \frac{\exp(\lambda_d \beta_c^{*i} x_{ijt})}{\sum_{i=1}^{J} \exp(\lambda_d \beta_c^{*i} x_{ijt})} \qquad (Eq.5.6)$$

We included all attributes into the model, including *benefit, distribution, duration, added restriction,* and *participation* as well as *opt-out* variables to capture class heterogeneity on REDD+ preferences. We treated all attribute variables (except *benefit*) as categorical variables (with effect coding) to capture non-linearity effects. We also introduced covariates to represent heterogeneity in REDD+ implementation contexts and individual characteristics (Table 5.2). Before including the covariates into the model, we did correlation test among covariates to make sure that all covariates are free from each other.

Table 5.2. Description of covariates

Covariates	**Description**
Forest management regime	1 = Private; 2 = Government; 3 = Community
REDD+ participation	0 = Non-REDD+ participant; 1 = REDD+ participant
Male	0 = Female; 1 = Male
Age	Age of household head (years)
Household member	Number of household members (persons)
Experience	0 = No experience in local organization; 1 = Having experience in local organization
Distance to forest	Distance to the forest (kilometres)
Total income	Total income (million IDR/year) or (thousand USD/year)
Education level	1 = 0 – 6 years; 2 = 7 – 11 years; 3 = 12 years or more
Occupation	0 = Does not base on non-natural resources (i.e., labour, trader, employee); 1 = Based on natural resources (i.e., fisherman, farmer, hunter)

Latent GOLD® Choice 5.1 Syntax (Vermunt and Magidson, 2013) was used to conduct latent class choice analysis in this study. We followed common practices to select the fittest scale adjusted latent class model by minimisation of Bayesian information criterion (BIC) and conditional Akaike information criterion (CAIC). We first conducted a series of simulation with different numbers of preference and scale classes. Class number with the smallest BIC and CAIC was selected as the preferred model (Burton et al., 2017; Liao et al., 2015).

5.2.3. Respondent profiles

About 68% of respondents were male with an average age of 39 years. On average, there are 4 to 5 persons per household, and about 24% of respondents have organisational experience, mostly at the village level. Respondents live relatively close to the forest, on average at 1.8 km from the forest boundary. Average income level is around IDR 37,000,000 (USD 2,880) per year with on average 7 to 11 years of formal education. 58% of respondents work in natural resource-based occupations such as fishermen, farmers, hunters, and loggers. The rest of respondents work as labours, traders, drivers and employees who are not engaged in natural resources sectors. Based on one-way ANOVA test, respondent profiles are significantly different at 5% level [32] among forest management regimes (private, government, and community) and between REDD+ participation status (participating and non-participating villages).

5.3. Results

Based on results of BIC and CAIC simulation, we found that a model with two scale classes and four preference classes has the smallest BIC and CAIC with only 5% of classification error[33]. We have selected this model as our most preferred model. Information on scale parameters and the probability are presented in Table 5.3.

[32] Except for gender (male and female) between participating and non-participating villages. See Appendix 5.4 more information on respondents' characteristic.
[33] See Appendix 5.5 for a full model comparison.

Table 5.3. Scale parameters and the probability

	sClass A	sClass B	Wald	p-value
Scale Parameter	1.00 (-)	0.06** (0.25)	118.05	0.00
Scale Probability	82.63 %	17.37 %		

Coefficient (Standard error); ** $p < 0.01$

For measuring purposes, scale parameter of scale class (sClass) A is normalised to one. We found that sClass B exhibits significantly more variability than sClass A (0.06 < 1). This indicates the members of sClass A are more certain in their choices than the members of sClass B. About 83% of respondents are likely to be the member of sClass A. Further results based on sClass A are presented in the following tables[34]. Estimates of attribute parameters (utility functions) for preference classes are shown in Table 5.4. Furthermore, parameter estimates and the probability of preference class memberships are presented in Table 5.5.

[34] Following common practices, estimation results based on sClass with larger error variance (sClass B) are not used in the analysis.

Table 5.4. Estimates of attribute parameters (utility functions) for preference classes

Attributes^	**Class 1** ***(Supporters emphasising household benefits)***			**Class 2** ***(Supporters emphasising community projects)***			**Class 3** ***(Indifferent group objecting restrictions)***			**Class 4** ***(Opponents demanding monetary benefits)***		
	Coef	**Sig**	**SE**	**Coef**	**Sig**	**SE**	**Coef**	**Sig**	**SE**	**Coef**	**Sig**	**SE**
Benefit	-0.08		0.07	-2.87		2.35	1.98		7.43	12.36	**	4.46
Distribution (half to household)	0.87	**	0.15	-18.98	**	6.84	0.91		7.02	14.96	**	4.76
Distribution (all to household)	0.73	**	0.15	-70.09	**	21.16	-1.07		11.18	4.60	**	1.67
Duration (4 years)	0.36	*	0.14	-17.25	**	6.31	-12.74		14.38	-7.82		7.02
Duration (6 years)	0.47	**	0.15	-1.54		3.81	-15.01		13.96	-11.05		6.65
Added restriction (50%)	0.10		0.14	19.07	**	5.45	-57.72	**	21.02	-1.13		1.90
Added restriction (100%)	0.64	**	0.15	5.14		4.65	-102.58	**	33.65	-12.52	**	4.78
Participation	0.42	**	0.10	24.71	**	8.60	17.31		11.48	19.91	*	9.81
Opt-out	-2.67	**	0.63	-27.38	**	9.63	-45.80		29.53	24.74	**	8.92

$*\ p < 0.05$, $**\ p < 0.01$

^ Baselines are Distribution (All to community); Duration (2 years); Added restriction (0%); and No participation respectively;

Table 5.5. Parameter estimates and the probability^ of preference class memberships

Covariates	**Class 1** *(31.90%)*				**Class 2** *(23.87%)*				**Class 3** *(22.67%)*				**Class 4** *(21.56%)*				**Overall**
	Coef	**Sig**	**SE**	***%***	**Coef**	**Sig**	**SE**	***%***	**Coef**	**Sig**	**SE**	***%***	**Coef**	**Sig**	**SE**	***%***	**Sig**
Private regime	-0.75	**	0.20	*14.04*	-0.75	**	0.25	*7.98*	1.41	**	0.23	*54.33*	0.10		0.20	*23.65*	**
Government regime	1.28	**	0.22	*67.33*	-0.48		0.30	*8.39*	-0.81	*	0.34	*4.44*	0.001		0.23	*19.84*	**
Community regime	-0.53	**	0.18	*19.96*	1.23	**	0.20	*53.61*	-0.60	*	0.25	*5.57*	-0.10		0.19	*20.86*	**
REDD+ participant	-0.41		0.25	*24.17*	1.28	**	0.31	*32.68*	0.06		0.27	*26.45*	-0.92	**	0.24	*16.69*	**
Male	-0.19		0.23		0.09		0.26		0.40		0.27		-0.29		0.23		
Age	0.001		0.01		0.02	*	0.01		-0.01		0.01		-0.01		0.01		
Household member	0.10		0.07		-0.15		0.09		-0.08		0.09		0.13		0.07		
Organizational experience	-0.78	**	0.28	*22.95*	0.28		0.30	*24.07*	0.39		0.27	*30.96*	0.11		0.26	*22.03*	**
Distance to forest	0.05		0.07		-0.02		0.07		0.04		0.10		-0.06		0.07		
Income	-0.19		0.18		0.25		0.20		0.23		0.20		-0.29		0.18		
0 – 6 years of education	-0.09		0.16		-0.40	*	0.18		0.21		0.18		0.28		0.17		
7 – 11 years of education	0.36		0.20		-0.01		0.22		-0.16		0.25		-0.19		0.22		
≥ 12 years of education	-0.27		0.21		0.41	*	0.21		-0.05		0.23		-0.09		0.22		
NR-based occupation	-0.34		0.25		-0.26		0.27		0.26		0.25		0.34		0.25		

* $p < 0.05$, ** $p < 0.01$; ^ We present probability of class memberships (in %) for overall significant covariates only

The scale adjusted latent class modelling results suggest four classes of respondents' preference towards REDD+ (Tables 5.4 and 5.5), which are described as follows:

1. Class 1: Supporters emphasising on household benefits. Class 1 members tend to choose REDD+ alternatives, but they like to distribute REDD+ financial benefits for individual households. They prefer longer contract duration, accept an additional restriction on forest-based livelihood, and prefer to participate in REDD+ decision-making. Class 1 members are most likely respondents from government regime and have no organisational experience. Respondents from private and community regimes are less likely to be in this class.
2. Class 2: Supporters emphasising on community projects. Class 2 members also tend to choose REDD+ alternatives; however, they prefer to distribute REDD+ benefit for community projects. They prefer a shorter contract and can only accept 50% added restriction on forest-based livelihood. This indicates that they accept REDD+ with caution and like to evaluate further progress and benefits of REDD+ projects. This class also requires participation in the decision-making of REDD+. Class 2 members are dominated by respondents from community regime and participant villages. Older and higher-educated respondents are likely to be in this class.
3. Class 3: Indifferent group objecting restrictions. Except for *added restriction*, all coefficients of Class 3 are not significant, indicating indecisive stance of Class 3 members towards REDD+. However, a negative coefficient of *added restriction* indicates an objection to restrictions on forest-based livelihood under REDD+ programs. Most of the respondents in private regime are in Class 3, while respondents from government and community regimes are less likely to be in this class.
4. Class 4: Opponents demanding monetary benefits. Among the four classes, this is the only class that opposes REDD+ alternatives, indicated by its positive coefficient for *opt-out*. However, if REDD+ must be implemented, this class requires higher REDD+ financial

benefits that are distributed mostly to individual households, participation in decision-making but no added restrictions. Members of Class 4 tend to be respondents with no REDD+ experience.

5.4. Discussion

5.4.1. A targeted approach for REDD+ implementation is important

Our findings demonstrate the importance of targeted approach in REDD+ policy design and implementation. We found significant preference heterogeneity towards REDD+ among the respondents. Besides supporters, there are also opponents and the indifferent group of REDD+ projects. Considering current limited funds and resources for further REDD+ projects (Angelsen, 2017; Angelsen et al., 2017), targeting REDD+ supporters (Class 1 and Class 2) and attracting indifferent group (Class 3) would be reasonable to enhance the effectiveness of REDD+ funds and to increase efficiency in REDD+ implementation. Lessons from past experiences of REDD+ projects and similar PES schemes that failed to secure genuine support from households suggest that inability to gain social support is a primary cause of failure (Blom et al., 2010; Sills et al., 2014). Therefore, it is difficult to expect long-term support for REDD+ projects from people who already have shown clear objection for REDD+ (Class 4). Thus, they should be given the least priority in selecting REDD+ participants.

We found that majority of respondents belong to REDD+ supporter classes (32% of Class 1 and 24% of Class 2), compared to 23% of the indifferent class (Class 3) and 21% of the opposition class (Class 4). This is very encouraging for further REDD+ implementation. However, the preference of households towards REDD+ is dynamic and highly dependent on the progress of REDD+ implementation, as well as environmental and social setting (Atmadja and Sills, 2016). Thus, it is imperative to consider that the current distribution of REDD+

supporters and the opponents could be changed in the future following implementation of REDD+ projects.

Within Indonesian context, targeted approach in REDD+ implementation is essential. As a developing country with severe problems in forestry sector management (Indrarto et al., 2012), Indonesia needs to balance the interests of conservation and economic growth. Utilizing REDD+ funds to satisfy both interests is difficult without using a targeted approach. REDD+ projects in Indonesia should be prioritised for groups of households that have both motivations for forest conservation and community empowerment. In this context, targeting Class 1 and Class 2 is the preferred option since these classes support for REDD+ though with a different preference for REDD+ benefit distributions.

5.4.2 Forest management regime could be a proxy to implement a targeted approach

All forest areas in Indonesia are state-owned where forest management regimes are set by the government based on forest allocations[35], forest functions, as well as ecological and biodiversity values of the forests (GoI, 1999). A general pattern seems to emerge that respondents from a particular forest management regime tend to be the members of a particular class. For example, 67% of respondents in the government regime are the members of Class 1. The pattern suggests that forest management regime could be a rough proxy to identify class membership to target particular groups to implement REDD+. For another instance, REDD+ supporters in Class 1 and Class 2 mainly come from government and community regimes, respectively. From the government perspective, targeting forest management regime is more practical than targeting classes. Also, forest management regime has demarcated boundaries that are easier to enforce.

[35] See Appendix 3.3 for more information on forest allocations in Indonesia.

The biggest forest management regime in Indonesia is the government regime, thus addressing the households' preferences towards REDD+ in government regime is crucial. More than half of respondents from government regime are the members of Class 1, the largest class. To ensure continued support from Class 1, involving households in the decision making and distributing REDD+ financial benefit to each household is necessary. This should be combined with providing adequate and valid information about REDD+. Insufficient information about the REDD+ projects is commonly observed among households, where most households assume that REDD+ is not more than a forest conservation program (Resosudarmo et al., 2012). Therefore, households' knowledge on the other aspects of REDD+ is essential to increase their participation in REDD+ projects (Sunderlin, 2011).

Targeting community forest for REDD+ implementation would be an option to increase effectiveness and efficiency on REDD+ projects and funds. Most of the respondents in community regime are members of Class 2 who would prefer to distribute REDD+ financial benefits for community projects. This could generate multiplier effects and increase support for REDD+ projects (Evans et al., 2014). This could also encourage local economic growth and bring REDD+ as a tool to balance conservation and economic interests at the local level. Furthermore, community regime is the most effective regime for forest sustainability (Loaiza et al., 2016) and could play a crucial role in realising effectiveness for REDD+ implementation (Skutsch and McCall, 2012), delivering efficiency and fairness (Agrawal and Angelsen, 2009) as well as reducing transaction costs in the implementation process (Chhatre et al., 2012). However, in Indonesia, community manages only a small fraction of forest[36] (MoEF, 2017a), thus indicating a scope to extend forest area under community regime while encouraging households currently under community regime to join REDD+ projects.

[36] See Appendix 3.3 for more information on forest management regimes in Indonesia.

Considering the limited funds for REDD+ projects, the private regime should be less prioritised for REDD+ implementation. Respondents from private regime tend to be in Class 3 that show uncertain support for REDD+ projects. This could be occurred because of perceived limited benefits of REDD+ projects and lack of information about REDD+. Furthermore, while forests under community regime are fully accessible for authorised households, forests under private regimes provide limited access to households[37] (GoI, 2011b; MoF, 2008c; GoI, 1999). Added restrictions on forest-based livelihood that might be implemented under REDD+ contract generate further concerns among the respondents because this might severely reduce their income (Resosudarmo et al., 2012). Therefore, effective and efficient REDD+ projects in private regime would be difficult to achieve. In Table 5.6, we suggest some preferred REDD+ designs to target particular groups of households by forest management regimes.

Table 5.6. Preferred REDD+ design by forest management regimes

	Forest management regime		
	Government	**Community**	**Private**
Targeted group	Proxy for Class 1 targeting 67% of households in government regime	Proxy for Class 2 targeting 54% of households in community regime	Proxy for Class 3 targeting 54% of households in private regime
Benefit distribution	Distribute REDD+ benefit for each household	Distribute REDD+ benefit to fund community projects	Not available
Contract duration	Apply long contract duration, 6 years or more	Apply short contract duration, 2 years or less	Not available
Added restriction on forest-based livelihood	Impose full restriction on forest-based livelihood	Impose half reduction on forest-based livelihood	Do not impose added restrictions on forest-based livelihood
Participation in decision making	Involve households in decision making	Involve households in decision making	Not available

37 See Appendix 3.1 for more information on the legal forest access for households in Indonesia.

5.4.3. Dealing with REDD+ opponents without losing REDD+ supporters

Although REDD+ implementation needs to adopt targeted approach with a focus on REDD+ supporters, understanding behaviour and preferences of REDD+ opponents is still required. Unlike supporters, REDD+ opponents (Class 4) are not attached to any particular forest management regimes, but, respondents without any REDD+ experience and low education level tend to be members of this group. This finding indicates a room to reduce the number of REDD+ opponents by adopting an excellent REDD+ governance practice to promote REDD+ among members of this class. This could be done by respecting households' livelihood in the forests, increasing effectiveness on forest monitoring, and involving households in the decision-making process (Enrici, 2016).

Further, since Class 4 is aware of REDD+ potential benefits, ensuring that REDD+ would deliver real benefits is essential to this class. Although direct financial benefit for individual households is preferred by Class 4 members, awareness and recognition of REDD+ indirect benefits among the class members could motivate them to participate. For example, in another study, forest conservation benefit has been identified as a major indirect motivating factor for local communities to support REDD+ (Resosudarmo et al., 2012).

5.5. Conclusions

This study enhances our understanding of the importance of targeted approach in REDD+ policy design and implementation that could increase effectiveness and efficiency of REDD+ projects and funds. Using SALCM on a data set gathered by DCE surveys, we identified preference heterogeneity of households towards REDD+ that is divided into four classes: supporters emphasising private and community benefits, opponents, and indifferent group. The success of REDD+ implementation would be determined by how the forest authorities implement targeted approach to keep current supporters engaged and to attract potential supporters, as well as to deal with REDD+ opponents. This could be performed by implementing different REDD+ policies for different targeted groups following their preferences for REDD+ designs, as well as by delivering sufficient and credible information about REDD+ projects to the households.

We also found that forest management regime would be a proxy to define latent classes. This finding implies policymakers to design REDD+ policies that are more likely to be based on forest management regimes in targeting particular groups of households. Government and community regimes could be prioritised for REDD+ project implementation as most of the REDD+ supporters come from these regimes, while private regime dominated by the indifferent group should be the next target. Distributing REDD+ financial benefit to individual households with longer contract duration, combined by imposing a full restriction on forest-based livelihood could be a suitable REDD+ policy for government regime. Meanwhile, in community regime, streaming REDD+ financial benefit to fund community projects with short contract duration and imposing half reduction on forest-based livelihood is a preferred REDD+ policy by the households. In both forest management regime, involving households in REDD+ decision making is essential.

Finally, we purposively chose three REDD+ projects from the same island, Kalimantan, but from different forest management regimes. This was done to better comparability of different sites and to minimise biases generated by location differences. However, this may limit the generalizability of our findings to some extent. Further similar research in other parts of Indonesia and other countries is recommended to generate comprehensive views on household groups and forest management regimes.

Bridging section 4: From the key findings of the last three chapters to the policy implications for future REDD+ implementation in Indonesia

The last three chapters discussed the key findings of this study, including perceptions and preferences of the local households for REDD+ under different implementation contexts (i.e. forest management regimes, socioeconomic settings, and participation in current REDD+ pilot projects). Chapter 3 discussed how REDD+ costs and benefits are perceived by the local households and influence their perceptions for current REDD+ pilot projects. Local households' preferences for hypothetical REDD+ contracts were examined and discussed in Chapter 4. Chapter 5 then identified the segments of the local households with distinct preferences for REDD+ and discussed how to implement targeted approaches (i.e. targeting specific groups of local households or specific forest area) based on the segmentation. Based on the key findings of the last three chapters, the next chapter (Chapter 6) will discuss and synthesise the key findings in the Indonesian policy context. It will identify some policy implications for future REDD+ implementation in Indonesia and provide some recommendations for REDD+ policy-making.

CHAPTER 6
Synthesis and policy implications

6.1. Introduction

Policy shifting and improvement for future REDD+ implementation are important to enhance efficiency and effectiveness of REDD+ projects. REDD+ projects should be designed and implemented based on improved understanding of how contextual differences (forest management regimes and socioeconomic settings) influence the perception, preference and segmentation of the local households towards REDD+ projects.

Therefore, within Indonesian context, this chapter discusses what policy improvements should be conducted to obtain a social licence from the local households and to increase efficiency in REDD+ implementation. By synthesising key findings of the previous chapters, this chapter aims to present how improved understanding of local households' perception, preference and segmentation towards REDD+ projects under different forest management regimes, socioeconomic settings, and participation in current REDD+ projects could improve REDD+ future policy and provide recommendation for the policy makers with the expected benefits.

6.2. Policy suggestions to improve REDD+ implementation

Based on key findings of Chapter 3, Chapter 4, and Chapter 5, further policy suggestions are formulated to improve future REDD+ implementation, as presented in Table 6.1.

Table 6.1. Policy implications and expected outcomes for future REDD+ implementation

Policies	Current situations	Improvements needed	Expected outcomes
Positioning REDD+ costs and benefits to the right orders.	REDD+ costs, especially from the perspectives of the local households, are not adequately estimated and addressed (Rakatama et al., 2017).	Perceived costs of REDD+ should be classified or addressed first by avoiding restriction on forest-based livelihood.	Securing supports and social license from the local households since the very beginning of REDD+ implementation.
	Economic benefits of REDD+ is the primary point used by REDD+ project developers to gain support from the local households (Chapter 3; Chapter 4).	Environmental benefits of REDD+ should be promoted more than economic benefits.	Increasing environmental awareness of the local households that might then increase their support for REDD+ projects.
	REDD+ project developers tend to divide REDD+ benefits to each household (Chapter 4).	REDD+ monetary benefits should be used to fund community projects.	Encouraging local economic growth and stimulate household's recognition of the additional benefits of REDD+ projects.
Utilising forest management regime as an approach to implement REDD+.	Current REDD+ projects in Indonesia are mostly implemented in government and private management regimes (CIFOR, 2017).	Community forests should be prioritised to implement the REDD+ scheme.	Increasing acceptability of REDD+ projects and promoting equitability in the broader context of forest management in Indonesia.
	The government attract the private sector to develop REDD+ projects under Ecosystem Restoration Concession (MoF, 2008b).	Implementing REDD+ project in private forest regime should be the last priority.	Reducing the failure risks of REDD+ projects because of insufficient support from the local households.
	There is no specific REDD+ strategy for specific forest management regime (SatgasREDD+, 2012).	Different REDD+ strategies should be implemented in different forest regimes.	Improving acceptability of REDD+ projects across different forest management regimes.
Identifying and targeting potential REDD+ supporters.	There is no adequate strategy to identify REDD+ supporters and opponents (SatgasREDD+, 2012).	REDD+ should target the supporter groups to participate.	Enhancing the effectiveness of REDD+ funds and increasing efficiency in REDD+ implementation.
	There is no adequate strategy to understand the relationship between socioeconomic settings and support for REDD+ (SatgasREDD+, 2012).	Certain socioeconomic profiles (i.e. forest-dependent groups, females, large families, small landholders) should be targeted as the REDD+ participants	Achieving REDD+ essential goal of poverty reduction and climate adaptation among the most vulnerable people living nearby the forests and potential supporters of REDD+.
Distributing sufficient, transparent and factual information about REDD+.	Local organisations are not optimally utilised to promote REDD+ and obtain a social licence from the local households (Chapter 3).	Local organisations should be positioned as the REDD+ information centre.	Ensuring further success of REDD+ implementation by securing a united voice within the organisations for supporting REDD+.
	Information about REDD+ is not sufficiently distributed to local stakeholders (Chapter 5).	Sufficient information about REDD+ should be delivered to anticipate REDD+ opponents.	Reducing the number and anticipating the growth of REDD+ opponents

6.3. Addressing REDD+ benefits and costs appropriately

6.3.1. Perceived costs of REDD+ should be classified or addressed first

From the early stages of policy formulation and implementation, REDD+ policy should reduce costs perceived by the local households by avoiding restriction on forest-based livelihood and encouraging participation of local households in decision-making. The future success of REDD+ implementation would depend on the efforts to anticipate perceived economic and social costs by avoiding or limiting the number of new restrictions on forest-based livelihood (Chapter 3). Also, restrictions that affect forest-dependent livelihoods are the most significant barrier to REDD+ adoption in REDD+ project design, while the financial benefit is not the main concern (Chapter 4). This could raise doubt about the role of financial payment to encourage participation in REDD+ projects. It also implies that realising REDD+ as a performance-based program for carbon sequestration would be challenging because the REDD+ payment might not be attractive to the local households.

Therefore, avoiding or limiting the extent of added restrictions in implementing REDD+ projects would be an important strategy to increase support for REDD+ among the rural households. Compensating any restrictions on forest-based livelihoods by simply increasing REDD+ financial benefit would not very likely to be helpful to boost support for REDD+ projects. However, the biological impacts of such strategy that might occur (i.e., decrease in forest cover and biodiversity) need to be studied further as well as be minimised and controlled. Hence, if added restrictions are unavoidable, the REDD+ strategy should be to encourage participation of local households in decision-making alongside distributing benefits for community projects as they might be able to secure better support from the local households.

Results from this analysis might contradict the findings from other studies presenting that financial compensation is the most important attribute of REDD+ projects (Appiah et al., 2016; Beyene et al., 2016; Komba and Muchapondwa, 2016). However, this suggestion is consistent with other literature indicating that the most prominent concern of the local households is not the benefits that they would obtain from REDD+, but the restrictions on forest-based livelihood that would be in place under REDD+ implementation (Resosudarmo et al., 2012). Although REDD+ might be financially beneficial, restrictions on forest-based livelihood might decrease income and increase living costs of the local households (Brimont et al., 2015). Any restrictions to access those forest products means extra economic costs to households for obtaining the products from other places. Most importantly, this situation could generate social costs that are intangible and difficult to measure, associated with conflicts among community members or between REDD+ project management and the local households (Dressler et al., 2012; St-Laurent et al., 2013b).

6.3.2. Environmental benefits of REDD+ should be promoted more than economic benefits

Ensuring that the local households understand the environmental benefits of REDD+ is essential for the success of REDD+. In delivering benefits, REDD+ policy should be shifted from only distributing economic-benefit to also ensuring environmental benefits of REDD+ perceived by the local households. The environmental benefit is the only category of perceived benefit that is significantly associated with support for REDD+, while perceived economic benefits of REDD+ is not likely to influence support for a REDD+ project in the contexts of this study (Chapter 3).

This finding reinforces the point that financial payment is not a sufficient condition to ensure support for REDD+ projects. There is limited funding available for REDD+ and uncertainty of the private sector involvement in financing REDD+ (Angelsen, 2017; Angelsen et al., 2017). Thus, future economic benefits of REDD+ might be less attractive compared to the opportunity costs, i.e. other economic activities and opportunities that can be pursued instead of REDD+ projects such as the expansion of palm oil plantation. However, eliciting or sharing the environmental benefits of REDD+ could increase environmental awareness of the local households that might then increase their support for REDD+ projects. It is also important to emphasise that the ability of REDD+ to bring forest conservation benefits to local households is one of the main reasons for their positive perception towards REDD+ projects in Indonesia and many other countries - Brazil, Cameroon, and Tanzania (Resosudarmo et al., 2012).

6.3.3. REDD+ monetary benefits should be used to fund community projects

Integrating REDD+ financial benefits into broader activities for community empowerment could potentially have multiplier or spill-over effects beyond REDD+ projects (Chapter 4). This could also encourage local economic growth and bring REDD+ as a tool to balance conservation and economic interests at the local level. In the future, this would stimulate household's recognition of the additional benefits of REDD+ projects and increase support for REDD+. Current REDD+ payment is only based on forest carbon services without taking into account non-carbon services of forest (Ojea et al., 2016). Thus, current REDD+ payment is too small to be distributed to each household and is perhaps more useful to pool the funds for community projects that would generate public benefits for all households.

Recent literature has shown that distributing REDD+ benefits through community funds for rural development activities within the forest area is a part of pro-poor policy in Mexico (Skutsch et al., 2017) as well as indirectly increasing carbon sequestration and involving wide range of local stakeholders (Skutsch et al., 2014). On the other hand, Chomba et al. (2016) suggested that distributing benefit for each actor could lead to inequality in benefit sharing and result in disputes.

A comparative study of five REDD+ countries indicates that current strategies on benefit distribution do not guarantee effectiveness, efficiency and equitability in the long term for the success of REDD+ implementation (Dunlop and Corbera, 2016). Although the decision to distribute REDD+ benefits depends on economic feasibility, local institutional capacity, and governance structures, the decision process should be consultative and participatory such that household preferences are accommodated in the decisions (Mohammed, 2011). Moreover, household's preference for REDD+ benefit distribution can be context specific and varies across countries. For example, a study in Nepal indicates that respondents prefer to distribute the benefits for community projects (Dissanayake et al., 2015b) while in Ethiopia respondents prefer to distribute the benefits to households (Dissanayake et al., 2015a).

6.4. Contextualization of REDD+ projects to specific forest management regime

6.4.1. Community forests should be prioritised to implement the REDD+ scheme

REDD+ projects should be prioritised to be implemented in community managed forest areas because this might be more successful than targeting other forest management regimes, because. REDD+ would be more acceptable in community regime than others (Chapter 3; Chapter 4). Households in the community regime perceive the highest REDD+ environmental and future benefits as well as present the highest support for REDD+ projects. Households are typically more involved in REDD+ activities in community forest regime and thus perceive a lower chance of potential conflicts with external stakeholders. Furthermore, most of the REDD+ supporters come from this regime (Chapter 5).

Within broader forest management context, community forest regime has been shown to be most effective in sustaining forest in other parts of the world (Loaiza et al., 2016; Ostrom, 2012). Community forest management has reduced degradation and stabilised forested landscapes while supporting local livelihoods (Pandit and Bevilacqua, 2011; Pelletier et al., 2016). In the context of REDD+ implementation, community managed forests can play an important role (Skutsch and McCall, 2012) by bringing effectiveness, efficiency and fairness (Agrawal and Angelsen, 2009) as well as minimising transaction costs in the implementation process (Chhatre et al., 2012).

However, community regime is not without problems. There is also literature arguing that forest management under community regime may not necessarily perform better than other regimes for a range of reasons. For example, inequality in the distribution of forest benefit among individual households from community forests could result in internal conflicts among forest users (Oyono et al., 2005), particularly in the poorest group (Malla, 2000). Some scholars argue that social, economic, and power heterogeneity among community members could also lead to the failure of community managed forest (Pradhan and Patra, 2013) leading to forest degradation (Pérez-Cirera and Lovett, 2006). Some are even concerned that REDD+ may disturb well-functioning community-based forest management systems (Bluffstone et al., 2013).

Within the Indonesian context, revitalising forest management regimes is therefore important for national REDD+ strategy since community manages only about 1.5% of Indonesian forests (MoEF, 2017a). Therefore, this strategy would also promote more equitable policy in the broader context of Indonesian forest management. Policy reforms, particularly in forestry and land tenure sector, is one of the keys to future success in REDD+ implementation (Angelsen, 2016). The government could promote community forest management by recognising management rights of the local households under clear regulations and concession permits such as village forest and community forest.

6.4.2. Implementing REDD+ project in private forest regime could potentially be the last option

Considering the limited funds for REDD+ projects, the private regime should be less prioritised for REDD+ implementation since it would be more challenging because of less support from the local households to REDD+ projects compared to the other regimes. Public support for REDD+ is lowest in private regime, and it is even lower after villages have experienced REDD+ intervention (Chapter 4). There is a tendency of local households to assume that private entities, as profit-oriented organisations, may take advantage of REDD+ programs. In broader forest management context, forest conservation programs require high costs to protect forest boundaries and generate extensive conflict with the local households under the private regime (Ostrom and Nagendra, 2006).

However, if REDD+ projects under private forest management regime must be implemented, it requires a better communication approach to understanding household needs and expectations. It is crucial to inform the households that REDD+ program would not impose added restrictions that affect livelihoods without adequate compensation. In other words, REDD+ program should focus on creating alternatives for forest-based livelihood activities before enforcing restrictions. Furthermore, in REDD+ decision-making processes, involving household representatives is important to ensure ownership of the decisions at the local level which in turn facilitates implementation of activities.

6.4.3. Different REDD+ strategies should be implemented in different forest regimes

There is heterogeneity of perceptions and preferences of the local households towards REDD projects across different forest management regimes (Chapter 3; Chapter 4). Furthermore, forest management regime could be a proxy to implement the targeted approach (Chapter 5). This indicates a need to adopt a different focus on further REDD+ strategy in different forest management regimes. Implementing REDD+ strategy based on forest management regime is practical since it has clear boundaries and entitlements. This strategy would improve acceptability of REDD+ projects across different forest management regimes. For example, imposing a full restriction on forest-based livelihood might perform well in REDD+ projects under government regime, but not in the community and private regimes where the respondents only accept a half reduction from the current practices and no added restriction on forest-based livelihood respectively.

6.5. Identifying and targeting potential REDD+ supporters

6.5.1. REDD+ should target the supporter groups to participate

Targeted approaches in REDD+ policy design and implementation is important (Chapter 5). We found significant preference heterogeneity towards REDD+ among the respondents. Besides supporters, there are also opponents and the indifferent group of REDD+ projects. Considering current limited funds and resources for further REDD+ projects (Angelsen, 2017; Angelsen et al., 2017), targeting REDD+ supporters and attracting indifferent group would be reasonable to enhance the effectiveness of REDD+ funds and to increase efficiency in REDD+ implementation.

Lessons from past experiences of REDD+ projects and similar PES schemes that failed to secure genuine support from households suggest that inability to gain social support is a primary cause of failure (Blom et al., 2010; Sills et al., 2014). Therefore, it is difficult to expect long-term support for REDD+ projects from people who already have shown clear objection for REDD+. Thus, they should be given the least priority in selecting REDD+ participants.

REDD+ is supported by most of the local households (Chapter 5). This is very encouraging for further REDD+ implementation. However, the preference of households for REDD+ is dynamic and highly dependent on the progress of REDD+ implementation, as well as environmental and social setting (Atmadja and Sills, 2016). Thus, it is imperative to consider that the current distribution of REDD+ supporters and the opponents could change in the future implementation of REDD+ projects.

Within Indonesian context, targeted approach in REDD+ implementation is essential. As a developing country with serious problems in forestry sector management (Indrarto et al., 2012), Indonesia needs to balance the interests of conservation and economic growth. Utilizing REDD+ funds to satisfy both interests is difficult without using a targeted approach. REDD+ projects in Indonesia should be prioritised for groups of households that have both motivations for forest conservation and community empowerment. In this context, targeting REDD+ supporters is the preferred option.

6.5.2. Certain socioeconomic profiles should be targeted as the REDD+ participants

The further REDD+ policy should deliver more REDD+ benefits for forest-dependent groups that farm in the forest area (Chapter 3). Forest-dependent group under REDD+ projects tend to be the poorest group among different forest-dependent communities (Skutsch et al., 2017) and the most affected group by the negative impacts of climate change (Angelsen and Dokken, 2018). Therefore, 'pro-poor' strategy would help REDD+ to achieve its essential goal of poverty reduction and climate adaptation among people living nearby the forests (Leggett and Lovell, 2012).

Furthermore, the REDD+ participation of females and large families with limited land ownership should be encouraged since they are the REDD+ supporters as well as a vulnerable group (Chapter 4). Larger households have a stronger intention to protect forests for the livelihoods of their descendants, and thus a positive attitude towards REDD+ projects. Larger households may also have more opportunities to benefit from REDD+ projects, particularly if REDD+ funds are mostly used for community projects. Respondents with smaller private land are more supportive to REDD+ because they are currently the main target group for community empowerment program under REDD+ projects. Female respondents are more supportive to REDD+ projects, while male respondents are more critical and sceptical.

6.6. Distributing sufficient, transparent and factual information about REDD+

6.6.1. Local organisations should be positioned as REDD+ facilitators

Valid information about REDD+ benefits should be distributed through the local organisation as a practical effort to engage local stakeholders in implementing REDD+ projects. Also, promoting memberships to local organisations could be a part of the successful

REDD+ implementation strategy. Experience in the local organisation would increase positive perception towards REDD+ because the organisation members would obtain frequent update and accurate information about REDD+.

There is a need to deliver credible and factual information about REDD+ benefits to households, and using local organisations to provide such information could be a useful strategy (Chapter 3). Castillo and Armenia (2016) showed that membership in local organisations is associated with high participation in REDD+ activities. A study by St-Laurent et al. (2013b) also demonstrated that local organisation has a strategic position to ensure further success of REDD+ implementation because the members of local organisation tend to have a united voice for REDD+ that could be either supportive or opposing to REDD+.

6.6.2. Sufficient information should be delivered to anticipate REDD+ opponents.

Although REDD+ implementation needs to adopt targeted approach with a focus on REDD+ supporters, understanding behaviour and preferences of REDD+ opponents is still required. Reducing the number of REDD+ opponents could be conducted by providing adequate and valid information about REDD+ combined with adopting an excellent REDD+ governance practice to promote REDD+, respecting households' livelihood in the forests, increasing effectiveness on forest monitoring, and involving households in the decision-making process (Enrici, 2016). Insufficient information of a REDD+ project is commonly observed among households, where most households assume that REDD+ is not more than a forest conservation program (Resosudarmo et al., 2012). Therefore, households' knowledge about other aspects of REDD+ is essential to increase their participation in REDD+ projects (Sunderlin, 2011).

CHAPTER 7
Conclusions

7.1. Introduction

Although REDD+ had been piloted in many parts of the globe since over a decade ago, some fundamental questions remained unanswered. There is no complete picture of REDD+ costs and benefits from the perspectives of the local households. There is limited understanding of the perceptions and preferences of the local household towards REDD+ projects. Also, how the local households are segmented based on their perceptions and preferences for REDD+ projects has not been well established. In the field, REDD+ projects are piloted across different institutional and socioeconomic contexts. However, there is insufficient knowledge on how these contextual differences affect households' perceptions and preferences for REDD+ projects.

This thesis filled these knowledge gaps by delivering new insights on how REDD+ pilot projects and their implementation could be improved by better understanding of contextual differences including forest management regimes, socioeconomic settings and current participation of the local households in REDD+ projects. This thesis revealed the perspectives of the local people towards REDD+ implementation including their perceived costs and benefits of REDD+ as well as their perceptions and preferences towards REDD+ projects. This thesis also identified the segmentation of local household's preference towards REDD+ and suggested a targeted approach for further REDD+ implementation. The findings of this thesis would be useful to design effective, efficient, and equitable policy for further REDD+ implementation.

Policy improvements for future REDD+ implementation are required for an effective REDD+ projects. There are some lessons learned from this thesis to be addressed to obtain a social license from the local community. This thesis suggests repositioning costs and benefits of REDD+ projects appropriately. REDD+ costs should be avoided at the beginning, and environmental benefits of REDD+ must be perceived by the local community. REDD+ monetary benefits should be used to fund community projects to generate public benefits for the whole community. Designing and implementing future REDD+ projects based on forest community regime might be useful to increase projects' effectiveness. Forests area under community regime should be prioritised for the establishment of REDD+ projects, and different policies could be applied to different forest management regimes. We recommend policymakers to use local organisations for delivering adequate, clear and truthful information about REDD+.

The following part section briefly summarises the research questions raised in this thesis, followed by a summary of the key findings by each research question or thesis chapter. The last part presents the limitations of this study and directions for future research.

7.2. Research questions and key findings

7.2.1. Research question 1: What are the different costs and benefits of REDD+ examined in the literature and what factors affect these costs and benefits?

The first research question is what are the different costs and benefits of REDD+ examined in the literature and what factors affect these costs and benefits. This question is answered in Chapter 2, "The costs and benefits of REDD+: A review of the literature". This chapter systematically reviewed current studies in REDD+ costs and benefits with emphasis on the categories of estimated costs and benefits, estimation approaches used, and the determinants of costs and benefits estimates. Using relevant keywords in prominent research databases, this chapter intensely reviewed at least 92 studies published between 1995 and 2015.

This chapter provides some key findings as lessons learned for future REDD+ costs and benefits studies. First, current REDD+ studies mostly estimate opportunity costs while transaction and implementation costs are paid little attention although these costs are also substantial parts of the total REDD+ costs. Second, estimates of indirect and non-monetary benefits are missed in the current literature although these are essential parts of a complete picture of REDD+ benefits. Third, from different estimation methods, the cost and benefit estimates are substantially different. Fourth, study location and scale affect REDD+ costs and benefits estimates. Fifth, there are limited studies on the distribution of REDD+ costs and benefits.

7.2.2. Research question 2: What are the different perceived costs and benefits of REDD+ projects among local households and how these perceived costs and benefits, along with their socioeconomic characteristics and institutional structure of forest management influence their perception towards REDD+ projects?

The second research question is what are the different perceived costs and benefits of REDD+ projects among local households and how these perceived costs and benefits, along with their socioeconomic characteristics and institutional structure of forest management influence their perception towards REDD+ projects. This question is answered in Chapter 3, "Perceived costs and benefits of REDD+ projects under different forest management regimes in Indonesia". This chapter is a perception study of REDD+ participating households in Indonesia. By using Structural Equation Modelling (SEM), this chapter analyses interrelationships of households' perceptions towards REDD+ projects with perceived costs and benefits of the scheme, forest management regimes, and socioeconomic settings. Perceived REDD+ costs and benefits have been grouped into economic, environmental and social categories by time - present and future - in three different forest management regimes: private, government, and community.

There are four key findings in this chapter. First, to ensure a social license for REDD+ implementation, avoiding perceived costs is more influential than delivering benefits. Second, among the three categories of perceived benefits, environmental benefit is the only category that significantly generates positive perception towards REDD+. Third, perceived environmental and future benefits of REDD+ projects under community regime are higher than private and government regimes, causing REDD+ projects would likely to be more successful in community forests. Fourth, involvement in the local organisation would significantly generate positive perception towards REDD+.

7.2.3. Research question 3: How and whether the preferences of the local households for REDD+ projects differ by forest management regime and other socioeconomic contexts, including the current REDD+ intervention?

The third research question is how and whether the preferences of the local households for REDD+ projects differ by forest management regime and other socioeconomic contexts, including the current REDD+ intervention. This question is answered in Chapter 4, "Heterogeneous Public Preference for REDD+ Projects under Different Forest Management Regimes". This chapter analysed a data set gathered by a choice experiment survey in Indonesia and examined heterogeneity in people's preference for REDD+ projects among three distinct forest management regimes (private, government, and community). There are five attributes included in the survey (benefit, distribution, duration, restriction, and participation) that are essential parts of a REDD+ contract.

This chapter has five key findings. First, direct monetary compensation of REDD+ has weaker impacts than the restrictions imposed under REDD+ implementation. Second, distributing REDD+ benefit for community projects is a preferred option. Third, community regime is most supportive to the REDD+ project. Fourth, support for the REDD+ project is lower in private regime. Fifth, female respondents from households with larger family size and limited land ownership are likely to support REDD+ projects more.

7.2.4. Research question 4: How and whether the local households are segmented into different groups based on their preferences towards REDD+, and how to utilise this segmentation to design more targeted REDD+ policies?

The fourth research question is how and whether the local households are segmented into different groups based on their preferences towards REDD+, and how to utilise this segmentation to design more targeted REDD+ policies. This question is answered in Chapter 5, "How to design more effective REDD+ projects? Importance of targeted approach in Indonesia". This chapter analyses choice experiment data obtained from two groups of households (project participants and outsiders) belonging to three types of forest management regimes (private, government and community) in Indonesia. The application of scale adjusted latent class modelling in this chapter reveals latent groups based on their preferences towards the hypothetical REDD+ contracts, as well as to identify the probability and membership for each group to understand the influences of contextual differences in the preference heterogeneity towards REDD+ projects.

This chapter delivers two substantial key findings. First, four classes of households based on their preferences towards REDD+ projects are REDD+ supporters emphasising household benefits (Class 1), REDD+ supporters emphasising community projects (Class 2), indifferent group objecting restrictions (Class 3), and REDD+ opponents demanding monetary benefits (Class 4). Second, forest management regime is a key determinant in separating these classes where REDD+ supporters mainly come from government and community regimes. Third, REDD+ opponents are mainly without any REDD+ experience and low education level.

7.2.5. Research question 5: How could improved understanding of local households' perception, preference and segmentation towards REDD+ projects improve future REDD+ policy?

The fifth research question is how could improved understanding of local households' perception, preference and segmentation towards REDD+ projects improve future REDD+ policy. This question is answered in Chapter 6, "Synthesis and policy implications". Based on the previous three chapters (Chapter 3-5), Chapter 6 synthesises the earlier findings and suggest some policy recommendations to implement future REDD+ projects in light of the findings of this thesis.

Four policy recommendations have been presented in Chapter 6. They are: First, REDD+ costs and benefits should be repositioned to the right orders by classifying or addressing perceived costs at the beginning, promoting environmental benefits more than economic benefits, and using monetary benefits to fund community projects. Second, contextualization of REDD+ projects to specific forest management regime by prioritising community forests to implement the REDD+ scheme, placing REDD+ implementation in private forest regime at the last priority, and implementing different REDD+ strategies for different forest regimes. Third, identifying and targeting potential REDD+ supporters with certain socioeconomic profiles to participate in REDD+ projects. Fourth, distributing sufficient, transparent and factual information about REDD+ to anticipate REDD+ opponents by positioning local organisations as the REDD+ information centre.

7.3. Study limitations and future research directions

We recognise that this study relies on survey data gathered from the three types of forest management regimes in the same island in Indonesia (Kalimantan). Although this would minimise bias generated due to location differences, the extrapolation of findings to other parts of the country could be potentially problematic. Similar studies on the other areas would be helpful to provide comparable information for a better understanding of the impacts of current REDD+ projects from the local households' perspectives. Such a broad base understanding would benefit REDD+ policy design and practices in the future. Furthermore, although we try to make an applicable survey instrument by conducting focus group discussions and pre-testings, the hypothetical aspect of the choice experiment questions might influence the thesis results.

There is a strong preference for the disbursement of funds in community-managed funds, which indicates that the potential attractiveness of such payment vehicle. However, how REDD+'s indirect and non-financial benefits should be distributed to encourage local support for REDD+ has not been explored by this thesis. Finally, agencies should be aware of the heterogeneity of the impact of people's experiences. It seems that in government-managed forest regime, the support for the future REDD+ project is higher if people already have experience with REDD+ projects, whereas, in private forest regime, the trend is opposite. Better knowledge about such heterogeneity can help facilitate initial adoption and ensure sustained success of REDD+ projects. Lastly, future studies could collect specific information such as the types of costs and benefits, standard measurement unit, geographical location and scale of study, forest types/governance structure, market forces in order to provide comprehensive estimates of REDD+ costs and benefits for a fair comparison of cost-effective CO2 emissions reduction options at local, national and global levels.

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APPENDICES

Appendix 2.1. Studies providing REDD+ costs and benefits estimates and a complete set of references
(Note: the cost and benefit estimates in parenthesis are adjusted to 2015 US dollars using inflation calculator for comparison)

Study (year)	Types of benefits: Indirect/ Non-Monetary	Types of benefits: Direct Monetary	Types of costs: Opportunity	Types of costs: Transaction	Types of costs: Implementation	Costs Estimation Approach	Benefits Estimation Approach	Location	Scale	Alternative land use	Emission reduction target	Forest type, carbon density, and forest governance
Andersen et al. (2012)	supporting biodiversity conservation program	$300 - $710 /villager/yr ($309.70- $732.96)		$700 million/year ($722.63)		modelling	supply estimation	Bolivia	national		50%	
Antinori and Sathaye (2007)				$0.03 - $4.05 /$tCO_2$e ($0.03 – $4.63)		global-empirical		28 projects	global			
Araya and Hofstad (2014)			$1/tCO_2$e ($1)			local-empirical		Morogoro, Tanzania	local	agriculture		montane forest
			$39/tCO_2$e ($39.05)									miombo woodlands forest
Bellassen and Gitz (2008)			$10.45 /tCO_2$e ($11.5)			averaging		Cameroon	national			
Blaser and Robledo (2007)			$10.4 billion/year ($11.89)			global simulation		global	global		50% - 65%	
			$12.2 billion/year ($13.95)								90% - 100%	
Boer (2001)				$9.22 /$tCO_2$e ($12.34)		modelling		Indonesia	national			
Bond (2010)		$8 million/yr ($8.7)	$2.49 /$tCO_2$e ($2.71)			local-empirical	supply estimation	Namibia	national			
		$21 - $25 million/yr ($22.82 – $27.17)	$2.12 - $2.60 /$tCO_2$e ($2.30 - $2.83)					Mozambique				
		$74 - $99 million/yr ($80.43 - $107.61)	$2.77 - $3.71 /$tCO_2$e ($3.01 - $4.03)					Zambia				
Borner and Wunder (2008)			$3.24/tCO_2$e ($3.57)			local-empirical		Amazonas, Brazil	local			

			$12.34/tCO_2e$ ($13.58)					Mato Grosso, Brazil		
Bottazzi et al. (2013)		$6.94 - $9.64 /tCO_2e$ ($7.06 - $9.81)		$2.35 - $6 /tCO_2e$ ($2.39 - $6.10)		local empirical	supply estimation	Pilón Lajas, Bolivia	local	
Boucher (2008)		$35 – $40 /tCO_2e$ ($38.53 - $44.03)	$2.51/tCO_2e$ ($2.76)		$1/tCO2e ($1.1)	global-empirical	demand estimation	29 sites	global	
			$11.26/tCO_2e$ ($14.54)			global simulation		global		
Butler et al. (2009)		$614 – $994 /ha ($678.34 - $1098.12)	$7.66 - $19.24 /tCO_2e$ ($8.46 - $21.26)			option ranking, local empirical	supply estimation	Sumatra, Indonesia	local	palm oil
Cacho et al. (2005)			$0.14 - $1.07 /tCO_2e$ ($0.17 - $1.30)			global empirical		6 countries	global	
Coomes et al. (2008)				$6.16/tCO_2e$ ($6.78)		averaging		Panama	national	
Dang Phan et al. (2014)				$15/tCO_2e$ ($15.02)		averaging		developing countries	global	
				$24/tCO_2e$ ($24.03)		option ranking				
				$64/tCO_2e$ ($64.08)		modelling				
				$21/tCO_2e$ ($21.02)						logging
				$25/tCO_2e$ ($25.03)						animal farming
				$31/tCO_2e$ ($31.04)						cropping
				$34/tCO_2e$ ($34.04)						palm oil
				$7.5/tCO_2e$ ($7.51)					national	
				$30/tCO_2e$ ($30.04)					local	
				$56/tCO_2e$ ($56.07)					global	
Deveny et al. (2009)	supporting biodiversity conservation program, and reducing the poverty of local people		$382/ha ($422.03)			global simulation		Africa	regional	
			$2,413/ha ($2665.84)					Europe		
				$9.35/tCO_2e$ ($10.33)				global	global	
		$1.3 - $2.2 billion/year ($1.44 - $2.43)					demand estimation	Indonesia	national	
		$6.9 - $8.8 billion/year ($7.62 - $9.72)						Brazil		

Diaz and Schwartzman (2005)			$4.05 /tCO_2e$ ($4.92)		averaging		Brazil	national			
Dissanayake et al. (2015)			$18.62/tCO_2e ($18.62)		local-empirical		Nepal	national			non-community governance
			$26.6/tCO_2e ($26.6)								community governance
Eliasch (2008)		$8 - $9 billion/year ($8.81 – ($9.91)	$7 billion/year ($7.71)	$0.5 billion/year ($0.55)	global simulation	demand estimation	8 countries	global		50% - 65%	
Enkvist et al. (2007)			€40 /tCO_2e or $55.32 /tCO_2e ($63.24)		local empirical		Africa	global		50%	
							Latin America			75%	
Fisher et al. (2011a)			$119.39 /ha ($125.8)		averaging		Malaysia	national			
Fisher et al. (2011b)			$29.92 /tCO_2e ($31.53)		averaging		Tanzania	national	agriculture		
Fisher et al. (2014)			$7,000/ha ($7008.31)		local empirical		Kalimantan, Indonesia	local			*Dipterocarpaceae* forest
Grieg-Gran (2008)			$1 - $2 /tCO_2e ($1.1 – $2.2)	$0.01 - $0.04 /tCO_2e ($0.01 - $0.04)	global empirical		8 countries	global		70%	
Heres et al. (2013)		R$8037 - R$32,149 /ha or $3748 - $14,994 /ha ($3813.32 – 15,255.32)				supply estimation	Brazil	national	soybean, pasture		
Hoang et al. (2013)	maintaining environmental services and sustaining forest management	$100/ha/yr ($101.74)	$500 - $750 /ha/year ($508.7 - $763.05)		local empirical	demand estimation	Vietnam	national	maize		
Hoare et al. (2008)			$70 - $460 million/year ($77 - $506)		global review		global	global			
Hope and Castilla-Rubio (2008)			$21-39 billion/year ($23.1 - $42.9)		global simulation		global	global		50% - 65%	
			$60-130 billion/year ($66 - $143)							90% - 100%	
Hunt (2010)			$3.40 - $5.64 /tCO_2e ($3.70 - $6.13)		local empirical		Papua New Guinea	national	logging		
			$40 /tCO_2e ($43.48)						palm oil		

Irawan et al. (2014)			\$0.56 /tCO$_2$e (\$0.56)			local-empirical		Papua, Indonesia	local	logging	
			\$12.9 /tCO$_2$e (\$12.92)							timber plantation	
			\$18.9 /tCO$_2$e (\$18.92)							palm oil	
			\$18.9 /tCO$_2$e (\$18.92)					Riau, Indonesia		timber plantation	
			\$56.3 /tCO$_2$e (\$56.37)							palm oil	
John et al. (2014)				\$79.06/ha (\$79.15)		local empirical		Dodoma, Tanzania	local		
Karky and Skutsch (2010)	increasing non timber forest products	\$1 - \$5 /tCO$_2$e (\$1.09 – \$5.43)		\$0.55 - \$3.70 /tCO$_2$e (\$0.60 - \$4.02)		local empirical		Himalaya, Nepal	local		
Kindermann et al. (2008)		\$15 /tCO$_2$e (\$17.06)	\$10 - \$21 /tCO$_2$e (\$11.01 - \$23.12)	\$0.3 - \$4.05 /tCO$_2$e (\$0.33 – \$4.46)		global simulation	supply estimation	global	global		50% - 65%
			\$2 - \$5 /tCO$_2$e (\$2.2 – \$5.5)								10%
Kremen et al. (2000)				\$19.40 /tCO$_2$e (\$26.7)		averaging		Madagascar	national		
Lasco and Pulhin (2001)				\$0.7 /tCO$_2$e (\$0.94)		modelling		Philippines	national		
Makundi and Okiting'ati (1995)				\$13.46 /tCO$_2$e (\$20.93)		averaging		Tanzania	national		
McKinsey & Company (2009)			\$20 - \$59 billion/year (\$22.10 – \$65.18)		\$1.5 - \$4 billion/year (\$1.66 – \$4.42)	global simulation		global	global		90% - 100%
Merger et al. (2012)			\$10.1 – \$12.5 /tCO$_2$e (\$10.43 - \$12.90)	\$0.27 - \$1.57 /tCO$_2$e (\$0.28 - \$1.62)	\$4.5 - \$12.2 /tCO$_2$e (\$4.65 - \$12.59)	local empirical		Tanzania	national	agriculture, fuel wood, logging, pasture	
Ndjondo et al. (2014)			\$4.4 - \$25.9 /tCO$_2$e (\$4.41 – \$25.93)			local-empirical		Haut-Abanga, Gabon	local	logging	
Nepstad et al. (2007)			\$5.16 /tCO$_2$e (\$5.9)			averaging		Amazon, Brazil	local		
Nepstad et al. (2009)		\$5.3 – \$15.86 billion/year	\$6.64 /tCO$_2$e (\$7.34)	\$1 – \$3 /ha/year (\$1.1 – \$3.31)		local empirical	demand estimation	Brazil	national		

	($5.86 - $17.52)							
Olsen and Bishop (2009)		$0 - $1.1 /$tCO_2e$ ($0 – $1.22)	$1 /$tCO_2e$	local-empirical	Brazil	national	subsistence agriculture	
		$0 - $3/$tCO_2e$ ($0 - $3.31)					ranching	
		$2.5 - $3.4 /$tCO_2e$ ($2.76 - $3.76)					soybean	
		$3.9 - $6.1 /$tCO_2e$ ($4.31 - $6.74)					logging	
		$0 - $0.47 /$tCO_2e$ ($0 - $0.52)			Indonesia		subsistence agriculture	low carbon
		$1.65 - $3.44 /$tCO_2e$ ($1.82 - $3.80)					logging	low carbon
		$0.18 - $4.29 /$tCO_2e$ ($0.20 - $4.74)					palm oil	low carbon
		$0 - $1.53 /$tCO_2e$ ($0 – $1.69)					subsistence agriculture	high carbon
		$3.82 - $7.96 /$tCO_2e$ ($4.22 - $8.79)					logging	high carbon
		$0.5 - $19.6 /$tCO_2e$ ($0.55 - $21.65)					palm oil	high carbon
Osafo (2005)		$29.59 /$tCO_2e$ ($35.91)		averaging	Ghana	national		
Osborne and Kiker (2005)		$0.39 /$tCO_2e$ ($0.47)		averaging	Guyana	national		
Overmars et al. (2012)		$0 - $3.2/$tCO_2e$ ($0 - $3.3)		global simulation	Africa	regional		
		$2 - $9/$tCO_2e$ ($2.06 - $9.29)			Latin America			
		$20 - $60/$tCO_2e$ ($20.65 - $61.94)			Southeast Asia			
Potvin et al. (2008)		$1.19 /$tCO_2e$ ($1.31)			local empirical			
Ravindranath et al. (2001)			$0.95 /$tCO_2e$ ($1.27)	modelling	India	national		

Ruslandi et al. (2011)	$ 30.29 /tCO$_2$e ($31.92)			averaging	Indonesia	national			
Sathaye et al. (2011)	$170.85 /ha ($180.02)			modelling	5 countries	global			
Silva-Chávez (2005)	$4.44 /tCO$_2$e ($5.39)			averaging	Bolivia	national			
Sohngen et al. (2008)	$24.56 /tCO$_2$e ($27.04)			modelling	global	global			
Stern (2007)	$2.76 - $8.28 /tCO$_2$e ($3.16 - $9.47)	$0.01 - $0.04 /tCO$_2$e ($0.01 - $0.05)		global simulation	8 countries	global		50% - 65%	
Strassburg et al. (2009)		$8/tCO$_2$e ($8.84)		global empirical, option ranking	20 countries	global		94.5%	
Swallow et al. (2007)	$5 /tCO$_2$ ($5.72)			global empirical	Indonesia	global		64% - 92%	
					Peru			90%	
Tomich et al. (2005)	$0.26 - $5.22 /tCO$_2$e ($0.32 - $6.34)			local empirical	Sumatra, Indonesia	local	agriculture		
	$13.34 /tCO$_2$e ($16.19)						logging		
UNEP (2011)	$18 billion/year ($18.97)		$22 billion/year ($23.18)	global simulation	global	global		90% - 100%	
Venter et al. (2009)	$1.63 – $4.66/tCO$_2$e ($1.8 – $5.15)			local-empirical	Indonesia	national	palm oil		peat soil
	$9.85 – $33.44/tCO$_2$e ($10.88 - $36.94)								mineral soil
Wangwacharakul and Bowonwiwat (1995)		$6.75 /tCO$_2$e ($10.5)		averaging	Thailand	national			
Wertz-Kanounnikoff (2008)		0.01–16.40 /tCO$_2$e ($0.01 - $18.05)		literature review	global	global			
Wulan (2012)	$5 /tCO$_2$e ($5.16)			local-empirical	Central Sulawesi, Indonesia	local	agriculture		
	$13.7 /tCO$_2$e ($14.14)						palm oil		
	$17.8 /tCO$_2$e ($18.38)						logging		

Yamamoto and Takeuchi (2012)	\$4.21/tCO_2e (\$4.35)	averaging	Central Kalimantan, Indonesia	local

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Appendix 2.2. Studies on the distribution of REDD+ costs and benefits by the scale of study and stakeholder

<table>
<thead>
<tr><th rowspan="2">Study (Year)</th><th rowspan="2">Country (Scale)</th><th colspan="3">Costs</th><th rowspan="2">Benefits</th></tr>
<tr><th>Opportunity</th><th>Transaction</th><th>Implementation</th></tr>
</thead>
<tbody>
<tr><td>Pagiola and Bosquet (2009)</td><td>global</td><td>biggest part</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Boucher (2008)</td><td>global</td><td>80%</td><td colspan="2">20% at the global level</td><td>-</td></tr>
<tr><td>Potvin et al. (2008)</td><td>Panama (national)</td><td>75%</td><td colspan="2">25% at country level</td><td>-</td></tr>
<tr><td>Merger et al. (2012)</td><td>Tanzania (national)</td><td>-</td><td>5% - 11% of project costs</td><td>89% - 95% of project costs</td><td>-</td></tr>
<tr><td rowspan="2">Deveny et al. (2009)</td><td rowspan="2">global</td><td rowspan="2">87%</td><td colspan="2">13% at the project level</td><td rowspan="2">mostly for developing countries</td></tr>
<tr><td>project and country level</td><td>-</td></tr>
<tr><td>Coad et al. (2008)</td><td>global</td><td colspan="4">mostly for local community</td></tr>
<tr><td>Karky and Skutsch (2010)</td><td>Himalaya, Nepal (local)</td><td colspan="4">mostly for local community</td></tr>
<tr><td>Irawan et al. (2014)</td><td>Indonesia (national)</td><td colspan="3">• national level: 45–59% private, 40–54% govt.
• central government share the most compared to provincial and district government</td><td>private, government, community</td></tr>
<tr><td>Andersen et al. (2012)</td><td>Bolivia (national)</td><td colspan="3">global fund</td><td>household, municipality</td></tr>
<tr><td>Luttrell et al. (2012)</td><td>Global</td><td colspan="3">national stakeholders, household or local group, government agencies</td><td>-</td></tr>
<tr><td>Hunt (2010)</td><td>Papua New Guinea (national)</td><td colspan="3" rowspan="2">the private sector, landowner, concessionaire, government</td><td>-</td></tr>
<tr><td>Ndjondo et al. (2014)</td><td>Haut-Abanga, Gabon (local)</td><td>-</td></tr>
<tr><td>Bond et al. (2009)</td><td>Global</td><td>-</td><td>buyers and sellers</td><td>-</td><td>-</td></tr>
<tr><td>Antinori and Sathaye (2007)</td><td>Global</td><td>-</td><td>government and individual</td><td>-</td><td>-</td></tr>
<tr><td>Bottazzi et al. (2013)</td><td>Pilón Lajas, Bolivia (local)</td><td>-</td><td>-</td><td>-</td><td>household, municipality</td></tr>
</tbody>
</table>

Appendix 3.1. Forest management regime, access rights to forest-based livelihoods and benefit-sharing arrangements for REDD+ projects in Indonesia.

State forest allocations and management regimes	**Example of forest concession or forest authority**	**Access and activities for households**	**Benefit sharing from selling carbon credit**
Conservation area under government management regime	Nature reserve, wildlife reserve, and national park (core and wilderness zone)	Access to research and education only	50% government, 20% community, 30% developer
Other conservation areas, protection forest and production forest under government and private management regime	National park (utilisation zone), forest park, nature park, hunting park, ecosystem restoration, industrial forest plantation, natural forest concession	Accessible for subsistence and small-scale livelihoods such as farming, fishing, collecting forest-based products	20% government, 20% community, 60% developer
Protection and production forest under community management regime	Village forests and community forests	Fully managed by the community for all subsistence and small-scale livelihoods including subsistence logging	20% government, 50% community, 30% developer

Note: All forest areas in Indonesia are state-owned where the government sets forest management regimes based on forest allocations, studies of functions, as well as ecological and biodiversity values of the forests.

Information in this table is according to:

- Forestry Act (*Undang-Undang tentang Kehutanan*). Number: 41/1999. Jakarta: Government of Indonesia.
- Government Regulation on Management for Sanctuary and Conservation Area (*Peraturan Pemerintah tentang Pengelolaan Kawasan Suaka Alam and Kawasan Pelestarian Alam*). Number: 28/2011. Jakarta: Government of Indonesia.
- Ministerial Decree on Village Forest (*Peraturan Menteri Kehutanan tentang Hutan Desa*). Number: P. 49/Menhut-II/2008. Jakarta: Ministry of Forestry-Republik of Indonesia.
- Ministerial Decree on Licencing Procedures for Business on Carbon Storage and Sequestration in Production and Protection Forest (*Peraturan Menteri Kehutanan Republik Indonesia tentang Tata Cara Perizinan Usaha Pemanfaatan Penyerapan dan/atau Penyimpanan Karbon pada Hutan Produksi dan Hutan Lindung*). Number: 36/Menhut-II/2009. Jakarta: Ministry of Forestry-Republik of Indonesia.

Appendix 3.2. Comparison of REDD+ project sites

No	Differences	Project 1	Project 2	Project 3
1	Forest management regime	Private company	Government	Community
2	Project proponent and developer	Private company	A government with NGO supports	Community with NGO supports
3	Benefit sharing from selling carbon credit*	20% government, 20% community, 60% developer	50% government, 20% community, 30% developer	20% government, 50% community, 30% developer
4	Forest allocations	Production and protection forest	Conservation area	Production forest
5	Concession scheme^	Ecosystem restoration	National park	Village forest
6	Forest access for community#	For primary and small-scale livelihood only	Very limited	Fully managed by community
7	Study area	The entire area under Ecosystem Restoration license	Some area of National Park under the REDD+ project only	The entire area under Village Forest license
8	Location	Kalimantan	Kalimantan	Kalimantan

* According to Ministerial Decree on Licencing Procedures for Business on Carbon Storage and Sequestration in Production and Protection Forest (*Peraturan Menteri Kehutanan Republik Indonesia tentang Tata Cara Perizinan Usaha Pemanfaatan Penyerapan dan/atau Penyimpanan Karbon pada Hutan Produksi dan Hutan Lindung*). Number: 36/Menhut-II/2009. Jakarta: Ministry of Forestry-Republik of Indonesia.

^ Concession scheme is a specific permit issued by the government to manage state-owned forest

According to:

- Forestry Act (*Undang-Undang tentang Kehutanan*). Number: 41/1999. Jakarta: Government of Indonesia.
- Government Regulation on Management for Sanctuary and Conservation Area (*Peraturan Pemerintah tentang Pengelolaan Kawasan Suaka Alam and Kawasan Pelestarian Alam*). Number: 28/2011. Jakarta: Government of Indonesia.
- Ministerial Decree on Village Forest (*Peraturan Menteri Kehutanan tentang Hutan Desa*). Number: P. 49/Menhut-II/2008. Jakarta: Ministry of Forestry-Republik of Indonesia.

Appendix 3.3. State forest allocations and management regimes in Indonesia

	Forest allocations			
	Conservation areas	**Protection forest**	**Production forest**	**Total land forests**
Million hectares	22.10	29.68	68.85	120.63
(%)	(18.32)	(24.60)	(57.08)	(100)
	Forest management regime			
	Government	**Private entity**	**Community**	**Total land forests**
Million hectares	78.42	40.46	1.75	120.63
(%)	(65.01)	(33.54)	(1.45)	(100)

Note: Data is based on *Ministry of Environment and Forestry Statistics 2016* and *Evolution of Forest Areas, TORA and Social Forestry 2017*. Ministry of Environment and Forestry - Republic of Indonesia.

Appendix 4.1. Descriptions of each REDD+ project included in this study

1. REDD+ project in private forest management regime

This REDD+ project was initiated in 2009 by a private company under Ecosystem Restoration Concession (ERC) concession to reduce GHG emissions by conserving tropical peat swamp forest. The project was founded with the aims to make a profit and take advantage of business opportunities provided by the REDD+ mechanism. The project was granted with ERC permit after three years of the application process. In 2014, this project was also verified and certified by the VCS (Verified Carbon Standard) and CCB (Climate, Community & Biodiversity) Standard for selling carbon credit into the voluntary carbon market. The VCS verification reported that there are no conflicts or legal disputes over the ownership or the rights to use the land forest within the project areas. The project area was surrounded by at least 14 villages, dominated by the local Dayak ethnic groups, with the total population around 11,000 people. However, only nine villages were targeted for REDD+ intervention due to the limited financial and human resource capacity of the REDD+ project. The majority of household members in the villages are either the fishermen or labourer of palm companies. Despite efforts on Free, Prior and Informed Consent (FPIC) was conducted, our FGDs and observation found that resistance against the REDD+ project occurred because the project was seen as a threat to palm oil plantation.

Currently, the project has conducted several REDD+ activities that include: establishment of a biodiversity reserve; employment generation for local communities in the form of field crews, guard for patrol and fire brigades; monitoring of biodiversity; establishment of nurseries, replanting of seedlings; supporting agroforestry activities; establishment of community centres and distributing stimulus fund for economic activities to the local community; conducting agricultural training; distributing water filter devices; distributing fuel-efficient stoves; and conducting capacity building programs and early childhood education for the local community. However, activities in this project were dominated by the establishment and protection of project boundaries.

The project is also intended to protect the biodiversity of an adjacent national park by creating a physical buffer along the border of the park. Before the initiation of this REDD+ project, the provincial government was planning to convert the project area into palm oil plantations. This could have resulted in habitat and biodiversity degradation of the endangered Bornean orangutan. Also, palm oil activities that include logging, burning and slashing remaining forest, and drainage of peatlands would release million tons of GHG emissions. Currently, the provincial government support the implementation of this REDD+ project.

2. REDD+ project in government forest management regime

This REDD+ project covers some area of a National Park (NP). The area is peatland dome that was deforested and drained during the 1990s. Drainage of tropical peatland is a key source of greenhouse gas (GHG) emissions. Also, the degradation of peat swamps also affects the socio-economic wellbeing of local populations that depend on the peatland resources for livelihoods. Historically, the peatland was covered by dense lowland rainforest. Illegal loggers created a network of canals dug into the peat surface that was used for floating the logs out of the peatland area. The canals left by the illegal loggers are a major problem for the national park. They accelerate water flow from the peat dome leading to peatland drainage. Therefore, this project aims to stop peat drainage, rewet the peatland, and raise the groundwater level in the project area by applying canal blocking system whereby dams are established in drainage canals.

The project was initiated by the NP office from 2009 with technical support from an international NGO and funded by several international donors. Although the NP office is the project proponent, the managerial and FPIC roles are handled by the NGO. More than 400 dams were built within the entire project area initially, hiring the local community as paid labours and using the local resources as the raw and building materials (logs, poles, stakes, bricks, etc.). The project objective is not for profit, but for ensuring sustainable funding by selling carbon credit to restore the hydrological and ecological functions of the peat swamp forests in the area, as well as for improving the local economy and development. VCS and CCB validation were approved in 2015. Current funding of the REDD+ project comes from donors, not from the voluntary carbon market.

Apart from building dams, the current project activities also include monitoring, reporting and validating carbon sequestration by employing the local community, enhancing livelihoods with income generating measures such as fish farming, and tree planting. The project is surrounded by several fishermen villages of Banjar and Dayak ethnic groups. Most households work as traditional fishermen. By rewetting the peatland, this project potentially increases fishery resources in the area by improving the fish habitat. However, many villagers see this project differently. Canals in the project area are still used by the fishermen for transportation. Therefore, canal blocking as the main project activity might close the canal access for the fishermen and generate objections to the project. Other villagers also state that canal blocking system reduces their fishing yield instead of increasing it. However, the project might also reduce the risk of forest fire by rewetting the peatland.

3. REDD+ project in community forest management regime

This REDD+ project was initiated in 2008 by an international NGO to secure forest management under community regime, to strengthen the local community in forest management, as well as to conserve forest and biodiversity. Initially, the project was funded by the aids from several international donors. The NGO started by carrying out FPIC within the local community to provide sufficient information about village forest and REDD+ projects. Application for Village Forest concession as a legal entity for the community to manage the state forest and REDD+ project was submitted in 2009 and granted by the government in 2011. The community formed a community forest institution that is supported technically by the NGO to manage the village forest area and to implement the REDD+ project. This institution is responsible to the village head which is selected by the community through a democratic election.

The project area is surrounded by palm oil plantations and is the remaining area of a vital ecosystem which provides fresh water, erosion control and other services to local inhabitants, while also supporting a variety of threatened species. It is located on a lowland hilly area and the main source of spring water for the surrounding villagers. There are several culturally important spots in the village forest such as sacred groves and old trees. The REDD+ project generates carbon credit through avoided deforestation and forest conservation scheme that could prevent the critically important remaining forest from being converted to palm oil plantation. REDD+ finance is essential to fund the long-term community-based management of the village forest and ensure that the threat of conversion continues to be avoided. The Plan Vivo Project Idea Note (PIN) was drafted and accepted in 2012.

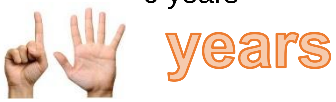
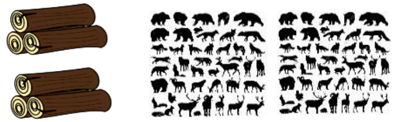
The initiation of the REDD+ project helps the community to obtain their 35 years licence of village forest. This is a significant step to prevent future land use change and to obtain recognition of community rights over the forest carbon. Currently, the REDD+ project activities include regular patrolling and monitoring to protect forest and biodiversity. Forest replanting is also conducted by introducing naturalised and native species. Nurseries were established to support the reforestation and tree enrichment programs. Planting trees are also conducted beyond the project area to provide sufficient fuelwood and timber for future subsistence needs of the villagers. The REDD+ project is also promoted sustainable livelihood activities such as agroforestry and extraction of non-timber forest products. Investments in diversifying livelihoods are also implemented by establishing businesses in spring water packaging, poultry, and animal husbandry. The local community runs all of the REDD+ related activities.

Appendix 4.2. Focus group discussion and local enumerators

Site	No. of Local Enumerators	FGD #	Type of Villages	FGD Participants
Site 1 (private)	3 males	1	REDD+ participating village	6 villagers; 4 community leaders; 1 government officers
		2	REDD+ non-participating village	2 villagers; 1 community leaders; 1 government officers
		3	REDD+ participating village	1 villagers; 1 community leaders; 2 government officers
Site 2 (government)	4 males	4	REDD+ non-participating village	1 villagers; 1 community leaders; 2 government officers; 2 project developers
		5	REDD+ participating village	2 villagers; 1 community leaders; 1 government officers; 1 project developers
Site 3 (community)	3 males & 4 females	6	REDD+ participating and non- participating villages	3 villagers; 1 community leaders; 1 government officers; 4 project developers

Appendix 4.3. An example of a choice set (in English) used in the survey

Block : 1 Choice Set: 1

Attributes	Option 1	Option 2	No REDD+
The rate of REDD+ financial benefit (IDR/household/year).	Rp500,000 	Rp1,000,000 	No benefit (Rp0) 
Distribution or sharing of received REDD+ benefit between households and community projects.	Half to community projects and a half to households 	All to households 	No benefit distribution 
Duration of commitment for REDD+ contract	6 years 	2 years 	No contract 
Added restriction and reduction in logging and hunting from current practices.	Full restriction 	Half reduction 	No added restriction 
Participation of households in decision-making	Yes 	No 	No 
Most preferred (tick one)	☐	☐	☐

Appendix 4.4. Mixed MNL regression results for participating and non-participating villages

Base variables	Variables	REDD+ Participating		REDD+ Non-participating	
		Mean	S.D.	Mean	S.D.
Non-random parameters					
500,000 & Private	*1,000,000 & Private*	0.29**		0.21	
	1,500,000 & Private	0.27**		0.30*	
500,000 & Government	*1,000,000 & Government*	0.01		0.18	
	1,500,000 & Government	-0.01		0.04	
500,000 & Community	*1,000,000 & Community*	0.26**		0.34**	
	1,500,000 & Community	0.27**		0.44**	
All to community & Private	*Half to households & Private*	0.30**		0.51**	
	All to households & Private	0.03		0.32*	
All to community & Government	*Half to households & Government*	0.05		0.07	
	All to households & Government	-0.10		0.05	
All to community & Community	*Half to households & Community*	-0.30**		0.39**	
	All to households & Community	-0.83**		0.45**	
No added restriction & Private	*50% restriction & Private*	-1.37**		-0.82**	
	100% restriction & Private	-1.38**		-0.99**	
No added restriction & Government	*50% restriction & Government*	-0.09		-0.07	
	100% restriction & Government	-0.24**		-0.17	
No added restriction & Community	*50% restriction & Community*	-0.04		-0.31**	
	100% restriction & Community	-0.12		-0.27**	
No Participation & Private	*Participation & Private*	0.48**		0.46**	
No Participation & Government	*Participation & Government*	0.27**		0.34**	
No Participation & Community	*Participation & Community*	0.11**		0.26**	
Random parameters (normal distribution)					
	ASC_{optout}	-6.04**	-0.03	-8.71*	-0.15
ASC_{optout} *& Community*	ASC_{optout} *& Private*	3.81**	-0.02	0.78	0.07
	ASC_{optout} *& Government*	2.49**	1.13**	-0.17	-2.07**
	ASC_{optout} *& Male*	0.32	-0.04	1.23*	0.13
	ASC_{optout} *& Age*	0.00	0.00	-0.01	0.00
	ASC_{optout} *& Hhmember*	-0.21**	0.06	-0.14	-0.19*
	ASC_{optout} *& Distance (logged)*	-0.14	0.00	0.34	0.00
	ASC_{optout} *& Land (logged)*	0.14**	-0.01	0.07	0.01
	ASC_{optout} *& Experienced*	-0.01	0.00	0.45	0.78
	ASC_{optout} *& Income (logged)*	0.16	0.01	0.42	0.10
	ASC_{optout} *& Fincome*	0.21	0.15	-0.50	-0.06
	Log likelihood	-1029.67		-680.08	
	Observations	4413		2574	

* $p < 0.05$, ** $p < 0.01$

Appendix 4.4 indicates that forest management regime and participation in current REDD+ projects generally have a small impact on general respondents' preference for REDD+ attributes. For *Benefit* attribute, the modelling results indicate that respondents in private and community regimes from both participating and non-participating villages have a similar preference for higher *Benefit.* The minimum impact is also indicated by the respondents' preference for lower *Restriction* in private regime regardless they REDD+ participation status. Moreover, respondents from all forest management regimes and villages types have the same expectation to propose households' *Participation* in REDD+ decision making.

Meanwhile, participation on current REDD+ projects significantly influences preference for *Distribution* attribute, particularly in community regime. Respondents in community regime from REDD+ participating villages tend to distribute REDD+ financial benefit for community projects, while their counterparts in REDD+ non-participating villages prefer differently, distributing the benefits for individual households. However, in private regime, there is no difference between respondents from REDD+ participating and non-participating villages. They prefer to distribute the benefits for households. Furthermore, there is an indication that forest management regime effects respondents' preference in REDD+ participating villages. While respondents from private regimes prefer to distribute REDD+ benefits for households, their counterparts in community regime prefer to distribute the benefits for funding community projects.

In overall, respondents in REDD+ participating villages have less preference for opt-out than whom in non-participating villages, indicating higher support for REDD+ in participating villages. Furthermore, in REDD+ participating villages, respondents in private regime show the least support for REDD+, indicated by a higher preference for opt-out. They are followed by the respondents in government and community regimes. Households with more member and smaller land ownership tend to support REDD+ more. Meanwhile, in non-participating villages, female respondents are more supportive to REDD+.

Appendix 5.1. Number of villages in each REDD+ project

REDD+ Projects	**Project 1 (private)**	**Project 2 (government)**	**Project 3 (community)**	**Total Number**
REDD+ participating villages	5	3	4	12
REDD+ non-participating villages	2	1	2	5
Total number of villages	7	4	6	17

Appendix 5.2. Minimum and actual respondents in each research site

Project	Population (number of households in research area)*	Minimum respondents^	Actual respondents
Project 1 (private)	810	89	150
Project 2 (government)	1752	95	152
Project 3 (community)	826	89	158
Total	3388	273	460

* Data is obtained from:

- Subdistrict of Nothern Matan Hilir in Figures 2016 (*Kecamatan Matan Hilir Utara Dalam Angka 2016*). Ketapang: Statistics of Ketapang Regency.
- Sabangau Subdistrict in Figures 2016. Palangka Raya: Statistics of Palangka Raya Municipality.
- Danau Sembuluh Subdistrict in Figures 2016. Seruyan: Statistics of Seruyan Regency.
- Seruyan Hilir Subdistrict in Figures 2016. Seruyan: Statistics of Seruyan Regency.
- BPS.Seruyan. (2016c) *Statistik Daerah Kecamatan Danau Sembuluh 2016 (Statistic of Danau Sembuluh Subdistrict 2016),* Seruyan: BPS-Statistics of Seruyan Regency.

^ According to Yamane (1967), *Elementary sampling theory,* Englewood Cliffs, New Jersey: Prentice-Hall, Inc.: The minimum sample size is given by: $n = \frac{N}{(Nd^2)+1}$, where *n*, *N* and *d* represent sample size, group population size and precision. Given the population sizes on three chosen sites, the minimum sample sizes for 95% of the confidence interval and 10% of precision are 89, 95 and 89, respectively.

Appendix 5.3**.** The script of the introductory *cheap talk*

> "In a choice set, we will ask you to choose one between two options of REDD+ contract. You may choose *No REDD+* if you do not like the two options. We will ask you to answer six choice sets. Please be aware that all attribute levels in presented REDD+ contracts are hypothetical. However, your answers could influence the research results and associated policy recommendations, and this might affect the terms of real REDD+ contract that would be implemented further. Therefore, please answer these questions as if you face the real situation. Do you understand and agree with this?"

Appendix 5.4**.** Respondents' characteristic by REDD+ projects and villages

Variables and Definition	Full Sample (Mean or Percentage)	Sub-samples (Mean or Percentage) and the significance (p-value) of one-way ANOVA test						
		Private	**Government**	**Community**	**Sig.**	**REDD+ participating**	**REDD+ non-participating**	**Sig.**
Gender**:** 0 = female	32%	24%	36%	37%	**	32%	33%	-
1 = male (% male)	68%	76%	64%	63%		68%	67%	
Age**:** Age of household head (years)	41.45	39.45	42.09	42.74	**	41.81	40.95	**
Household member: Number of household members (persons)	4.15	3.85	4.99	3.63	**	3.97	4.41	**
Experience: 0 = no experience on local organization	76%	70%	74%	84%	**	73%	81%	**
1 = having experience on local organization (% with experience)	24%	30%	26%	16%		27%	19%	
Distance to forest: Distance to forest (kilometres)	1.76	1.75	1.16	2.33	**	1.98	1.44	**
Total income: Total income in million IDR/year (thousand USD/year)	36.94 ($2.88)	34.29 ($2.67)	42.57 ($3.32)	34.20 ($2.67)	**	35.95 ($2.80)	38.38 ($2.99)	**
Education level: 1 = 0 – 6 years ;	63.45%	72.48%	52.52%	64.56%	**	67.55%	57.46%	**
2 = 7 – 11 years ;	17.49%	11.41%	26.62%	15.19%		15.09%	20.99%	
3 = 12 years or more	19.06%	16.11%	20.86%	20.25%		17.36%	21.55%	
Occupation**:** 0 = based on non-natural resources (i.e., labour, trader, driver, employee) ;	42%	36%	28%	59%	**	32%	55%	**
1 = based on natural resources (i.e., fisherman, farmer, hunter, logger)	58%	64%	72%	41%		68%	45%	

** p < 0.01

Appendix 5.5. BIC and CAIC simulation results

Model	**LL**	**BIC (LL)**	**CAIC (LL)**	**Npar**	**df**	**Sig.**	**Class. Err.**	**$R^2(0)$**	**R^2**
2-sClass 1-Class Choice	-2139.99	4346.18	4357.18	11	400	**	0	0.28	0.21
2-sClass 2-Class Choice	-1831.48	3861.57	3894.57	33	378	**	0.07	0.44	0.38
2-sClass 3-Class Choice	-1422.39	3175.81	3230.81	55	356	**	0.03	0.62	0.58
2-sClass 4-Class Choice	-1310.79	3085.01	3162.01	77	334	**	0.05	0.70	0.67
2-sClass 5-Class Choice	-1270.52	3136.89	3235.89	99	312	**	0.03	0.72	0.69

** $p < 0.01$