Doctoral Thesis

Local Perceptions Toward REDD+ Project Development and Implementation – Case Studies in Cambodia –

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Abstract

REDD+ is a result-based payment scheme to support developing countries in taking action to reduce deforestation and forest degradation. It has huge potential for carbon emission reductions and increasing carbon stocks, while improving the livelihoods of the people who live within the boundary of the forest. Although REDD+ projects have been implemented throughout the tropics, their effects on local livelihoods are little known to the scientific community.

This study assessed the effects of REDD+ projects before and during implementation on local livelihoods in two REDD+ project sites, in Oddar Meanchey (OM) and Keo Seima (KS), where the projects have been validated and verified and carbon credits have been sold since 2012 in OM and 2016 in KS. Livelihood assets were assessed on a Likert scale from a pool of 232 household questionnaire interviews and 19 key informants from OM and KS REDD+ project sites. Generally, the mean scores for local livelihood assets increased in both OM and KS study areas. Specifically, however, natural capital assets sharply declined from 3.50 and 3.32 to 2.09 and 2.25, respectively. Local people mainly blamed illegal logging for this decline, suggesting that strict patrolling and law enforcement must be implemented.

Using the Likert scale and based on questionnaire interviews with 215 people, five direct and three indirect drivers of deforestation and forest degradation were identified. Direct drivers are illegal logging and unauthorized forest encroachment, commercial timber production, land clearance for commercial cultivation, charcoal production, and land clearance for subsistence agriculture. Indirect drivers are limited law enforcement, demand for timber, and land tenure and rights issues. All direct and indirect drivers are considered permanent. Findings from this study suggest that these permanent drivers need to be addressed, if the long-term success of REDD+ implementation is to be achieved. Eleven out of eighteen activities necessary to address these drivers were determined by the local community. Membership of a community forest seems to influence opinion about drivers.

A scarcity of carbon credit buyers and the projects' inability to generate carbon-based revenues have led to dissatisfaction among local communities, inducing avoidable illegal activities in pursuit of short-term benefits. A financial mechanism to ensure sufficient and sustained financial support in the face of carbon market volatility is urgently needed.

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List of abbreviations

AM	Arithmetic mean
COP	Conference of the Parties
D & D	Deforestation and Forest Degradation
FA	Forestry Administration
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse gas
KS	Keo Seima
MAFF	Ministry of Agriculture, Forestry and Fisheries
MoE	Ministry of Environment
NGO	Non-Governmental Organisation
NTFP	Non-Timber Forest Products
OM	Oddar Meanchey
REDD	Reducing Emissions from Deforestation and Forest Degradation
RGC	Royal Government of Cambodia
SLF	Sustainable Livelihood Framework
TR	Tumring
UNFCCC	United Nations Framework Convention on Climate Change
VCUs	Verified Carbon Units
WCS	Wildlife Conservation Society

Chapter 1 Introduction

1.1. Background

Since the adoption of the Bali Action Plan at the 13th Conference of the Parties (COP13) of the United Nations Convention on Climate Change (UNFCCC) in 2007, the REDD+ scheme of reducing emissions from drivers of deforestation and forest degradation, forest conservation, sustainable management of forests, and enhancement of forest carbon stocks has garnered national and global attention from governments, and the public and private sectors. REDD+ is a result-based payment for eligible activities, undertaken in developing countries, that reduce carbon emissions from the forest sector or enhance forest carbon stocks. Through REDD+, deforestation and forest degradation (D & D) can be reduced, and local communities, whose daily subsistence depends on forest products and other ecosystem services, can benefit from carbon benefit sharing, biodiversity conservation, ensuring and strengthening land tenure rights, and protecting traditional rights of natural resource use.

Forests provide various types of ecosystem services to approximately 2 billion people, ranging from basic shelter to food, medicine, fresh water, renewable energy for daily cooking, and other ecosystem services. Therefore, the loss of forest cover continues to affect the lives of these people in different forms in addition to causing huge carbon emissions in the tropics. The Food and Agriculture Organization of the United Nations (FAO) estimated the loss of forest cover to be approximately 10 million hectares (ha) between 2015 and 2020, a decline from 12 million ha in 2010–2015 (FAO, 2020). REDD+ plays an important role in reducing the speed of this forest loss and the 2 billion people dependent on forests are key for on-the-ground implementation and monitoring of REDD+ projects.

D & D remains the second largest source of global carbon emissions, 12 years after the adoption of the Bali Action Plan of the UNFCCC in 2007. The plan adopted policy incentives to reduce carbon emissions from D & D through conservation, sustainable management, and enhancement of carbon stocks, commonly known as the REDD+ scheme. Recent studies have estimated that global deforestation emitted 4.0 Pg CO_2 $year^{-1}$ during 2001–2010, with rates remaining at 2.9 Pg CO_2 $year^{-1}$ (petagram or billion tons of CO_2) during 2011–2015 (Federici et al., 2015). Zarin et al. (2016) found similar emissions of 2.3 Pg CO_2 $year^{-1}$ between 2001 and 2013. Apart from carbon emissions, loss of forests

reduces ecosystem services, especially provisioning, supporting, and regulating services (Barrios et al., 2018; Kim et al., 2008) upon which 1.6 billion people depend for daily subsistence and livelihoods (Erbaugh and Oldekop, 2018). Foreseeing the consequences of D & D, global leaders signed the Paris Climate Agreement and developed the Sustainable Development Goals in 2015, with both global agreements coming into force in 2016. Among the various strategies for implementing and achieving the targets of both agreements, REDD+ is an important mitigation option because of its ability to tackle climate change while safeguarding and improving local benefits and biodiversity (Phelps et al., 2013). Although there are currently 359 REDD+ projects in the tropics (Simonet et al., 2018), only about 300 have actually been implemented (Simonet et al., 2015).

The long-term sustainability of REDD+ projects in mitigating climate change and safeguarding socioeconomic conditions and biodiversity remains questionable, mostly because of low demand for carbon offsets from these projects (Foster et al., 2017; Laing et al., 2016) and a lack of specific biodiversity goals (Panfil and Harvey, 2016). Enrici and Hubacek (2018) found that the deforestation rate in Indonesia has neither decreased nor stabilised, even though REDD+ has been implemented there since 2007. Similar declines in forest cover have been seen in Cambodia (MoE, 2018) and Myanmar (Cho et al., 2017), although these countries have also actively participated in REDD+ projects. Milne et al. (2019) reviewed REDD+ projects in mainland Southeast Asia and argued that many of the projects created social conflicts and failed to address the drivers of D & D. Some studies, however, have found improvement resulting from REDD+ projects. Simonet et al. (2018), for instance, analysed data from interviews with 181 farmers in a REDD+ project in the Brazilian Amazon and found that the project reduced deforestation by up to 50%. Using publicly available social and spatial data, Jagger and Rana (2017) found that early REDD+ interventions protected the rights of local communities in Indonesia. Atela et al. (2015) found that a REDD+ project in Kenya improved land rights and local people's willingness to protect the forest. Furthermore, based on reviews of 80 REDD+ projects, Panfil and Harvey (2016) found some improvement in biodiversity safeguards and related capacity building where REDD+ projects had been implemented within the past 10 years. Through analysis of links between an agricultural census and remote-sensing data on D & D, Godar et al. (2014) found that REDD+ areas dominated by smallholders could be protected from fragmentation and degradation. Based on several governance indicators tracked in the Maderacre and Maderyja Madre de Dios Amazon REDD+ projects in

southeast Peru, Pettenella and Brotto (2012) found that transparency and accountability needs to be carefully addressed if REDD+ projects are to be successfully implemented.

1.2. Problem Statement and Rationale

Although the studies described above have shed light on the development and implementation of REDD+ projects in the tropics, studies on the effects of project implementation on local livelihoods remain limited. In addition to reducing carbon emissions, successful implementation of REDD+ projects provides benefits to forest-dependent communities through intensive low-carbon agricultural practices and employment in farming, ecotourism, and social enterprises (CBD and GIZ, 2011; Peras et al., 2016). Indigenous and local communities are considered key stakeholders in protecting forest ecosystems and supporting the long-term efforts of REDD+ projects (CBD and GIZ, 2011). Local communities, especially indigenous people and forest-dependent communities play a crucial role in protecting and managing forest resources and associated ecosystems. When properly designed, REDD+ activities can provide huge non-carbon benefits to local people (Hvalkof, 2013). Nevertheless, not all REDD+ projects have produced these expected results. In the Babati district in north-central Tanzania, Jacob and Brockington (2020) found that local communities were dissatisfied with benefit sharing from a REDD+ project because they perceived that weak governance resulted in many benefits going to a small group of elites.

Cambodia has suffered from D & D for many years. Studies on the implementation of REDD+ that focus on various aspects from local to national levels have gained attention in recent years. Sasaki et al. (2016) examined the establishment of the forest reference emission level (FREL) while Nhem et al. (2017) focused on the use of media to improve the effectiveness of REDD+ policy. Nathan and Pasgaard (2017) analysed the contribution of the REDD+ project in Oddar Meanchey to the economic efficiency, environmental effectiveness, and social equity of local communities. They found that revenues from the carbon market alone would not be adequate to realise REDD+ objectives of improving local livelihoods.

Presently, a few REDD+ projects in Cambodia have been validated and implementation of these projects is underway. However, limited study on the effects of REDD+ projects on local livelihood assets exists to guide future informed decision-making. Therefore,

assessment of local livelihoods before and during REDD+ project implementation is important for long-term successful implementation of REDD+ projects in Cambodia and elsewhere.

1.3. Study Objectives

The main objective of this study is to assess the livelihoods of people living in the project areas before and during project implementation using the sustainable livelihoods framework, with particular focus on two important REDD+ project areas where carbon credits have been generated from REDD+ activities.

To achieve this main objective, the following specific objectives are formulated:

1. To understand the latest REDD+ developments in Cambodia from the viewpoint of drivers of D & D;
2. To assess livelihood differences within and across project sites before and during implementation of REDD+ projects in Cambodia;
3. To analyse the sociodemographic factors that affect perceived impacts of REDD+ projects on local livelihoods in REDD+ project areas; and
4. To propose a policy framework for improving the livelihoods of local people in REDD+ project areas.

1.4. Study Scope and Limitations

Since REDD+ projects have been implemented in Cambodia since 2007, there are many existing reports about REDD+ development, implementation, stakeholder engagement, and local communities in Cambodia. Assessment of existing REDD+ projects was based primarily on literature review except at new REDD+ project sites, where questionnaires, focus group discussions, and key informant interviews were conducted to obtain information from key informants such as REDD+ developers, forest government officials, non-governmental organisation (NGO) staff, and village chiefs.

Although there are various ways of assessing the effects of REDD+ project development and implementation on local livelihoods (e.g., Atela et al., 2015; Bottazzi et al., 2013), the sustainable livelihood framework (SLF) is the most commonly used method because of its ability to capture the various aspects of livelihoods in terms of criteria, indicators,

and sub-indicators (Narula et al., 2017; Pandey et al., 2017). Here, the SLF was used to assess local livelihoods in terms of local assets, which can be studied through analysis of natural, human, physical, financial, and social capital prior to and during project implementation.

Biases could occur when asking about local people's memories during the initial stage of REDD+ project development but such biases can be reduced through focus group discussions and key informant interviews. In addition, only adults were interviewed to obtain memories that are acceptable for this type of study. Furthermore, biases can be minimised because of the author's own experience in the field and through key informant interviews.

1.5. Conceptual Framework

D & D in the tropics affect local livelihoods in different ways, depending on local socio-economic conditions. Such effects can be measured using the SLF Ken at al. (2020a). SLF employs a number of criteria and indicators to account for livelihood effects from different aspects. Local livelihoods were assessed during the REDD+ project development phase to form a basis for comparison. As the project was implemented (implementation phase), local livelihoods were affected. Assessments were made through questionnaire surveys. Comprehensive literature reviews as well as qualitative surveys with key informants revealed the progress of existing projects elsewhere in Cambodia and lessons that can be learned from these projects. Using a combination of quantitative and qualitative assessment, appropriate policy interventions can be introduced to reduce D & D and related carbon emissions (Figure 1.1). Finally, the most appropriate policies for implementing REDD+ projects for carbon emission reduction and livelihood improvement can be identified.

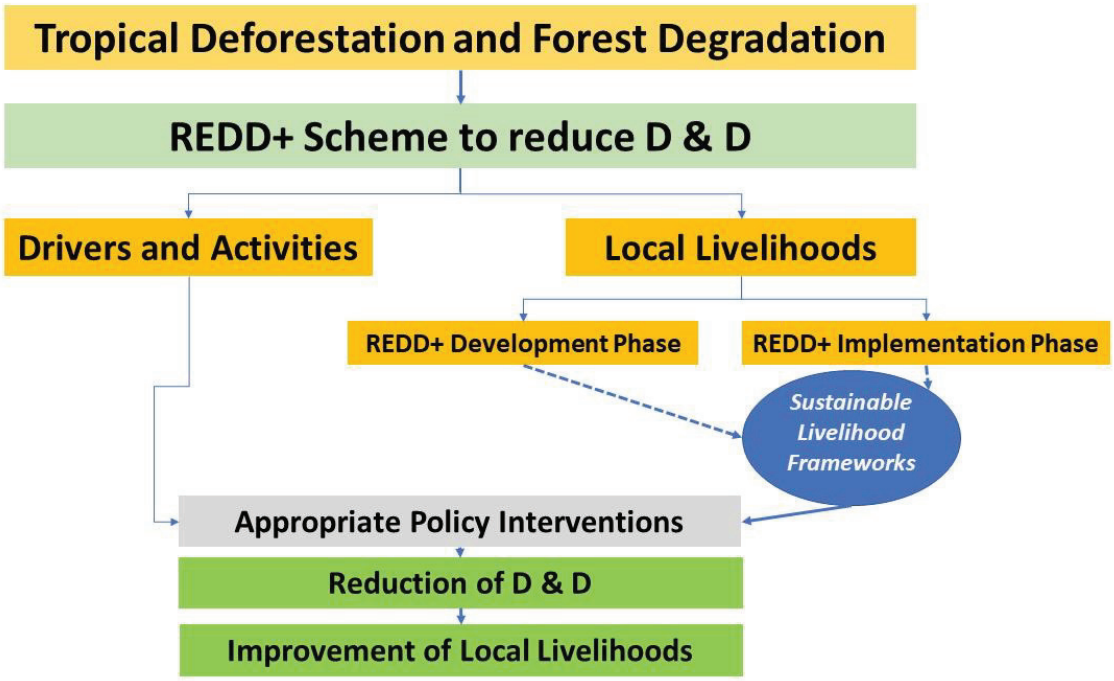

Figure 1.1. Conceptual framework for the study of local perceptions of REDD+ effects (D & D is deforestation and forest degradation)

Chapter 2 Literature Review

2.1. What is REDD+?

Globally, the total area of forests is 4.06 billion ha, or approximately 0.5 ha per person. More than 50% of these forests are found in the Russian Federation, Brazil, Canada, the United States of America, and China. Although it represents only about 10% of global forests, tropical forest has the highest biodiversity on Earth. A recent report suggests that about 880 million people collect fuelwood or produce charcoal every year, while 90% of people living in extreme poverty depend on forests for part of their livelihoods (FAO and UNEP, 2020). Unfortunately, D & D continue to take place at alarming rates, mainly in tropical countries. D & D cause huge carbon emissions, as well as contributing to the ongoing loss of biodiversity and of other ecosystem services and wildlife habitats. Since 1990, about 420 million ha of forest have been lost through conversion to other land uses or as a result of fires, but the rate of such loss has decreased over the past three decades. The latest global report estimated that between 2015 and 2020, deforestation was 10 million ha $year^{-1}$, down from 16 million ha $year^{-1}$ in the 1990s (FAO, 2020). With average carbon stocks of 400 $MgCO_2$ ha^{-1} (Chheng et al., 2016a), losing 420 million ha could mean that 168 $PgCO_2$ (petagram or billion tons of CO_2) were released to the atmosphere between 1990 and 2020. In 2019 alone, global carbon emissions were 38.0 $PgCO_2$, indicating that loss of tropical forests results in huge carbon emissions to the atmosphere.

D & D are the second largest source of carbon emissions from tropical forests, responsible for approximately 15% of global greenhouse gas emissions. Tropical forests are home to at least two billion people whose livelihoods depend on forests and their ecosystem services for survival. Biologically, tropical forests are rich in terms of flora and fauna, but many species have been declining due to rapid deforestation, forest degradation, and illegal poaching. Foreseeing the danger to forests and people, global leaders reached agreements to protect tropical forests in 2007, recognising that such protection can achieve many other objectives in addition to reducing carbon emissions, and ultimately mitigating climate change. At the COP13 of the UNFCCC in 2007 in Bali, Indonesia, the Bali Action Plan was adopted (UNFCCC, 2008). This action plan provides result-based financial compensation (Angelsen et al., 2017) to developing countries for their successful efforts to reduce D & D (REDD), conservation of forests, sustainable management of forests, and enhancements of forest carbon stocks (REDD+). Under the Paris Agreement, whose implementation period is between 2020 and 2030, REDD+ is an important mitigation and

adaptation measure for meeting the commitments of individual countries to the Paris Agreement, which are commonly referred to as Nationally Determined Contributions (NDCs). Emission reductions need to be real and verified before financial support is made available or before carbon credits can be traded. Therefore, REDD+ is commonly known as the result-based payment scheme that provides financial support to developing countries for achieving actual emission reductions.

2.2. REDD+ Development

The aim of REDD+ is to encourage developing countries to contribute to climate change mitigation efforts by: i) reducing greenhouse gas (GHG) emissions by slowing, halting and reversing forest loss and forest degradation; and ii) increasing removal of GHGs from the atmosphere through the conservation, sustainable management and expansion of forests. Under the Warsaw Framework for REDD+ (sometimes known as the REDD+ Rules), countries interested in REDD+ are required to progress through three phases, which are closely linked with one another (UNFCCC Decision 1/CP.16, paragraph 73 in 2016):

Phase 1 or Readiness phase: This phase involves the development of national strategies or action plans, REDD+ mitigation actions, and capacity building in preparation for the implementation of REDD+ activities.

Phase 2 or Implementation of national strategies and results-based demonstration activities: This phase enacts REDD+ actions and national strategies or plans that could involve further capacity building, technology development and transfer, and result-based demonstration activities. Many countries in the tropics have started to implement REDD+ pilot projects, and some have even generated revenue from the sale of carbon credits.

Phase 3 or Results-based payment and actions: This phase must ensure that REDD+ activities at different scales are fully monitored, measured, reported, and verified. Results from the activities must be transparent.

The following five REDD+ activities contribute to mitigation actions in the forest sector and have been globally agreed to:
Reducing emissions from deforestation,

- Reducing emissions from forest degradation,

Conservation of forest carbon stocks,

- Enhancement of forest carbon stocks, and
- Sustainable management of forests.

These five activities can best be implemented – collectively or separately – through a package of coordinated REDD+ actions defined by each country and included in national strategies and action plans. These activities may also provide important climate change adaptation co-benefits. Adaptation refers to the resilience of ecosystems, as well as societies. Where forests have not been degraded, people have enjoyed greater protection from natural disasters such as flooding and landslides. In coastal areas, mangroves can protect against storms and waves. Healthy forests also reduce vulnerability, offering food, shelter, medicine, and livelihood support to some of the world's poorest people.

2.3. Forest Resources and REDD+ in Cambodia

2.3.1. Current REDD+ Projects in Cambodia

The forest definition under the REDD+ programme has been re-defined to make it consistent with the FAO definition as follows:
Forest under the REDD+ programme refers to a unit of an ecosystem in the form of wetland and dry land covered by natural or planted vegetation with a height from 5 metres on an area of at least 0.5 hectares, and canopy crown cover of more than 10%. Other areas included in the REDD+ programme are forest regrowth and areas under afforestation or reforestation. Rubber, oil palm plantations, and perennial crops are excluded from this definition.

REDD+ pilot projects are the first stage of REDD+ phase 2. Therefore, to move to the next stage, Cambodia must work on pilot projects. Table 2.1 shows existing and potential REDD+ pilot project sites in Cambodia, which are under the supervision of three institutes, the Forestry Administration (FA), Ministry of Environment (MoE), and Fisheries Administration (FiA).

Table 2.1 Pilot and potential pilot sites in Cambodia

National Agencies	Project Names
Forestry Administration	1. Oddar Meanchey Community Forest REDD+ Pilot Project
	2. Keo Seima Wildlife Sanctuary REDD+ Pilot Project (From 2016, the area has been under the management of the Ministry of Environment)
	3. Southern Cardamom Mountains
	4. Central Cardamom Mountains
	5. Cardamom Mountains REDD+ Project
	6. Siem Reap REDD Project
	7. Prey Lang REDD Project
	8. Western Siem Pang Important Bird Area
	9. Tumring REDD+ project
Ministry of Environment	1. Kulen Promtep Wildlife Sanctuary REDD+ Pilot Project
	2. Phnom Oral REDD+ Project
	3. Phnom Samkos REDD Project
	4. Lomphat Wildlife Conservation Area
Fisheries Administration	1. Koh Kong Mangrove and Flooded Forest REDD Project
	2. Kampong Chhnang REDD Project
	3. Sihanouk Ville REDD Project

Source: Ngoun (2014)

Although many REDD+ project sites are listed in Table 2.1, only three projects have been validated, namely Oddar Meanchey Community Forestry REDD+ Project (OM), Keo Seima Wildlife Sanctuary REDD+ project (KS) and Tumring REDD+ project (TR). These projects are currently listed in the registry of the Verified Carbon Standard (VCS) and Climate Community and Biodiversity (CCB) Alliance. Another project, the Southern Cardamom REDD+ Project has been validated and verified recently.
Project summaries are shown in Table 2.2.

Table 2.2. Overview of REDD+ projects in this study

Project Name	Reduced Emissions from Deforestation and Degradation in Community Forests-Oddar Meanchey (OM)	Reduced Emissions from Deforestation and Degradation in Keo Seima Wildlife Sanctuary (KS)	Tumring REDD+ Project (TR)
Project Proponent	Royal Government of Cambodia (RGC), Forestry Administration	RGC, Ministry of Environment	RGC, Forestry Administration
Sectoral Scope	Agriculture, Forestry, Land Use	Agriculture, Forestry, Land Use	Agriculture, Forestry, Land Use
Province	Oddar Meanchey	Mondulkiri and Kratie	Kampong Thom
Project Start Date	28 February 2008	1 January 2010	1 January 2015
GHG Accounting Period and Lifetime	28 February 2008 -28Februray 2038 30 years	1 January 2010-31 December 2069 60 years	1 January 2015-31 December 2045 30 years
VCS Project Status	Registered	Registered	Registered
CCB Standards Status	Verification expired	Verification approved	Validation approved
Gold Level Criteria	Yes	Yes	No
Project Validator	Tuev Sued Industrie Service GmbH (Tuev Sued)	SCS Global Services	SCS Global Services
Registry	Verra	Verra	Verra
Estimated Annual Emission Reductions	204,792 t CO_2e	1,426,648 t CO_2e	378,434 t CO_2e
Implementing Partners	Pact, Terra Global Capital, Children's Development Association, Monks Community Forestry, 13 CF groups	WCS, Cambodia Rural Development Team, Community Legal Education Centre	Action for Development (AFD), Wildlife Works Carbon, Forestry Administration, 23 CF groups
Donors	Clinton Climate Initiative, Danida, DFID, JICA, NZAID, Pact TGC, UNDP, US Department of State	ADB, Eleanor Briggs, Japanese Embassy, JICA, The MacArthur Foundation, UN-REDD, USAID, WCS, Winrock International	Forestry Administration, ITTO, Korea Forest Service

Source: VCS Project Database (www.vcsprojectdatabase.org), Wildlife Works Carbon LLC (2018)

This study covers OM, KS, and TR, which have already been validated by VCS and CCB and are reviewed in the following sections. Locations are shown in Figure. 2.1.

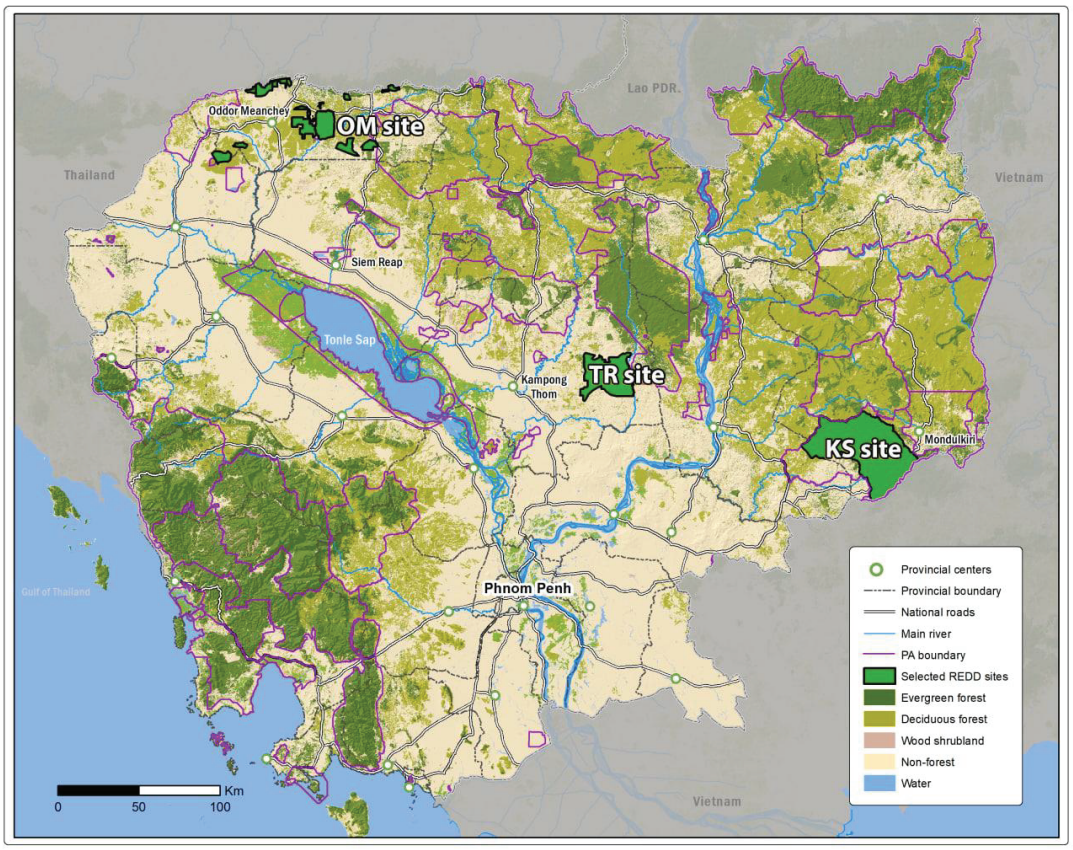

Figure 2.1. Map of study areas
Source: Author

2.3.2. Oddar Meanchey Community Forestry REDD+ Project (OM)

The project area is located in the northwest of Cambodia in Oddar Meanchey Province, as presented in Figure 2.1. The area consists of 13 community forests, with a total area of 63,831 hectares, of which 56,050 hectares is forested (Terra Global Capital, 2012). The REDD+ project is expected to generate an estimated 6,143,767 Verified Carbon Units (VCUs) over 30 years.

Oddar Meanchey was one of the most forested regions of the country during the 1970s. Due to intense pressure from commercial and illegal logging, encroachment, forest fires, and economic land concessions, and several other factors such as rapid economic growth, population growth, migration, and land speculation, deforestation has occurred rapidly throughout the province at a rate of 2% annually from 2002 to 2006 (Terra Global Capital,

2012). In response, a Community Forestry (CF) area was established by the local community in order to protect the remaining forest. This initiative generated the opportunity for long-term forest conservation with support from forest protection finance through the sale of carbon offsets.

2.3.3. Keo Seima Wildlife Sanctuary REDD+ Project (KS)

The project area is located in eastern Cambodia, in Mondulkiri Province with a small area extending into Kratie Province. Keo Seima Wildlife Sanctuary (KSWS; previously Seima Protection Forest) covers an area of 292,690 ha, and the REDD+ project area covers 166,983 ha of forest in the core protection area of KSWS (WCS, 2014). The project is expected to reduce emissions by 14 million tCO_2e from unplanned deforestation over the next 10 years.

Threats include forest clearance for agriculture and unsustainable resource extraction such as hunting, logging, and fishing, which harm both biodiversity and local forest-dependent livelihoods. The drivers of threats are improved road access, population growth, limited law enforcement and governance framework, and limited recognition of biodiversity and environmental values. In response to this situation, the FA (and, from 2016, the Ministry of Environment), the Wildlife Conservation Society (WCS) and other local NGO partners have worked together to develop a management system to conserve and restore biodiversity in the protected area and enhance livelihoods of local people since 2002. However, interventions have been limited in scale and do not match the level of threats; the rates of deforestation and biodiversity decline continue to increase. To encourage greater support from different stakeholders, to improve the effectiveness of interventions, and to generate financial incentives for conservation in the long-term, sustainable financing from carbon revenue for this site is crucial (WCS, 2014).

2.3.4. Tumring REDD+ Project (TR)

The Tumring REDD+ project (TR) is located in Kampong Thom Province. It lies on the south-western edge of Prey Long Wildlife Sanctuary and covers approximately 66,645 hectares of land located in the central part of Cambodia, to the west of the Mekong river

(Wildlife Works Carbon LLC, 2018). TR is designed to promote climate change mitigation and adaptation, maintain biodiversity, and generate alternative livelihoods under REDD+.

The TR area is a buffer zone for Prey Long Wildlife Sanctuary. It is expected to avoid 2.8 million tCO_2e of emissions over a 10-year timeframe. Therefore, protecting TR forest is essential for mitigating global climate change, achieving biodiversity conservation, and ensuring ecosystem service provision for the local community. Despite its importance, there has been uncontrolled conversion of forest to agricultural land at both small and commercial scales, leading to increasing deforestation. To address this, the FA, in consultation with the Korean government, decided to establish the Tumring REDD+ project.

2.4. Drivers of D & D and Activities in OM, KS, and TR

According to the Cambodia UN-REDD+ programme, there are two types of drivers of D & D in Cambodia, direct and indirect. These drivers occur both within and outside the forest sector. Details of the drivers are presented in Table 2.3.

In OM REDD+ project area, the main drivers of D & D are conversion to cropland, timber harvesting (economic land concessions), illegal logging, fuelwood collection, forest fires, and conversion to settlement (Terra Global Capital, 2012). The main cause of deforestation in the KSWS REDD+ project area is smallholder farmers (WCS, 2016). The drivers of D & D in the TR REDD+ project area are high demand for agricultural and cash crops, population growth, illegal logging, fuel gathering, and charcoal production (Wildlife Works Carbon LLC, 2018). The main agents of deforestation are in-migrants and outsiders, who are mainly landless households, forest land speculators or land grabbers, and middlemen.

Table 2.3. Drivers of D & D in Cambodia

	Within the Forest Sector	Outside the Forest Sector
Direct	- Unsustainable and illegal logging - Fire - Unsustainable fuelwood collection	- Clearance for agriculture - Expansion of settlements - Infrastructure development
Indirect	- Lack of demarcation of forest areas - Low institutional capacity and weak policy implementation - Inadequate forest law enforcement - Weak forest sector governance: low levels of stakeholder participation and involvement, lack of transparency and accountability, and inadequate assessment of social and environmental impacts - Lack of sustainable or alternative supply of wood and timber, including for wood energy to meet demand - Demand for wood energy for domestic and industrial use - Low efficiency of wood conversion and use for construction, energy production, etc. - Lack of incentives promoting sustainable management of forests - Lack of finance to support sustainable forest management activities by line agencies, local authorities and local communities	- Population increase - Poverty - Rising incomes and demand for resources - Increasing accessibility of forest areas - Low agricultural yields - Migration into forest areas - New settlements, including in border areas - Large-scale agro-industrial developments (including economic and social land concessions and other concessions) - Land speculation - Regional demand for resources - Poor Environmental and Social Impact Assessment (ESIA) regulations and lack of implementation - Governance: Weak forestland tenure – tenure is weakest in forests and other areas outside residential or farming zones; land grabbing; weak law enforcement; limited implementation of land registration (private and state); insufficient implementation of land-use planning; overlapping/unclear jurisdictions - Social norms (claiming land through utilisation) - Economic benefits provided by sustainable management of forests at the national level often appear lower than alternative land uses - Opportunity costs of sustainable management of forests at the local level - Low awareness of environmental roles of forests

Source: Adopted from FCPF and UN-REDD (FCPF and UN-REDD, 2011)

2.5. Appropriate Measures for Reducing D & D in Study Area

To address these drivers, appropriate measures have been proposed and practised in these project areas. Table 2.4 shows the activities to be implemented in each REDD+ project.

Table 2.4. REDD+ activities proposed or implemented in each REDD+ project

Oddar Meanchey (OM)	Keo Seima (KS)	Tumring (TR)
1. Reinforcing land tenure status 2. Sustainable forest and land-use plans 3. Forest protection 4. Assisted natural regeneration and enrichment planting 5. Fuel-efficient stoves 6. Livestock protection from mosquitoes 7. Agricultural intensification 8. Natural resource management projects 9. Fire prevention	1. Develop key legal and planning documents for KSWS and surrounding landscape that are approved and implemented 2. Reduce forest and wildlife crime by direct law enforcement 3. Establish sustainable community use of land and natural resources adapted to climate change 4. Support alternative livelihoods that reduce pressure on forest and natural resources 5. Effective monitoring 6. Effective administration 7. Fundraising	1. Income-generating activities 2. Deforestation-free commodities and promotion of production forestry 3. Promoting effective land use planning and tenure security 4. Strengthening community organisations 5. Training on agricultural methods and intensification 6. Employment and motivation of a larger ranger force 7. Improve health facilities and care

Source: Terra Global Capital (2012), WCS (2016), Wildlife Works Carbon LLC (2018)

2.6. Sustainable Livelihoods Framework

The sustainable livelihoods framework (SLF) or approach is a way of thinking about the objectives, scope, and priorities for development activities (Serrat, 2017). SLF is based on evolving thinking about the way that the poor and vulnerable live and the importance of policies and institutions. SLF helps to formulate development activities that can be designed to be "people-centred, responsive and participatory, multilevel, conducted in partnership with the public and private sectors, dynamic, and sustainable" (Serrat, 2017).

Although it is not a panacea, SLF facilitates the identification of practical priorities for actions that are based on the views and interests of those concerned. SLF does not replace other tools, such as participatory development, sector-wide approaches, or integrated rural development. However, it makes the connection between people and the overall enabling environment that influences the outcomes of livelihood strategies. It brings attention to bear on the inherent potential of people in terms of their skills, social

networks, access to physical and financial resources, and ability to influence core institutions.

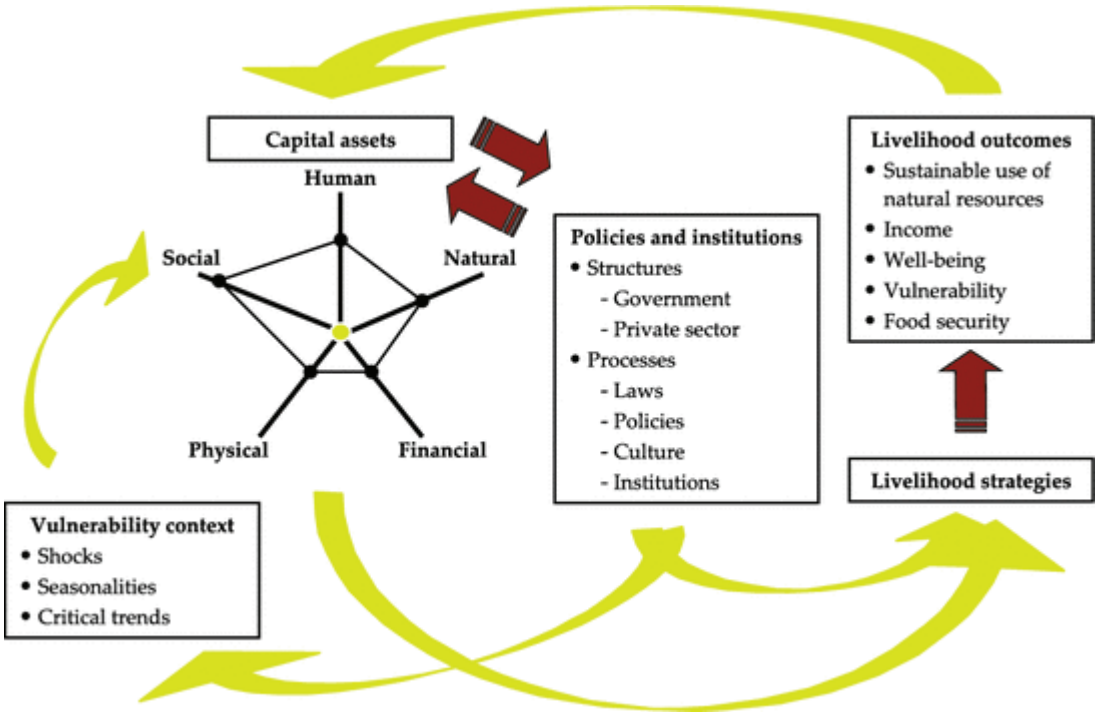

Figure 2.2. The sustainable livelihoods framework
Source: Serrat (2017)

SLF has been used to assess the performance of ecotourism development in China (Qian et al., 2017) and Cambodia (Kry et al., 2020) by looking at livelihood assets in terms of natural, physical, social, human, and financial capital, measured using indicators. The five-point Likert scale, ranging from 1 for 'strongly disagree' to 5 for 'strongly agree', is commonly used to assess development impact scores by combining indicators of the assets listed above. The scores for individual indicators are obtained by asking respondents to provide a rank based on their perceptions.

Social capital is not always used for positive purposes: social relationships, networks and trust can act as a foundation for negative actions and exclusion – or even oppression – of particular social groups. Similarly, a society may be well-organised, with strong institutions and embedded reciprocal mechanisms, but be based on fear and power (for example in feudal, hierarchical, or racist societies). Some forms of social capital may also have adverse effects upon the sustainability of natural resources.

Since social capital can represent only one of the five capital assets for local livelihood assets, it would not provide a comprehensive assessment of the effects of REDD+ development on local livelihoods in Cambodia. Therefore, SLF was adopted for this study.

According to Serrat (2017), through the study of perceptions, local livelihoods can be measured across five capital assets as follows:

Human capital: This includes, but is not limited to, health, nutrition, education, knowledge and skills, capacity to work, capacity to adapt.

Social capital: This includes networks and connections (patronage, neighbourhoods, kinship), relations of trust and mutual understanding and support, formal and informal groups, shared values and behaviours, common rules and sanctions, collective representation, mechanisms for participation in decision-making, leadership.

Natural capital: This includes land and produce, water and aquatic resources, trees and forest products, wildlife, wild foods and fibres, biodiversity, environmental services.

Physical capital: This includes infrastructure (transport, roads, vehicles, secure shelter and buildings, water supply and sanitation, energy, communications), tools and technology (tools and equipment for production, seed, fertiliser, pesticides, traditional technology).

Financial capital: This includes savings, credit and debt (formal, informal), remittances, pensions, and wages. In this sense, this term focuses on household-level financial capital rather than from the point of view of economic status in society.

2.7. Household Surveys

Individual household surveys, focus group discussions, and key informant interviews are common mixed methods for assessing local perceptions of aspects of development (Abukari and Mwalyosi, 2020). One important element for household surveys is determining the number of samples (sample size) that is sufficient to represent the study area in question. Although there are various methods available for determining this sample size, Yamane's equation (Yamane, 1967) is commonly used. The equation is expressed as follows:

$$n = \frac{N}{1 + Ne^2} \tag{2.1}$$

where
n is the minimum suggested sample size in the study area (people or households);
N is the total population in the study area (people or households);
e is the margin of error (5 to 10% or *e* = 0.05 or 0.1 based on the location).

If the total household population is 10,000, at *e* = 0.05, the sample size would be as follows:

$$n = \frac{10000}{1 + 10000 \times 0.05^2} = 384.6$$

As some data may not be able to be collected or may be lost during data entry, it is common practice to collect 10% more than the *n* value provided by the Yamane equation to ensure that the minimum sample size is valid and acceptable for data analysis. In the above case, the actual number of households to be interviewed will be *n* = 384.6 + (384.6 × 0.1) = 423 households. The minimum suggested sample size was calculated using Equation 2.1 with a margin of error of 0.05 or 5%.

Chapter 3 Overview of REDD+ Drivers in Cambodia

3.1. Introduction

Various methods have been used to identify drivers of D & D. On a global scale, Curtis et al. (2018) used satellite imagery and a forest loss classification model. According to Ken et al. (2020b), the studies found that clearance of forests for commodity production was the main driver (27%), followed by logging activities (i.e., forestry, 26%), shifting agriculture (24%), and wildfires (23%). Using a questionnaire to collect information from managers of 28 landscapes across the tropics, Jayathilake et al. (2021) identified some major drivers of D & D in the surveyed regions. Their findings indicate that commercial and subsistence agriculture are the main drivers of deforestation, followed by settlement expansion and infrastructure development. Specifically, land is cleared for rice, rubber, cassava, and maize cultivation in these emblematic conservation landscapes. Generally, five main drivers of deforestation have been identified for all tropical continents, namely urban expansion, infrastructure, mining, agriculture for local subsistence, and agriculture for commercial purposes (Weatherley-Singh and Gupta, 2015). There are four main drivers of forest degradation: livestock grazing in forests, uncontrolled fires, fuelwood charcoal, and logging for timber.

Although previous studies on identification of drivers provide useful insights into the causes of tropical deforestation, they fail to focus on drivers that are actually perceived to be essential for the survival of local people, especially for those whose livelihoods have depended on forest ecosystem services for subsistence over many generations. In Vietnam, Khuc et al. (2018) suggested a need to understand drivers at the local level before introducing interventions to reduce D & D. By understanding the drivers, of such drivers can also be identified so that appropriate policy interventions can be introduced to reduce or even stop the drivers; such policies would be doomed to failure if they do not address the activities of the drivers (Skutsch and Turnhout, 2020). Therefore, identifying drivers can have various implications for protecting tropical forests. Skutsch and Turnhout (2020) analysed the drivers of D & D in 12 countries across the tropics and found that local activities and agents were responsible for more than 70% of D & D drivers. This shows that it is important to identify drivers at the local level through direct interviews and field observations before proposing policy interventions to ensure effective implementation.

This chapter aims to identify the drivers of D & D and appropriate and acceptable activities for reducing these drivers through analysis of local perceptions to set the basis for understanding why REDD+ projects have been implemented in Cambodia as well as in many other developing countries. To achieve this aim, field questionnaire interviews, focus group discussions, and field observations were conducted in seven communities adjacent to the recently validated Tumring REDD+ project site located in Kampong Thom Province, Cambodia.

3.2. Identification of Drivers

3.2.1. Description of Study Area

The study area is located in Kampong Thom Province in Cambodia presented in Figure 3.3. It was part of an FA feasibility study project, sponsored by the International Tropical Timber Organization (ITTO) in 2015, under the project name "Sustainable Forest Management through REDD+ mechanisms in Kampong Thom Province, Cambodia".

This project covers a total of 23 forestry communities with a total population of 5,267 families. Fieldwork in this study was conducted in 7 of the 23 communities. These communities are Veal O Khdey, Prey Cheam Smach, Prey Naktala, Prey Kbal Daun Tey, Prey Kbal Ou Kror Nhak, Beong Rolom, and Andoung Pring, located inside the Prey Lang Wildlife Sanctuary in Kampong Thom Province, Cambodia as shown in Figure 2.1.

Identification of the drivers of D & D is important for all member countries of the UNFCCC for development of national REDD+ strategies, in which drivers, intervention policies, and activities need to be included as part of the requirements for the REDD+ result-based payment scheme. Researchers have attempted to document the drivers of D & D across the tropics. Hosonuma et al. (2012) analysed drivers in self-reported REDD+ readiness activities and the Readiness Plan Idea Notes (R-PIN) prepared for the Forest Carbon Partnership Facility of the World Bank by 46 countries. They identified five types of drivers of deforestation and four types of drivers of forest degradation as presented in Table 3.1. In Cambodia, drivers of D & D are difficult to identify due to complicated demands and links among different stakeholders (FCPF and UN-REDD, 2011).

Table 3.1. Characteristics and scales of drivers of D & D across 46 countries

Driver	Description and Scale
Drivers of deforestation	
Agriculture (commercial)	• Forest clearing for cropland, pasture and tree plantations • For both international and domestic markets • Usually large- to medium-scale
Agriculture (subsistence)	• For subsistence agriculture • Includes both permanent subsistence and shifting cultivation • Usually by (local) smallholders
Mining	• All types of surface mining
Infrastructure	• Roads, railways, pipelines, hydroelectric dams
Urban expansion	• Settlement expansion
Drivers of forest degradation	
Timber/logging	• Selective logging • For both commercial and subsistence use • Includes both legal and illegal logging
Uncontrolled fires	• Includes all types of wildfire
Livestock grazing in forest	• On both large and small scales
Fuelwood/charcoal	• Fuelwood collection • Charcoal production • For both domestic and local markets

Source: Hosonuma et al. (2012)

This study employed both a questionnaire interviews as presented in Figure 3.1 and focus group discussions shown in Figure 3.2 to understand the drivers of D & D, and to obtain a consensus among the local communities on appropriate activities for addressing the drivers.

Questionnaire interviews were conducted in August 2018, covering seven community forests out of 23 communities in Kampong Thom, Cambodia as shown in Figure 3.3. These communities were selected as they are located in or near areas with the highest rate of forest cover change. In each community, households were randomly selected with help from the local leader. Due to the high level of illiteracy in the study area, the research team took the questionnaire to local villagers (or interviewees) at their homes. As shown in Figure 3.1, interviewees answered the questionnaire with help from the interviewer (for language, terms, and content) if necessary.

Figure 3.1. Household interview

As the household population in the study area is 5,267 households, the minimum suggested sample size by equation 2.1 with a margin of error of 0.05 or 5% is in the range of 98. Therefore, interviews were targeted in 200 households. In case any errors in data collection led to unusable observations, the study aimed to interview an additional 10% of households, or 215 households in total in the study area. Due to the lack of government records on the population size of each community and limited access to rural areas, a convenient sampling method (Etikan et al., 2016), which selects equal sample size from each community, was used to interview households who were at the home during the time of the visit.

The study randomly visited each house and interviewed the household head, if present. Where both wife and husband were at home, only the husband was interviewed, because the husband is the common head of the household in Cambodia. Four households were intentionally removed because some information was missing from the original data. In each community, households were randomly selected from the roster obtained from the community leader. Table 3.2 shows the number and percentage of households interviewed in each community forest.

Previous studies have shown the need of focus group discussions to integrate local views and experiences of the communities for project implementation, if a project to be achieved for long-term success (Ban et al., 2009; Engen et al., 2018; Poudel, 2019). Focus group discussions with senior locals who have lived in the study area for a long time were organised to understand changes that have occurred, and to agree on and/or eliminate general drivers of D & D that are found elsewhere in Cambodia, in order to save time during subsequent surveys by not asking questions related to issues that are not actually seen in the study area. Furthermore, focus group discussions helped to understand local acceptance of driver and appropriate activities for reducing drivers. These focus group discussions served to re-affirm the results from individual surveys in the study area.

The main criteria for selecting the focus group participants was that they were locals who had lived in the study area for at least 10 years; to ensure that they were knowledgeable about forest clearing, logging, and other land clearing activities by locals, private companies, and others. With these criteria, and in consultation with government officials and village chiefs, 72 participants (39 of which were female) were chosen. Their residences were unevenly distributed throughout the study area as presented in Table 3.2. Accordingly, four focus groups held discussions separately, in Prey Cheam Smach (18 participants), Prey Naktala (18), Prey Kbal Ou Kror Nhak (19), and Prey Kbal Daun Tey (17) villages on the 28th and 29th of August 2018.

Figure 3.2. Focus group discussions during fieldwork at the TR site

Table 3.2. Number and percentage of households interviewed and focus group discussions in the selected community forests

	Households Interviewed		Focus Group Discussion
Community Forest	Sample Size	(%)	Participants (Female)
1. Veal O Khdey	31	14.4	
2. Prey Cheam Smach	31	14.4	18 (12)
3. Prey Naktala	32	14.9	18 (6)
4. Prey Kbal Daun Tey	31	14.4	17 (8)
5. Prey Kbal Ou Kror Nhak	32	14.9	19 (13)
6. Beong Rolom	29	13.5	
7. Andoung Pring	33	15.3	
Valid sample size	215	100	72 (39)

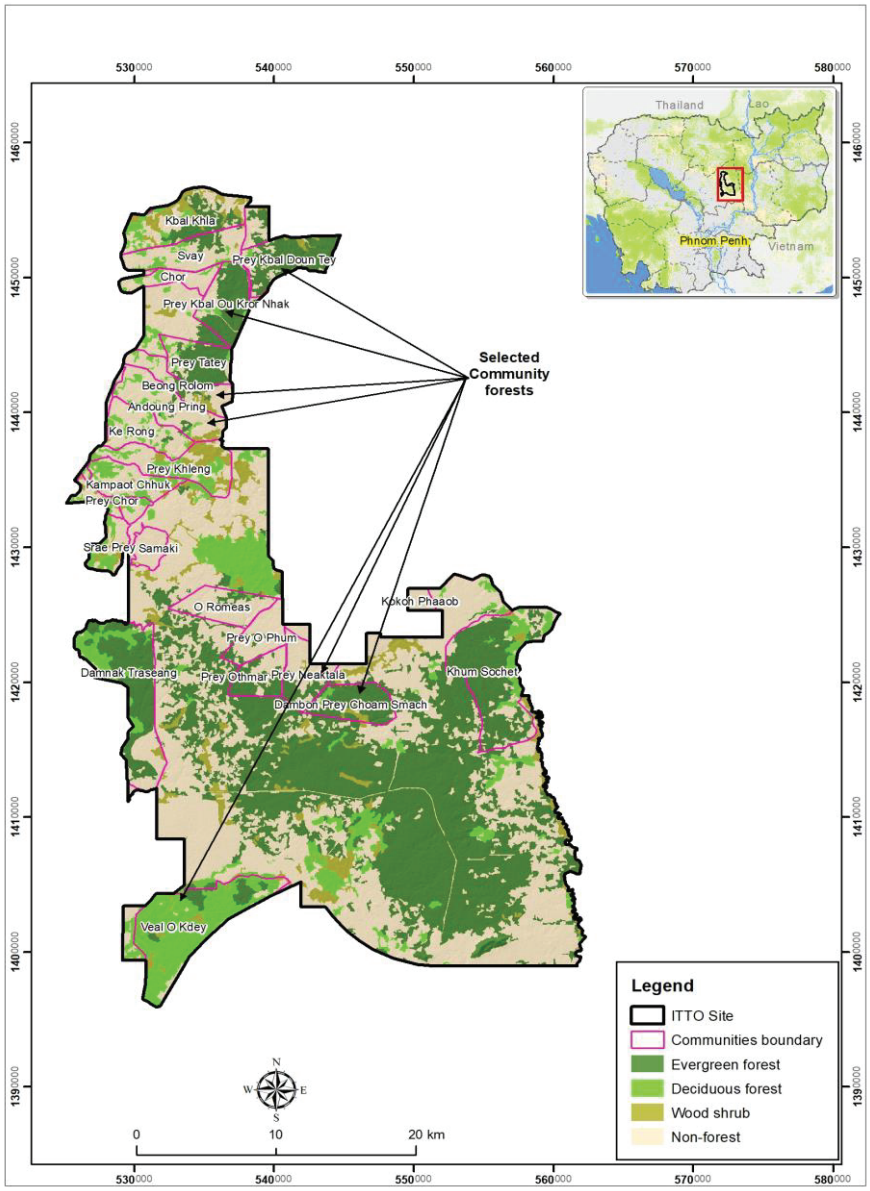

Figure 3.3. Seven community forests from 23 community forest areas in TR site
Source: Author

3.2.2. Analysis

The perception of nine direct drivers and eleven indirect drivers was elicited based on Table 2.3. The basic profile of eleven factors which are sociodemographic variables of the respondents rather than household characteristics are elicited.

The questionnaire interview was designed based on the Likert scale format to elicit the degree of agreement of local residents with what the drivers of D & D in their area are,

as well as suitable solutions for their region. On the Likert scale, scores 1, 2, 3, 4, and 5 refer to 'strongly disagree', 'disagree', 'neutral', 'agree', and 'strongly agree', respectively, in response to the associated questionnaire statement. Question asked 'to what extend do you agree that the following drivers exist in your areas?'
Descriptive statistics for the five-level ordinal variables representing the extent of agreement with nine direct drivers, eleven indirect drivers, and 18 types of REDD+ activities were analysed using frequency distribution, mean, median, and standard deviation. For articulation, these drivers, and activities were ranked per respective category according to their mean scores. Quantitative results are discussed in conjunction with insights from focus group discussions. In addition, regression analysis was employed to examine how sociodemographic factors influence the perceived drivers, and activities to reduce the drivers.

The study initially estimated the ordered probit model. However, in our attempts to test for the parallel-line assumption, iterations in the maximum likelihood estimation failed to converge because of the concentration of observations at less than three values. Most ordinal variables representing perceptions were found to be concentrated at one or two levels. Hence, these ordinal variables were converted to binary variables for analysis in a probit regression (Salaisook et al., 2020) rather than applying ordinal regression models (Bhat and Srinivasan, 2005). The multi-collinear variables are removed based on the variance inflation factor (VIF). Lastly, heteroscedasticity robust standard errors were used to account for unknown structures of variation. Quantitative analyses were performed using STATA 15.

3.3. Results and Discussion

3.3.1. Respondents' profiles

Although the sampling unit was a household, key variables were based on respondents' individual perceptions. Table 3.3 summarises the descriptive statistics of respondents' profiles. More than two-thirds (68%) of respondents are women, and the rest (32%) men. The higher number of female respondents was due to their availability during the time of the survey. Most women were at home, while men were in the field or far from home. Many of the male household leaders not interviewed are labourers in Thailand or Korea. Respondents' ages range from 18 to 81 years. The combined age segment from 18 to 50 accounts for 69.7% of the sample. Some of these adults work on farms or used to go to

the forest to collect non-timber forest products (NTFPs), and have participated in forest protection and management, in roles such as rangers. Therefore, they have witnessed how the forest in their community has previously been degraded or deforested. A total of 30.3% of the sample is above 50 years old. These people have experience and knowledge of changes in forest cover and other conditions in their community and were thus able to provide perspectives on how and why local forested regions have been lost or degraded.

Table 3.3. Profile of survey respondents in the study area (n = 215)

Sociodemographic Profile Variable	Category or Level	Frequency (%)	Mean (SD)
S1 Gender of respondent*	Male	32.6	
	Female	67.4	
S2 Age of respondent (years)	18-30	23.7	42.3 (14.3)
	31-40	28.8	
	41-50	17.2	
	51-60	17.7	
	>60	12.6	
S3 Marital status of respondent	Single	0.5	NA
	Married	88.8	
	Divorced	2.8	
	Other	7.9	
S4 Household size (headcount)	Less than 4	21.9	4.8 (1.6)
	4-7	70.2	
	More than 7	7.9	
S5 Level of education of respondent	No education	26.5	NA
	Informal education at pagoda	1.9	
	Literacy class	2.8	
	Primary school	38.1	
	Secondary school	21.4	
	High school	7.0	
	Diploma, vocational education	0.5	
	College or higher	1.9	
S6 Duration of residency of respondent in study area (years)	1-10	15.4	32.9 (18.4)
	11-20	14.4	
	21-30	16.7	
	>30	53.5	
S7 Primary occupation of respondent	Farmer	80.5	NA
	Labourer	8.4	
	Businessperson	5.1	
	Government officer	0.9	
	NTFP collector	0.9	
	Rancher	0.5	
	Other	3.7	

Table 3.3 (contd.). Profile of survey respondents in the study area (n = 215)

S8 Duration of primary occupation (years)	1-10 11-20 21-30 >30	54.9 15.8 10.7 18.6	16.4 (14.0)
S9 Household income from primary occupation (USD/year)	<500 500-1000 1001-2000 >2000	28.4 39.1 15.8 16.7	1266.3 (1604.8)
S9 Household income from other occupations (USD/year)	<500 500-1000 1001-2000 >2000	61.4 9.3 21.9 7.4	790.7 (1181.2)
S10 Community forest membership status of respondent	Member Non-member	68.8 31.2	NA
S11 Participation in forest management committee by respondent	Participant Non-participant	43.7 56.3	NA

Note: * adult at home at the time interviews were conducted.

From the study site, it was revealed that two-thirds (68.8%) of respondents are members of community forests. However, only 43.7% had ever participated in activities related to forest management or conservation, such as attending forestry-related meetings or acting as forest rangers.

3.3.2. Drivers of D & D in the Study Area

3.3.2.1. Direct Drivers

The descriptive statistics of responses to the Likert scale questionnaire on direct drivers of D & D are presented in Table 3.4. Each of the direct drivers is explained as follows:

***N1 Illegal logging and unauthorized encroachment*:** Elsewhere in the tropics, illegal logging has been reported as a major cause of deforestation and loss of carbon stocks (Brancalion et al., 2018; Lynch et al., 2013; Rudel et al., 2016; Vidal et al., 2014). Poffenberger (2009) reported that land encroachment is a known driver of deforestation and forest degradation in north-eastern Cambodia. In addition to illegal logging, trees are also cut down by local hunters to facilitate hunting of wild animals. Although felling of trees for hunting purposes is not a major cause of forest degradation, this practice, if repeated over large areas, could cause forest degradation and even deforestation (Khai et al., 2016).

According to the questionnaire, the mean rating score for this direct driver of D & D was the highest (4.53) of all drivers. Almost all respondents (97.7%) agree that illegal logging is the main reason for forest degradation, and that unauthorized encroachment is the main reason for deforestation in their respective community forests. According to focus group discussions, illegal logging is the main concern for forest degradation and eventual loss of forest cover in community forests and surrounding areas, and will continue until all the forest has disappeared. Participants observed that there is almost no forest left near their community forests, and their community forests are increasingly threatened by unauthorized encroachment by outsiders. Community forests are encroached, and trees felled by both local community members and outsiders, due to the lack of alternative resources for daily subsistence and livelihoods. Furthermore, participants noted that although people with lower socioeconomic status commit most of the illegal logging, there have been instances where the more affluent were involved.

***N2 Commercial timber products*:** This driver refers to organised logging activities involving the export of timber by truck for delivery to external parties. The score by questionnaire for this item is 4.20, and approximately 87.7% of respondents perceived that commercial timber products are the second main driver of forest degradation and eventual loss of forest cover in their respective communities. In general, participants perceive that commercial timber products trigger the need for timber in huge amounts; therefore, increasing volumes of wood are being logged for commercial export. Respondents felt that the loggers have little knowledge about tree felling, thus their activities cause excessive damage to residual stands, resulting in rapid forest degradation and reduction in forest cover. Collection of commercial timber products was a leading cause of rapid deforestation in the Philippines between the 1970s and 1980s (Bensel, 2008) and in the Baltistan region of Pakistan (Ali and Benjaminsen, 2004).

***N3 Land clearance for commercial agriculture*:** The score for this item is 4.19, with 80.4% of respondents perceiving it as a major driver of the loss of forest cover in their respective communities. Economic land concessions, offered to investors growing cassava, rubber, and cashew, have caused a huge reduction in forest cover because concessions were granted for land in forested areas. Vast tracts of forest were leased to private companies in the name of development. Moreover, these investors also profited from the sale of timber logged while clearing the land in preparation for agriculture. Using high-resolution remote sensing data, a recent study found that land clearance incentivised by

economic land concessions has caused rapid deforestation in Cambodia (Davis et al., 2015).

***N4 Charcoal production*:** The score for this driver is 3.60, with 66.7% of respondents believing that charcoal production contributes to D & D in their region. Charcoal kilns have been constructed in the project study area for commercial charcoal production, such as in Ou Thmor and Ou Phoum. Charcoal production has caused D & D in Mozambique (Sedano et al., 2016), Brazil (Sonter et al., 2015), and Angola (Chiteculo et al., 2018).

N5 Land clearance for subsistence cultivation: The score for this driver is 3.54, with 55.2% of respondents of the opinion that subsistence cropping by local residents contributes to forest clearance. In order to grow more crops for agricultural purposes, local people clear any forest land to which they have access. A recent study indicated that clearing the forest for subsistence agriculture may be motivated by declines in crop productivity; in order to support the livelihoods of increasing numbers of family members, a greater area is sown with crops to maintain sufficient output (Kong et al., 2019). Subsistence cultivation does not always cause deforestation or forest degradation. This is supported by studies in Indonesia (where slash-and-burn agriculture is practised) (Henley, 2011), eastern Madagascar (Styger et al., 2007) and the Philippines (Uitamo, 1999). Moonen et al. (2016) found that subsistence cultivation in the Democratic Republic of the Congo did not cause deforestation. Instead, clearance of forests by rich farmers for cash was the cause of deforestation. Similarly, Ravikumar et al. (2017) found that subsistence agriculture did not cause deforestation in the Peruvian Amazon, arguing that previous studies with results to the contrary had analysed remotely sensed data only.

***N6 New settlements*:** New settlements are established by the flow of migrants to the community and through increases in the number of members in each household. The score for this driver is 3.44, with 47.5% of respondents perceiving it as a driver of D & D. Links between migration and clearance of forests have previously been reported in Cambodia (Kong et al., 2019; Milne, 2012). Clearing forests for new settlements has also been reported in other tropical regions such as Brazil (Fearnside, 2005; Rudel et al., 2009), Thailand (Entwisle et al., 2008), Vietnam (Binh et al., 2005), and Indonesia (Purnomo et al., 2017).

***N7 Natural disaster*:** This driver has a score of 3.31 out of 5, suggesting that it is also a driver of D & D in the region. About 45.2% of respondents agree with this response and corroborate its impacts on community forests. For example, drought and storm conditions

in 2016 caused many trees to fall, and eventually die, in Prey Kbal Ou Kror Nhak community forest. A recent study around Tonle Sap Great Lake, adjacent to our study area, confirmed that natural disasters can result in deforestation and forest degradation in Cambodia (Kim et al., 2019).

***N8 Human-induced forest fire*:** The score for this item is 3.24, with 45.7% of respondents agreeing that it is a driver of forest loss. Based on this score and the response from local people, human-induced forest fires are a recent concern for forest loss, although only occurring occasionally. Fire is used by humans as a means of land clearance for agriculture and hunting. In the tropics, human-induced fires are the main cause of large-scale D & D in Brazil (Silva Junior et al., 2018; Souza et al., 2013), Indonesia (Adrianto et al., 2019; Alisjahbana and Busch, 2017), and the Democratic Republic of the Congo (Deklerck et al., 2019).

***N9 Fuelwood for domestic consumption (local consumption)*:** This driver received an average score of 3.21. About 37.9% of respondents believe that fuelwood for domestic consumption contributes to forest loss but feel that it is not a serious concern because most of the wood used is from dead trees or cassava. Based on the focus group discussion, local people confirmed that there is no electricity available for use as cooking energy, and gas is unaffordable. Therefore, the use of fuelwood for daily cooking is inevitable. When wood is required for daily consumption, forest degradation and deforestation is effected to various degrees. A study in Kampong Thom Province found a per capita wood fuel consumption rate of approximately 200 kg of wood per year (Top et al., 2004). Another study found higher fuelwood consumption for cooking and boiling water, reaching 8 kg per day per family in the same province (San et al., 2012). Although respondents in the study area tend to consider this driver to be less important, 100% of the Cambodian rural population depends on the use of wood from nearby forests for daily cooking energy and to fuel fires for other purposes such as boiling water, protecting livestock from insect bites, and making bricks (San et al., 2012). Therefore, this driver may be considered important enough to necessitate being addressed in different activities.

This study adopted scores of arithmetic mean (AM) and median as a threshold to determine if a driver is considered to be permanent or non-permanent. The driver was determined to be permanent if AM is greater than or equal to 3.5 and the median is greater than or equal to 4. The threshold of a driver being permanent or non-permanent were verified by the local experts and interviewees from the locality.

Table 3.4. Extent of agreement with nine direct drivers of D & D in the study area ($n = 215$)

	Direct Driver	Mean Score* (SD)	Median Score
N1	Illegal logging/unauthorised forest encroachment	4.53 (0.60)	5
N2	Commercial timber production	4.20 (0.71)	4
N3	Land clearance for commercial agriculture	4.19 (1.15)	5
N4	Charcoal production	3.60 (1.12)	4
N5	Land clearance for subsistence agriculture	3.54 (0.75)	4
N6	New settlement/migration	3.43 (0.81)	3
N7	Natural disaster (flood, storm)	3.31 (0.91)	3
N8	Human-induced forest fire	3.25 (0.96)	3
N9	Fuelwood (domestic usage or local consumption)	3.21 (0.77)	3

* Mean score for each driver was based on the average of all responses received from household surveys through direct interviews

Based on this threshold, the study found five direct drivers of D & D are permanent. These are N1: illegal logging and unauthorized encroachment, N2: commercial timber production, and N3: land clearance for commercial agriculture, N4: charcoal production, and N5: land clearance for subsistence agriculture.

3.3.2.2. Indirect Drivers

Descriptive statistics of the responses to the Likert scale questionnaire on indirect drivers of D & D are shown in Table 3.5. By the same threshold as direct drivers, P1: limited law enforcement action against illegal logging, P2: demand for timber, P3: land tenure and rights issues are considered to be permanent. They are explained in details as follows:

***P1 Limited law enforcement*:** This indirect driver received an average score of 4.33. Almost all respondents (96.8%) view weak enforcement of the law as the main indirect driver for D & D in their region. Based on focus group discussions, participants perceived limited capacity of those involved in forest protection (such as government officers and forest rangers) to arrest illegal loggers as contributing to forest loss. Rangers normally go into the forest two to three times per week, and illegal logging occurs on the other days. In addition, community forest areas are usually large, meaning rangers cannot effectively patrol the whole area. Examples include Prey Kbal Ou Kror Nhak (1,593 ha), Veal O Khdey (4,450 ha), and Prey Kbal Daun Tey (1,803 ha). Illegal loggers have exploited the absence of rangers, using the opportunity to fell trees. This perception has been confirmed

in recent studies in Cambodia (Milne, 2015) as well as in the Amazon (Santos de Lima et al., 2018), Indonesia (Degen et al., 2013), and different parts of Africa (Adams et al., 2020).

***P2 Demand for timber*:** This driver has an average score of 4.15, and 84.5% of respondents perceive that increased demand for timber results in higher prices; therefore, timber is a high priority for illegal loggers. This driver contributes to forest degradation through the gradual loss of highly valuable timber species. Focus group discussions corroborated that demand for timber is an indirect driver that significantly contributes to forest loss. Participants stated that the high price of timber and huge demand for it drives impoverished people to cut down trees to support their daily needs and wealthy people to cut down trees out of greed. Participants felt that if there was no demand, there would not be people seeking to sell timber. Without buyers and sellers of timber, there would be no illegal logging for commercial purposes. The complicated relationship between the demand for timber, buyers and sellers, and timber fellers has been reported in various studies (Kishor and Lescuyer, 2012; Leipold et al., 2016; Zhang et al., 2016), indicating the existence of this driver at different scales.

Table 3.5. Extent of agreement with 11 indirect drivers of D & D in the study area (*n* = 215)

	Indirect Drivers	Mean Score (SD)	Median Score
P1	Limited law enforcement	4.33 (0.54)	4
P2	Demand for timber	4.15 (0.68)	4
P3	Land tenure and rights issue	3.72 (0.78)	4
P4	Population growth	3.47 (0.73)	3
P5	Lack of fertile land availability	2.94 (0.97)	3
P6	Road construction	2.79 (0.84)	3
P7	Shifting cultivation	2.73 (0.94)	3
P8	Public service	2.32 (0.89)	2
P9	Mining	1.95 (0.83)	2
P10	Livestock grazing	1.85 (0.69)	2
P11	Hydropower development	1.60 (0.63)	2

***P3 Land tenure rights*:** The score for this indirect driver is 3.72. Approximately 70.7% of respondents agree that land tenure and rights issues contribute to forest clearance. Local people tend to need an increasing amount of land for family purposes and to sell; therefore, they clear accessible forest to claim land. Some local people clear forest land that belongs to the community to grow temporary crops and then subsequently claim the

land. Similar clearing of land due to a lack of land tenure has been reported in different parts of the tropics, such as Peru (Anderson et al., 2018), Brazil (Yanai et al., 2020), and others (Austin et al., 2017).

3.3.3. Appropriate REDD+ Activities to Address Drivers of D & D

Any introduction of REDD+ activities needs to be acceptable to local residents, who will play multiple roles in implementing on-the-ground activities and monitoring performance of REDD+ projects. Table 3.6 shows the levels of agreement of survey respondents with activities that may be introduced to address the drivers of D & D. Comparing to the drivers in Tables 3.4 and 3.5, the median scores of activities are high, i.e., those of 17 out of 18 activities are more than 4. Correspondingly, the average scores of the activities tend to be higher than those of the drivers. It indicates that it easy for the local people to realize the activities rather than to think about the drivers. Because of these high average and median scores, the threshold of an activity being determined to address D & D if AM is greater than or equal to 4 and the median is greater than or equal 4. This was accepted by the local experts and interviewees from the study site. Out of the 18 types of activities inquired above, 11 activities have been considered as a key activity to address the drivers. These activities are explained as follows:

Table 3.6. Extent of agreement with eighteen types of activities proposed to address drivers of D & D in the study area (n = 215)

Rank	Activity	Frequency of Response (% of Households) Responding Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), and Strongly Agree (5)					Average Score (SD)	Median Score
		(1)	(2)	(3)	(4)	(5)		
A 1	Sufficient farmland for household	0.0	0.0	9.3	31.2	59.5	4.50 (0.66)	5
A 2	Financial incentives for agriculture	0.0	0.9	7.4	35.4	56.3	4.47 (0.68)	5
A 3	Law enforcement action against illegal logging	0.0	0.0	4.2	51.6	44.2	4.40 (0.57)	4
A 4	Improved market access for agricultural products	0.0	2.3	2.3	54.4	40.9	4.34 (0.64)	4
A 5	Community forest management	0.0	0.5	3.3	67.9	28.4	4.24 (0.53)	4
A 6	Policy and governance reform	0.0	0.9	8.4	61.9	28.8	4.19 (0.61)	4
A 7	Reforestation/tree planting	0.0	1.9	9.8	60.9	27.4	4.14 (0.66)	4

Table 3.7 (contd.). Extent of agreement with eighteen types of activities proposed to address drivers of D & D in the study area (n = 215)

A 8	Environmental education on forest management	0.5	1.9	7.9	62.8	27.0	4.14 (0.67)	4
A 9	Land tenure and rights	1.4	0.5	8.4	67.4	22.3	4.09 (0.67)	4
A 10	Agricultural intensification	0.0	0.5	12.6	71.6	15.4	4.02 (0.55)	4
A 11	Restoration of degraded forests	0.0	0.9	17.2	60.9	20.9	4.02 (0.65)	4
A 12	Good land use planning	0.0	4.7	12.6	76.3	6.5	3.85 (0.60)	4
A 13	Environmental and social impact assessment for development proposals	1.4	3.3	15.8	73.0	6.5	3.80 (0.66)	4
A 14	Fuelwood-efficient cook stoves and rooftop solar power	0.0	0.5	26.5	67.0	6.1	3.79 (0.55)	4
A 15	Building infrastructure for local employment	1.4	5.1	22.8	62.3	8.4	3.71 (0.75)	4
A 16	Creating alternative income opportunities	1.9	7.9	23.7	60.0	6.5	3.61 (0.80)	4
A 17	Agroforestry	1.4	4.2	34.9	51.6	7.9	3.60 (0.75)	4
A 18	Livestock rangeland management	11.6	9.8	29.3	36.3	13.0	3.29 (1.17)	3

A1 Sufficient farmland for households: Respondents were in strong agreement (90.7%) that their current farmland was insufficient for supporting their growing family sizes. Average and median scores of agreement with the potential for this activity to reduce D & D were high at 4.50 (standard deviation 0.66) and 5, respectively. In rural areas, nearly 100% of the population depends almost entirely on agricultural cultivation (Dasgupta et al., 2005; Scheidel et al., 2014) to support their families. Since farming can only be implemented in the wet season (due to lack of rainfall in the dry season), more land is needed, unless water supplies are made available throughout the year. In the dry season, some farmers go to other provinces or cross the border into Thailand to look for work. The majority however, opt to look for timber or other forest products to sell to support their families (Beauchamp et al., 2018).

***A2 Financial incentives for agriculture*:** The average score for this activity is 4.47 (0.68) and the median score is 5. Approximately 91.8% of respondents state that this activity would reduce illegal logging by local residents because respondents have faced many problems in the past, such as prolonged drought during wet seasons (Chhinh,

2015),uncertainty of harvesting yields due to natural hazards (Chantarat et al., 2019), variations in weather patterns (Nguyen et al., 2020), and fluctuations in crop price. The worst situations occur at the start of the season, when farmers have to borrow money from others to begin cultivation, but poor harvests or low sale prices of agricultural products make it impossible to repay debts. This is the reason that they must find alternative sources of income by felling trees and selling cleared forest land. Approximately 81% of respondents are farmers, and financial incentives for farming would encourage these respondents to focus on working on their farms rather than going into the forests to fell trees. In many parts of the tropics, financial incentives have reduced deforestation to some extent (Brancalion et al., 2018; Newton et al., 2016).

***A3 Law enforcement action against illegal logging*:** Average and median scores for this activity are 4.40 (0.57) and 4, respectively. Approximately 95.9% of respondents thought that in order for laws on logging to be respected and to reduce illegal logging, perpetrators must face maximum penalties. Based on survey responses and focus group discussions, illegal logging and encroachment are the main causes of forest loss in the region. It is usually difficult to stop illegal logging without intervention from central government (Sunderlin, 2006), especially if the crime is supported by powerful groups (Poffenberger, 2009; Sunderlin, 2006). Many studies have found that law enforcement is critical to reduce or eliminate illegal logging in the tropics (Gavin et al., 2009; Heeswijk and Turnhout, 2013; Mukul et al., 2014; Ploeg et al., 2011). Therefore, it is important to enforce logging laws and associated regulations in order to reduce D & D.

***A4 Improved market access for agricultural products*:** The average score for this activity is 4.33. A total of 94.9% of respondents agree that this activity would address D & D. According to focus group discussions, respondents believe that local residents are the main agents for almost every driver of D & D. They argue that their activities are justified by the need to fulfil their daily needs and livelihoods, because crop calendars of local farmers are dependent on rainfall and market access. If there is more rain, farmers can increase crop production but their products cannot reach the market, which forces them to sell their products for less than the cost of production before the products spoil. These farmers do not have the means to store their products for longer. As 81% of respondents are farmers, improving market access for agricultural products is necessary to ease pressure on logging or clearing forests. Recent studies indicate that improving market access for farmers can improve agricultural productivity (Muhanji et al., 2011; Shiferaw et al.,

2011), thereby discouraging local people from clearing forests to produce agricultural products to meet the needs of their families. The development of social enterprises for selling products online or to ecotourism visitors could also connect products to responsible consumers (Kry et al., 2020; Macqueen, 2008).

***A5 Community forest management*:** This activity refers to a coordinated effort to manage the forests on which communities depend for their daily needs. The average score for this activity is 4.24 out of 5. Approximately 95.4% of respondents are of the opinion that this activity is practical for addressing D & D. Based on focus group discussions, participants strongly believe that community forest management could protect remaining forests. They have witnessed the benefits of community forest management first-hand. They understand that community forests comprise a large part of the remaining forest, as all the forested land outside the community forest has already been converted to agricultural land or cleared for other purposes. A meta-analysis of community forest management globally found that community forest management is important for long-term successful management of forests (Bowler et al., 2012; Klooster and Masera, 2000; Pagdee et al., 2007).

***A6 Policy and governance reform*:** The average score for this activity is 4.19. Respondents agree that the government needs to reform its policies and governance regarding natural resource use in favour of the activities in Table 3.6. Local people seem to have lost their trust in the government because of corruption and ongoing illegal logging in their area. Policy and governance reform can lead to reductions in corruption among law enforcement officers at various levels. Previous studies have indicated that governance and policy reform can lead to reduced illegal logging and improved trust between locals and the government (Larson and Petkova, 2011; Tacconi et al., 2003).

***A7 Reforestation and tree planting*:** The average score for this activity is 4.14. Approximately 87.7% of respondents perceive that reforestation or tree planting could address drivers of D & D such as illegal logging, illegal encroachment, natural disasters, and the use of timber for commercial or domestic purposes. Reforestation is viewed as an important activity for increasing forest cover. A previous study found that reforestation programmes reduced deforestation in Indonesia (Nurrochmat et al., 2019). A study in the Philippines showed similar results after reforestation projects were introduced (Dinh et al., 2014).

***A8 Environmental education on forest management*:** The average score for this activity is 4.14. Of the respondents, 89.9% agree that it is a solution that will reduce the following drivers: forest fires, illegal logging, and land clearance without government permission. Education on sustainable use and harvesting of timber and non-timber forest products such as wild animals, wild fruits, wild vegetables, mushrooms, potatoes, honey, resin, bamboo shoots, rattan, herbs, and traditional medicines can be an important avenue for reducing D & D. Therefore, environmental education on how to obtain necessary forest food and products in a sustainable way is essential for local residents. For example, in order to harvest honey, locals use smoke to chase thousands of bees from their hives. Forest fires can then be unintentionally started by careless honey collectors who do not keep their fires under control or abandon them. The sustainable exploitation and use of timber can save many young trees in the vicinity of logged trees. Therefore, environmental education on forest management can give local residents a broader picture of practical forest management and its long-term benefits, which can eventually reduce forest fires and forest clearance. A study of 101 local households in Honduras found that education contributes to a reduction in deforestation (Godoy et al., 1998).

***A9 Land tenure and rights*:** The average score for this activity is 4.09. Approximately 89.5% of respondents agree that improved land tenure and rights can reduce land encroachment and land clearance drivers. Tenure is a term that describes rules regulating how people, communities, and others gain rights to land, water, fisheries, and forest, including access rights, management rights, and alienation rights. Local residents believe that land tenure can reduce illegal forest clearance and encroachment by the community. As there is no land tenure specified in the study area, residents tend to enlarge their land as much as possible. Moreover, without recognition of customary rights to their land, they fear losing access to it, so they use the land in an unsustainable way to extract the maximum benefit while they are still able to. Then, when their existing land loses fertility, they look for new fertile land in forested areas. Tenure and rights are good measures to reduce deforestation and degradation caused by land tenure and rights issues and the problem of forest clearance for subsistence cultivation. The successful prevention of land encroachment and clearing due to this measure has been confirmed in previous studies (Esteve et al., 2011; Robinson et al., 2014; Wannasai and Shrestha, 2008).

***A10 Agricultural intensification*:** The average score for this activity is 4.02. Approximately 86.8% of respondents think that agricultural intensification would reduce forest

clearance for agriculture because it would increase productivity and income from existing cleared land, as the land can be cultivated outside of the wet season. Intensification of agriculture refers to a reduction in fallow time, greater use of organic fertiliser to offset declines in soil fertility, and investments in mechanisation and irrigation systems (thereby increasing the number of cycles of crop cultivation). These measures potentially offset the negative impact of population growth on farm size and can maintain or increase per capita food production (Binswanger-Mkhize and Savastano, 2017). Depending on location, building water tanks or creating water reservoirs to store water for year-round use can increase crop production and improve the health of local residents. Use of the Internet of Things (IoT) and big data technologies can also help manage water efficiently. One study provided mixed results for agricultural intensification implemented at large scales because it can increase the cost of conservation of nearby forests (Phelps et al., 2013). A recent study indicated that reductions in deforestation based on agricultural intensification can only be achieved when smaller farms use higher quality seeds for farming (Pelletier et al., 2020).

***A11 Restoration of degraded forests*:** The score for this activity is 4.02. This activity refers to enrichment planting on degraded forest land in community forests. Approximately 81.7% of respondents agree that restoration of degraded forests can address forest degradation. This method is suitable for areas affected by overexploitation, natural disasters, and human-induced forest fires. It has been reported that restoration could avoid further deforestation and even increase carbon stocks in the tropics (Edwards et al., 2010).

Seven activities that did not receive a high level of agreement from respondents in terms of effectiveness to address D & D drivers are summarised in Table 3.7 with a focus on challenges to their implementation.

Table 3.8. Explanation of REDD+ activities deemed by local people to be inappropriate for the study area

Activity	Characteristics	Applicability to Study Area and Challenges
A12	Land use planning for sustainable natural resource use	Local people have less knowledge of the importance of good land use planning.
A13	Assessment of the impact of project development on environment and society	Practised in the region; however, economic development variables are often the overriding criteria considered when accepting proposals.
A14	Reduce fuelwood demand for cooking energy and other purposes	Local people are not aware of efficient cook stoves; they continue to use traditional three-stone cook stoves. Solar power is not considered by local people to be an option.

Table 3.9 (contd.). Explanation of REDD+ activities deemed by local people to be inappropriate for the study area

A15	Building schools, hospitals or tourist centres, then hiring local people to work in them	Requires funds for development, a solid plan and long-term investments
A16	Promote ecotourism in the region Create income from aquaculture, handicrafts, and souvenirs	Takes time to promote ecotourism and build reputation Lack of staff with skills in tourism Lack of support from local people in making handicrafts (a handicraft store in Kbal Daun Tey community selling handicrafts made by local people closed soon after opening)
A17	Trees or shrubs are grown near or on the same land as agricultural crops or grazing land for livestock	Not suitable in the study area
A18	Management of land for livestock farming, especially land that can provide forage	Does not contribute to forest loss in the study area as less than 1% of respondents raise livestock

According to a group discussion, the effects of activities to the drivers are shown in Table 3.8. The Table illustrates the drivers of D & D that have the potential to be addressed by certain activities assessed as promising. These activities identified through focus group discussions are confirmed to have the greatest effect on reducing N1: illegal logging practices, followed by N8: human-induced forest fires and N9: fuelwood collection.

Table 3.10. Appropriate activities for addressing D & D

Activity	Drivers								
	N1	N2	N3	N4	N5	N6	N7	N8	N9
A1					√				
A2	√								
A3	√	√		√					
A4	√								
A5	√								
A6									
A7	√						√	√	√
A8		√		√				√	√
A9					√	√			
A10	√				√				
A11	√						√	√	√

3.3.4. Sociodemographic factors influencing respondents' perceptions

Multivariate ordered probit analysis was applied in order to understand the factors affecting perceptions, because the dependent variables are ordinal (Likert scale).
The underlying relationship in ordered probit is:

$$y_{is}^{*}=\sum_{j=1}^{k}\beta_{js}x_{ij}+\varepsilon_{is} \quad (3.1)$$

where,

y_{is}^{*} the exact but unobserved degree of agreement of respondent *i* regarding driver *s*;

x_{ij} is the value of sociodemographic factor *j*;

β_{js} is the regression coefficient to be estimated.

Although the latent variable y_{is}^{*} cannot be precisely observed, it is possible instead to observe five discrete levels of agreement as follows:

$$y_{is}^{*}=\begin{cases} 1\ if\ y_{is}^{*}\le\mu_{s1} \\ 2\ if\ \mu_{s1}<y_{is}^{*}\le\mu_{s2} \\ 3\ if\ \mu_{s2}<y_{is}^{*}\le\mu_{s3} \\ 4\ if\ \mu_{s3}<y_{is}^{*}\le\mu_{s4} \\ 5\ if\ \mu_{s4}<y_{is}^{*}\le\mu_{s5} \end{cases} \quad (3.2)$$

Multivariate analysis was applied because the dependent variables (i.e., different perceptions measured by Likert scale) are likely to be correlated with each other, after controlling for independent variables.

The error term in Equation 3.2 has the following properties.

$$corr(\varepsilon_{is},\varepsilon_{it})\neq 0 \quad (s\neq t), \quad (3.3)$$

Table 3.9, shows sociodemographic factors that influence the perception of both direct and indirect drivers of D & D. The dependent variable is each driver shown in Tables 3.4 and 3.5. Independent variables are the 11 sociodemographic factors in Table 3.3. The 11 independent variables were included in the analysis: gender dummy variable (1 if a woman), age, marital status dummy (1 if married), household size (headcount), secondary school dummy (1 if completed), residency duration (years), farmer dummy (1 if a farmer), occupation duration (years), income (natural logarithm of annual income in USD), CF membership dummy (1 if a member), and participation in CF management dummy (1 if participating in management).

Table 3.9, indicates that four independent variables namely S1: gender (women), S9: income, S10: community forest membership, and S11: participation in community forest management have significant influences on the perceived drivers. The coefficients of S10

are positive for most of the drivers, although those of S11 are negative, and vice versa in the other drivers. The effects of S10 and S11 on the drivers are opposite.

From Table 3.9, S1: gender (women) seem not to care about driver N1: illegal logging. S10: community forest membership increases the perception that direct drivers N1: illegal logging, N2: commercial wood production, and N3: land clearing for commercial agriculture strongly exist, but those without community forest membership do not perceive existence of these drivers. S1: women perceived indirect drivers negatively. This indicates that men would involve more in logging activities than women. Other factors appeared less significant. For instance, as women tended to underestimate the importance of law enforcement against illegal logging and community forest management, gender-sensitive awareness-raising related to these topics may be useful.

Table 3.11. Sociodemographic factors influencing the perception of direct and indirect drivers of D & D in the study area: Probit regressions (n = 215)

	Sociodemographic factors										
Number	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
Direct drivers											
N1				++						+++	- - -
N2	- - -							+	++	+++	- - -
N3	- - -									+++	- - -
N4	-			++	- -		- -				
N5								+			-
N6	- - -	- -							+	+++	
N7						+					
N8									+	+	- - -
N9						+	+		- -		
Indirect drivers											
P1	- - -			+						+++	- - -
P2				+					+++	+++	- -
P3	+								++		
P4	- - -						- -			+++	- -
P5	- - -		+				- - -			+++	- -
P6									–		
P7		++	- -				+++	- - -	- - -	- - -	++
P8									- - -		
P9							- -		+++	- - -	++
P10										- - -	+++
P11									+	- - -	+

Regarding which activities are conducive to reductions in D & D in the study area, Table 3.10 shows six independent variables have significant influences on more than four perceived activities. These are S1: gender, S3: marital status, S6: residency duration, S9: income, S10: community forest membership, and S11: participation in community

forest management. Table 3.10 presents that S9: income was the factor most associated with perception of activities for D&D.

The women perceived direct and indirect drivers negatively in Table 3.9. The women tended to underestimate the importance of A3: law enforcement against illegal logging and A5: community forest management in Table 3.10. This indicates that men would involve more in logging activities than women. Such a gender-sensitive awareness-raising related to these topics may be useful.

Table 3.12. Sociodemographic factors influencing the perception of activities in the study area: Probit regressions (n = 215)

	Sociodemographic factors										
Number	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
Activities											
A1	+++		-			++					
A2						++	++		++		
A3	---								+++	+++	---
A4			++					+			
A5	-							++		+++	---
A6			++	++					--	+	--
A7				++			+++				
A8			+++						---		
A9		-		+			+			++	---
A10									++		
A11			+				+	+	+++		--
A12	+++								+++		
A13		--			--	++			+++	-	+
A14		--			--	++			+++	-	+
A15	++									---	
A16										---	+++

Note: + and - indicate positive and negative coefficients, respectively. +++, ++, and + indicate $p < 0.01$, < 0.05, and < 0.10, respectively.

3.4. Conclusion and Recommendations

Data from 215 respondents in seven communities in TR study are were analysed to understand local perceptions of the direct and indirect drivers of D & D, and appropriate activities to reduce these drivers measured using a five-point Likert scale.

The study concludes that local residents seem to accept that five direct drivers and three indirect drivers are permanent. As far as activities to reduce the drivers of D&D are concerned, the study found that local communities seem to accept 11 activities indicated in Table 3.8. For example, about 96% of respondents from the study stated that activity like A3: law enforcement on illegal logging is to be respected and enforced, if a driver like N1: illegal logging is to be stopped or reduced. If law is being enforced effectively, illegal loggers would have to be made to face maximum penalties.

Another example from about 92% of respondents in the study confirmed that activity A2: financial incentives for agriculture has an important role in reducing illegal logging. This is because people from both the local and outside communities will find alternative sources of income by felling trees and selling cleared forest lands, when they had faced problems such as drought, uncertainty of harvesting yields due to natural hazards or poor year, variations in weather patterns, and fluctuations in crop price.

Since the drivers and activities that are accepted by local people are also REDD+ project activities, the REDD+ project can play an important role in the sustainable management of community forests, while providing carbon-based incentives and creating local development opportunities to ensure the long-term sustainability of projects and improve local livelihoods. As many potential REDD+ activities to reduce D & D are still novel to local communities, provision of training and environmental education may increase the success of reducing drivers through implementation of the REDD+ project. In designing these training and education programs, the gap in perception among different segments of the population should be considered.

Chapter 4 Effect of REDD+ Projects on Local Livelihood Assets Prior to and During Project Implementation

4.1. Introduction

This chapter assesses the effects of REDD+ projects on local livelihoods in two REDD+ project sites during project development (i.e., prior to implementation) to set the stage for comparing baseline conditions at both study sites. Perceptions of local people were assessed using the sustainable livelihoods framework.

Since the adoption of the Bali Action Plan at COP11 in Bali, Indonesia in 2007, REDD+ has become a topic of scientific and policy debates on how projects seeking to reduce emissions from D & D and promote sustainable management of forests can result in tangible improvement of local livelihoods. Since 2007, developing countries have introduced REDD+ pilot projects in line with the three phases of REDD+ implementation described in Chapter 2. Studies on REDD+ projects have tended to concentrate mainly on project monitoring, carbon measurement, reporting, and verification aspects (Chheng et al., 2016b; Sasaki et al., 2016; Venkatappa et al., 2020) at various scales. Although these aspects are important to measure the performance of REDD+ projects, these studies do not provide much information about the impacts of REDD+ project development and implementation on the local people who live inside or near REDD+ project areas. Interventions are unlikely to be effective unless the impacts of project development and implementation on local people are assessed.

REDD+ projects affect the livelihoods of local people if not managed appropriately because project activities are usually designed to address the multi-scale drivers of D & D (Davis et al., 2015; Poffenberger, 2009). Some of these drivers occur at local levels because of the need for timber and non-timber forest products for daily subsistence (Khuc et al., 2018; Kim et al., 2008) and in some cases, for resettlement of new families. Land clearance for new settlers or migrants is illegal (Pan et al., 2007; Unruh et al., 2005), whereas collection of timber and non-timber products is a practice that has taken place for many generations (Hafner et al., 2018). Some drivers, such as illegal logging and land speculation, affect local livelihoods in different ways (Santos de Lima et al., 2018). For example, illegal loggers target timber from socially and culturally important tree species (Omotayo and Aremu, 2020), but preventing such illegal logging is difficult without

adequate law enforcement. Consequently, local livelihoods are affected to various degrees, as a function of dependency on the tree species involved (Vasco et al., 2017). Although previous studies have assessed the impacts of drivers of D & D on local livelihoods in the tropics, studies of these impacts on local livelihoods in REDD+ project areas in the tropics during project development and implementation remain limited. As REDD+ projects will be introduced more intensively to achieve climate change mitigation as agreed in the Paris Agreement, it is important to assess their impacts on local livelihoods, so that REDD+ project implementation can become more effective through gaining the full support of local people.

Although there are different ways of assessing the impacts of development projects on local livelihoods, a common assessment approach is to analyse perceptions of local people against various criteria and related indicators from different frameworks or approaches (Kry et al., 2020; Qian et al., 2017; Yamsrual et al., 2019). A sustainable livelihoods framework was used to assess the impacts of ecotourism development on local livelihoods in Cambodia (Kry et al., 2020) and China (Qian et al., 2017) by analysing livelihoods in terms of local capital assets under two development policies, namely community-based development and state-owned development. In this chapter, local livelihoods in two REDD+ project areas in Cambodia are assessed during project development and implementation, using the sustainable livelihoods framework. A 5-rank Likert scale was used to assess local livelihoods against various indicators in both locations.

4.2. Study Methods and Materials

4.2.1. Description of Study Sites and Data Collection

This section discusses the results from OM and KS study sites as presented in Figure 4.1. The study sought to understand the perception of REDD+ projects by Cambodian local people. The implemented REDD+ projects reflect the characteristics and backgrounds of the different areas, such as community size, land use, main income-generating occupation, and history. Moreover, the authorised organisations differ from private to public. For these differences, the base line difference and the change difference between the two sites are considered.

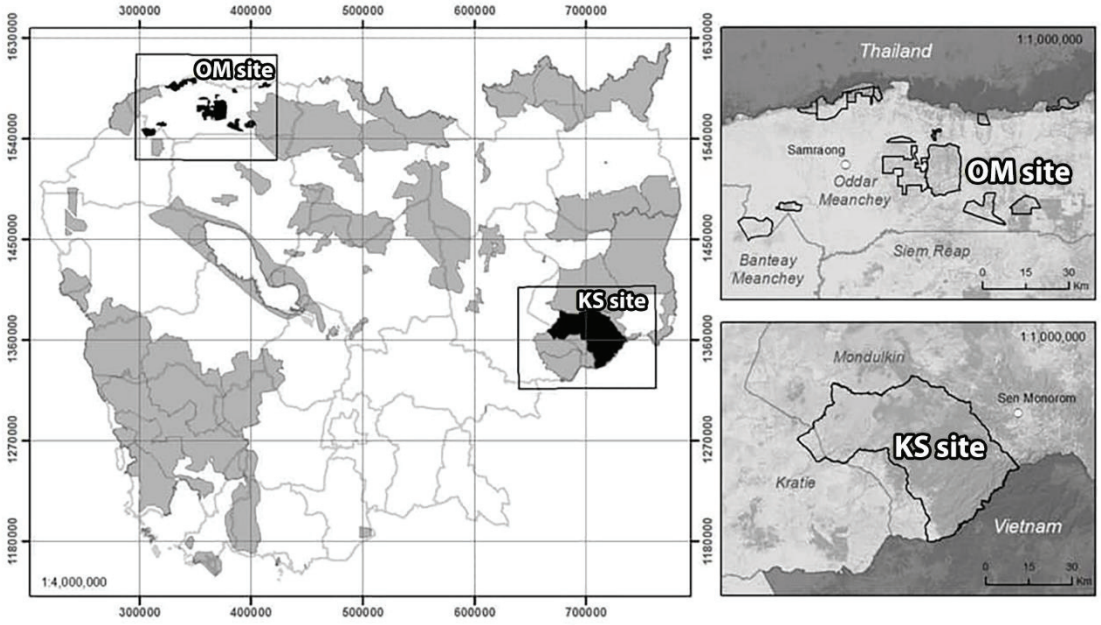

Figure 4.1. Location of OM (top right) and KS (bottom right) sites
Source: Author

Primary data was collected and analysed. Fieldwork took place in September and November 2018 in OM and KS sites, respectively, using a mixed methods approach. Quantitative data were collected through questionnaire interviews of each sample household in the study areas, while qualitative information was collected through key interviews.

The minimum sample size for the household survey was obtained using Yamane's (1967) formula as described in Equation 2.1. Since there are 9,893 households at the OM site, the minimum sample size is 99 households. To allow for missing or erroneous observations in the data, an additional 21 were included for a total sample size of 120. Likewise, the minimum sample size for KS with 2,825 households was calculated to be 97, with 15 added for a total sample size of 112. This study employed the random sampling method for the household survey in order to generate a representative sample of the population. However, not all residents were at home when the surveys were conducted. In those cases, an aspect of convenience sampling (Etikan et al., 2016) was adopted. In terms of interviews, one to three leaders per community forest participated in addition to six NGO staff members and government officials. Sample sizes for the surveys and interviews are presented in Table 4.1.

Key interview participants were selected by purposive sampling, which is effective in targeting the most relevant respondents and thus accessing the most pertinent information.

Table 4.1. Sample size for household survey and key interviews in 2018

Project	Community Forest	Household Survey	Key Interview	
		N	Key Participants	*N*
OM	Sorng Roka Vorn	14	Leader	1
	Samaky	13	Leader	1
	Prey Srors	38	Leaders	3
	Rolus Thom	12	Leader	1
	Dung Beng	43	Leader	1
	Ratanak Ruka	0	Leader	1
			NGO staff	1
	Total	120		8
KS	Chakchar	35	Leader	1
	Andoung Kraloeng	37	Leaders	2
	Pu Char	20	Leaders	2
	Sre Preah	20	Leader	1
			NGO staff & government officials	5
	Total	112		11

4.2.2. Analysis

Descriptive statistics such as mean and frequency distribution are used to present respondents' profiles. Mean values are also calculated for indicators of livelihood assets. In general, it is controversial to compute means for ordinal-scale data such as Likert scale data (Michell, 2014). In this study, however, most of the important indicators are based on multi-item sub-measurements and thus can generate more than 30 possible outcomes. Therefore, this study treats the main indicators as a semi-continuous measurement for which mean values are presented. An overall indicator is defined per livelihood capital category (e.g., financial, natural) as the mean over the sub-indicators in each category. The aggregate indicator is the mean over the five overall indicators.

For inferential analysis, the Wilcoxon signed-rank test (Seetha et al., 2018), a nonparametric alternative to the paired *t*-test, is employed to examine the change in livelihood

indicators over time. Harnessing the recall data, panel regression (Tsusaka and Otsuka, 2013) is adopted to identify the change in livelihood indicators while determining and controlling for factors affecting their levels. Moreover, in the panel regression, the difference-in-difference framework (Seetha et al., 2018) is incorporated to estimate the differential effects between the two projects in terms of livelihood indicators.

4.2.2.1. Assessment of Local Livelihood Assets or Capital Assets

This study adopts an SLF (Kry et al., 2020; Qian et al., 2017; Scoones, 1998) to assess capital assets at the two sites. These capital assets represent five broad categories, namely natural, financial, human, social, and physical assets (Section 2.7). Atela et al. (2015) employed SLF to investigate the impacts of REDD+ projects on local livelihood assets in Taita-Taveta County in Kenya. Qian et al. (2017) used SLF to understand local livelihood assets under two ecotourism development systems in rural China. An SLF is used in this study because of its ability to capture the complexities of local livelihoods, especially in rural areas.

The five capital assets were assessed based on various indicators, criteria, and principles as shown in Table 4.2. The questions used in the household survey (questionnaire interview) were based on the indicators (Appendix). They were modified from Qian et al. (2017) who studied local livelihoods under differing governance models of tourism development in Huangshan mountainous area in China. However, some indicators and criteria used in the original study were removed, altered, or added to fit the situation and characteristics of the current study sites. Household heads (husband or wife who holds greatest influence over decisions and generates the greatest proportion of household income) were the intended respondents, however spouses were interviewed when the household head was not available. Survey respondents were asked to rate their perceptions of various indicators before and during project implementation on a 5-point Likert scale ranging from 1 (low) to 5 (high). The validation periods for OM and KS sites were before 2008 and before 2010, respectively. Local perceptions during the REDD+ project implementation period were the local perceptions that had formed prior to our fieldwork in 2018. Therefore, survey respondents (and interview participants) were asked to recall their livelihoods prior to project implementation (before project implementation, 10 years for OM and 8 years for KS) and during project implementation. The recall method has

limitations because of potential inaccuracies in past memories. Nevertheless, it still provides useful information and tends to be reliable when the questions are closely related to livelihoods and daily activities.

Key informants were interviewed as a group or individually. Similarly, to the household survey, questions were based on the indicators in Table 4.2 for two time periods, before and during project implementation. In the interviews, the reasons for their evaluations were discussed.

Table 4.2. Principles, criteria, and indicators for assessing the five capital assets

Capital Assets (j)	Principle Description	Criterion for Individual Principles	Indicators (i)	Questions
Natural Capital	• Options for future use are maintained • Quality and quantity of natural resources and services are maintained or improved	• Biodiversity is conserved or not • Ecosystem function is maintained or not	• I-N1: Biodiversity • I-N2: Forest coverage • I-N3: Environmental conservation	• Q21 • Q22 • Q23,Q24, Q25
Physical Capital	• Physical capital is maintained or improved over time	• Household physical status is maintained or improved	• I-P1: Household fixed assets	• Q26,Q27, Q28
Human Capital	• Ability to provide added value is improved over time	• Education or skill knowledge is improved or not • Local people's physical condition is maintained or improved	• I-H1: Technical assistance • I-H2: Environmental education • I-H3: Skills and knowledge • I-H4:Capacity building	• Q29 • Q31 • Q30 • Q62

Table 4.3 (contd.**).** Principles, criteria, and indicators for assessing the five capital assets

Financial Capital	• Financial capital grows and is equitably distributed • Financial capital is circulated within the system	• Revenue is improved or not • Household harvest	• I-F1: Household income related to forest • I-F2: Household income not related to forest • I-F3:Agricultural production	• Q32 • Q33 • Q36
Social Capital	• Maintenance of systems of social reciprocity	• Economic and other shocks are buffered by system of social activity	• I-S1: Rights in resource management/ control over resources • I-S2:Participation in community affairs	• Q37,Q38, Q39, Q40 • Q41,Q42, Q43

Source: Modified from Qian et al. (2017)

It was difficult, and occasionally impossible, to collect information on income directly generated from forests during our fieldwork because of the sensitivity of forest incomes due to their relation to illegal logging. Locals were wary of answering freely and we therefore removed indicators of income both related to and not related to forest from our analysis.

4.2.2.2. Difference-in-Differences

In this study, the difference-in-differences (DID) approach (Zhou et al., 2019) is applied to estimate the differential effects of the two REDD+ projects on local livelihood capital assets as measured by the respective indicators. The DID method is widely used to investigate policy effectiveness when there are two groups (typically a treatment group and a control group) and two observation points in time (typically before and after an intervention or before and during project implementation) (Seetha et al., 2018) .

Figure 4.2 presents the basic concept of DID. OM and KS sites are the two groups considered in this study. Y_{kt} represents the level of overall livelihood capital assets for group k at time t, where $k = 0$ for the KS site and 1 for the OM site, and $t = 0$ before the project and 1 during the project. D_0 is the change in livelihood capital in KS, while D_1 is the same

in OM. In other words, D_0 and D_1 capture the difference between the two points in time at KS and OM sites, respectively. The DID is defined as $D_1 - D_0$, representing the difference between the two differences, therefore the difference-in-differences. The DID is a robust estimator of the effect of the differential regime between two groups on the outcome variable. In this study, it captures the effect of the REDD+ project implementation differential between the KS and OM sites on the level of livelihood capital.

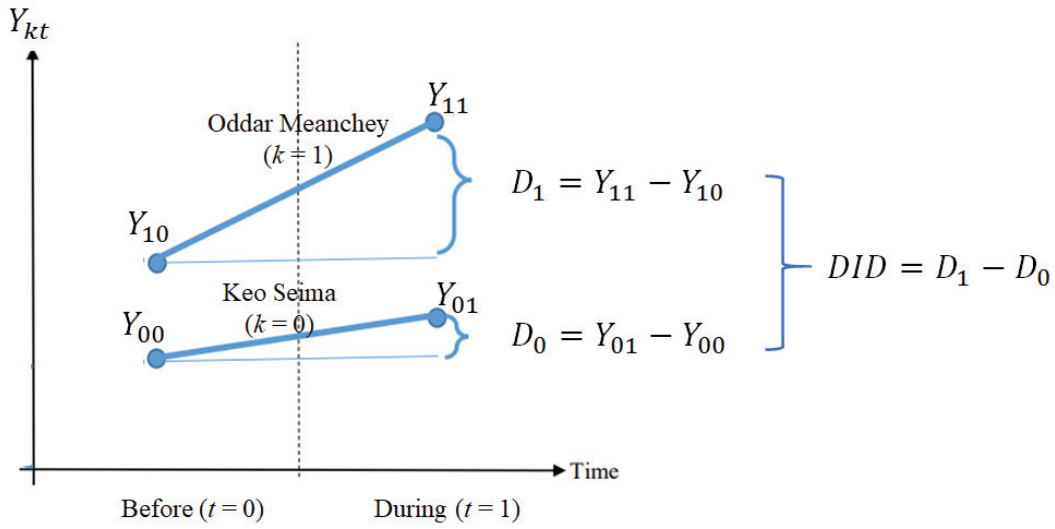

Figure 4.2. Schematic diagram of the difference-in-differences (DID) of livelihood assets in the study area

Source: Adapted from Lechner (2011)

The DID can be calculated using the notation in Figure. 4.2 as follows:

$$DID = D_1 - D_0 = (Y_{11} - Y_{10}) - (Y_{01} - Y_{00}) \quad (4.1)$$

4.2.2.3. Random Effect Model

When disaggregated data (e.g., household-level data) are available, each Y value can be obtained by calculating an average over the sampled households. However, simply calculating the average does not provide the confidence interval of the estimated DID. If the confidence interval is too large and includes zero, then the DID is statistically regarded as no different from zero. The confidence interval (or the p-value) can be obtained using a statistical test on the value of DID, such as the independent sample t-test, Mann Whitney

U-test, or regression analysis. Where data are available for multiple independent variables that potentially affect *Y*, it is advisable to apply multiple regression analysis to control for covariates, as expressed below:

$$Y_{ikt} = \beta_0 + \beta_1 X_{1ikt} + \beta_2 X_{2ikt} + \cdots + \beta_j X_{jikt} + \alpha_1 G_{ik} + \alpha_2 T_{it} + \alpha_3 (G_{ik} \cdot T_{it}) + \varepsilon_{ikt} \quad (4.2)$$

where,

Y_{ikt} represents the level of livelihood capital for household *i* in group *k* at time *t*;
β_0 is the intercept and β_1 to β_j are coefficients representing the effects of X_1 to X_j;
G_{ik} is the group dummy, where $G_{i0} = 0$ and $G_{i1} = 1$;
T_{it} is the time dummy, where $T_{i0} = 0$ and $T_{i1} = 1$;
ε_{ikt} is the random error term.

Importantly, α_3 represents the DID, while α_1 represents the initial difference between the two groups (i.e., $Y_{10} - Y_{00}$) and α_2 represents the change over time in KS (i.e., $Y_{01} - Y_{00}$).

Equation 4.2 does not assume that the same set of households are sampled in both time periods (*t* = 0 and 1). The two periods may sample two different sets of households from the respective sites. In that case, the model is referred to as a pooled regression model. The major limitation of a pooled regression model is that it suffers from estimation bias arising from unobserved heterogeneity among households. This bias can be minimized by employing panel regression (Tsusaka and Otsuka, 2013), which requires that the data for both time periods comes from the same set of households. Fortunately, the current dataset satisfies this condition as the recall method was used for data collection, i.e., households were asked about before and during REDD+ project implementation in one interview session. Harnessing the nature of panel data, Equation 4.2 is modified as follows:

$$Y_{ikt} = \beta_0 + \sum_{j=1}^{n-1} \gamma_j D_{ij} + \beta_1 X_{1ikt} + \beta_2 X_{2ikt} + \cdots + \beta_j X_{jikt} + \alpha_1 G_{ik} + \alpha_2 T_{it} + \alpha_3 (G_{ik} \cdot T_{it}) + \varepsilon_{ikt} \quad (4.3)$$

or

$$Y_{ikt} = \beta_0 + \mu_i + \beta_1 X_{1ikt} + \beta_2 X_{2ikt} + \cdots + \beta_j X_{jikt} + \alpha_1 G_{ik} + \alpha_2 T_{it} + \alpha_3 (G_{ik} \cdot T_{it}) + \varepsilon_{ikt} \quad (4.4)$$

where,
D_{ij} is the dummy variable, and D_{ij} is 1 for $i = j$ and 0 for $i \neq j$;
γ_j (j = 1, 2, …, n − 1) are the set of unobserved time-invariant household-specific fixed effects with the n^{th} household being the base;
μ_i is unobserved time-invariant household-specific random effects.

All other notation follows Equation 4.2. Equation 4.3 is referred to as the fixed effect model, whilst Equation 4.4 is the random effect model. The major difference in assumptions between the two models is that γ_j is allowed to be correlated with X variables, while μ_i is assumed to be uncorrelated with X variables.

The advantage of the fixed effect model is that the estimated coefficients are unbiased, whereas those in the random effect model can be biased when the above assumption is violated. The disadvantage of the fixed effect model is that the coefficients of the independent variables that do not vary over time are absorbed by the fixed effect terms and thus cannot be estimated. In contrast, the advantage of the random effect model is that the estimated coefficients are more efficient (i.e., smaller p-values) than for the fixed effect model, and the coefficients can be estimated even for time-invariant independent variables. The random effect assumption can be tested by the Hausman test (Tsusaka and Otsuka, 2013). In this study, all regression specifications passed the Hausman test and therefore the random effect model was employed for all analysis.

Based on the set of estimated coefficients α_1, α_2, and α_3, the following quantities were estimated:

- The baseline (before) difference between OM and KS = α_1
- The difference in change over time (during) between the two sites = α_3
- The change over time in KS = α_2
- The change over time in OM = $\alpha_2 + \alpha_3$

Lastly, the effect of each factor variable on the livelihood capital value, as well as the overall model significance indicators such as the Wald χ^2 statistic and the $R^2$are obtained.

4.2.3. Local Livelihoods by Livelihood Asset Indicators

Using the Likert scale to measure local perceptions allows estimation of the mean scores of individual indicators of the respective livelihood assets presented in Table 4.2 (Apine et al., 2019; Kry et al., 2020; Qian et al., 2017)

The mean score for each individual indicator, X_{kijt}, can be obtained using the following equation:

$$X_{kijt} = \frac{\sum_{i=1}^{n_k} x_{kijt}}{n_k}, \quad (4.5)$$

where,

i (i =1,…n) is the indicator, t (t =0,1) represents before and during implementation, and n_k is the numbers of households in group k (k =0,1 corresponding to study sites KS and OM). X_{kijt} can have values of 1 (minimum) to 5 (maximum), corresponding to strongly disagree and strongly agree, respectively.

Accordingly, the mean scores for individual capital livelihood assets can be obtained by:

$$Y_{kjt} = \frac{\sum_{i=1}^{m_j} X_{kijt}}{m_j}, \quad (4.6)$$

where,

j ($j = 1, \ldots, 5$) is the capital assets: natural capital, physical capital, human capital, financial capital, and social capital, and m_j is the total number of indicators for each capital asset j.

The mean score of individual assets of two groups, A_{jt}, is obtained as

$A_{jt} = \frac{\sum_{k=0}^{1} Y_{kjt}}{2}$.

The overall livelihood asset score of group k in time t, Y_{kt}, is obtained as a mean score by

$$Y_{kt} = \frac{\sum_{j=1}^{5} Y_{kjt}}{5} \quad (4.7)$$

The change rate in the mean scores of indicators of individual capital assets before and during implementation of the REDD+ project is obtained as

$$r_{kj} = \left(\frac{Y_{kj1} - Y_{kj0}}{Y_{kj0}}\right) \times 100 \quad (4.8)$$

where,
r_{ki} is the rate of change in the mean score of indicator i of group k before and during implementation of REDD+ activities at the study site (%). A positive sign means greater improvement in that indicator, while a negative sign indicates otherwise. Equation 4.8 is also used to calculate any change in indicator values between and across study sites.

4.3. Results

4.3.1. Socioeconomic Characteristics of Respondents

The survey was conducted in 120 households in OM and 112 households in KS. In both study sites, there are more female than male respondents as presented in Table 4.3 because the survey was conducted during rice harvesting season when more men were in the paddy fields. Respondents' ages range from 17 to 75, with most ranging from 22 to 60. All respondents are directly involved in some type of work to support their family. The majority of respondents (96% in OM and 92% in KS) are married. Many households (68% in OM and 59% in KS) have four to six members. In terms of education, 69% and 72% of respondents in OM and KS, respectively, have completed primary school.

Table 4.4. Demographic profile of surveyed households

Demographic Variable	Category	OM		KS	
		Frequency	Percent	Frequency	Percent
Gender	Male	49	40.8	35	31.3
	Female	71	59.2	77	68.8
Age	17-30	22	18.3	42	37.5
	31-45	39	32.5	45	40.2
	46-60	42	35.0	18	16.1
	>60	17	14.2	7	6.3
Marital status	Single	2	1.7	6	5.4
	Married	115	95.8	103	92.0
	Divorced, Widow, or Widower	3	2.5	3	2.7
Number of household members	1 to 3	26	21.7	14	12.5
	4 to 6	82	68.3	66	58.9
	More than 6	12	10.0	32	28.6
Completed education level	No education (1)	37	30.8	29	25.9
	Literacy class (3)	0	0.0	2	1.8
	Primary school (4)	55	45.8	52	46.4
	Secondary school (5)	20	16.7	17	15.2
	High school (6)	7	5.8	12	10.7
	College or higher (8)	1	0.8	0	0.0
Occupation	Crop farming	123	95	105	85
	Livestock farming	64	50	58	47
	NTFP harvesting	22	17	33	27
	Forest ranger	31	24	12	10
	Hunting	3	2	0	0
	Fishing	16	12	12	10
	Government em-ployment	7	5	16	13
	Casual labour	13	10	7	6
	Business	14	11	22	18
	NGO employment	0	0	5	4
	Other occupation	10	8	10	8

4.3.2. Capital Assets

In Table 4.4, the scores of the indicators using Equation 4.5 and those of five overall livelihood capital assets of two groups/sites from Equation 4.6 are shown.

Table 4.5. Mean scores of each indicator and overall score for five livelihood capital assets (natural, physical, human, financial, social) in OM and KS

Indicators	OM				KS			
	Bef.	Dur.	*p*-value	(%)	Bef.	Dur.	*p*-value	(%)
N-Overall	3.50	2.09	0.000	-40	3.32	2.25	0.000	-32
I-N1	3.76	1.58	0.000	-58	3.60	2.10	0.000	-42
I-N2	3.58	1.68	0.000	-53	3.21	2.01	0.000	-37
I-N3	3.17	3.05	0.782	-4	3.14	2.65	0.000	-16
P-Overall	3.03	3.62	0.002	+19	2.56	3.69	0.000	+44
H-Overall	2.50	3.80	0.000	+52	2.36	3.67	0.000	+56
I-H1	2.62	3.93	0.000	+50	2.46	3.86	0.000	+57
I-H2	2.33	3.94	0.000	+69	2.14	3.90	0.000	+82
I-H3	2.38	4.02	0.000	+69	2.45	3.73	0.000	+52
I-H4	2.56	3.23	0.000	+26	2.32	3.08	0.000	+33
F-Overall	2.04	2.53	0.000	+24	1.90	2.48	0.000	+31
I-F1	2.73	3.46	0.000	+27	2.38	3.25	0.000	+37
I-F2	2.03	2.78	0.000	+37	1.69	2.63	0.000	+56
I-F3	1.37	1.32	0.599	-4	1.63	1.55	0.141	-5
S-Overall	2.83	3.10	0.000	+8	2.71	3.10	0.000	+15
I-S1	2.23	2.32	0.617	0	2.24	2.61	0.694	-1
I-S2	3.44	3.88	0.005	+14	3.19	3.60	0.001	+21

Bef.: Before project, Dur.: During project, *p*-value: by Wilcoxon signed-rank test, (%): Change ratio of during-score to before-score

4.3.2.1. Natural Capital

Table 4.4 presents the mean overall score for natural capital assets in OM before project implementation is 3.50 ± 0.09 (mean ± standard error), which decreases to 2.09 ± 0.09 during implementation, a decline of 40%. Similarly, the overall score for natural capital stock in KS declined by 32% from 3.32 ± 0.09 before implementation to 2.25 ± 0.09 during implementation. One possible cause for this decline is that early in the project

when carbon-based revenues were initially priced, people were highly motivated to participate in the project. However, the validation period was lengthy at both project sites and by the time OM was approved in 2012 and KS in 2015, carbon markets had started to collapse (Fletcher et al., 2016), driven by a global failure to reach the highly anticipated climate agreement at COP15 in Copenhagen in 2009. Since demand for carbon credits was low compared to excessive supply, many carbon credits generated from REDD+ projects were untradeable (Peters-Stanley et al., 2013). This was particularly true in OM, where despite having been verified with triple gold recognition, the project could not sell generated carbon credits. Personal communications with the government officer in charge of the project in Oddar Meanchey in 2018 and 2019 suggest that few of the VCUs had been sold at that point.

Based on the calculated changes in scores for natural capital, KS has performed somewhat better than OM in I-N1: biodiversity conservation and I-N2: forest cover protection. This is probably due to its location in a more peaceful area where local communities, rangers, and NGO staff can patrol and monitor the forests. OM, which is located next to the border with Thailand in Figure 4.1, on the other hand, was affected by border conflict between Cambodia and Thailand from June 2008 to December 2011, when both countries mobilised and stationed soldiers along their borders. The collapse of carbon markets seems to have affected both locations equally. During the stakeholder consultation workshops, villagers were informed of the potential revenues from carbon credits if they gave up illegal logging and jointly protected the forests. However, since actual carbon revenues from the REDD+ projects were miniscule compared to what they had been told during workshops, villagers from OM grew to distrust project developers and resorted to illegal clearance or logging to meet the immediate needs of their families. Financial support has been found to be the main challenge to successful implementation of REDD+ projects in Tanzania.

4.3.2.2. Physical Capital

In Table 4.4, the mean score for physical capital assets, representing household fixed assets, is 3.03 ± 0.12 in OM before REDD+, which then increased by 19% to 3.62. Similarly, the score for physical capital stock at KS rose from 2.56 ± 0.11 to 3.69 ± 0.12, an increase of 44%. Local communities agreed that during implementation, there was an increase in I-P1: household fixed assets, improvement of local utilities, and construction of infrastructure.

In the key informant interviews at OM, support for physical capital came from various sources and in different forms, such as sanitary toilets and a drinking water system provided by non-governmental organisation. For KS, carbon finance supported the construction of wells, meeting halls, and public infrastructure. Moreover, WCS provided REDD+ funding to build toilets for local communities. Communities in KS also received support from the Cambodian Rural Development Team (a local NGO) for a clean water system and toilets and from Centre d'Etude et de Développement Agricole Cambodgien (CEDAC) for ponds and toilets. With support from different partners, the majority of households at the KS site now have toilets and access to clean water.

Although the project implementation period thus far has been relatively short, findings of an increase in physical capital assets are consistent with those of Atela et al. (2015) in Kenya, who found that REDD+ improved community-level physical capital such as clinics and schools.

4.3.2.3. Human Capital

As shown in Table 4.4, the mean overall scores for human capital assets at the OM site are 2.50 ± 0.05 before implementation, rising to 3.80 ± 0.05 during implementation, an increase of 52%. Likewise, the overall scores for human capital assets in KS increased by 56% from 2.36 ± 0.06 before implementation to 3.67 ± 0.05 during implementation. The results show that all indicators of human capital assets increased during project implementation. In both locations, progress in I-H2: environmental education was particularly pronounced, while progress in I-H4: capacity building was relatively slow. In the key informant interviews, it was found that I-H2: environmental education indicator achieved a higher score because during project formulation and development, local households received training on different aspects of natural resources and environmental management through repeated consultation workshops. The workshops are forums to provide updated information, listen to residents' concerns, and propose REDD+ activities for implementation. I-H1: technical assistance and I-H3: skills and knowledge also achieved higher scores in both locations. These results are consistent with those of previous studies that found positive effects of REDD+ projects on human capital in Kenya (Atela et al., 2015) and in the tropics based on a review of 45 articles (Duchelle et al., 2018). Where there

have been conflicts and natural disasters, human capital growth has tended to stagnate as the use of resources is focused on maintaining peace and stability.

As demand for OM carbon credits decreased due to border conflicts and the collapse of carbon markets, carbon-based financial incentives were not available to improve human capital. Instead, communities were supported by the Society Integration Development Organisation (SIDO) with training on swine- and poultry-raising and high-production rice and vegetable farming. The Cambodian Department of Women's Affairs also provided training on processing NTFPs for long-term storage. Prey Srors community forest provided a savings and rice bank where local farmers could borrow and deposit money.

Responses from the group interviews indicate that KS was able to sell carbon credits, and carbon financing from the project helped provide capacity building for local committees. Thus, local communities were able to create their own three-year development plans. The committees held open meetings and identified areas that needed support such as systems for clean water, wells, meeting halls, water holes, and bridges. WCS also provided agricultural training, especially for fruit growing in six villages, namely Pu Charm, Sre Preah, O Rona, Srae Lvea, Pu Char, and Ou Chrar.

4.3.2.4. Financial Capital

From a household point of view, at the OM site, Table 4.4 indicates that the mean overall indicator for financial capital assets increased by 24% from 2.04 ± 0.06 before REDD+ to 2.53 ± 0.06 during REDD+. Likewise, at the KS site, it increased by 31% from 1.90 ± 0.06 before REDD+ to 2.48 ± 0.06 during REDD+. The scores for financial capital are generally lower than those for other types of livelihood assets as shown in Figures 4.3 and 4.4. The sub-indicator for I-F3: agricultural production is particularly low, with a mean of 1.37 and 1.63 in OM and KS, respectively. Furthermore, I-F3 did not improve from the pre-project period to the implementation period, as shown by the *p*-value. In both sites, I-F1: household income related to forest exhibits higher values than IF-2: household income not related to forest, which is understandable as both sites have substantial areas covered by forests.

Hvalkof (2013) found that REDD+ could contribute to maintaining sustainable livelihoods, food security, dynamic subsistence, income generation, and employment opportunities. Our findings in both locations confirm that REDD+ projects have contributed to maintaining sustainable livelihoods and food security. To achieve long-term sustainable development in both locations, greater emphasis should be placed on improving soil fertility, conserving underground water, and storing water for agricultural cultivation, since the majority of residents are farmers who depend almost entirely on rainfall and soil fertility. In addition, as healthy forests can provide various ecosystem services to local people, REDD+ activities must urgently include restoration of degraded forests through planting, fire prevention, and prevention of unauthorised exploitation of fuelwood. Only 22 families (7.2% of respondents) in OM and 33 families (11.8%) in KS collect NTFPs for their daily livelihood, either as direct or indirect sources of income. Of particular interest, only one family in each area was involved in NTFP collection as their main source of income. Therefore, forest products are not a main direct income source for local communities at either site.

4.3.2.5. Social Capital

At OM as shown in Table 4.4, the mean overall indicator of social capital assets increased from 2.83 before REDD+ to 3.10 during REDD+. At the KS, the indicator also increased from 2.71 to 3.10. These increases are statistically significant. By Table 4.4 showed that the differences between the two sites in terms of social capital levels and changes are minor.

The overall scores of social capital asset of both sites increase, they are between 2.71 to 3.10. This could cause by the influence of high scores of Q41: participation in decision-making about natural resource development or management.

Furthermore, score of sub-indicators Q38: access to information related to REDD+ management, Q39: access to information about budget of REDD+ implementation, and Q40: access to information about planning REDD+ implementation of I-S1: rights in resources management/control over resources in Table 4.5 is low. There are various reasons that could lead to these stagnant scores. Many community forests in Cambodia do not have forest management plans and a related budget. Even if written documentation exists, locals are often excluded from decision-making because they are illiterate or because they

are not motivated to take management planning seriously unless there are monetary incentives.

As information on REDD+ as a source of carbon-based income generation spread, local people were motivated to learn more about issues such as budgets for forest management. However, since this information was not made available, local communities tended to develop negative perceptions. Previous studies (Husseini et al. 2016) have found that involving local communities in the planning of forest management activities can encourage active participation in project implementation and monitoring.

Table 4.6. Mean scores of questions corresponding to social capital

Questions		OM				KS			
		Bef.	Dur.	*p*-value	(%)	Bef.	Dur.	*p*-value	(%)
I-S1		2.23	2.32	0.617	0	2.24	2.62	0.694	-1
	Q37	3.73	3.73	1.000	0	3.37	3.44	0.569	+2
	Q38	1.88	2.00	0.236	+6	1.99	2.58	0.000	+30
	Q39	1.68	1.79	0.175	+7	1.79	2.15	0.001	+20
	Q40	1.65	1.78	0.106	+8	1.84	2.28	0.000	+24
I-S2		3.44	3.88	0.005	+14	3.19	3.60	0.001	+21
	Q41	3.43	3.86	0.005	+13	3.02	3.54	0.000	+17
	Q42	3.81	4.25	0.003	+12	3.38	4.11	0.000	+22
	Q43	3.09	3.52	0.000	+14	3.16	3.16	0.691	+31

4.3.3. Multivariate Analysis of Livelihood Capital Assets, REDD+ Implementation, and Respondents' Characteristics

Table 4.7 presents the result of random effect regressions by Equation 4.4, including all relevant factor variables. The coefficient is considered statistically significant when the corresponding *p*-value is smaller than 0.10. Before project implementation, the levels of physical, financial, social, and overall livelihood capital were higher in the OM site than in the KS site, indicating that the OM site was generally better off before implementation of the REDD+ projects. The over-time increase in physical assets is lower in OM than in KS, suggesting that livelihoods of local communities in KS improved significantly after the REDD+ projects were implemented. In both sites, natural capital levels significantly decreased during implementation while all other types of capital including aggregate capital significantly increased. For instance, the physical capital score increased in OM by

0.583 and in KS by 1.125 from before to during implementation. Moreover, the aggregate livelihood capital score increased 0.205 faster in KS than in OM.

Table 4.7. Random effect regression analysis of determinants of livelihood capital assets

Independent Variable	Marginal Effects of Independent Variables (*p*-value)					
	Natural Capital	Physical Capital	Human Capital	Financial Capital	Social Capital	Overall Livelihood Capital
Difference before: OM vs. KS	0.076 (0.702)	0.638 (0.012)	0.105 (0.375)	0.271 (0.039)	0.161 (0.066)	0.250 (0.001)
Difference in changes OM vs. KS	-0.334 (0.061)	-0.542 (0.016)	0.006 (0.957)	-0.092 (0.371)	-0.062 (0.310)	-0.205 (0.000)
Change in OM During vs. Before[1]	-1.408 (0.061)	0.583 (0.016)	1.301 (0.000)	0.579 (0.000)	0.236 (0.000)	0.228 (0.000)
Change in KS During vs. Before	-1.074 (0.000)	1.125 (0.000)	1.301 (0.000)	0.579 (0.000)	0.236 (0.000)	0.433 (0.000)

In Table 4.6, financial assets have improved such that the coefficients for both sites are positive, 0.579. However, the scores are less than 2.5 in Table 4.4. This indicates that the local communities need financial support. In detail, in Table 4.7, with respect to financial capital, the coefficient of hunting income is negative, although those of NTFP and ranger incomes are positive. These incomes are related to the forest, however, the benefits for hunters are limited.

Table 4.8. Random effect regression analysis of determinants of livelihood capital assets

Independent Variable	Marginal Effects of Independent Variables (*p*-value)					
	Natural Capital	Physical Capital	Human Capital	Financial Capital	Social Capital	Overall Livelihood Capital
Livestock income[2] 1 if Yes, 0 otherwise	-0.282 (0.009)	0.225 (0.105)	0.067 (0.300)	0.025 (0.731)	0.159 (0.001)	0.039 (0.345)
NTFP income[2] 1 if Yes, 0 otherwise	-0.086 (0.501)	0.022 (0.894)	-0.005 (0.947)	0.233 (0.008)	-0.012 (0.840)	0.030 (0.536)
Ranger income[2] 1 if Yes, 0 otherwise	0.213 (0.109)	-0.147 (0.389)	-0.002 (0.980)	0.274 (0.002)	0.133 (0.030)	0.094 (0.062)
Hunting income[2] 1 if Yes, 0 otherwise	0.225 (0.105)	-0.949 (0.076)	0.123 (0.619)	-0.481 (0.090)	-0.109 (0.573)	-0.366 (0.021)
Fishery income[2] 1 if Yes, 0 otherwise	-0.111 (0.454)	0.257 (0.177)	0.160 (0.071)	-0.079 (0.432)	0.066 (0.341)	0.0584 (0.300)
Business income[2] 1 if Yes, 0 otherwise	-0.193 (0.161)	0.293 (0.098)	0.177 (0.031)	0.052 (0.581)	-0.014 (0.828)	0.0629 (0.229)
Seven other variables[3]	NS	NS	NS	NS	NS	NS
Wald χ^2 (d.f. = 20)	225.12 (0.000)	87.82 (0.000)	631.81 (0.000)	152.50 (0.000)	96.62 (0.000)	186.52 (0.000)
R^2	0.337	0.164	0.588	0.244	0.184	0.274

Note: *n* (number of observations) = 464, number of respondents = 232

1. The sum of 'change in KS' and 'difference in change (OM vs. KS)'. The *p*-values presented are the lower of the two original coefficient *p*-values.
2. Dummy variables that take the value of one when the respondent has income from the respective source and zero otherwise.
3. Seven variables that were statistically insignificant (i.e., $p > 0.10$) for all five capital assets and overall livelihood capital are not presented in the table, though they are included in the analyses as control variables. NS denotes statistically not significant. The variables are: respondent's gender, age, age squared, marital status, education level, and origin and whether the respondent worked as a civil servant or at an NGO, whether the household had crop income, and family size.

4.4. Discussion

The multivariate analysis showed that overall scores have improved during the implementation period for both locations. In Figures 4.3 and 4.4, the summary of the scores of overall livelihood asses in Table 4.4 are illustrated. By multivariate analysis, the scores of all assets except natural capital increased. The increase in scores for the social capital assets of participation can be interpreted as a positive sign to maintain cultures and communities (Hvalkof, 2013).

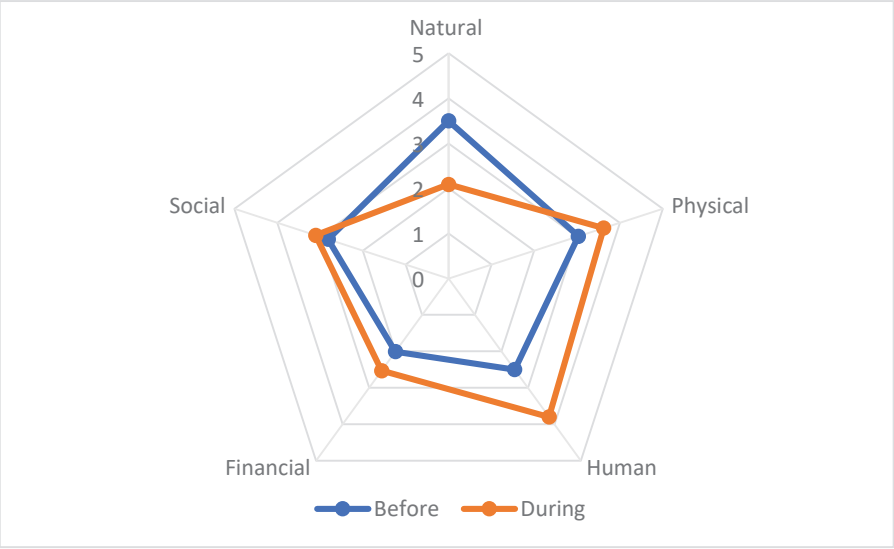

Figure 4.3. Local livelihood assets in OM before and during project implementation

Figures 4.3 and 4.4 show that local livelihood assets before and during REDD+ implementation follow similar patterns at both sites. However, the scores in Table 4.4 show that people in OM generally felt less positive about the impact of REDD+ implementation than those in KS. This highlights the potential impact of underlying contextual factors (e.g., border conflict, failure to meet expected levels of carbon-based revenue) on actual detailed perceptions of livelihood assets before and during project implementation and shows the importance of considering the situation in which REDD+ projects are introduced and how this may impact long-term success of the project.

A main objective of OM activities regarding livelihoods is agricultural intensification. The proposed agricultural intensification is to be implemented in the community only if there is carbon financing. Therefore, the local communities were initially motivated by carbon-based incentives for forest protection because it was the first such project in Cambodia. However, no carbon finance was generated and the activity has not been implemented. This can be seen in Table 4.4, where the scores of IF-3: agricultural production are low, 1.37 before and 1.32 during. This was because of the inability of the REDD+ project developer, the FA, to deliver carbon revenues as promised. Then, trust from local communities was lost, encouraging some to pursue a business-as-usual scenario. Simultaneously, local people lost motivation.

On the other hand, the main purpose of KS was to support alternative livelihoods that reduce pressures on forests and natural resources. The local communities were not as interested in forest protection because they had heard about the inability of the project developer (FA) to deliver the promised revenues in OM. From Table 4.4, the increased ratio of the score of I-F2: household income not related to forest is higher in KS than in OM. Nonetheless, with full support from WCS, KS was able to generate carbon revenues, including USD 2.6 million, in 2016, and has implemented alternative livelihood activities such as training for vegetable cultivation and animal husbandry. Therefore, local communities regained trust in the REDD+ project and are highly motivated.

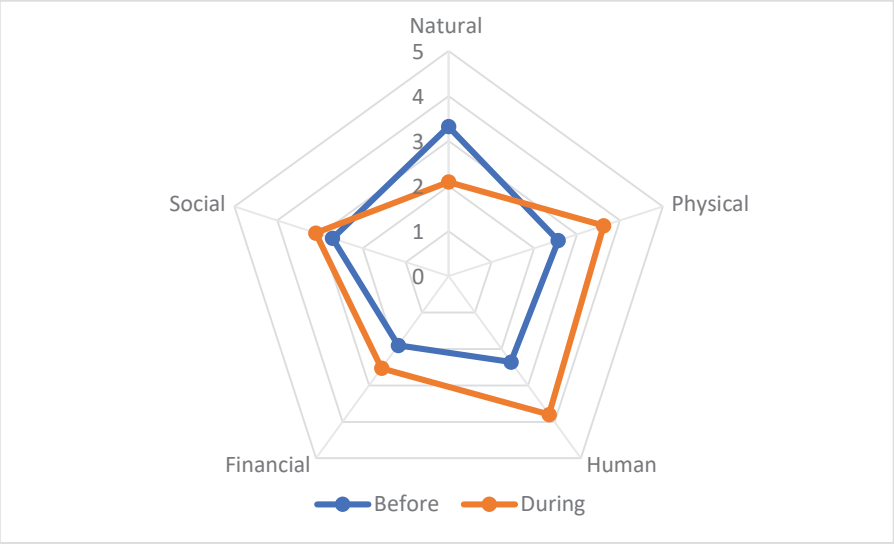

Figure 4.4. Local livelihood assets in KS before and during project implementation

Many local residents indicated that their trust and motivation depend mostly on the ability of the project developer to deliver on promises. Forestry has been a sensitive issue due to illegal logging and land clearance by both local communities and government authorities. Carbon financing has played an important role in maintaining local involvement in project implementation at the KS site. Support from an NGO (WCS) during each step of implementation of REDD+ activities has contributed significantly to the success of KS. Maintaining carbon financing for local communities is critical for the long-term success of REDD+ projects in Cambodia.

Findings are in line with those of previous studies. Duchelle et al. (2018) reviewed 45 articles on REDD+ implementation and its impacts on local livelihoods and agreed that the lack of long-term financial support hampers the sustainability of REDD+ projects. To lessen dependence on carbon markets that are significantly affected by legislation and global agreements, financial support should be aimed at transforming individual REDD+ activities (such as intensive or organic farming, fish farming, forestry enterprises) into investment projects either for local people or for which local people are hired and share in the benefits.

4.5. Conclusion and Recommendations

REDD+ projects are important performance-based financial incentives for reducing emissions from D & D and for enhancing forest carbon stocks in developing countries. Using

questionnaire data, this study assessed local livelihoods before and during implementation of REDD+ activities in two project sites in Cambodia. An SLF was adopted to assess livelihood improvement according to 13 indicators of livelihood capital assets. In general, a significant increase in overall capital assets is seen in the two REDD+ sites. Specifically, physical capital assets achieved the highest rate of increase (approximately 57.4-60.7%) from before to during implementation of REDD+ activities, followed by human capital (26.5-34.9%). However, natural capital assets sharply declined by approximately 31% and 26% at the OM and KS sites, respectively. Lack of sustained carbon-based financial support has created distrust between local communities and the project developer and consequently the status quo of illegal logging and land clearance for personal gain has remained, contributing to a decline in natural capital assets. It is essential that sustainable, performance-based financial support to reduce carbon emissions or improve carbon storage in forests is available and that benefit sharing is clear and transparent in order to gain trust and maintain participation from local communities.

Given the unpredictability of carbon-based revenues and volatile carbon markets, it is important to create alternative sources of income through various REDD+ project activities such as investment in sustainable agriculture, production of efficient cooking stoves, renewable energy for rural electrification, ecotourism, and social enterprises for NTFPs for online and offline sales. With sustainable income from any of these investment opportunities, local communities are likely to focus on forest protection. Therefore, investment in REDD+ activities with local involvement could generate higher, independent incomes for local communities for multiple generations.

It can be concluded that REDD+ project implementation can contribute to the improvement of local livelihoods. As both projects are still ongoing, further study on the progress of REDD+ project implementation and transparent benefit sharing could provide additional insights into REDD+ projects and local livelihoods.

Chapter 5 Community Membership and Community Involvement in REDD+ Projects for Livelihood Improvement

5.1. Introduction

This chapter discusses the roles of community membership and community involvement in the effective planning and execution of REDD+ projects. It builds upon previous studies and the findings in Chapters 3 and 4.

Various studies have attempted to understand the roles of community membership and the involvement of local people in management decision-making regarding the management of community forests in the tropics (Balana et al., 2010; Persson and Prowse, 2017; Shrestha and Shrestha, 2017). Local community participation and involvement in community management planning and implementation may lead to livelihood improvement (Kumsap and Indanon, 2016) because individuals feel that they are responsible for their own decisions, are responsible for their family, community, and forest, do not fear that benefits will be taken unfairly by local authorities, and feel that their cultural beliefs and traditional practices are not compromised (Kumsap and Indanon, 2016). The studies in Cambodia (Ido, 2019), Thailand (Pinyopusarerk et al., 2014), Myanmar (Feurer et al., 2018), Indonesia (Meijaard et al., 2020), and Nepal (Adhikari et al., 2014), found that members of community forest organisations have stronger commitment to protect their community forests.

Membership of a community forest provides the right to use and manage forest resources, but such membership is governed by a set of rules. Under the REDD+ scheme, community forests need to be managed according to guidelines, which are agreed by the community and other stakeholders through a series of stakeholder consultations. This chapter discusses how membership of a community forest can contribute to the effective development and implementation of REDD+ projects that improve the livelihoods of communities, while reducing carbon emissions from D & D or increasing or maintaining carbon stocks through effective conservation, sustainable management of forests, and enhancement of forest carbon stocks.

In the following, the analysis in chapter 3 and 4 are reviewed focusing on community forestry membership.

5.2. Community Membership and Drivers of D & D

Effective implementation of REDD+ projects requires an understanding of the drivers of D & D and the activities behind these drivers. Only then can appropriate measures or activities be introduced to eliminate or reduce some drivers that occur at certain levels. In Chapter 3, drivers and activities were discussed in detail. When drivers are reduced or eliminated in REDD+ project areas, REDD+ projects can then be considered an option for mitigating climate change and improving the livelihoods of local communities in the project areas.

From Table 3.9, drivers of D & D in Cambodia were observed at both national and local levels. It is evident that S10: members of community forests in REDD+ project areas are very deliberative in identifying direct and indirect drivers of D & D. It indicates that they are greatly concerned that their forests would be lost if the drivers cannot be eliminated. Therefore, it is important to include people living in communities in REDD+ project areas, and when individuals are being a member of community forests, they will need to follow the rules outlined by the community. Eventually, they will become willing to protect community forests for long-term use and sustainability (Agarwal, 2001).

5.3.Community Membership and Activities to Reduce Drivers

In REDD+, understanding drivers and their activities can pave the way for introducing appropriate interventions or activities to reduce one or more of the drivers of D & D through consultative stakeholder workshops, in which all relevant stakeholders discuss and agree on courses of action. Stakeholder consultation is part of the safeguarding guidelines of the Warsaw Framework for REDD+ (UNFCCC, 2016) to ensure that any activities obtain consensus from local people.

Since drivers of D & D occur at various scales, effective activities need to be designed to address individual drivers (Poffenberger, 2009). The effectiveness of activities including A3: law enforcement in addressing drivers can affect carbon emission reductions in particular or can affect the rate of D & D in general (Ty et al., 2011). Based on an analysis of sociodemographic factors from Table 3.10, the responses from S10: members of community forests have strong correlation with activities for reducing D & D.

S10: members of community forests consider two activities to be most capable of reducing D & D: A3: law enforcement action against illegal logging, and A5: community forest management. Further to membership status in the community forest, respondents who were concerned about S9: income tend to additionally prefer to implement the following activities as shown in Table 3.10 to reduce D & D in project areas: A11: restoration of degraded forests, and A12: good land use planning, environmental. All these activities were suggested and therefore would be accepted by local people because most have lived in their forests for many generations and believe that these activities would work.

Although the members of community forests felt that A3: law enforcement is useful, law enforcement by local authorities remains challenging, due to a lack of enforcement, collusion, and even corruption among law enforcement agencies at all levels (Biddulph, 2014; Milne, 2015; Un and So, 2009). When officials of local authorities do not enforce the law with respect to land clearance, illegal logging, and charcoal production carried out by people of various ranks from the private sector and even government, relationships between government and community members start to deteriorate. This can lead to large-scale illegal clearance because local communities have no means to stop illegal loggers supported by powerful people from entering their forests. When such a situation occurs, D & D are likely to accelerate because forests are state-owned resources in Cambodia; if government authorities do not enforce the law, people are likely to take chances to clear and claim land for temporary control, despite knowing that such activities are illegal. Therefore, it is essential that authorities at all levels enforce the law in order to prevent forest clearing, illegal logging, and other illegal activities in a transparent way and in line with international commitments. Offenders need to be held accountable for their actions. Eventually, trust can be rebuilt with forest communities.

5.4. Community Membership and Local Livelihood Improvement

As discussed in Chapter 4, analysis of the effects of REDD+ project development and implementation on local communities at two different locations indicates that members of community forests have many advantages. For instance, as member of community forest, they can access to educational opportunities. Finding shown in Table 4.4 from Chapter 4 indicated that members of community forests in OM and KS seem to be satisfied with the I-H1: technical assistance, I-H2: environmental education, I-H3: skills and

knowledge, and I-H4: capacity building they received from REDD+ projects in both locations. As Table 4.4 showed indicators of human capital assets are increased. Physical and financial capital assets have also increased in both REDD+ locations. Such improvement indicates that membership of community forests provides the advantages of being recognized and granted rights to manage and use one's own land and community land.

However, local communities in both locations seem to face similar problems with respect to natural capital assets due mainly to a lack of law enforcement and the impact of carbon prices and international climate agreements. As addressed earlier, the government needs to consider law enforcement seriously in order to reduce or prevent illegal logging and land clearance in community forests, especially those that have been designated REDD+ sites. Enforcement and transparency in resource management is crucial for achieving long-term use and management of forest resources. From a community perspective, being a member of community forests can give individuals a strong basis for influencing management decision-making that could result in positive outcomes for the community.

5.5. Impacts of International Development on Carbon Prices and Livelihood Improvements

The re-joining of the Paris Climate Agreement by the US administration is likely to result in positive impacts on climate change mitigation and adaptation worldwide. Accordingly, as demand for carbon emission reductions increase, global carbon prices are also likely to increase. In fact, since the Paris Agreement entered into force in 2016, carbon markets have already remarkably increased between 2016 and 2019 just before the outbreak of the COVID-19 pandemic (www.spglobal.com).The rise in carbon prices can provide greater carbon-based revenues to local communities and therefore, it can increase the scores of livelihood assets and improve local livelihoods. Benefits from such carbon revenues can only be shared to community members and other partners of the REDD+ projects.

5.6. Phases of REDD+ Implementation for Local Livelihood Improvement

The REDD+ project cycle commonly follows five important phases, namely 1) development of the project idea, 2) project design, 3) validation and registration, 4) project start up and implementation, and 5) the verification phases. In the Section 2.2, phases 1-4 and phase 5 are compared. The first two phases involve extensive stakeholder consultations

with the local community, implementing partners, and local and national authorities, amongst others. During these two phases, participation of the communities in question is important because these project phases decide the direction of the project, especially prior to the validation and registration phase. The REDD+ project will be implemented over one cycle, which is usually about 30-35 years.

Based on findings from the previous chapters and to improve the livelihood assets of local communities living in or around the REDD+ project sites, the following steps are recommended. These steps are shown in Figure 5.1.

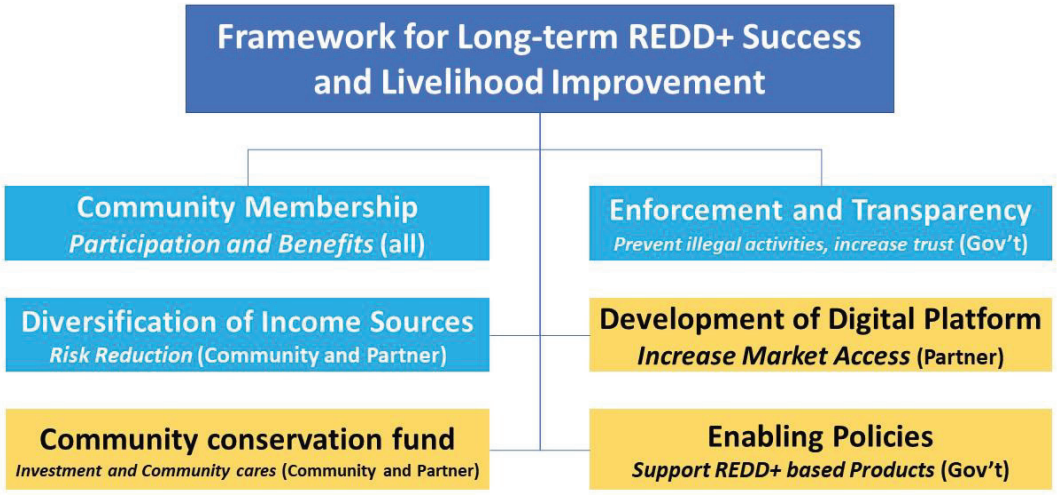

Figure 5.1. Framework proposal for long-term REDD+ success and livelihood improvement

Step 1 Community membership

During the project idea development and project design phases, local people living in community forests should be recognized and included as official members of the community. They will be governed by the rules and regulations of the community in question. Consultation workshops will be important to explain and seek consensus among newcomers and those who have lived in the area for many generations and who are very familiar with the management of community forests.

Step 2 Enforcement and transparency

Local and national authorities should establish a communication centre to work with local communities and undertake patrols and enforce laws in their jurisdiction. Offenders need to be held accountable for any illegal activities at REDD+ sites. With widespread internet access and availability of smartphones, a platform should be developed for rapid communication with communities, law enforcement agencies, NGOs, and other stakeholders in order to act quickly to respond to any illegal activities.

Step 3 Diversification of income sources

Although benefit sharing from carbon sales is important, relying on this alone is risky for local people because of their immediate, daily survival needs. Carbon projects are lengthy and affected by market demands, which are driven by many factors, notably international agreements and buyers' motivations. Therefore, it is important that when formulating activities or measures to address drivers, developers, communities, government and other partners discuss activities that will create more income streams for local people without jeopardising the ultimate goal of carbon sequestration and biodiversity safeguarding. For example, introducing intensive agroforestry should begin with planting species for harvest. Using digital platforms, local products can reach consumers in any location. Introducing fish farming or smart agriculture that can produce basic food for local communities can provide greater confidence to local people and eventually, individuals can spend more time on forest patrolling or other activities that prevent land clearance and illegal logging. By diversifying activities that generate income for local people, there will be less dependence on benefit-sharing from carbon revenues. Instead, the carbon revenues can be considered a bonus to local people if carbon credits can be sold.

Step 4 Development of digital platform

As projects are implemented, more local farm products and fish are likely to become available. Connecting these products to sustainability-conscious consumers anywhere can ensure that these products have direct access to markets, thereby eliminating middlemen traders. By doing so, local people are likely to generate higher income while consumers can pay less than market prices. Development of a marketplace app is affordable and NGOs (i.e., implementing partners) could manage platforms on behalf of communities.

Step 5 Community conservation fund

Community conservation funds are very important to ensure that local products can be sold (i.e., product surplus can be bought using the conservation fund) and local communities have money in reserves to help other communities in the event of bad weather or unexpected disasters. This fund may also be used as microfinance to help individual community members who wish to establish sustainable enterprises, such as ecotourism and souvenir shops.

Chapter 6 Overall Conclusion and Recommendations

This study assesses the overall effects of REDD+ project development and implementation on local livelihoods in Cambodia. The study analysed the drivers of deforestation and forest degradation because drivers are the most important elements to consider for effective introduction of measures or intervention policies for reducing deforestation and forest degradation, and for improving local livelihoods and biodiversity safeguarding. Using the Likert scale and based on questionnaire interviews with 215 people, only five direct drivers of D & D, namely illegal logging and unauthorised forest encroachment, commercial timber production, land clearance for commercial cultivation, charcoal production, and land clearance for subsistence agriculture and three indirect drivers, limited law enforcement, demand for timber, and land tenure and rights issues are considered permanent. Findings from this study suggest that these eight drivers need to be reduced or eliminated to ensure the long-term success of REDD+ implementation.

To address these drivers, this study identified 11 activities as appropriate and accepted by the local community as critically or urgently needed. These activities include provision of sufficient farmland for households, financial incentives for agriculture, law enforcement action against illegal logging, improved market access for agricultural products, community forest management, policy and governance reform, reforestation/tree planting, environmental education on forest management, land tenure and rights, agricultural intensification, restoration of degraded forests. Other activities include good land-use planning, environmental and social impact assessments for development proposals, fuelwood-efficient cook stoves and rooftop solar power, building infrastructure for local employment, creating alternative income opportunities, and agroforestry, while livestock rangeland management are considered to be neutral.

This study suggests that if local communities accept the activities, the REDD+ project can play an important role in the sustainable management of community forests, while providing carbon-based incentives and creating local development opportunities to ensure the long-term sustainability of projects and improve local livelihoods. As many potential REDD+ activities to reduce D & D are still novel to local people, provision of training and environmental education may increase the success of reducing drivers through the implementation of REDD+ projects. In designing these training and education programs, gaps in perception among different segments of the population should be considered.

As REDD+ projects are implemented, livelihoods of the local communities living in and around the REDD+ sites are affected. This study assessed the effects of REDD+ projects before and during the implementation period on local livelihoods in two REDD+ project sites, in OM and KS, where the projects have been validated and verified and carbon credits sold since 2012 in OM and 2015 in KS. Local livelihoods were assessed using the sustainable livelihoods framework by looking specifically at five livelihood assets, namely natural, social, human, physical, and financial capital assets assessed with 13 indicators of these assets. This study directly interviewed 120 households in OM and 112 in KS, with responses recorded on a five-point Likert scale. This study found that overall scores of local livelihood assets increased both in OM and KS, indicating that REDD+ projects can contribute to livelihood improvement. Using the difference-in-difference approach, KS generally performed better with 9.2% greater improvement of local livelihoods than in OM. This increase was due to better carbon credit sales and allocation of carbon-based revenues, as KS could sell more carbon credits. The improvement in scores varies by capital asset. Human capital assets performed better (52-56% increase). With regard to indicators of the individual assets, environmental education increased approximately 69-82%, while biodiversity declined by 42-58%. Natural capital assets show a decline of 32% and 40% in KS and OM, respectively.

Although the financial capital assets were improved during REDD+ projects, the scores are low. Financial support based on the household is crucial. REDD+ projects are result-based payments for reducing emissions from D & D and for enhancing forest carbon stocks in developing countries. A lack of sustained carbon-based financial support created distrust between local communities and the project developer and consequently the status quo of illegal logging and land clearance for personal gain remained and contributed to a decline in natural capital assets. It is essential that sustainable, performance-based financial support to reduce carbon emissions or improve carbon storage in forests is available and that benefit sharing is clear and transparent to gain trust and maintain participation from local communities.

Given the unpredictability of carbon-based revenues and volatile carbon markets, it is important to create alternative sources of income through various REDD+ project activities such as investment in sustainable agriculture, production of efficient cooking stoves, renewable energy for rural electrification, ecotourism, and social enterprises for online

and offline NTFP sales. With sustainable income from any of these investment opportunities, local communities are likely to focus on forest protection. Therefore, investment in REDD+ activities with local involvement could generate higher yet independent incomes for local communities for several generations. It is possible to conclude that community membership and involvement in the planning, development, and implementation of REDD+ projects can ensure smooth implementation of the projects, resulting in local livelihood improvement. To ensure long-term success of the REDD+ projects, it is important that alternative sources of local income be created to reduce reliance on carbon-based revenues. Carbon-based sources of income are very vulnerable to international agreement and voluntary schemes, thereby creating uncertainty in future carbon prices. Alternative income sources could be generated from activities that are introduced to reduce the drivers of deforestation and forest degradation. These include but are not limited to renewable energy (management of forest resources, solar energy, wind energy, and/or micro hydropower), ecotourism, social enterprise (e.g., producing local souvenirs), improved market access, integrated farming, climate-smart agriculture, and environmental education. These income sources are crucial for preventing further loss of forest and illegal logging.

Future research may include more samples from REDD+ project sites across the country to further assess the drivers of deforestation and forest degradation at scale and to understand the effects of REDD+ project implementation on local livelihoods. Only then can appropriate interventions and measures be introduced to strengthen REDD+ project implementation and to stimulate local participation and engagement in REDD+ project activities toward harmonisation of local people with nature, a fundamental prerequisite for long-term sustainability.

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Appendix

Questions of the Questionnaire Survey for Assessing the Effect of REDD+ Projects on Local Livelihood Assets in Keo Seima and Oddar Meanchey, Cambodia

No. ……

Questionnaire Survey

****How long have you been living here? …… (if s/he moved here later than 2008, move to the next respondent)**

Date: …… Time: ……. Name of interviewer: ……

Name of respondent: ……..……. Village: …….

Commune: …….District: ……

Name of Community Forest: ……Others: ……..

Part 1. Socioeconomic

1) Sex: ☐ 1. Male ☐ 2. Female
2) Age: …….. Years old
3) Marital status: ☐ 1. Single ☐ 2. Married ☐ 3. Divorced
   ☐ 4. Other (Specify: …….)
4) Size of household (people): ……
5) Education level: ☐ 1. No education ☐ 2. Informal education at local pagoda
   ☐ 3. Literacy class ☐ 4. Primary school ☐ 5. Secondary school
   ☐ 6. High school ☐ 7. Diploma, Vocational Education ☐ 8. College or higher
6) Origin: ☐1. Khmer ☐ 2. Vietnamese-Cambodian ☐ 3. Chinese-Cambodian
   ☐ 4. Cham/Muslim ☐ 5. Indigenous minority (specify……)
7) What is your occupation (in case respondent has more than one occupation write number 1 in the box for main occupation, followed by number 2, 3 etc.)?
   ☐ 1. Farmer ☐ 2. Livestock raiser ☐ 3. NTFP collector
   ☐ 4. Forest ranger ☐ 5. Hunter ☐ 6. Fisherman
   ☐ 7. Government officer ☐ 8. Labour worker
   ☐ 9. Business person ☐ 10. NGO Staff
   ☐ 11. Others (specify: …… ……)

Length of involvement: 1.....

2.....

3…….....

8) Your family income from main source (write number 1 in the box for the main source of income, followed by 2, 3 etc.)

☐ 1. Farming (specify…….)

☐ 2. Livestock raising (specify……)

☐ 3. NTFP collecting (specify……)

☐ 4. Forest patrolling ☐ 5. Hunting ☐ 6. Fishing ☐ 7. Government salary

☐ 8. Labour ☐ 9. Business (selling……..…) ☐ 10. Remittances (from relatives) ☐ 11. NGO work ☐ 12. Others (specify:…….)

9) Do you want to earn more from farming activities? ☐ 1. Yes ☐ 2. No

10) Would you like to sell your products online if there was a platform?

☐ 1. Yes ☐ 2. No

11) Would you like to grow the crops according to what is ordered? ☐ 1. Yes ☐ 2. No

12) Are you willing to plant trees around your house or farmland if you get paid annually for doing so? ☐ 1. Yes ☐ 2. No

13) Would you like to provide a homestay to tourists who visit your farm and be paid for this?

☐ 1. Yes ☐ 2. No

14) What is your source of energy right now? ……

15) How much do you pay for energy? …….monthly or ……yearly

16) Are you willing to install solar panels on your rooftop to get cheaper energy than what you pay now? ☐ 1. Yes ☐ 2. No

If yes, under what conditions?

A. You pay for the installation of solar. (How much you are willing to pay?.....)
B. You get a loan to install it, then pay it back monthly or yearly when you can sell farming products/services)
C. Other option, please specify……

Part 2. Drivers and activities to address D & D

17) Are you a community forest member? ☐ 1. Yes ☐ 2. No

18) Have you participated in any activities of forest management and conservation?

☐ 1. Yes ☐ 2. No

If yes, please describe: ……..……

19) Do you know about REDD+? ☐ 1. Yes ☐ 2. No

If yes, just ask them to briefly explain what they know and understand about REDD+.....……

The drivers of forest loss in your region (in the community and surroundings)

To what extend do you agree that the following items are drivers of D & D in your region?

Drivers	REDD+	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
1) Commercial logging	Before	1	2	3	4	5
	During	1	2	3	4	5
2) Illegal logging	Before	1	2	3	4	5
	During	1	2	3	4	5
3) Forest fire	Before	1	2	3	4	5
	During	1	2	3	4	5
4) Economic land concessions	Before	1	2	3	4	5
	During	1	2	3	4	5
5) Encroachment	Before	1	2	3	4	5
	During	1	2	3	4	5
6) Conversion to settlement	Before	1	2	3	4	5
	During	1	2	3	4	5
7) Clearing forest for agriculture	Before	1	2	3	4	5
	During	1	2	3	4	5
8) Forest clearing for land sales	Before	1	2	3	4	5
	During	1	2	3	4	5
9) Timber harvesting for domestic use	Before	1	2	3	4	5
	During	1	2	3	4	5
10) Fuelwood gathering	Before	1	2	3	4	5
	During	1	2	3	4	5
11) Improved road access	Before	1	2	3	4	5
	During	1	2	3	4	5
12) Population growth	Before	1	2	3	4	5
	During	1	2	3	4	5
13) Weak law enforcement and government framework	Before	1	2	3	4	5
	During	1	2	3	4	5
14) High demand for wild products and agricultural produce	Before	1	2	3	4	5
	During	1	2	3	4	5
15) Limited recognition of the value of biodiversity and environmental services	Before	1	2	3	4	5
	During	1	2	3	4	5
16) Others …….	Before	1	2	3	4	5
	During	1	2	3	4	5

20) Activities to address D & D

To what extent do you agree that the following items can address drivers of D & D in your region?

Activities	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
1) Reinforcement of land tenure	1	2	3	4	5
2) Formulation of land use plans (participatory land-use planning)	1	2	3	4	5
3) Community-based forest protection	1	2	3	4	5
4) Implementation of assisted natural regeneration (ANR) activities	1	2	3	4	5
5) Fire prevention and control	1	2	3	4	5
6) Introduction of fuel-efficient stoves	1	2	3	4	5
7) Protection of livestock	1	2	3	4	5
8) Agricultural intensification	1	2	3	4	5
9) Water resource development projects	1	2	3	4	5
10) NTFP development activities	1	2	3	4	5
11) Restoration	1	2	3	4	5
12) Reduce forest crime through direct law enforcement (patrolling, monitoring system etc.)	1	2	3	4	5
13) Establish community-based ecotourism	1	2	3	4	5
14) Provide infrastructure support linked to conservation activities	1	2	3	4	5
15) Develop and manage a system to share carbon benefits	1	2	3	4	5
16) Improve literacy and numeracy	1	2	3	4	5
17) Others……..	1	2	3	4	5

Part 3. Local livelihood assessment (before and during REDD+ implementation)

Natural capital:

21) Situation of biodiversity (birds, animals, water, fish, forest etc.)

Before REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐ 4. Slightly increase ☐ 5. Significantly increase

During REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐ 4. Slightly increase ☐ 5. Significantly increase

22) Improvement of forest coverage: Has the forestland coverage increased?

Before REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐4. Slightly increase ☐ 5. Significantly increase

During REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐ 4. Slightly increase ☐ 5. Significantly increase

23) The situation of forest protection

Before REDD+: ☐ 1. Very bad ☐ 2. Bad ☐ 3. Average

☐ 4. Good ☐ 5. Very good

During REDD+: ☐ 1. Very bad ☐ 2. Bad ☐ 3. Average

☐ 4. Good ☐ 5. Very good

24) The frequency of illegal logging and encroachment occurrences in community forest per month (in case there is no occurrence per month, ask for per year, and note)

Before REDD+: ☐ 1.Never ☐ 2. Rarely (once or twice)

☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times)

☐ 5. Very often (more than 10 times)

During REDD+: ☐ 1.Never ☐ 2. Rarely (once or twice)

☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times)

☐ 5. Very often (more than 10 times)

25) Has REDD+ changed the traditional consumption mode of extracting forest (e.g. The way of harvesting wood products)?

☐ 1. Extremely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

Explain: ……

Physical capital:

26) Is there an increase in household fixed assets such as land, furniture, radio, telephone, motor, boat etc. in your house?

Before REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐ 4. Slightly increase ☐ 5. Significantly increase

During REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐ 4. Slightly increase ☐ 5. Significantly increase

27) Is there improvement of local utilities (water, electricity)?

Before REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐ 4. Slightly increase ☐ 5. Significantly increase

During REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐ 4. Slightly increase ☐ 5. Significantly increase

28) Is there improvement of infrastructure (roads, schools, health centres, dams, transportation)

Before REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐ 4. Slightly increase ☐ 5. Significantly increase

During REDD+: ☐ 1. Significantly decrease ☐ 2. Slightly decrease

☐ 3. Remains the same ☐ 4. Slightly increase ☐ 5. Significantly increase

Human capital:

29) Is there support for local production systems, including technical assistance and agricultural inputs for soil mechanisation and irrigation?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

30) Is there technical assistance for new enterprises (skills and knowledge about fish farming, poultry and beekeeping)?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

31) Is there any environmental education training conducted for local community or any training related to forest management or REDD+ per year?

Before REDD+: ☐ 1.Never ☐ 2. Rarely (once or twice)

☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times)

☐ 5. Very often (more than 10 times)

During REDD+: ☐ 1.Never ☐ 2. Rarely (once or twice)

☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times)

☐ 5. Very often (more than 10 times)

Financial capital:

32) How much do you earn from related forest income (NTFP collecting, fee from protecting forest etc.) per month?

Before REDD+: ☐ 1. Less than 10 USD ☐ 2. 11 to 25 USD ☐ 3. 26 to 50 USD ☐ 4. 51 to 100 USD ☐ 5. 101 to 200 USD ☐ 6. 201 to 300 USD ☐ 7. More than 300 USD

During REDD+: ☐ 1. Less than 10 USD ☐ 2. 11 to 25 USD ☐ 3. 26 to 50 USD ☐ 4. 51 to 100 USD ☐ 5. 101 to 200 USD ☐ 6. 201 to 300 USD ☐ 7. More than 300 USD

33) How much do you earn from other activities beside forest-related income (fishing, remittance, livestock, plantation, labour) per month?

Before REDD+: ☐ 1. Less than 10 USD ☐ 2. 11 to 25 USD ☐ 3. 26 to 50 USD ☐ 4. 51 to 100 USD ☐ 5. 101 to 200 USD ☐ 6. 201 to 300 USD ☐ 7. More than 300 USD

During REDD+: ☐ 1. Less than 10 USD ☐ 2. 11 to 25 USD ☐ 3. 26 to 50 USD ☐ 4. 51 to 100 USD ☐ 5. 101 to 200 USD ☐ 6. 201 to 300 USD ☐ 7. More than 300 USD

34) Any change in resources before REDD+ and during REDD+ development?

If yes, explain the change ……

…… ……..

If No: Explain the similarity

……

Is access to or use of land limited or restricted?

Before REDD+: ☐ 1. Very restricted ☐ 2. Slightly restricted ☐3. Neutral ☐ 4. Less restricted ☐ 5. No restrictions

During REDD+: ☐ 1. Very restricted ☐ 2. Slightly restricted ☐ 3. Neutral ☐ 4. Less restricted ☐5. No restrictions

35) Is there improvement in agricultural production?

Before REDD+: ☐ 1. Significant decrease ☐ 2. Slight decrease ☐ 3. Neutral ☐ 4. Slight improvement ☐ 5. Significant improvement

Please describe: the agricultural activities……

During REDD+: ☐ 1. Significant decrease ☐ 2. Slight decrease

☐ 3. Neutral ☐ 4. Slight improvement ☐ 5. Significant improvement

Please describe: the agricultural activities…….

Social capital:

36) Do you have control over resources (forestry production, NTFPs, ….)?

Before REDD+: ☐ 1. Very restricted ☐ 2. Restricted ☐ 3. Neutral

☐ 4. Some control ☐ 5. Full control

During REDD+: ☐ 1. Very restricted ☐ 2. Restricted ☐ 3. Neutral

☐ 4. Some control ☐ 5. Full control

37) Can you access information related to REDD+ management?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral

☐ 4. Yes ☐ 5. Definitely yes

Please describe: what information you know……

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐3. Neutral

☐ 4. Yes ☐ 5. Definitely yes

Please describe: what information you know……

38) Can you access information about budgets for REDD+ implementation?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

Please describe: what information you know……

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

Please describe: what information you know……

39) Can you access information about planning REDD+ implementation?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

Please describe: what information you know……

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

Please describe: what information you know……

40) Are you involved in or do you participate in decision making about natural resources development or management?

Before REDD+: ☐ 1.Never ☐ 2. Rarely (once or twice)

☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times)

☐ 5. Very often (more than 10 times)

During REDD+: ☐ 1.Never ☐ 2. Rarely (once or twice)

☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times)

☐ 5. Very often (more than 10 times)

41) Do you participate in any meetings for community or natural resource development and management?

Before REDD+: ☐ 1. Never ☐ 2. Rarely (once or twice)

☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times)

☐ 5. Very often (more than 10 times)

During REDD+: ☐ 1. Never ☐ 2. Rarely (once or twice)

☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times)

☐ 5. Very often (more than 10 times)

42) How do you think of the situation regarding land tenure and rights over land use?

Before REDD+: ☐ 1. Very bad ☐ 2. Bad ☐ 3. Average ☐ 4. Good

☐ 5. Very good

During REDD+: ☐ 1. Very bad ☐ 2. Bad ☐ 3. Average ☐ 4. Good

☐ 5. Very good

Part 4: Local perception on the effectiveness of REDD+ development

43) Does the forest improve local people's livelihoods?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

44) Are you satisfied with your income from forest or natural related sources?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

45) Are you satisfied with your income from alternative sources beside forest?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

46) What is your opinion on infrastructure (roads, schools, health centres, dams, transportation)?

Before REDD+: ☐ 1. Extremely poor ☐ 2. Poor ☐ 3. Neutral ☐ 4.Good ☐ 5. Very good

During REDD+: ☐ 1. Extremely poor ☐ 2. Poor ☐ 3. Neutral ☐ 4.Good ☐ 5. Very good

47) What is your perception of ecological quality (forest, wildlife, NTFPs, water etc.)?

Before REDD+: ☐ 1. Very poor ☐ 2. Poor ☐ 3. Neutral ☐ 4. Good ☐ 5.Very good

During REDD+: ☐ 1. Very poor ☐ 2. Poor ☐ 3. Neutral ☐ 4. Good ☐ 5.Very good

48) Has your community integrated their planning and budget efficiency?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

49) How do you feel about collaboration and partnership within your community?

Before REDD+: ☐ 1. Extremely poor ☐ 2. Poor ☐ 3. Neutral ☐ 4.Good ☐ 5. Very good

During REDD+: ☐ 1. Extremely poor ☐ 2. Poor ☐ 3. Neutral ☐ 4.Good ☐ 5. Very good

50) Does your community always inspect/monitor daily/weekly/monthly forest protection?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

51) Does your community always settle the matter promptly?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

52) Is forest management and conservation evaluated by outsiders (by government or private company or NGOs, just not by the community themselves) monthly/yearly?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

53) Do local households bear the burden of taking part in forest protection and conservation (such as contributing membership fees, being forest rangers, taking part in conservation by giving time, labour etc.)?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

54) Are you satisfied with the benefits that you get from the forest (including both monetary and non-monetary benefits)?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

55) Do you have opportunities to work in any task related to forest management and conservation (for payment)?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

56) Does your community have proper utilisation of the monthly allocation of funds?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

57) Does your community publish the accounts regularly?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

58) Do you know about carbon finance (that carbon can be sold)?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

59) Do you know about (how) benefit from REDD+ are shared in your community?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

60) What is the frequency of committee and assembly meetings (per year)?

Before REDD+: ☐ 1.Never ☐ 2. Rarely (once or twice) ☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times) ☐ 5. Very often (more than 10 times)

During REDD+: ☐ 1.Never ☐ 2. Rarely (once or twice) ☐ 3. Sometimes (three to five times) ☐ 4. Often (more than five times) ☐ 5. Very often (more than 10 times)

61) Are you satisfied with the opportunities for decision-making and capacity building?

Before REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐ 2. No ☐ 3. Neutral ☐ 4. Yes

☐ 5. Definitely yes

62) How is the relationship between your community and the local government, NGOs and others?

Before REDD+: ☐ 1. Extremely poor ☐ 2. Poor ☐ 3. Neutral ☐ 4. Good ☐ 5. Very good

During REDD+: ☐ 1. Extremely poor ☐ 2. Poor ☐ 3. Neutral ☐ 4. Good ☐ 5. Very good

63) How do you feel about overall forest management and protection?

Before REDD+: ☐ 1. Extremely poor ☐ 2. Poor ☐ 3. Neutral ☐ 4. Good ☐ 5. Very good

During REDD+: ☐ 1. Extremely poor ☐ 2. Poor ☐ 3. Neutral ☐ 4. Good ☐ 5. Very good

64) Are you willing to support forest management and protection?

Before REDD+: ☐ 1. Absolutely not ☐2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

During REDD+: ☐ 1. Absolutely not ☐2. No ☐ 3. Neutral ☐ 4. Yes ☐ 5. Definitely yes

65) Do you think REDD+ development in your area is effective (of long-term benefit)? Why? Why not?

……

66) What are appropriate strategies for effective forest management and protection in the future for your community?

……

Thanks for your time and collaboration!