Effect of Community-Based Natural Resource Management on Conservation and Poverty Reduction: Evidence from Tonle Sap Lake, Cambodia

by

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Table of Content

List of Figures

List of Tables

Abbreviations

ACL	: Adjacent Category Logic
AE	: Adult Equivalent
AEC	: Adult Equivalent Consumption
ATE	: Average Treatment Effect
ATT	: Average Treatment Effect on the Treated
CBNRM	: Community-Based Natural Resource Management
CIA	: Conditional Independence Assumption
CNMC	: Cambodia National Mekong Committee
CPRs	: Common-Pool Resources
CRL	: Continuation Ratio Logic
DD	: Double Difference
FAO	: Food and Agriculture Organization
FGDs	: Focus Group Discussions
FiA	: Fisheries Administration
GDP	: Gross Domestic Product
GIS	: Geographic Information System
GPS	: Global Positioning System
HH	: Household Head
IUCN	: International Union for Conservation of Nature
IV	: Instrumental Variable
JFM	: Joint Forest Management
MAFF	: Ministry of Agriculture Forestry and Fisheries
MFAIC	: Ministry of Foreign Affairs and International Cooperation
MoE	: Ministry of Environment

MoWRAM	: Ministry of Water Resources and Meteorology
MRC	: Mekong River Commission
NGOs	: Non-Governmental Organizations
NTFPs	: Non-Timber Forest Products
OECD	: Organization for Economic Co-operation and Development
OLR	: Ordinal Logistic Regression
PIM	: Participatory Irrigation Management
PO	: Proportional Odds
PRA	: Participatory Rural Appraisal
PRK	: People's Republic of Kampuchea
PSM	: Propensity Score Matching
RD	: Regression Discontinuity
RGC	: Royal Government of Cambodia
RRA	: Rapid Rural Appraisal
TPB	: Theory of Planned Behavior
TRA	: Theory of Reasoned Action
TSBA	: Tonle Sap Basin Authority
TSBMO	: Tonle Sap Basin Management Organization
TSBR	: Tonle Sap Biosphere Reserve
TSI	: Tonle Sap Initiative
UNDP	: United Nations Development Program
UNDP-EC	: United Nations Development Program-European Commission
UNESCO	: United Nations Educational, Scientific and Cultural Organization

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Abstract

After failures of privatization and centralization suggested by the conventional theory of common-pool resources (CPRs), community-based natural resource management (CBNRM), one of the approaches of contemporary theory of CPRs, has risen to the forefront in natural resource management. Unlike privatization and centralization considering local people a threat to successful natural resource management, CBNRM values their roles in natural resource management. Theoretically, CBNRM aims to achieve both conservation and poverty reduction.

To generate the state revenue, the Royal Government of Cambodia (RGC) privatized a large part of the Tonle Sap Lake (TSL) area, called commercial fishing lots, for more than 100 years. However, due to tax evasion by commercial fishing lot owners, ineffective upward accountability, and violent conflicts between those owners and local fishers, commercial fishing lots were gradually abolished through two successive fishery policy reforms in 2001 and 2012. Since 2006, the RGC has introduced CBNRM into practice in the TSL area as a replacement for privatization. There were two types of communities in the TSL areas: CBNRM-implemented and non-CBNRM-implemented communities. Although CBNRM promises to achieve both fishery resource conservation and poverty reduction in the TSL area, the effect remains doubtful. This is due to 1) its large physical boundary and proneness to any development in the Mekong River; 2) shortcomings of effort and practice of the RGC in granting property rights to local people; and 3) unwillingness to create alternative sources of income to reduce the poverty of local people.

So far, there has not been any research focusing on the effect of CBNRM on fishery resource conservation and poverty reduction in the TSL area. Therefore, the present research aims to answer the following questions:

(1) Does CBNRM have a positive effect on fishery resource conservation?

(2) Does CBNRM have a positive effect on poverty reduction?

(3) What are root causes of success or failure of CBNRM in fishery resource conservation and poverty reduction?

(4) What are the determinants of local people's perception of the trade-off between fishery resource conservation and poverty reduction?

The present research is expected to make four main contributions to the existing literature related to the effect of CBNRM on conservation and poverty reduction and policy related to fishery resource management. First, the present research contributes to the limited existing research on fishery resource conservation in a large-scale setting by using the TSL area as a research area, which belongs to a transboundary resource, that is, TSL. Second, it contributes to the limited exiting research using local people's behavior to examine the effect of CBNRM on fishery resource conservation. Third, besides using an objective approach to understand the effect of CBNRM on fishery resource conservation and poverty reduction, the present research also contributes to the studies using a subjective approach to understand local people's perception of the trade-off between fishery resource conservation and poverty reduction. Additionally, it contributes to the ongoing debate on the trade-off between the two. Lastly, the present research is expected to make a practical contribution by providing concrete evidence on the effect of CBNRM on fishery resource conservation and poverty reduction in the TSL area for the RGC to improve CBNRM implementation.

Two communities were chosen as case studies, namely Chivieng and Preak Sromoach communities. The former is a community that has been implementing CBNRM and is considered a treatment. The latter is a community that has not been implementing CBNRM and is considered a control. The sample size was 471 households, of which 232 households were from the former, and the rest, 239 households, were from the latter. Structured interviews, focus group discussions (FGDs), and key informant interviews were conducted to collect data. Convenience sampling was used to collect samples. It is worth mentioning that in Chivieng

community, only CBNRM members were selected as the samples. Methods of propensity score matching (PSM) including the nearest neighbor with and without replacement, kernel, and the radius matching methods were used to answer the first and second research questions. Regarding the third research question, directed content analysis was used. The proportional odds model (PO) of ordinal logistic regression (OLR) was used to answer the fourth research question.

In terms of the first and second research questions, it was found that CBNRM had a negative effect on both fishery resource conservation and poverty reduction. There were two common reasons for the failure. The first reason is weak enforceability of property rights of local people to exclude outsiders from fishing inside the community boundary and weak enforceability of bylaws and internal regulations. The second reason is ineffectiveness of alternative source of income due to uneven and limited financial distribution. Regarding the first reason, according to the context of fishery resource conservation in Chivieng community, local people had no right to restrict fishers from the outside to fish inside their community boundary and punish them when they did not obey bylaws and internal regulations. As a result, community members had to compete daily with fishers from the outside in fishing. Regarding the second reason, only 3% of local people in Chivieng community were engaged in ecotourism related jobs, and the amount of earning was 100 US dollars per month. Furthermore, they could only earn this amount during the peak season lasting from October to December.

Regarding the third research question, it was found that seven out of the eight of Ostrom's principles (Ostrom, 1990), except the "nested enterprises principle," were observed to apply by local people. Root causes of CBNRM's failure were concerned with the first, second, and eighth principles of Ostrom. The first root cause is an ineffective practice of the first principle (clearly defined boundary) and ineffective practice of the eighth principle (nested enterprises) in Chivieng community. The sub-decree on community fisheries management of Cambodia states

that non-members of the CBNRM have the right to use fishery resources in the CBNRM-implemented community if they obey bylaws and internal regulations. However, local people cannot punish them when they violate their bylaws and internal regulations. Local people can only report illegal fishing to the nearest Fisheries Administration (FiA) and request an intervention (RGC, 2005). As a result, local people cannot manage fishery resources effectively. Moreover, the second root cause of the failure of CBNRM to achieve fishery resource conservation and poverty reduction is likely to be highly associated with the second principle of Ostrom, namely appropriated rules. In Chivieng community, financial benefits derived from ecotourism were highly limited and distributed unevenly, which does not reward the efforts of local people in the community to conserve fishery resources.

Regarding the fourth research question, it discovered that three out of Ostrom's eight principles were significant determinants of local people's perception of the trade-off between fishery resource conservation and poverty reduction. Those determinants include exclusion, monitoring, and nested enterprises. The principle of nested enterprises was a negative determinant of the perception of the trade-off of local people, while the former two were positive determinants. Exclusion is a positive determinant because local fishers and fishers from the outside do not focus on the clearly defined boundaries. It is also because they think that it is unpractical for them to fish only in a specific fishing ground since fish could move anywhere. Moreover, monitoring may be a positive determinant because patrollers are local people and are active in patrolling. Regarding the principle of nested enterprises, the best reason for "being a negative determinant of the perception of the trade-off" is that there are many government officials from different government institutions, and their duties and responsibilities overlap with one another and are ambiguous. Consequently, there is bribery and negligence in their duties and responsibilities.

There are two types of academic contribution from the present research to Ostrom principles (1990), which can be applied when CBNRM is implemented in a large-scale setting with dynamic resources. The first type of academic contribution is confirming some of Ostrom's principles, namely clearly defined boundaries in terms of clearly defined right to collect resources, appropriate rules, monitoring, and nested enterprises. The second type of academic contribution is that there should be a rejection as well as a modification of the principle related to clearly defined boundaries. Clearly defined resource boundaries are difficult to apply where fair access to resources is practiced. Furthermore, in a large-scale setting with dynamic resources where there is involvement from many different stakeholders, there should be fewer overlapping duties and responsibilities among them by having more clearly defined boundaries with each stakeholder's jurisdiction.

The present research suggests that the RGC should strengthen enforceability of property rights of local people in terms of excludability, bylaws, and internal regulation enforcement. Doing so enables local people, represented by a CBNRM committee, to exclude fishers from the outside to fish inside the community boundary and enforce their bylaws and internal regulations. Moreover, doing so can ensure benefits from efforts in fishery resource conservation will be obtained mostly by local people. As a result, this will make local people feel more motivated to conserve fishery resources and ultimately lead to success in fishery resource conservation and poverty reduction in the long run. Moreover, this suggests that the RGC should create more alternative sources of income as a means to reduce poverty and act as an incentive for local people to conserve fishery resources. Lastly, since the nested enterprises principle in Chivieng community was observed to apply in TSL only by government officials, there should be more involvement of local people to manage fishery resources. Involvement of local people to manage fishery resources would increase their ownership in fishery resources. Moreover, the present research suggests that there should be more clearly defined duties and

responsibilities of government officials from each government institution in fishery resource conservation. The present research suggests that FiA should share more responsibilities with CBNRM committees to conserve fishery resources in CBNRM-implemented communities including inundated forests and conservation areas established by CBNRM-implemented communities. The Ministry of Environment (MoE) should be responsible for fishery resource conservation in terms of protection of inundated forests outside CBNRM-implemented communities and protected areas created by the RGC. The Tonle Sap Basin Authority (TSBA) should help the government institutions mentioned earlier and local people to conserve fishery resources by combatting illegal fishing in fishing grounds outside CBNRM-implemented communities since it is more powerful than FiA and MoE. Moreover, there should be more awareness-raising among local people to clearly understand the duties and responsibilities of each government institution to avoid duty and responsibility confusion among local people. Doing so can also reduce the risk of government officials seeking rent from local people.

Chapter 1: Introduction

1.1 Research Background

Hardin (1968) claims that local people are individualistic; as a result, common-pool resources (CPRs) will be overexploited. This dilemma was recognized by Aristotle 2000 years ago. He claims that "what is common to the greatest number has the last care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest" (Aristotle, trans. 1966, p.33). Perhaps one of the most well-cited works supporting the opinion of both Hardin and Aristotle is the book entitled The Economic Theory of a Common-Property Resource: The Fishery by Gordon (1954). It argues that in open access fishery, fishers try to increase their fishing effort as much as possible before the other fishers extract resources, leading to resource depletion. Around the same time that the scholars above published their works, a widely known example of a game analyzed in game theory called the prisoner's dilemma (Tucker, 1983) was used by political economists to understand nature of people working together. The assumption of this game theory is similar to that of the studies above. It assumes that individuals do not have complete information, are selfish, and are pursuing their self-interest (Davis & Holt, 1993).

Hardin (1968) calls for government intervention in limiting the fishing effort of fishers. Hardin proved that destructive biological and economic outcomes could be avoided by using single ownership of fishery resources. This work led to the development of a conventional theory of common-pool resources. Under this theory, privatization and centralization are considered the most effective ways to manage resources. The theory considers local people as a threat to resource management. Inspired by the theory, both governments and donors focused on using privatization and centralization to halt resource depletion, manage resources sustainably, and improve the livelihoods of local people. However, privatization and centralization brought out more undesired results than the conventional theory claims.

Overharvested fish stocks, degraded forests, poorly managed irrigation facilities, poor health resulting from air and water pollution, and waste were all outcomes that occurred under the management of privatization and centralization. Due to those failures, scholars, policymakers, and practitioners question the validity of the conventional theory for CPRs that aims to manage resources and improve the livelihoods of local people (Schlager, 2004).

Fellow scholars claim that there are many cases where local people could manage their resources successfully because local people created rules, cooperated, coordinated, and limited their CPRs use (National Research Council, 1986). Likewise, a second school of thought regarding CPRs or the contemporary theory of CPRs has been established and developed. Local people are no longer perceived as a threat to resources. Moreover, they are considered one of the most important actors to help manage resources successfully. Based on this contemporary theory of CPRs, a bottom-up approach or decentralization has become an alternative approach to privatization and centralization in natural resource management. Among many tools for decentralization of the natural resource management, community-based natural resource management (CBNRM) is popularly implemented by most governments, particularly those in developing countries that have bitter experiences with centralization. According to Blaikie (2006), there are many theoretical benefits of CBNRM, which circulates among donors, non-governmental organizations (NGOs), and governments of recipient countries. It is claimed that the main reason for CBNRM's increased popularity is its dual objectives, conservation and poverty reduction (Rozemeijer, 2001; Taylor, 1998).

As in most developing countries, including Cambodia, privatization and centralization were implemented to manage natural resources based on the conventional theory of CPRs. Fishery resource management in Tonle Sap Lake (TSL) area is one of the other types of natural resource management placed under privatization. A large part of TSL was under privatization by auction as commercial fishing lots for over 100 years (Thol & Sato, 2014). However, privatization in

TSL came to its end in 2012[1] due to insufficient tax payment from commercial fishing lots' owners to the Royal Government of Cambodia (RGC), not being subjected to any effective upward accountability to the Fisheries Administration (FiA), and for being causes of violent conflicts between small-scale fishers and owners of commercial fishing lots (Jones & Sok, 2015). After ending fishery resources privatization in TSL, the RGC decided to implement CBNRM by sharing responsibilities of fishery resource management with small-scale fishers living in the TSL area (Mak, 2011).

1.2 Problem Statement and Research Significance

1.2.1 Problem Statement

Although CBNRM has been popularly implemented, its success in achieving both conservation and poverty reduction remains doubtful among developing countries (Agrawal & Gibson, 1999; Allison & Ellis, 2001; Blaikie, 2006; Leach, Mearns, & Scoones, 1999). Reasons for CBNRM's failures in conservation and poverty reduction are different from case to case. There are at least three reasons in general for explaining why CBNRM has failed to achieve conservation and poverty reduction. The first reason is related to one of CBNRM's criticisms that it makes an inappropriate focus on communities (Agrawal & Gibson, 1999). This means that CBNRM perceives communities as small and uncomplicated, not as they are in the real world. The second reason is the limitation of developing countries in CBNRM implementation in particular when the government is in charge of implementation. This means that the failures of CBNRM are not derived from CBNRM itself, but from the actors implementing CBNRM in an improper way. Lastly, excessive pressure from external agencies and their working manners is the main cause of failures of CBNRM in conservation and poverty reduction. According to

[1] There were two successive fishery policy reforms. The first reform was in 2001, and the second one was in 2012. In the first reform, more than half of commercial fishing lots were eliminated. In the last reform, all the remaining commercial fishing lots were abolished (Jones & Sok, 2015).

Mosse (2004, 2005), rather than voluntarily, NGOs' staff force local people to participate in CBNRM to get desirable outcomes. Likewise, according to Baviskar (2002), the villages that have been chosen to implement CBNRM are not based on local people's needs, but on the feasibility of the villages to implement CBNRM.

Moreover, some scholars claim that a project or program including CBNRM attempting to assimilate both conservation and poverty reduction is just rhetoric. This means that it cannot happen in the real world (Holland, 2012). To accept the truth that both conservation and poverty reduction cannot be achieved at the same time in the real world, it is recommended that the trade-off between conservation and poverty reduction should be taken into consideration (Brown, 2004; Faith & Walker, 2002; McShane & Wells, 2004; Sunderland et al., 2008). However, so far, not many studies have paid attention to the trade-off between the two in terms of extent or determinants.

The success of CBNRM in conservation and poverty reduction in the TSL area in Cambodia remains doubtful. Why does it remain so? Based on the root causes of CBNRM's failures in general mentioned above, two concrete reasons make its success doubtful.

The first reason is related to the nature of TSL itself. TSL is considered the largest freshwater fishing ground in Southeast Asia. Approximately one million people are living around it (Keskinen, 2006), comprising hundreds of communities, including both CBNRM and non-CBNRM-implemented communities. Moreover, TSL is transboundary since it is connected with and easily affected by any development in the Mekong River. The theories that support CBNRM or other decentralization approaches in natural resource management have been derived from successful cases of natural resource management in different settings, in particular, cases that were studied by Ostrom (1990). However, Araral (2014) criticizes that successful case studies introduced by Ostrom are feasible only for a small-scale resource management and that they are not valid for a large-scale resource management at the levels of

nation, region, and globe. As TSL is transboundary, not isolated, and likely to be affected by any development from the Mekong River, CBNRM implementation in the TSL area has a high chance to fail in fishery resource conservation and poverty reduction.

The second reason for making CBNRM implementation in the TSL area unlikely to be successful is related to shortcomings of the government's efforts and practice to implement CBNRM. It has been criticized that the fishery policy reforms by eliminating all commercial fishing lots and implementing CBNRM were extraordinarily rushed in the TSL area. Moreover, local people have not been granted enough power to manage fishery resources effectively. The RGC also has no willingness to create more alternative sources of income to improve the livelihoods of local people (Jones & Sok, 2015; Thol & Sato, 2014). Consequently, some scholars even warn that despite CBNRM implementation in the TSL area, the tragedy of the commons can still occur in the area (Johnstone et al., 2013).

Besides whether or not CBNRM can achieve fishery resource conservation and poverty reduction in the TSL area, the trade-off between the two should be concerned. Without examining the trade-off between the two, the ultimate impact[2] of CBNRM in the TSL area cannot be well understood.

Thus, the present research aims at answering the following research questions:

(1) Does CBNRM have a positive effect on fishery resource conservation?

(2) Does CBNRM have a positive effect on poverty reduction?

(3) What are root causes of success or failure of CBNRM in fishery resource conservation and poverty reduction?

(4) What are the determinants of local people's perception of the trade-off between fishery resource conservation and poverty reduction?

[2] It refers to the intended impact of a project or program, not the impact that is just an outcome from the project or program's inputs and outputs (Global Environment Facility, 2009).

1.2.2 Research Significance

The present research is expected to make four main contributions to the existing literature related to the effect of CBNRM on conservation and poverty reduction and policy related to fishery resource management.

First, there is a wealth of existing studies on the effect of CBNRM on either conservation or poverty reduction, though being dominated by forest resources, and only a few studies were conducted on fishery resources in a large-scale setting. Outcomes of a resource management regime may depend on a specific type of resources (Agrawal & Benson, 2011). Since the present research focuses on fishery resources in TSL that are transboundary resources, it contributes more to those small number of studies focusing on fishery resources in a large-scale setting.

Second, by using local people's behavior instead of their attitudes, the present research contributes not only more to the few existing studies using behavior of local people to examine the effect of a resource management regime on conservation, but it also avoids any leakage and spillover effects that are not the effects from a resource management regime. This can be caused by using remotely sensed imagery, which can lead to under or overestimate the effect of a project or program (Ewers & Rodrigues, 2008).

Third, the present research also aims at finding out determinants of the trade-off between fishery resource conservation and poverty reduction by focusing on the Ostrom's principles[3] by using perception of local people, which is a subjective approach. Therefore, the present research contributes not only more to the ongoing debate on the trade-off between fishery resource conservation and poverty reduction, but it also considers local people's perception, which is important for successful project or program implementation.

[3] Ostrom's (1990) principles are the principles for long-enduring CPR institution.

Lastly, in addition to the above contributions, the present research is also expected to make a practical contribution by providing concrete evidence on the effect of CBNRM on fishery resource conservation and poverty reduction in the TSL areas, Cambodia. This information is essential for the RGC to improve CBNRM implementation so that CBNRM can contribute more to fishery resource conservation and poverty reduction.

1.3 Limitations

There are two main limitations of the present research. The first limitation is on the measurement of fishery resource conservation and poverty reduction. The second limitation is on differences in geographical conditions of the sample communities.

Although the present research aims at examining the effect of CBNRM on fishery resource conservation and poverty reduction, it could not cover all aspects of conservation, particularly abundance of fishery resources, and those of poverty reduction including material and non-material aspects. An abundance of fish species is the best indicator to measure the effect of CBNRM on conservation. However, it is not practical to measure the abundance of fish species. The reason is fishery resources are mobile in TSL that is transboundary and easily gets affected by any development in the Mekong River. The present research used per adult equivalent consumption to measure the effect of CBNRM on poverty reduction. The present research used consumption to measure poverty due to two reasons. The first reason is that consumption is considered to be a better means to measure poverty reduction than other aspects such as income, food consumption, food ratio, calories, medical data, and basic needs because consumption does not fluctuate from time to time, does not focus only on one aspect like food or calories, and is not subjective as in the case of basic needs. The second reason is that CBNRM implementation in Cambodia mainly aims at reducing poverty in terms of increasing consumption and income (material aspect), not wellbeing (non-material aspect). Therefore, it

is not feasible for the present research to examine the effect of CBNRM on poverty reduction from the non-material aspect.

1.4 Structure of the Dissertation

This dissertation consists of eight chapters. Following this introductory chapter, Chapter 2 reviews the literature on the theory of CPRs; it provides an overview of CBNRM, indicators to measure conservation and poverty reduction, debate on the impact of conservation and poverty reduction, and importance of acknowledgment of the trade-off between conservation and poverty reduction.

Chapter 3 reviews the methodology used in the present research. It includes the setting of the research area, data collection, and the analytical framework and tools.

Chapter 4 reviews the institutional management of TSL. It includes the history of fishery resource management, current institutional management, state fishery laws, and CBNRM and non-CBNRM-implemented communities in the TSL area.

Chapters 5 aims at answering the first research question, that is, does CBNRM have a positive effect on fishery resource conservation? It includes an introduction to the research question, impact evaluation methods[4], data and method of analysis, results and discussion, and the conclusion of the chapter.

Chapter 6 aims at answering the second research question, that is, does CBNRM have a positive effect on poverty reduction? It includes an introduction to the research question, data and method of analysis, results and discussion, and the conclusion of the chapter.

Chapter 7 aims at answering the third research question, that is, what are root causes of success or failure of CBNRM in fishery resource conservation and poverty reduction? It

[4] Since the method used to analyze data in Chapters 5 and 6 is the same, to avoid repetition, the impact evaluation methods are only reviewed in Chapter 5.

includes an introduction to the research question, qualitative content analysis, data and method of analysis, results and discussion, and the conclusion of the chapter.

Chapter 8 aims at answering the fourth research question, that is, what are the determinants of local people's perception of the trade-off between fishery resource conservation and poverty reduction? It includes an introduction to the research question, methods for the ordinal dependent variable, data and method of analysis, results and discussion, and the conclusion of the chapter.

Chapter 9 is a concluding chapter that summarizes findings from Chapters 5, 6, 7, and 8, explains the academic contributions of the present research, and provides recommendations to relevant policies.

Chapter 2: Literature Review

The chapter reviews the literature related to the impact of CBNRM on conservation and poverty reduction. First, it describes the two schools of thought in natural resource management: 1) the conventional theory of natural resource management; and 2) the contemporary theory of natural resource management. The review of those schools of thought becomes a foundation to understand the trends in natural resource management and how CBNRM has been developed. Then, the chapter discusses CBNRM in detail, which is followed by the description of indicators for conservation and poverty reduction used by previous studies. This discussion is essential to justify why the present research chooses a specific indicator. Lastly, the chapter describes the debate on the impact of CBNRM on conservation and poverty reduction.

2.1 Theory of Natural Resource Management

What are CPRs? CPRs are goods that are either natural or human-made. It is costly to exclude anyone from resource systems, and the resource consumption of one person will subtract resource consumption of the others. These characteristics (excludability and rivalry) make CPRs easy to be overharvested and destroyed, which is the so-called the tragedy of the commons (Ostrom, 1990). So far, there have been two schools of thought of how to manage CPRs, which are based on different theories and assumptions. The first school of thought is mostly inspired by Hardin's work in 1968, and the second school of thought is inspired by Ostrom's work in 1990.

2.1.1 The Conventional Theory of Natural Resource Management

The first school of thought, which is called the "conventional theory" CPRs, argues that CPRs will be doomed to destruction, or the tragedy of the commons will occur. The reason for the argument is based on the fact that people are greedy and selfish. They only try to maximize

profit as much as they can. For example, pasture is considered a CPR since it is open to all. This means that there is no restriction for every herdsman to keep their cattle on the pasture and appropriate profit as much as they can. The pasture will lose its productivity due to overgrazing and finally be destroyed, leading to the tragedy of the commons. This problem had already been recognized by Aristotle 2000 years ago. Aristotle claims that "what is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest" (Aristotle, trans. 1966, p.33). Perhaps the most popular evidence supporting both Hardin (1968) and Aristotle's claims are the studies of Gordon (1954) and Scott (1955). They argue that in open access fishery, fishers try to increase their fishing effort as much as possible to maximize their profit before other fishers extract the resource, leading to resource depletion. Gordon calls for centralization, while Scott calls for privatization. Gordon and Scott blame and treat local people as a threat to resource management.

1) Assumptions

According to Ostrom (2002), although many subsequent studies in law and economics attempt to use different models to see problems of CPR management differently, those studies are still based on similar assumptions of the studies of Gordon (1954) and Scott (1955). As a result, there is no doubt that those subsequent studies still consider the conventional theory of the CPRs mentioned above to be the only theory to understand CPR management. The question here is what the assumptions of those studies by Hardin (1968), Gordon (1954), and Scott (1955) are? The first assumption of their studies is that the supply of resources, for instance, fuelwood, in such CPRs is highly predictable and finite in each relevant period. It is also assumed that users of resources are homogenous in terms of skills, assets, culture, and views on discount rates. Moreover, the users are assumed to have complete information, prefer short-term benefits, and like to maximize profit. The users do not communicate or coordinate activities with one another and act independently. Anyone can access and collect the resource.

Property rights are only for resources that they harvest and sell in an open competitive market. Lastly, it is assumed that the users have no intention to change the open access condition. Under those assumptions, the tragedy of the commons will happen (Ostrom, 2002). Around the same time as Gordon and Scott's studies, political economists used a widely known game in game theory, the prisoner's dilemma, to understand why people cooperate. The assumptions in the prisoner's dilemma are similar to those of previous studies. Some critical assumptions are: 1) individuals have no complete information since they cannot communicate with one another; 2) they are selfish or have narrowly self-interested behavior; and 3) they cannot change are be trapped in such a situation (Davis & Holt, 1993).

Besides being supported by the studies of Gordon (1954), Scott (1955), and Hardin (1968), the tragedy of the commons became well known by the support of Mancur Olson who developed the theory of collective action in 1965. The main question of his study is under what conditions cooperation may emerge. The answer to this question is that although people share the same goal, it is unlikely that those people will cooperate voluntarily to achieve that goal. The reason is that every individual will think that without their voluntary cooperation, they still get benefits from achieving the goal, causing a free-rider problem. Olson claims that unless the group size is quite small, and there is some particular device such as coercion to motivate people to act in their common interests, people will not work together to achieve the goal or their common interests (Olson, 1965). His main assumption is that people have no altruism and cannot perceive intangible benefits from their cooperation.

2) Approaches to Resource Management

According to the conventional theory of CPRs, what is an approach to manage CPRs or avoid the tragedy of the commons? According to Hardin (1968), to avoid the tragedy of the commons or manage CPRs sustainably, centralization or privatization are the only solutions. Centralization taps a stock of expertise and resources, which is enough to make people free

from the tragedy of the commons. In addition, it can protect and increase a viability of natural resources (Schlager, 2002). The nearly unified conclusion from these studies is that CPRs will be overexploited if left with local people. Therefore, to manage resources successfully, governments of both developed and developing countries as well as international aid organizations need to focus on roles of the central government to manage resources by rules and regulations (Schlager, 2002, 2004).

Have governments and international aid organizations successfully managed CPRs by using centralization? Unfortunately, over the past twenty years, centralization has not succeeded as expected. CPRs such as high-value fish, forest, and irrigation facilities, managed and owned by the government, are in destruction. Despite its success in limiting and restoring resource degradation, centralization fails in managing resources, and it is speculated that their failure contributes to exacerbating environmental problems (Schlager, 2004). The failure of centralization is extensive in both developed and developing countries. In the United States of America, it is reported that 70% of all kinds of marine fisheries are endangered or depleted. Forty percent of the forests in countries like Thailand, the Philippines, Pakistan, and Bangladesh have been destroyed for over two decades (Ascher, 1995).

Why does centralization fail in managing CPRs sustainably? Before answering this question, one should know that there are two kinds of failures from centralization in managing CPRs. The first kind of failure occurs when the government does not consider conservation as a priority. The second kind of failure happens when the government considers conservation as a priority but fails in achieving it (Acheson, 2006). Here only the second kind of failure will be described. Perhaps the simple answer to the question above is mismanagement of the government. However, this answer is too general and obvious.

There are at least four main reasons for centralization's failure in resource management. The first is a strong tendency of government agencies to create regulatory uniformity and not take

into account differences in local ecology. Worse, since government agencies have a good deal of power in their hands, they can carry out their plans without taking wishes of local government officials into consideration. Consequently, the local authority may be hostile and go against the central government agencies (Ascher, 1995). Therefore, it is highly likely that any policy imposed by the government including CPR conservation cannot work successfully without cooperation from the local authority. The second well-known reason is ignorance of knowledge, experience, and support of local people. Government agencies are supported by well-educated engineers and scientists who have little interest in the local culture as well as local people's knowledge and experiences (Acheson & Wilson, 1996; Anderson, 1996). Government agencies do not even intend to ask local people to join in rule or regulation formation although they will be ones affected by the policies (Freeman & Lowdermilk, 1985). As a result, the government agencies intend to do is likely to cause a negative impact on resources and impose a huge cost on local people (Takahashi, 1970). Third, insufficient understanding of the context in which changes in subsidies, rules, and technologies are introduced can motivate resource users to misuse resources (Acheson, 2006). For instance, to provide beef for urban markets, the Kenyan government encouraged tribesmen to raise more cattle and fewer goats. However, since cattle were less resistant to drought than goats, when the drought occurred, the tribesmen were in serious difficulty (Dyson-Hudson, 1985). Besides failing to conserve resources, actions of governments have caused many harmful effects ranging from conflicts over resources (Smith, 2000) to loss of control and autonomy (Apostle & Barrett, 1992). Additionally, policies of the governments often cause resource concentration in the hands of a small group of people like corporations and local elites (Leslie, 2000). Lastly, centralization and progress in scientific and technical knowledge have made government programs unsuccessful (Acheson, 2006).

Similar to centralization, privatization also fails at managing CPRs. Although economists claim that there are many advantages of privatization to manage CPRs such as efficiency in

resource and capital utilization and lower transaction costs, using privatization to solve the CPRs' problems is much more limited than what the economists have assumed. It is hard for privatization to solve those problems since property rights have to be well defined and complete. Moreover, enforcement of property rights has to be low cost, and markets have to be efficient for CPRs. Unfortunately, in the real world, it is infeasible to use privatization. For instance, privatization cannot be used for migratory fish species. It cannot deal with both positive and negative externalities. Interestingly, although markets are efficient, and there are complete property rights, privatization does not always lead to resource conservation. Owners still overexploit resources (Acheson, 2006).

What are the reasons for owners overexploit their resources? There are at least four reasons owners do so. The first reason is claimed by Clark (1973). He argues that owners of a renewable resource may increase their profit maximization at the expense of conservation. It happens when the resource growth rate is less than the discount rate, making owners deplete their resources and invest elsewhere that will give them higher returns. The second reason is that it takes a long time for them to get a return from the privately-owned resource. For example, trees grow very slowly. Therefore, it would be better for owners to invest the money elsewhere (Maass & Vicary, 1991). Third, when the availability of resources is uncertain, the incentive to overexploit the resources is high. Resources with high uncertainty include fish, wildlife, and forests. These resources are unpredictable and quickly change because of various factors like weather and disease (Acheson, 2006; Wilson, 2002). Lastly, financial pressure is another reason to explain why owners overexploit a resource. This problem can occur in both developed and developing countries. Owners may have to force themselves to forgo benefits from harvesting the resource in a sustainable way for the long-run to stay in business for the short-run (Acheson, 2006; Baland & Platteau, 1996).

2.1.2 The Contemporary Theory of Natural Resource Management

The second school of thought, which is called the "contemporary theory of natural resource management," is highly related to second-generation theories of collective action. This theory states that self-governance is a feasible solution to manage CPRs sustainably. What has led to the shift of CPR management from privatization and centralization to the local level or bottom up approach? There have been many studies both in fieldwork and experiments that pointed out that privatization and centralization cannot successfully manage CPRs (see Baland & Platteau, 1996; Ostrom, 1990). Over 40 years after Gordon (1954) and Scott (1956), and over 30 years after Hardin (1968), a considerable dissatisfaction emerged from scholars and policymakers regarding individual decision making and natural resource problems' conceptualizations, as well as policy programs which had been pursued by the government (Schlager, 2002). Consequently, in the mid-1980s, there was a call from many scholars to seriously rethink the conventional theory of CPRs (Schlager, 2004). Many case studies are proving that local people can free themselves from the tragedy of the commons by developing rules and cooperating, coordinating, and limiting their CPR use (National Research Council, 1986). The second school of thought regarding CPRs has emerged and gradually developed since then. Perhaps the most well-known case studies showing that successful CPR management can occur without the use of privatization and centralization are introduced in the work of Ostrom, Ostrom, Feeny, and Picht (1988). They chose and selected four famous success stories of CPR management by local communities with different types of resources including 1) water in West Basin, California; 2) an inshore fishery of Alanya, Turkey; 3) agriculture, forest, wetlands, and the Alps in Toerbel, Switzerland; and 4) agriculture and common land in Hirano, Nagaike, and Yamanoka villages in Japan (Ostrom et al., 1988).

From those successful cases, Ostrom (2000, p.40) points out attributes of CPRs and resource appropriators that are supportive of the emergence of cooperation:

Attributes of CPRs that Support the Emergence of Cooperation

(1) Feasible improvement: Conditions of resources are not at such a point of deterioration which they are so underutilized that few benefits result from organizing or it is useless to organize.

(2) Indicators: There are reliable and valid indicators of condition of the resource system[1] that are available at a relatively low cost.

(3) Predictability: Flow of the resource units is relatively predictable[2].

(4) Spatial extent: If using communication technology and transportation, the resource system is quite small, and the resource appropriators can develop internal microenvironments and accurate knowledge of external boundaries.

Attributes of the Resource Appropriators to the Emergence of Cooperation

(1) Salience: The resource appropriators' main livelihoods or important activities depend on the resource system.

(2) Common understanding: The resource appropriators share the same image of how their actions influence one another and the resource system and how the resource system operates.

(3) Low discount rate: By using a sufficiently low discount rate, the resource appropriators can estimate future benefits received from resources.

(4) Trust and reciprocity: The resource appropriators trust other appropriators that they will keep promises and relate to others with reciprocity.

(5) Autonomy: Without being countermanded from external authorities, the resource appropriators can determine their access to resources and harvesting rules.

[1] Resource system refers to a type of goods or resource that is either natural or human-made, for example, a river or irrigation system.

[2] Resource unit refers to the quantity or amount of goods or resource, for example, species.

(6) Prior organizational experience and local leadership: Through studying from the organization of their neighboring groups and participation in other social associations, the resource appropriators have at least learned minimal skills of leadership and organization.

Ostrom (2000) also highlights that the attributes of both CPRs and the resource appropriators are not considered necessary or sufficient for the resource appropriators to involve in collective action to create or modify arrangements with their institutions. However, those attributes should be regarded as conditions that are positively related to collective action's emergence. There are many possible outcomes between the setting having only one attribute and the setting having all the attributes, depending on values of those ten attributes that are related to one another. Moreover, values as well as the importance of those ten attributes are prone to change under various institutional settings. Therefore, although only ten attributes make the theory simple, it is complicated since the theory is configured and contingent (Schlager, 2004).

If the resource appropriators succeed in supplying a set of rules, or arrangements of their institution for CPRs governance, the arrangements have higher chances to be robust, meaning that there will be a long, enduring CPR institution when the principles described in Table 2.1 are met.

Table 2.1: Long-Enduring CPRs Institutions' Principles

Principles	Explanation
1. Clearly defined boundaries	Boundaries for CPRs must be well defined as well as the rights of resource appropriators.
2. Match between appropriation and provision rules, and local conditions	Rules for resource appropriation that restrict time, place, quantity of resource units and/or technology are related to local conditions as well as to rules that require money, material and/or material.
3. Collective-choice arrangements	Most people who are affected by operational rules can modify the rules.
4. Monitoring	Monitors are the resource appropriators or accountable to resource appropriators.
5. Graduated sanctions	Those who violate operation rules may be assessed graduated sanctions that depend on contexts of the offense and seriousness by other resource appropriators and/or officials that are accountable for appropriators.
6. Conflict-resolution mechanisms	The officials and resource appropriators can access to low-cost conflict resolutions when there are conflicts between officials and appropriators or among them.
7. Minimal recognition of rights to organize	Resource appropriators have rights to devise their own institutions without being challenged by external government authorities
Additional principle for CPRs which are a part of a larger system	
8. Nested enterprises	There are multiple layers of nested enterprise for organization of provision, appropriation, enforcement, monitoring, conflict resolution, and governance activities.

Source: Ostrom (1990, p. 90)

1) Assumptions

Every theory has its assumptions, and there is no exception for the second school of thought of CPRs theory. There are four assumptions of CPRs theory: 1) rationality model, 2) single resource unit in a resource system, 3) outcomes of the resource management depend on predefined principles, and 4) social learning process.

CPRs theory considers an individual as a unit of analysis. His or her rational choices have to be controlled or explained under a set of constraints (Bardhan & Ray, 2006). It is assumed that an individual, who is a rational actor that is influenced by restrictions of resource institutions and rules, will make decisions based on his or her own best interests (Ostrom, 1990). The rational choice theory assumes that the individual has perfect information and unlimited computing capability. However, Ostrom believes that due to natural limitations, "the option of optimal design is not available to mere mortals" (Ostrom, 2005, p.31). Ostrom assumes bounded rationality[3] as a driving force of individual behavior. According to this theory, an individual's choice is influenced by four internal variables: 1) expected costs, 2) expected benefits, 3) discount rates, and 4) internal norms (Ostrom, 1990). Although this broad conception of rationality can be a useful tool to study individual behavior, it poses difficulty since it depends on the explicit assumption that an individual's choice is affected by shared norms of behavior in a society or community (Steins, Röling, & Edwards, 2000). Why is this assumption of bounded rationality problematic? There are two reasons. The first reason is that the CPRs theory considers an actor-world relation as a subject-object model. This means that an individual is alone and tries to live in a world one has to manipulate and where cooperation will only happen to the extent that it fits with the egocentric calculus utility. The second reason

[3] Bounded rationality implies that the individual behavior or action and the value that one attributes to that behavior or action is affected by the context of complex and uncertain situations (Steins, Röling, & Edwards, 2000).

is that this theory undermines the role of an entity in the social world, prescribing a normative context for an actor that aims at setting norms for an action (Habermas, 1997).

The second assumption of the theory is a single resource unit in a resource system. This assumption has led to a problem in methodology. Generally, a resource system produces multiple units of products. Therefore, it is unrealistic to assume that a user will make use of a resource system for only one purpose. For example, a user can cut timber not only for fuelwood but also for clearing the land for grazing cattle (Edwards & Steins, 1998; Selsky & Creahan, 1996). Moreover, different groups of users could also use the same resource system for various purposes, which can affect the activities of others (Steins et al., 2000). Although supposing that a resource system produces only one unit of product, for instance, water in an irrigation system, there is still a chance that different social groups of users have various claims over the resource as well as potentially different uses for water like domestic or drinking water. As a result, it turns out that this single unit of product is very complicated with multiple uses (Meinzen-Dick & Bakker, 1999).

The third assumption is that outcomes of resource management depends on the predefined principles. Ostrom introduced those predefined principles, and other scholars further developed them. According to Steins et al. (2000), there are three problems derived from using those principles to assess the outcomes of resource management. First, relying on those principles makes CPRs theory ignore the contextual factors' role that can shape collective action at different levels of institutions. The large body of CPRs literature considers those contextual factors as an excuse for degradation of resources. It seems that some researchers do not provide fuller explanation of how significant the contexts of their studies are although those factors are thought to be responsible for determining the failure of the common property regime (Edwards & Steins, 1999). The main underlying reason why those researchers fail to explain the contextual factors fully is their eagerness to show as much empirical evidence as possible that

local people or resource users can manage their resources successfully through those predefined principles (Steins et al., 2000). The second problem is related to the tendency of considering those principles as a general blueprint for successful CPR management. It is a risk since those principles may lead to successful CPR management in one situation, but they do not necessarily lead to success in other situations. Moreover, an analyst may construct and interpret categories differently from the others in CPR management. There may also be a tendency that the researchers put the same weight on each principle and overlook other factors that are not listed in those principles. Lastly, it is problematic to use those prescriptive principles as a guideline to determine the success or failure of a resource management regime. The reason is similar to that of the second problem mentioned above. Different analysts or stakeholders may define success or failure differently. Moreover, stakeholders may inevitably establish normative criteria for assessing outcomes from those principles. As a result, those criteria will divert attention of stakeholders from construction of CPR management and processes that collective action can develop (Steins et al., 2000).

The fourth assumption is related to the social learning process. Ostrom (2000) assumes that resource users are rational and argues that natural resource institutions evolve through the social learning process. Thus, this view combines an aspect of rational choice with communicative planning theories and implies some unfolding and intentionally positive adaptation through trial and error to create progressively more effective and efficient institutions, which is referred to as a process of "self-organization." Ostrom also claims that over time, repeated benefits of cooperation facilitated with enforcement will weed out "rational egotists," resulting in an evolutionary projection of collective action and therefore increasing efficiency of institutional arrangements. This view assumes that a community is isolated, homogeneous, and small-sized, and the eight principles are designed based on those assumptions. However, a community is rarely isolated and heterogeneous although in the real world a community can be small-sized

(Saunders, 2014). New institutional economics has inspired it as “thin” theory of CPRs, and the alternative “thick” theory of CPRs that does not assume that resource users are rational and a community is homogenous. The latter theory assumes that resource users do not always decide based on rationality. Their decision is influenced by many other factors like political and social factors (Saunders, 2014).

2) Approaches to Resource Management

Unlike the conventional CPRs theory that was developed from the work of Hardin (1968) and supported by the studies of Gordon (1954) and Scott (1955), which mentions that there are two approaches in resource management, that is, privatization and centralization, in the contemporary CPRs theory, there are a wide range of approaches in resource management. The approaches in contemporary CPRs theory include some approaches such as co-management and CBNRM. Although those approaches are based on the same contemporary CPRs theory, their main focuses and characteristics can vary from one to another. One cannot reject that those approaches aim at achieving conservation and poverty reduction and have valued the roles of local people. However, to fulfill their objectives in conservation and poverty reduction, those approaches have different methods and give different priorities to their objectives. It should be noted that some aspects of those approaches might be the same despite the different priorities given each objective, especially the benefit sharing typology. Since many approaches are based on the contemporary CPRs theory, only the most popular approaches will be described here.

CBNRM is considered one of the most popular approaches that has been developed by using the contemporary CPRs theory. The contemporary CPRs theory inspired CBNRM because it has a close alignment with popular narratives of democracy and participation that value local people’s roles and knowledge for natural resource management (Chambers, 1983). CBNRM aims at achieving both conservation and poverty reduction simultaneously (more details of CBNRM will be described in the next section).

Co-management is another popular approach that uses the contemporary CPRs theory as one of its foundations. Co-management refers to a share of responsibility and power between local people and the government (Berkes, George, & Preston, 1991). Singleton (1998) defines co-management in a much deeper sense than this. He defines it as the term describing a governance system that combines local/decentralized decision-making and accountability with government control. Ideally, it combines their strengths and mitigates their weaknesses (Singleton, 1998). Compared to CBNRM, co-management has different degrees of valuing local people's roles and knowledge in natural resource management depending on types of co-management. There are seven types of co-management (Sen & Nielsen, 1996). Each kind of co-management has its level of local participation in natural resource management. Below is the description of each type of co-management.

- Instructive co-management: Characterized by a minimum exchange of government officials and local people, meaning that the former makes a decision and informs the latter of the decision through dialogue facilitation.
- Constructive co-management: Describes the situation where although the government reserves a large area for consensus with local people, the government is still a decision-maker.
- Cooperative co-management: Describes the situation where local people and the government treat each other equally.
- Advisory co-management: Describes the situation where local people give advice to the government, and the government is one who considers or approves a decision.
- Informative co-management: Describes the situation where the government delegates the power to local people. At the same time, local people have duties and responsibilities to inform the government of their decisions.

- Instrumental co-management: Describes the situation where local people's role is to implement the measures decided by the government. Therefore, there is no institutional reform.
- Empowerment co-management: Describes the situation where local people and the government have equal rights to define management objectives and gathering knowledge for decision-making. This kind of co-management is a learning process for all the stakeholders involved.

2.2 Community-Based Natural Resource Management (CBNRM)

2.2.1 Concept of CBNRM

Natural resource management is considered a wise means to use and protect critical areas of fauna and flora. Moreover, it is a long-term action plan for natural resource conservation such as water and land quality of for both present and future generations (Ghimire & Pimbert, 2000; Rudquist, Falter, Berkhuysen, & Jencs, 2004). "Community-based" is an approach where is derived from the participatory theory. This theory claims that to manage natural resources successfully requires participation from local people and other stakeholders, and laws (Murray & Marmorek, 2003). These factors are necessary for providing rights and delegating powers to local people to manage resources (Jones, 2004). Therefore, it is considered that the concept of CBNRM is a partner with natural resource management in terms of sustainable development practices. The main objectives of CBNRM are both to conserve natural resources and to improve the livelihoods of local people (Engel & Korf, 2005; Kellert, Mehta, Ebbin, & Lichtenfeld, 2000; Mehta & Heinen, 2001; Western & Wright, 1994).

The concept of CBNRM has become the most vital rural development policy in the context of developing countries (Menon, Singh, & Shah, 2007). The governments in South Asia and South-east Asia, Latin America, and Africa have adopted and implemented CBNRM in

different ways. Agents that initiate CBNRM implementation include NGOs, national government, and international institutions (Kellert et al., 2000). Moreover, it has been involved in individual programs such as irrigation system and wildlife management or multi-sector programs such as watershed and rural livelihood development. Usually, those programs are supported with a statutory backing or in an ad-hoc manner via state agencies or NGOs and with or without support from donors (Menon et al., 2007). Sometimes, local people also implement CBNRM without guidance from external agencies (Wood, 2008).

2.2.2 Definitions of CBNRM

There are many terms related to CBNRM, including community fishery, community-based coastal resource management, community forestry, co-management, collective resource management, community resource management, and community-protected area (Ken, 2005). Recently used terms include decentralized natural resource management (Ramakrishnan et al., 2002) and democratic decentralization of natural resources (Ribot, 2002). Those terms and their definitions are used and based on different contexts and locations. There are various ways to define CBNRM. Below are CBNRM's definitions that are defined differently by institutions, scholars, and researchers.

The World Bank defines CBNRM as an approach where local people take responsibility to manage natural resources in a defined area with monitoring and assistance from technical experts. Their participation can enhance environmental and economic benefits (World Bank, 2006). DANIDA defines CBNRM as a natural resource co-management approach. Similar to the World Bank, it stresses the importance of external stakeholders. It states that to develop a process of natural resource management with local people successfully, CBNRM should involve both negotiated terms and conditions between two or more stakeholders (DANIDA, 2007).

Different from the World Bank and DANIDA, Child and Lyman (2005), Menon et al. (2007), and Nhantumbo, Norfolk, and Pereira (2003) seem to exclude the roles of external stakeholders. Menon et al. (2007) define CBNRM as a situation where local people participate in natural resource management in their local area in some manner. Likewise, Child and Lyman (2005) define CBNRM as an approach relying on the roles of local people in resource identification, technology selection and adaptation, development prioritization, and implementation of management practices. Nhantumbo, Norfolk, and Pereira (2003) refer to CBNRM as a process of decentralization which aims at giving local institutions both rights and decision making to control resources.

Unlike the institutions and researchers mentioned above, Schmink (1999) seems to focus not only on resource conservation and livelihood enhancement, but also equity in society. CBNRM is defined as a kind of project aiming at accomplishing social equity by local people's participation in natural resource management.

Overall, CBNRM may be defined differently. However, its general aim is to conserve the natural resource and increase the livelihoods of local people through their participation in resource management with or without help from other stakeholders.

2.2.3 Emergence of CBNRM

CBNRM has become one of the well-known approaches in natural resource management in the last two decades (Neth, 2008). Academically, CBNRM is one of the other approaches derived from the second school of thought of CPRs theory, which is an alternative to the management of privatization and centralization. However, major discourses directly and indirectly support that CBNRM emerged as a result of lived experiences as well as a paradigm shift.

The major academic discourse emerging in the 1980s highlights the limitation of the post-colonial state in environmental management, which contributes to the emergence of CBNRM.

This discourse blames ideologies of politics and colonial and post-colonial development that focus on industrial needs and commercial prioritization, making environmental policies exclude local people from natural resource management (Gadgil & Guha, 1992; Shankari, 1991). The central focus of this discourse is the critical role of local people in natural resource management (Menon et al., 2007).

Unlike the first discourse focusing on the post-colonial state in environmental management, another discourse leading to the emergence of CBNRM emphasizes on manners of development planning and how local people's roles are underplayed. In this discourse, some scholars stress that development planning ignores the voice and knowledge of local people and pays more attention to development planners (Chambers, Pacey, & Thrupp, 1989; Thompson & Scoones, 1994). Those scholars claim that failures of many development programs, projects, and policies, particularly in agriculture and rural development, are a result of using excessive technocratic, centralized, and bureaucratic approaches (Menon et al., 2007). Chambers takes a stand in this discourse. He focuses on the vitality of participatory techniques like rapid rural appraisal (RRA) and participatory rural appraisal (PRA). Those techniques are considered the means by which local people can voice their concern and needs. This discourse does not reject the importance of external support in terms of expertise, funds, and policies for development. However, it instead focuses on changing the process of development to give more control and participation to local people (Menon et al., 2007).

The third discourse is traditional knowledge discourse. Going beyond the critique of development planning, as its name suggests, it focuses on the importance of traditional knowledge in development. In the 1980s, there was a significant number of publications seeking to underline the cultural embeddedness of local knowledge, indigenous, or traditional systems, as well as environmental soundness (Shankari, 1991). Local knowledge practiced by local people is considered an alternative to disastrous modern technology like large dam construction.

In the 1990s, there were two congresses on traditional sciences and technologies to acknowledge and highlight the vitality of non-Western scientific heritage (Menon et al., 2007).

"Small is beautiful" and appropriate technology is another discourse related to traditional knowledge. It highlights failures of development process in terms of its unsustainability and inequity to match local people's needs with the technology. To make technologies ecologically, economically, and socially more viable, this discourse values the need to develop innovative technologies by blending modern scientific methods with local people's knowledge (Chambers et al., 1989). Although it is not necessarily a part of a broader critique aimed at limiting development rationalism and cultural plurality's stifling, much of this discourse matches well with this critique. The main point of this critique is that the modern state governed by excessive centralization has hindered cultural plurality and cultures of local people (Chatterjee, 1998; Ostrom, 1990). Works of social anthropologists highlighting the emergence of a community as well as community development focuses on not only the importance of community development but also on a more extensive process of local people's democratic empowerment. Moreover, other works of ecological philosophies, particular that by Schumacher, whose influential work is titled "small is beautiful," contributes to the importance of community (Menon et al., 2007).

Partly, CBNRM has emerged from a paradigm shift called the flux of nature. This paradigm shift promotes a new thought on how species, particularly humans, are related to the environment. It claims that participation in natural resource management is a feasible and vital endeavor. It believes that humans are a part of the landscape, and it is most suitable for local people to participate in managing ecology (Berkes, 2004; Callicott, 2003). This paradigm shift has led to more efforts in incorporating of local people in natural resource management than that in excluding them because of what happened in the past (Agrawal & Gibson, 1999; Leach et al., 1999). Moreover, political ecology and ecological economy also contribute to the

emergence of CBNRM. According to Berkes (2004), these approaches also developed gradually from the paradigm shift mentioned above. These approaches show a convergence of knowledge in scientific, traditional, and indigenous aspects from social and physical sciences (Burns, Audouin, & Weaver, 2006). In most cases, these approaches are implemented due to disparities between natural resource management and society, which is considered a root cause of natural resource degradation (Thrupp, 1993).

2.2.4 Critique of CBNRM

Despite its popularity in recent decades, CBNRM faces many serious critiques. Generally, there are three main critiques for community-driven development, particularly for the case of CBNRM. Those critiques include design, content, and implementation of community-driven development.

The first critique concerns "community." Many scholars indeed regard a community as a rational and economic space that is important for culture and history in recent development practices. However, many mediating factors have been poorly understood in the formation of a community like caste, race, class, and gender. In the recent development practices, a community is a small, locally located, autonomous, and harmonious formation of society although there are many internal differences in its history and culture as well as in the ways the government influences its social relation structures (Agrawal & Ostrom, 2001; Baviskar, 2002; Mosse, 2004; Mosse & Sivan, 2003; Sundar, 2001). Although the notion of community is a way to give a privilege to local people and highlight decentralization's needs, there is still the concern with work related to CBNRM (Menon et al., 2007). Based on the work of Menon et al., (2007), four points need to be highlighted. The first one is that a community is always envisaged as a shared understanding among local people (Agrawal & Gibson, 1999; Agrawal & Ostrom, 2001). Consequently, differences in internal situations of a community are ignored (Menon et al., 2007). Second, deriving from the first point, despite being within the same community, the

exact voices are more from the privileged than the less privileged. Third, there is insufficient examination of priorities in a community. Finally, it is believed that community has autonomy, and that management based on the community is a solution for government opposition (Menon et al., 2007). Elite capture, exclusion of women, and marginal classes and castes are also within the dimension of this critique (Agrawal, 2001; Agrawal & Gibson, 1999; Baland & Platteau, 1996; Harrison, 2002; Manor, 2004; Mollinga, 2002). All the assumptions mentioned above and problems regarding community can be seen in practice in CBNRM at different levels. CBNRM is roughly viewed only in a small-scale community and primarily to create a group of people to manage resources. Community is considered a user group that invariably has government officials as ex-official members such as in the case of Joined Forest Management (JFM) and Participatory Irrigation Management (PIM) as well as CBNRM led by NGOs. Less involvement from the representative of a community in the user group remains due to actualities and limitation in internal democracy. Besides, although participatory methods are used, the focus on different and competing needs is insufficient. As a result, taking of different needs of a community into account and addressing inequities is insufficient (Jairath, 1999; Meinzen-Dick, DiGregorio, & McCarthy, 2004; Mosse, 2004).

The second critique of CBNRM is that more significant development's hegemonic discourse and practices limit the success of community-based development. Due to this constraint, a community faces limitations in possibilities of articulating its agendas and maneuverability (Chatterjee, 1998; Manor, 1999). According to the idea of Foucauldian development, perception in development is undoubtedly, deeply and firmly rooted in regimes of rationality acting as a structure of knowledge. Exact patterns of events, historical periods, and involvement of agencies can allow this structure of knowledge to occur (Rossi, 2004). This means that developing countries still have some limitations of practicing community-based development

that previously used the state-centered approach. Besides, "depoliticized" development[4] also puts a limit on more recent development based on a neo-liberal paradigm. This kind of critique is used on CBNRM led by the states. For example, a significant amount of literature on JFM and PIM in some countries highlights the limited power of local people and the previous state-centered approach that the government uses to solve new problems with environmental management (Kolavalli, 1995; Sundar, 2001). Moreover, excessiveness of government intervention restrains both further collective action, which is initiated by local people, and old collective action that the government uses in joint forest programs to hinder collective action. For instance, Edmunds et al. (2003) state that the autonomy of local people in involvement in community forest management in Orissa decreased by their incorporation with official JFM's strategies.

Lastly, CBNRM is criticized for considerable pressure from large external agencies as well as working manners. For instance, to get desirable outcomes for a project, NGOs' staff have involved local people in the project in a forceful manner (Mosse, 2004, 2005). Similarly, some villages are selected to implement CBNRM not for the real need to implement but based on their feasibility for the project (Baviskar, 2002).

2.3 Conservation

2.3.1 Direct Indicators of Conservation Outcomes

There are many indicators to measure conservation outcomes derived from any project or program. Those direct indicators depend on types of resources under conservation. For example, if the resource is forest, the density of forest can be used to measure the impact of a program or project on conservation. If there are certain species of fishery resources, an increase in the number those species can be used to determine the impact of a program or project on conservation.

[4] Anything that limits a new form of democratization to happen (Ferguson, 1990).

Although those direct indicators provide a precise estimation of the impact on conservation, those indicators can be time-consuming, technologically demanding, and expensive to conduct. Moreover, they are highly likely to provide a misleading picture of a program or project. The first reason is environmental factors, including climate change in particular. For example, the level of rain in an area may affect the density of forest rather than efforts in conservation. Therefore, the density of forest to measure conservation outcomes cannot be a good indicator. The second reason is related to leakage and spillover effects. It is claimed that conservation of forest in one area can stimulate conservation[5] or deforestation[6] somewhere else (Sohngen, Mendelsohn, & Sedjo, 1999). According to Wear and Murray (2004), 43% reduction of public timber harvest is affected by the public forest conservation of American and Canadian regional forest production and a market would be replaced by increasing the harvest of timber in the private timberlands in the Pacific Northwest and other places in the United States of America and Canada. Similarly, it is found that around 20% of the cropland enrolled in Conservation Reserve Program was replaced by cropland expansion in somewhere else (Wu, 2000).

2.3.2 Indirect Indicators of Conservation Outcomes

Besides real indicators, numerous studies use other indirect indicators and proxies to measure the impact of a program or project on conservation.

1) Attitude

Attitude is the most popular proxy to estimate conservation outcomes as well as other environmentally friendly behavior. Theoretically, attitude is used to predict individual behavior. Two famous theories focus on attitude and their potential impact on behavior. Those theories include the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior

[5] This phenomenon is referred to as spillover effects.
[6] This phenomenon is referred to as leakage effects.

(TPB).[7] Numerous studies use those theories to predict behavior ranging from behavior of the public to that of a specific group of people like farmers or local people.

TRA is the first theory used to predict attitude leading to a specific individual behavior, proposed by Icek Ajzen and Martin Fishbein in 1980. TPB is an extension of TRA that was developed by Icek Ajzen in 1985. These two theories assume that an individual is rational and makes a decision based on the information he or she knows. However, TRA is different from TPB in the sense that it assumes that individual behavior is under total volitional control. Unlike TRA, TPB does not assume that individual behavior is under total volitional control. It includes perceived behavioral control as a determinant of the intention of a specific behavior of an individual (Madden, Ellen, & Ajzen, 1992). This means that an individual sometimes cannot have total control of volition under some circumstances.

It is worth mentioning that a specific attitude may lead to a different type of behavior since there may be other factors or variables interacting with the effect of belief or attitude, resulting in a different behavior. This is supported by the claim made by Fishbein and Ajzen that we cannot expect that general attitude would always lead to a specific type of behavior (Fishbein & Ajzen, 1975). There are many studies on relation between environmental attitude and environmentally friendly behavior. Those studies used general attitudes to predict a specific kind of environmentally friendly behavior, that is, environmental concern. However, they found that there is a weak relationship between general attitude and environmental concern. For instance, it is indicated in the literature related to recycling that relevant attitude to recycling has a consistent relationship to recycling behavior. However, general attitude towards the environment does not have consistent relationship to recycling behavior (Schultz, Oskamp, & Mainieri, 1995).

[7] These refer to the perception of people of how difficult or easy it is to perform a specific behavior (Ajzen, 1991).

Therefore, it can be concluded that using attitude as a proxy to evaluate the impact of any project or program on conservation outcomes may not be efficient enough. Attitudes should only be considered inputs not outcomes. Behavior may be considered a better proxy for conservation outcomes. The reason is that inferring from those theories, behavior is the result of attitude, meaning that behavior should be regarded as outcome of attitude. To achieve satisfactory results or outcomes, most of programs or projects aim at changing local people's belief or attitude since they expect that changing belief or attitude will automatically change people's behavior. However, as mentioned earlier, belief or attitude does not necessarily influence behavior. Many other factors can come in between belief or attitudes and behavior. Therefore, changing belief or attitudes of local people may not result in changing behavior. What a program or project really wants is behavior change, not attitude change per se. Therefore, behavior should be considered a better proxy for measuring outcomes than attitude.

2) Behavior

Despite many studies on attituded and general environmentally friendly behavior like recycling and environmental farming practices, there are not many studies on behavior towards natural resources conservation. There are even fewer studies that use behavior as a proxy to measure conservation outcomes from programs or projects (see Infield & Namara, 2001 for a notable exception).

Different programs or projects aim at achieving different conservation outcomes depending on objectives and contexts of their implementation. For example, CBNRM in forest resources aims at changing local people's behavior toward forest resource usage and destruction, while CBNRM in fishery resources aims at changing local people's behavior toward fishing equipment usage and fishing effort. In the context of CBNRM in the TSL area, one of its main aims is to make all local fishers obey the state fishery laws by not using illegal fishing equipment, not fishing inside conservation areas, and cutting inundated forests for commercial

uses. In addition, it aims at involving more people in conservation related activities like planting inundated forests and reporting any illegal fishing to the government officials so that natural resources, specifically fishery resource conditions, can be improved.

Since one of the main objectives of CBNRM in the TSL area is to conserve fishery resources by reducing illegal fishing, this chapter, Chapter 2, focuses mainly on compliance behavior towards natural resources. Hereinafter, the development of compliance behavior models is reviewed.

Becker (1968) develops the first formal model of compliance or neoclassical deterrence. His pure deterrence model was developed based on the assumption that non-compliant and compliant behavior are derived from the calculation of costs and gains when deciding to comply or not comply with rules or regulations. This means that an individual is not compliant with rules or regulations when the expected utility from non-compliant activities exceeds the utility from compliant activities. Therefore, the only policy mechanism for improving compliance is a threat of sanction (Becker, 1968).

However, this model is criticized due to two significant shortcomings. The first shortcoming is that there is no available evidence supporting the model. The reason is that is not always the case that under expected penalty will result in a high degree of non-compliance behavior. Second, it is not feasible for policy prescriptions, in most cases, that more inputs for enforcement and higher penalties are enough to counteract the difference between the gain from compliance behavior and that from non-compliance behavior (Sutinen & Kuperan, 1999). In fishery cases, according to Furlong (1991) and Sutinen, Gauvin, and Gordon (1989), there is a below 1% chance of illegal fishers being caught and often the chance is near or at zero percent. However, penalties are not large enough. For instance, the gross profit of flagrant violators in fishery ground of the northeast USA was around 15,000 US dollars per trip. However, the total amount of illegal earning was 225,000 US dollars in 1987. When caught and sanctioned for

their violations, they had to pay from 3,000 to 15,000 US dollars to the authority. In most fishery cases, there tends to be a similar pattern of potential gross profit from violation relative to the certainty and severity of sanction (Sutinen, Rieser, & Gauvin, 1990). Moreover, generally, high penalties are not feasible in the real world. Courts have no willingness to excessively sanction the violator. However, courts are likely to impose sanctions fitting the violations, which are measured by illegal money gained or harms caused to society. Consequently, sanctions of fishing rules or regulations will not be high and according to a framework of basic deterrence, it is not high enough for combatting illegal fishing (Sutinen & Kuperan, 1999). However, it turns out that although there is a weakness in law enforcement of illegal fishers, 50% to 90% of fishers usually comply with rules and regulations in fishing (Sutinen et al., 1989, 1990).

From the description above, it is clear that it is insufficient to determine the level of rule or regulation compliance among fishers based on the degree of sanctions or punishment as well as their cost and benefit calculation from illegal fishing. Sutinen and Kuperan (1999) claim that fishers complying with rules and regulations do so because of their needs to do the right thing. They are obliged to follow a set of their own or the authority's values. Moral obligation is very common in society, and it tends to be an essential motivation to explain why a large portion of fishers comply with rules and regulations. Consequently, intrinsic motivation and morality of fishers should be incorporated into the basic deterrent model.

There are two kinds of intrinsic motivation: 1) an internal obligation to follow what is right or wrong based on one's own sense and 2) an intrinsic obligation to follow legitimate authority like police or a boss although the individual has to do something that contradicts his interest (Tyler, 2006). There are four sets of characteristics of the authority related to legitimacy or intrinsic motivation according to the literature on compliance. The first set of characteristics is the outcome's effectiveness, involving how likely conservation goals are to be achieved and how better off fishers can be. The second set is related to the process of authorization. It focuses

on whether or not there is a justice distribution of outcome among affected people in terms of costs and benefits. The third set is the efficiency of the process involving efficiency and speed that people perceive in response of authority to problems. The fourth set is procedural justice involving the fairness of the authority's treatment of people and concern for people who are affected by the process (Sutinen & Kuperan, 1999). The second and fourth sets of characteristics are still a topic of debate. Psychological theories of leadership and public choice theory claim that legitimacy is based mainly on the ability of the authority to provide a favorable outcome for people when people perceive that outcome is positive for them. Different from those theories, Tyler (2006) argues that procedural justice matters more than the favorable outcomes. According to Tyler (2006), people will obey rules or regulations more if they perceive that procedures used by the authority are fair. Therefore, the most crucial factor in promoting legitimacy is procedural justice while a less important one is the efficiency of the process, and the least important one is a favorable outcome.

In terms of morality, although contemporary economics does not account much for morality of behavior, research in sociology and psychology considers it important to explain behavior. It is hypothesized that compliance with rules and regulations is related to an individual's internal capacities and external influences of the environment, and the process of socialization is the linkage between society and individuals. Two psychological theories mainly explain how the process of socialization work with compliance behavior. Those theories include cognitive and social learning (Sutinen & Kuperan, 1999).

Cognitive learning theory emphasizes individual and stages of moral development. Therefore, its key determinants are personal morality as well as stages of moral development.[8] It is hypothesized that moral development has a direct link with a tendency to follow the rules or regulations. Whether or not personal morality supports rules or regulations, education that

[8] There are three different levels of moral development. The first one is pre-conventional; the second one is conventional; and the third one is post-conventional (Kohlberg, 1969, 1982).

provides information to people can induce desirable behavior in society (Fishbein & Ajzen, 1975). Social learning theory pays attention to the conditioning impact of the environment. Key determinants of compliance behavior depend on how significant the social influences the individual encounters and opinion from peers are. There are two basic perspectives on compliance behavior in the sociology literature: normative and instrumental. The normative perspective focuses on what the individual considers fair and moral rather than their self-interest. The individual will likely obey rules or regulations as long as he/she thinks that rules and regulations are consistent and appropriate with his internalized norms. Therefore, the main determinants of compliance behavior are appropriateness and fairness of rules and regulations. In terms of the instrumental perspective, similar to Becker's, its assumption is due to an individual response to changes in tangible, immediate incentives and penalties associated with an act, and motivation. Hence, the main determinants of compliance behavior in this perspective are certainty and severity of sanctions (Sutinen & Kuperan, 1999).

Besides intrinsic motivation and morality, extrinsic motivation is another determinant of compliance behavior. Social influence is considered extrinsic motivation, and social reputation has been regarded as a motivation that is important for compliance behavior. According to Sutinen and Kuperan (1999), there is a close linkage between morality and social influence. The standard that the individual uses to judge his or her behavior is also used to judge another in society. Hence, his or her principles for judgement are a foundation for the social influence that he or she exercises. The stronger the social influence is, the more widespread moral obligation is among fishers. Social influence has an important role in social exchange. It is found that the more non-compliant people in the community there are, the more their peer groups and community are not compliant (Geerken & Gove, 1975; Vogel, 1974; Witte & Woodbury, 1985). In addition, the more prevalent compliance behavior of people in the community is, the more forceful self-enforcement is practiced in the community, which is just

like the case with sakura ebi in Japan, herring roe in Alaska, Oregon, San Francisco and British Columbia, Bay, and American lobster in Maine and Massachusetts (Sutinen & Kuperan, 1999). This means that the more compliant people in the community there are, the more the rest of people in the community have an incentive to comply with rules or regulations (Runge, 1982, 1986).

2.4 Poverty Reduction

Two types of measurements can be used to measure the poverty or welfare level of an individual or household: non-material and material. Non-material measurements refer to any factor that affects human satisfaction and happiness. By contrast, material measurements refer to any type of measurement using economic criteria like income and consumption (Glewwe & Gaag, 1990).

Since the scope of the present research as well as one of CBNRM's objectives in the TSL area in Cambodia is to reduce material poverty, only economic welfare or poverty will be discussed.

Generally, economic welfare indicates the country's economic welfare as a whole. It refers to levels of equality and prosperity of living standards in an economy. There are various types of indicators used as measurements for economic welfare such as gross domestic product (GDP), literacy rates, and level of pollution (Pettinger, 2008). In terms of household level, economic welfare refers to that utility function that is considered a well-being index that increases as more services and goods are consumed (Glewwe & Gaag, 1990). Based on dynamic and static perspectives, economic welfare is a combination of economic security (dynamic perspective) with current level of material comfort (static perspective). Broadly speaking, economic welfare includes not only aspects of income, but also aspects of economic security determined partly by wealth and living standards that have a strong connection with consumption (Matthew, 2011).

Measuring welfare level will be easier if it is measured in terms of material or economic indicators rather than non-material ones that are usually subjective (Glewwe & Gaag, 1990). Generally, there are seven proposed indicators for economic welfare measurement as well as definitions of poverty. Those indicators include income per capita, total household consumption, consumption per capita, food consumption per capita, food ratio, calories, medical data, and basic needs. All seven indicators have different usage and limitations. Based on the objective of CBNRM implementation in the TSL area on poverty reduction, which aims at increasing consumption and the income of local people, only two indicators should be considered for measuring the effect of CBNRM on poverty reduction, that is, income and consumption. However, since there are some fluctuations in fishing income between rainy and dry seasons[9], consumption is the most appropriate indicator to measure the effect of CBNRM in the present research.

2.4.1 Income per Capita

Total income and income per capita usually are used to determine a welfare level (Glewwe & Gaag, 1990). It is used to assess the welfare levels of households that have more than one source of income (Matthew, 2011). Despite its popularity, income per capita is criticized for two crucial reasons. First, theoretically, income of people or households in developing countries varies from one year to another, especially income from agriculture. Based on the permanent income hypothesis proposed by Friedman (2008) and common sense, people or households may have some savings in an abundant year so that they can use them in a lean year. Therefore, an income level in a given year is unlikely to correspond to the household's welfare level as indicated by their consumption. Moreover, although using income per capita as a welfare indicator may be less problematic in the case of developing countries because not many of them

[9] During the rainy season, fishers cannot fish regularly due to strong wind and rain, making their fishing income in the rainy season lower than that of the dry season.

are self-employed, it is more serious for the case of developed countries (Glewwe & Gaag, 1990).

2.4.2 Household Consumption

Theoretically, total household consumption is a good indicator for measuring welfare (Glewwe & Gaag, 1990). However, there are still two problems. The first problem is the adjustment of welfare for various household consumptions. The second problem is the horizontal time that defines poverty. Total household consumption may exaggerate the welfare level of large households since the more members they have, the more goods and service consumption that households consume. To solve this problem, consumption per capita may be a good indicator, but it still underestimates the welfare level of large households. The reason is that it ignores the joint-consumption possibility and benefits of economies of scale in consumption. Household equivalence scale consumption can solve the problem of exaggeration and underestimation of large households' welfare level. It gives lower weights to any extra member in a household, especially children, when dividing values of household consumption by household size. To deal with horizontal time, the systematic impact from seasonal patterns, which can be derived from any economic activities that take less than one-year, a substantial amount of long term data is required to measure poverty (Glewwe & Gaag, 1990).

2.5 Debates on the Impact of CBNRM on Conservation and Poverty Reduction

There are three distinct kinds of debates on the impact of CBNRM on conservation and poverty reduction. The first one is solely on whether CBNRM can contribute to conservation. The second one is on whether it can contribute to poverty reduction. The last one is on whether CBNRM can achieve both conservation and poverty reduction. Hereinafter, each kind of debate will be described.

2.5.1 Impact of CBNRM on Conservation

The main idea that CBNRM can contribute to conservation is derived from collective action theory. It states that under appropriate conditions, local people can manage resources much better than the government (Child, 2004). Local people are concerned more about sustainable use of resources than private management institutions or centralized government. They are more capable of effective resource management based on their local or traditional practices (Leach et al., 1999; Tsing, Brosius & Zerner, 1999; Twyman, 2000). Moreover, one of CBNRM assumptions is that spirit of ownership and development of positive attitudes towards resource management of local people will be cultivated when they participate in resource management and obtain economic benefits from it (Leach et al., 1999; Tsing et al., 1999; Twyman, 2000).

However, some scholars argue that CBNRM as well as other people-centered approaches cannot conserve resources successfully. One of their main points of argument is that those approaches, including CBNRM, focus on people at the expense of natural resources. Therefore, they undermine the goal of strict conservation areas where there are restrictions such as on human visitation and use (Locke & Dearden, 2005; Oates, 1999). Furthermore, CBNRM assumes that local people will have a positive attitude towards conservation when they can derive economic benefits from their participation and conservation. This means that economic benefits are very important to work as a motivation or incentive for local people to conserve resources. However, in reality, it is challenging for this assumption to work. Although local people can get economic benefits, they are so insignificant for their livelihoods (Twyman, 2000). Consequently, local people may still have to exploit resources rather than conserve them. At the same time, some studies claim that at areas where there is a tourism operation, local people get too few benefits compared with foreign companies since they do not have entrepreneurship and marketing skills and lack capital (e.g., Mbaiwa, 2005). Consequently, it is no doubt that local people will not tend to conserve resources when they cannot get what they

have expected or be paid their efforts. Another argument that CBNRM cannot achieve its conservation goal is from ecologists. They argue that although it is not always the case, people usually simplify resources to the detriment of their biodiversity to improve their livelihoods (Freese, 2012; Robinson, 1993). Moreover, a project or program that depends on natural resource use and extraction is not fundamentally ecologically sound (Songorwa & Toit, 2007). Therefore, it is unlikely that conservation can be achieved from projects or programs. Another argument is related to an indirect impact of those projects or programs. Buffer areas created from projects or programs can act as a growing magnet encouraging migration to areas implementing those projects or programs (Scholte & De Groot, 2010). Additionally, the establishment of conservation areas from CBNRM can reduce local people's access to resources or increase their time for collecting resources (Hori, 2015). The last argument is that a project or program fails to link with other powerful external interests that tend to be a root cause of conservation problems (Kramer, van Schaik, & Johnson, 1997; Oates, 1999; Terborgh, 2004).

2.5.2 Impact of CBNRM on Poverty Reduction

There are eight arguments related to theories and sentiments supporting the idea that CBNRM can contribute to poverty reduction. First, it is a belief that CBNRM is a safety net and pro-poor approach. It gives privilege to local people over outsiders by maximizing internal trade transactions, providing labor-intensive jobs, and getting more surplus in local areas. It can overcome some problems related to depending on outsiders such as loss of artisanal occupations of local people, privatization, enclosure, and outflow of profits and reinvestment outside local areas. Typically, this argument is used by some governments in developing countries, for example, in most African countries, to get rid of debt. Those countries use CBNRM as one of their national poverty reduction strategies (Blaikie, 2005).

Second, CBNRM can promote local technology appropriation, successful usage of indigenous technical knowledge, and efficient resource use and allocation. The reason is that specificities of local ecology can be addressed by local people's experience, adaptive agricultural practice, and local farmer networks (Blaikie, 2005).

Third, according to new institutional economics and public choice theory, CBNRM can contribute to poverty reduction since the resource systems that are managed by local people with clear boundaries will be likely to internalize externalities[10]. Moreover, it can provide services to match needs since local people tend to make use of all the information that decision makers need to about resources. It can also make local institutions work as solutions to problems of malfeasance, promote stability in local people's livelihoods, and help to deal with issues of transparency and representation, requiring face-to-face discussion and witnessing of events (Cleaver, 1999; Ribot, 2002).

Fourth, CBNRM will solve open access problems derived from coercive and inadequately policed state property regimes. Local people can police more efficiently since they are on the spot and can quickly apprehend rule violators. The local community can secure either their de facto or de jure tenure rights and protect their resources (Blaikie, 2005).

Fifth, according to Escobar (2011), CBNRM is perceived as a form of local site resistance to de-humanizing invasions and modernization. Moreover, it can resist colonial and post-colonial states' depredations as well as forces of globalization.

Sixth, a benign cycle of effective participation, empowerment as well as expertise financial independence, and politically confident development can be derived from CBNRM, denoted as the "fulcrum for democratic change" (Ribot, 2011). This means that local people can express their opinion as well as voice their needs and concerns that are likely to be related to their access

[10] Decision-makers pay for their actions' costs.

and usage rights regarding natural resources. Ensuring access and usage rights can ensure that local people have relatively secure sources of income for food.

Seventh, CBNRM is viewed as an alternative to failures of centralization in natural resource management (Adams & Hulme, 2001). CBNRM is implemented when high economic costs for wildlife protection cannot be borne by the government and when there is disenchantment with total exclusion of local people from conservation in fortress conservation (Ghimire & Pimbert, 2000; Inamdar, Jode, Lindsay, & Cobb, 1999).

Lastly, the idea that CBNRM can contribute to poverty reduction is derived from the economic theory of property rights and comparative advantages (Murphree, 2009). According to the economic theory of property rights, local people can get financial benefits when they have private ownership in natural resources (Jones & Murphree, 2004). From the viewpoint of comparative advantage, local people can earn more financial benefits from tourism-based nature if there are more impressive landscapes and wildlife species in their local areas compared with other areas (Child, 1996, 2004).

Besides arguments for the impact of CBNRM on poverty reduction, there are arguments against it. For some scholars, adaption of an existing community-based institution is no more than a disturbance of remaining local relations, providing a chance for powerful rent-seekers. This chance can be used to reinforce or protect archaic and regressive forms of governance, for example, patriarchy and chieftaincy. Moreover, benefits from reinforcement and protection can be only captured by local elites, meaning that the poor or those depending on the resource in question are at last in the bottom line to get those benefits (Chatty & Colchester, 2002; Wells, Ganapin, & Uitto, 2001). As a result, the rich will only get richer, while the poor will remain poor or get poorer (e.g., McDermott & Schreckenberg, 2009). Although there is a chance that there is an equal benefit distribution or no elite capture, those benefits may not be enough to reduce poverty if a local community is overpopulated (Attwell & Cotterill, 2000). Moreover,

those benefits may not arrive quickly enough for local people, or it cannot provide a wide range of income-generating as well as labor-intensive activities that can meet local people's livelihood needs. Sometimes, those economic activities may have a conflict with local people's livelihood strategies (Chatty & Colchester, 2002; Wells et al., 2001). From arch-modernists and conservationists' perspectives, CBNRM can cause some epistemological problems considered as ecological imperatives. The reason is that those people think that CBNRM is an assault on rational ecology-based conservation (Attwell & Cotterill, 2000).

2.5.3 Conservation and Poverty Reduction: Verity or Illusion?

Projects or programs attempting to assimilate both conservation and poverty reduction have been criticized in recent years. In particular, the debate on whether or not CBNRM can achieve both conservation and poverty reduction is the latest iteration in a more extensive debate (Holland, 2012). CBNRM is criticized for its lack of clear criteria to assess if it can achieve both conservation and poverty reduction simultaneously (Western & Wright, 1994). While this debate is increasing rapidly, some scholars like Mbaiwa (2005) and Stronza (2000) still believe that CBNRM is vital to achieve both conservation and poverty reduction.

The win-win scenario has commonly become a target by international organizations to describe simultaneous achievement of conservation and poverty reduction (McShane et al., 2010). It is not only what CBNRM has promised to achieve, but also what other projects or programs like the Millennium Development Goals, the Convention on Biological Diversity, and the United Nations Development Program-European Commission (UNDP-EC) Poverty and Environment Initiative have aimed at (Ambler, 1999; OECD, 1996). Why has this scenario become so popular? The main reason is that this scenario appears to be ethical, efficient, and hugely marketable. It is ethical in the sense that it acknowledges both conservation and poverty reduction. In terms of efficiency, this scenario can create and take advantages from synergies between local desires and needs, and conservation priorities in regional and global levels. This

scenario tends to be hugely marketable in the sense that it can be used as an approach to get grants easily (McShane et al., 2010).

As mentioned by Redford, Robinson, and Adams (2006), the win-win scenario is considered by some scholars as only rhetoric, meaning that it cannot be achieved in the real world. Why is it only rhetoric? The win-win scenario has raised the classic problem of being a "jack of all trades, master of none" (Robinson & Redford, 2004). The first and foremost criticism is derived from international conservation experience and empirical studies' findings. For more than 20 years, the win-win scenario seems to be an exception, as opposed to a reality (Christensen, 2004; McShane & Wells, 2004; Robinson, 1993; Sunderland, Ehringhaus, & Campbell, 2008). It has been a rare case that any project or program can show how natural resources can be managed in a way whereby both conservation and poverty reduction are achieved simultaneously (Agrawal, 1997; Barrett & Arcese, 1995; Ferraro, 2001; Miller, Minteer, & Malan, 2011; Redford & Richter, 1999; Wells & McShane, 2004). According to findings of empirical studies, so far, there have been few instances where local people conserve resources when their livelihoods increase (Emerton, 2001; McShane & Wells, 2004). Worse than that, some studies find that some local people even invest more in technology or equipment to exploit the resource when their livelihoods increase, leading to more resource destruction (Aylward, 2003; Christ, Hillel, Matus, & Sweeting, 2003; Murombedzi, 1999; Smith, Khoa, & Lorenzen, 2005). Another criticism is that those projects or programs are not internally imposed by conservation organizations or local people but instead by the external agencies. As a result, they just represent agendas as well as the idea of those external agencies (Gockel & Gray, 2009). The last criticism is related to a lack of devolved rights for local people. According to Chapin (2004), and Kaimowitz and Sheil (2007), local people have been given little actual control over and access to natural resources from those projects or programs. This makes them have no incentive to conserve resources and little chance to increase their livelihoods.

The elusiveness of this scenario stems from the notion that we have to prioritize one objective rather than prioritizing two at the same time. However, giving priority to any objective, conservation or poverty reduction, is a dilemma. It is considered as a modern form of tragedy, which means that the greatest and most troubling conflicts do not depend on choosing between good and bad, but between good and good. The German philosopher Hegel names this modern form of tragedy a "collision of goods" (Brechin, Fortwangler, Wilshusen, & West, 2003). Poverty reduction is significant since it is highly related to human rights, the right to survive and live properly. Therefore, separating poverty reduction from conservation is a false dichotomy (West & Brockington, 2006), tending to lead to the return of the fortress model (Hutton, Adams, & Murombedzi, 2005). Conservation is very important for people of not only this generation but also the next generations. Moreover, since the poor often live in threatened tropical areas, they depend largely on natural resources (Cordeiro et al., 2007; Upton et al., 2008). Thus, some scholars argue that conservation should be considered the main goal, and poverty reduction should be an afterthought (Sanderson & Redford, 2004).

To accept the truth that the win-win scenario between conservation and poverty reduction cannot be achieved in the real world, several scholars in conservation and related fields have acknowledged the importance of the trade-off between the two objectives (Brown, 2004; Faith & Walker, 2002; McShane & Wells, 2004; Sunderland et al., 2008). However, so far, there have not been many studies about the trade-off from any project or program in terms of its extent or determinants. So, why is it so important to acknowledge the trade-off between conservation and poverty? Before answering this question, it is worth discussing the core meaning and types of trade-offs between conservation and poverty reduction.

The core meaning of a trade-off is to acknowledge that something will be given up while gaining something in return; it is incurred by different actions or choices in the domains of conservation and poverty reduction (McShane et al., 2010). The trade-offs between

conservation and poverty reduction are divided into four types to differentiate various achievements of a project or program. Those four types of trade-off are: 1) Win-Win, 2) Lose-Win, 3) Win-Lose, and 4) Lose-Lose (McShane et al., 2010). It can be inferred from previous studies that the trade-off, in particular, the second and third types are unavoidable during the process of project or program implementation, and the first type of trade-off only happens in a particular case. The fourth type of the trade-off is claimed to be the case if a project or program fails to take any strong stand in either conservation or poverty reduction (McShane et al., 2010).

Why is it so important to acknowledge the trade-off between conservation and poverty reduction? There are five reasons. The first and foremost reason is that acknowledgment of the trade-off can ensure acknowledgement of the ultimate impact of a project or program on conservation and poverty reduction. Distinct evaluation of the impact of a project or program on conservation and poverty reduction is highly unlikely to inform stakeholders of the ultimate impact of a project or program since it does not take into account loses and gains from another project or program. For example, although a study finds that a project or program has helped to improve fishery resource conditions and reduce poverty in a community fishery, it is impossible to conclude that a project or program has successfully achieved both conservation and poverty reduction (win-win scenario) if the trade-off between conservation and poverty reduction has not been examined.

The second reason is that there are only limited studies on the trade-off between the two in the literature (except Brown, 2004; Garnett, Sayer, & du Toit, 2007; Nelson et al., 2010). Although there have been many studies focusing on the impact of a project or program on conservation and poverty reduction separately, those studies did not show how achievement in conservation of a project or program affected poverty reduction and *vice versa* or what determined the trade-off between them.

The third reason is that acknowledgement of the trade-off between conservation and poverty reduction can improve trust in project or program implementation. According to McShane et al. (2010), it is a positive step when thinking and communicating in terms of trade-offs since it moves beyond a win-win scenario that only has a rhetorical benefit. The rhetorical benefit can fuel a cycle of optimism and disenchantment when supposed panaceas fail to fulfill their promise (Redford & Adams, 2009). Therefore, it reduces trust in a project or program over the long term (McShane et al., 2010).

The fourth reason is that acknowledgment of the trade-off between conservation and poverty reduction can improve the effectiveness of project or program implementation. Acknowledgment of the trade-off does not imply inaction or paralysis of a project or program. However, it can invite and promote dialog, creativity, and learning, which can allow more comprehensive planning and decrease the probability of disillusionment and disappointment that is associated with a project or program that has mixed impacts (Hirsch et al., 2011). Besides, it can allow for more acknowledgment of conflicting views and interests, facilitating deliberation and concerted negotiation (Brechin et al., 2003).

Lastly, acknowledgement of the trade-off may help progress toward conservation and poverty reduction. The reason is that it can make stakeholders understand that some loss is inevitable. Hence, they will not hesitate to implement a project or program because no alternative can meet all values and interests (Hirsch et al., 2011).

Chapter 3: Methodology

This chapter reviews the methodology used in the present research. In the first section, it describes the research area and rationale for selecting the sample communities, that is, Chivieng and Preak Sromoach for the present research. In the second section, it describes data collection, which includes the sampling method, sample size, and data collection tools. In the third section, it describes the analytical framework and tools used in the present research, which is derived from theoretical and empirical review.

3.1 Setting of the Research Area

There are five provinces bordering TSL. In each province, there are many CBNRM and non-CBNRM-implemented communities. In the present research, two cases of communities were selected to answer the research questions. One community selected for a case study has been implementing CBNRM, which is regarded as a treatment case in the present research. The other is a community that has not been implementing CBNRM, which is regarded as a control case for the present research. Details of the treatment and control cases will be provided in Chapter 4.

Some criteria were used to select the sample communities disregarding geographical conditions to answer the research questions. Among the four research questions, two research questions are related to impact evaluation. From the viewpoint of comparison, there should be two types of sample community, one of which is for the treatment case (that is, the CBNRM-implemented community) and the other for the control case. Since there was no baseline data before CBNRM implementation in the TSL area, a non-CBNRM-implemented community was chosen as a control case. In terms of the CBNRM-implemented community, there were three criteria to select it. The first criterion is the duration of its CBNRM implementation. If the period of CBNRM implementation is too short, the effect of CBNRM cannot be achieved, leading to underestimating the effect of CBNRM. Therefore, only communities that have been

implementing CBNRM since the start of CBNRM (in 2006) in the TSL area should be selected for consideration. The second criterion is activeness in CBNRM implementation. This is because CBNRM-implemented communities may not yield the intended effect of CBNRM on both fishery resource conservation and poverty reduction as it is suggested in theory. The activeness of those communities depends on their activities in fishery resource conservation and livelihoods like patrolling, planting inundated forests, and creating alternative sources of income. This criterion is based on the assumption that local people will conserve resources as long as they can get economic benefits from their conservation. Those economic benefits can be from alternative livelihood activities like (eco) tourism jobs, acting as a mechanism to motivate them to conserve resources. The third criterion is whether the sample community has undergone any change in conservation and livelihoods after the fishery policy reforms.

Chivieng community was selected as a sample of CBNRM-implemented communities. It is located in Kors Chivieng commune, Eak Phnom district, Battambang province. Three out of five villages belong to Chivieng community, namely Preak Toal, Kompong Prohok, and Ornlong Taour. As of 2014, the total number of households was 2,300 in Kors Chivieng commune. These three villages had 1,448 households as of 2014. The other two villages were Tvang and Kbal Taol, consisting of 852 households. The majority of local people in Kors Chivieng commune were fishers. Some of them were engaged in fish trading, aquaculture, and jobs related to ecotourism.

Tvang and Kbal Taol were implementing CBNRM. However, their management and duration of CBNRM implementation was different from those of Chivieng community. Tvang used to be under Chivieng community, CBNRM-implemented community, but it was separated from Chivieng community at the end of 2013. Kbal Taol just started CBNRM in 2014. Regarding the criteria mentioned above, Chivieng community started CBNRM in 2006, the first year for CBNRM implementation in the TSL area. The community has been recognized as

the most active CBNRM-implemented community in the TSL area in terms of CBNRM-related activities. Moreover, the community has undergone dramatic changes after the fishery policy reforms. Before the fishery policy reforms, just like most of the communities in the other TSL areas, local people in Chivieng community were not engaged much in conservation besides obeying the state fishery laws[1] since most parts of the fishing grounds were under commercial fishing lots, and they had no right to manage resources by themselves. Management was in the hands of commercial fishing lot owners and government officials. After the fishery policy reforms, there were no more commercial fishing lots. Chivieng community started CBNRM so that local people, especially the members of CBNRM[2], started becoming involved in conservation works like replanting the flooded forests and patrolling. In terms of livelihoods, before the fishery policy reforms at least one-third of local people, who were better off in the community, were engaged in commercial fishing lots-related activities. Those activities include being sub-leasers[3] or sub-sub-leasers[4] of the fishing grounds. The rest worked as fishing laborers for commercial fishing lot owners, sub-leasers, or sub-sub-leasers. After the fishery policy reforms, those people in particular fishing laborers lost their jobs, and most of them became small-scale fishers. Lastly, Chivieng community had a mechanism to motivate local people to conserve resources. The mechanism was ecotourism-related jobs from an ecotourism site targeting to conserve endangered water bird species. Those ecotourism-related jobs include cooking, boat operation, provision of accommodation, and selling handicraft made of hyacinth. Only 3% of the total population were engaged in those ecotourism-related jobs. This group of local people were better-off members in the community who could afford to buy speed boats,

[1] The state fishery laws in Cambodia were promulgated in 1956 (Darren, 2005). See details of the state fishery laws in Chapter 4, Section 4.3.

[2] CBNRM members are those who have registered their names with the CBNRM committee and have fulfilled requirements to be the members such as paying an annual membership fee and participating in CBNRM-related activities.

[3] Fishers bought a certain fishing ground from commercial fishing lot owners.

[4] Other than buying from commercial fishing lot owners, fishers bought a specific fishing ground from the sub-leasers.

owned a house in good condition, or had good skills in cooking Western food in particular. Moreover, the financial benefits from those jobs were limited and seasonal. They could earn around 100 US dollars during the peak season that lasted only three months per year from October to December.

There are countless non-CBNRM-implemented communities in the TSL area. However, not all of them can be considered as a control case for the present research. The appropriate community should be one without undergoing any dramatic change in terms of both conservation and livelihood after the fishery policy reforms and represent other non-CBNRM-implemented communities in the TSL area in general.

Preak Sromoach community, located in Kompong Kleang commune, Sourt Nikom district, Siem Reap province, was chosen as the control case, that is, the non-CBNRM-implemented community. There were 10 villages in Kompong Kleang commune. As of 2014, there were 2,690 households in Kompong Kleang commune and 456 households in Preak Sromoach community. Just like Chiveing community, most local people in Preak Sromoach community were fishers. Some of them were engaged in fish trading or aquaculture, and only a few did farming during the dry season.

In terms of conservation, before the fishery policy reforms, the main role of local people was to obey the state fishery laws. Commercial fishing lot owners and government officials were responsible for fishery resource conservation. After the fishery policy reforms, local people started becoming engaged in a conservation-related activity, that is, patrolling. However, they were not active and irregularly went patrolling since they were not clearly assigned to engage in patrolling, and there was no schedule for their patrolling. Patrolling depended totally on volunteerism and the timing of a patrol depended on whether there was an increase in illegal fishing in their community. In terms of livelihoods, before the fishery policy reforms, only a few households worked with commercial fishing lots as sub-leasers, sub-sub-

leasers, or fishing laborers. Therefore, there were not many changes before and after the fishery policy reforms.

3.2 Data Collection

Two main surveys were conducted to collect data for answering the research questions. The first survey, which was the preliminary survey, was conducted from March to May in 2014, and the second survey was conducted during the same period in 2015. Three tools were used to collect data: structured interviews with local people, key informant interviews, and focus group discussions (FGDs). There were 471 households for the overall sample, consisting of 248 households in Preak Sromoach community and 223 households in Chivieng community.

In reality, since everyone in CBNRM-implemented community is not a CBNRM member, only CBNRM members were selected for interviews in Chivieng community, the CBNRM-implemented community. It is very likely that CBNRM members know quite well the activities of CBNRM, and theoretically, the members tend to be people who experience a direct effect from CBNRM. Due to the constraint that some fishers go fishing in the daytime, and other fishers go fishing for more than one day (in both sample communities), some of them could not be interviewed. To solve such problems, the household members who frequently went fishing with them were interviewed. Convenience sampling was used to collect data.

Key informant interviews were conducted to assess the general situation of fishery resource conservation and livelihoods in the research areas. Key informants were selected based on their roles and information in the sample communities. They were village and commune chiefs, patrollers, members of the CBNRM committee (for Chivieng community), government officials from FiA from the Ministry of Agriculture Forestry and Fisheries (MAFF) and the Ministry of Environment (MoE), and NGOs' staff. FGDs were conducted to find out their livelihoods, information, and opinions related to CBNRM implementation in Chivieng

community. To grasp the general situation, participants in FGDs were fishers who have different socioeconomic characteristics and use different kinds of fishing equipment.

3.3 Analytical Framework and Tools

Based on the theoretical and empirical review above, an analytical framework for the present research was developed as shown in Figure 3.1. Additionally, it shows which chapter of the dissertation focuses on which effect of CBNRM.

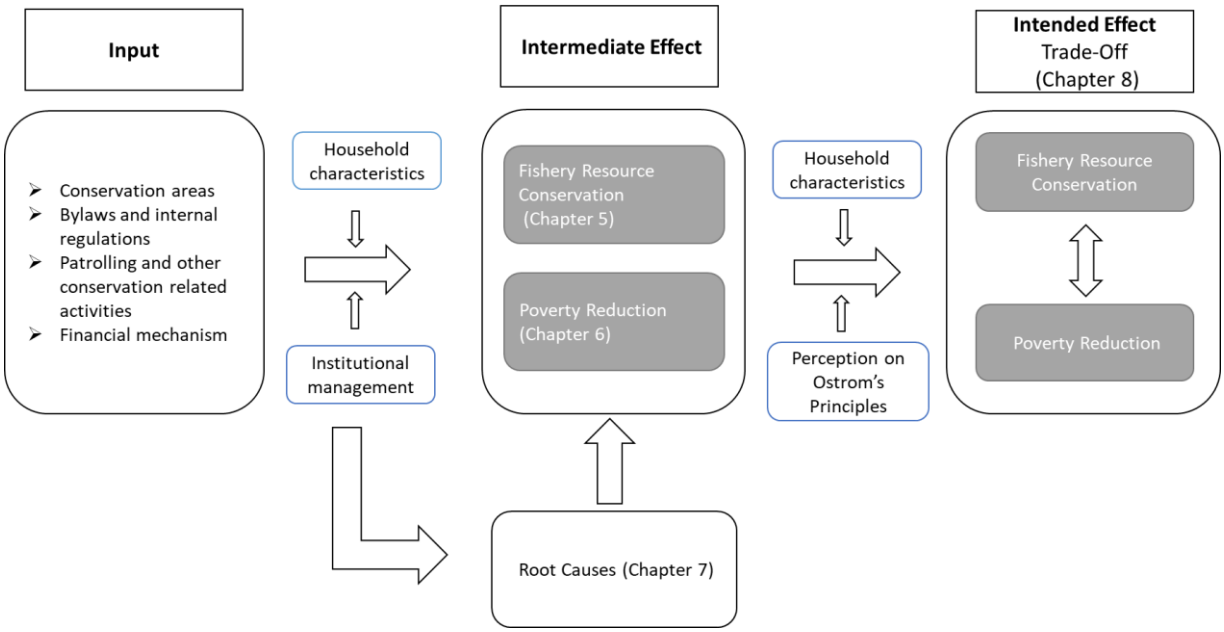

Figure 3.1: Analytical Framework

Source: Adapted from Global Environment Facility (2009)

To make CBNRM contribute to conservation and poverty reduction, the establishment of conservation areas, bylaws and internal regulations, patrolling and other conservation-related activities, and a financial mechanism is needed. However, the input mentioned above (what CBNRM gives or invests in order to achieve its objectives or intended effect) does not automatically affect the extent of the effect of CBNRM on conservation and poverty reduction. It depends on characteristics of individual households in the CBNRM-implemented community

as well as what kind of and to what extent the Ostrom's principles are observed to apply in the context of community.

Theoretically, CBNRM aims at achieving both conservation and poverty reduction simultaneously. However, many scholars argue that it is rhetoric to accomplish both objectives at the same time in the real world (Redford et al., 2006), and we should recognize that there is the trade-off between those objectives (McShane & Wells, 2004). This means that to achieve conservation, we need to give up attaining poverty reduction to some extent. So far, the principles of Ostrom have been used to assess success in either conservation or poverty reduction but not both of them or the trade-off between the two objectives. Success in one objective cannot determine the success of a resource management regime. Hence, it is likely that using those eight principles to assess only one side of success is insufficient to prove that a resource management regime is successful. Furthermore, most of the previous studies[5] focused only on the macro level such as the regional or country-level by using secondary data. Although it is true that we can make a generalization from those studies' results, those results are likely from researchers' perceptions rather than that of local people, which may not represent what local people perceive. Local people's perception is vital for the success of a project or program because it can affect their participation and support (Allendorf et al., 2012). Therefore, it is crucial to judge one factor as a determinant of successful resource management from the perception of local people rather than that of researchers.

To fill this gap, the present research focuses not only on the effects of CBNRM on fishery resource conservation and poverty reduction, but also on determinants of the trade-off between the two by using the perception of local people on the eight principles suggested by Ostrom (1990). Characteristics of individual households are also taken into account since they could

[5] See Anderson (2012), and Cox, Arnold, and Thomas (2010).

affect how local people perceive the trade-off between fishery resource conservation and poverty reduction.

The present research employed quantitative methods to answer three research questions and one qualitative method to answer one research question. The statistical software package, Stata Version 12.1, was used to quantitatively analyze data. For the first and second research questions “Does CBNRM have a positive effect on fishery resource conservation?” and “Does CBNRM have a positive effect on poverty reduction?”, propensity score matching (PSM) was used to analyze data. A detailed explanation of PSM will be provided in Chapter 5. For the third research question “What are root causes of success or failure of CBNRM in fishery resource conservation and poverty reduction?”, the present research used directed content analysis. A detailed explanation of directed content analysis will be provided in Chapter 7. For the fourth research question “What are the determinants of the perception of the trade-off between fishery resource conservation and poverty reduction?”, the present research used the proportional odds (PO) model of ordinal logistic regression (OLR) to analyze data. A detailed explanation of the PO model will be provided in Chapter 8.

Chapter 4: Institutional Management of Tonle Sap Lake (TSL), Cambodia

The chapter aims to provide the essential background of both past and current institutional management in the TSL area, Cambodia. The reason is that it is crucial to understand the overall background of fishery resource management in the TSL area before answering the main research questions.

The current natural resource management in TSL should be historically understood so that it is easier to trace back what happened in the past, leading to the current fishery resource management, CBNRM. Hereinafter, institutional management of TSL will be reviewed. Looking through the lens of institutional management, fishery resource management in TSL can be divided into four layers of management: local, national, regional, and global levels. Each layer of management will be reviewed by comparing the past with the current situation. In the last section, details of CBNRM and non-CBNRM-implemented communities will be described.

4.1 Historical and Current Fishery Resource Management of TSL, Cambodia

Before the fishery policy reforms in 2001 and 2012, TSL was considered a private property owned by different stakeholders, which ranges from commercial fishing lot owners to sub-contractors, sub-subcontractors, and small-scale fishers. The commercial fishing lot system was introduced by the RGC in the 1880s during the French colonization of Cambodia. It lasted for over 100 years before its total abolishment through the second fishery policy reform in 2012. The initial reason for implementing the commercial fishing lot system in TSL was to generate revenue for the French colonial administration. The commercial fishing lot system was made by selling licenses to wealthy businessmen and fishers (Thol & Sato, 2015). Each commercial fishing lot was geographically located on flooded land that may include inundated forest areas, a stretch of river, or river beach (Degen & Nov, 2000).

The commercial fishing lot system was reformed in 1908 to remove all Chinese commercial fishing lot owners. However, they still dominated the business. Those Chinese businessmen controlled many large and valuable commercial fishing lots between the 1910s and the 1920s (Cooke, 2011). They managed commercial fishing lots in four provinces, including Kompong Thom, Siem Reap, Pursat, and Battambang. Following Chinese businessman, Vietnamese and Khmer Muslims ranked the second and third places in owning commercial fishing lot business, respectively. However, Khmer people ranked in the fourth place in the business and did not earn much profit (Thol & Sato, 2015).

To reiterate, the initial aim of commercial fishing lot system was to generate the revenue for the French colonial administration without considering fishery resource conservation. As a result, there were no strict rules or regulations, and those businessmen tried to maximize their profits as much as they could without considering conservation. Although there was an attempt to ban fishing during the closed season by the Resident-Superior Louis Paul Luce, it was ignored. Consequently, it did not have any impact (Cooke, 2011). The French started to be concerned with fishery resource conservation, establishing conservation areas and ratifying new state fishery laws, in the late 1920s and the early 1930s. Their focus was placed on protecting inundated forest areas that were important for fish spawning (National Archive of Cambodia: 4118, 1897, cited in Thol & Sato, 2015).

Conflicts in fishing were not a new problem in the case of TSL. They had occurred even before the introduction of the commercial fishing lot system in 1908. Those conflicts occurred between small-scale fishers and fish traders gaining access to a specific fishing ground given by the government. Those conflicts were solved by the intervention of the king (Nov & Sengji, 2007). It is worth noting that even before commercial fishing lot system started, even non-Khmer people such as the Chinese and Vietnamese could fish in TSL during the open season by giving tea money to local authorities and 10% for a royal levy (Cooke, 2011). After the

introduction of commercial fishing lot system in 1908, conflicts started to occur between commercial fishing lot owners and small-scale fishers when the former expelled the latter from specific fishing grounds. The underlying reason is that the French administrators had mistakenly included fishing grounds for small-scale fishers in the boundaries of commercial fishing lots (National Archive of Cambodia: 9334, 1911 cited in Thol & Sato, 2015). However, this could only be solved in 1911 when the contract with those commercial fishing lot owners ended (Thol & Sato, 2015). Local fishers were encouraged to form fishery associations, and the first Cambodian Fishery Association was established on the 29th of July, 1911 (National Archive of Cambodia: 9334, 1911, cited in Thol & Sato, 2015) to control commercial fishing lots (National Archive of Cambodia: 35657, 1911, cited in Thol & Sato, 2015). In 1918, to conserve fishery resources, the French administrators introduced a plan to reduce the size of commercial fishing lots. However, this plan could be only implemented two years later, in 1920, when the contract with commercial fishing lot owners ended. Consequently, conservation areas appeared in TSL only after 1920 (Thol & Sato, 2015). More efforts to conserve fishery resources started in the late 1930s by establishing more conservation areas and ratification of state fishery laws and regulations. Commercial fishing lot operation was regulated by the Royal Ordinance No. 100. All the five provinces of TSL had their conservation areas, and during that time, clearing inundated forests was banned (Thol & Sato, 2015).

From the colonial to post-independence periods (1954-1970), fishery conflicts and conservation were managed relatively effectively with very few adverse outcomes. According to Thol and Sato (2015), although there were tensions between commercial fishing lot owners and local fishers, commercial fishing lot owners had rarely violated fishery regulations. Moreover, they even tried to conserve fishery resources by protecting conservation areas.

The commercial fishing lot system was slowly abandoned during the period between 1970 and 1979 due to a civil war and political transition to a communist regime, that is, the Khmer

Rouge regime. Fishing was strictly banned since not many efforts in fishing were needed to supply fish for top ranking leaders and export to China during that time. After the Khmer Rough regime ended, by the early 1980s, fish were abundant, enabling even traditional fishing equipment to catch enough fish for supporting local people's living (Thol & Sato, 2015). Fishery resource management during the People's Republic of Kampuchea (PRK) (1979-1989) was significantly transformed. It was managed collectively by Krom Samaki (solidarity groups) from 1981 to 1987, in particular. These groups had to pay fees to PRK in the form of salted or dried fish to different PRK departments and army units (Jones & Sok, 2015).

To improve conservation and generate revenue for the government, Krom Samaki was abolished, and a commercial fishing lot system came to operation in 1987. Initially, there were over two million hectares of water for commercial fishing lots via public bidding. However, the number of water areas allocated to commercial fishing lots decreased to a little over one million hectares in 2000 (Department of Fisheries, 1989). Besides using some elements in the former state fishery laws, the new state fishery laws in 1987 introduced some new aspects like dividing fishing and equipment into different types: small, medium, and large (commercial fishing) (Thol & Sato, 2015). Unfortunately, since 1987 there had been tensions between commercial fishing lot owners and small-scale fishers although they were not so serious. Until the early 2000s, the tensions reached an alarming level. Those tensions arose from encroachment of commercial fishery lot owners into the fishing grounds for small-scale fishers (Chiep, 2003).

The commercial fishing lot system came to an end in 2012. Until 2013 there were at least 516 CBNRM-implemented communities in Cambodia, of which 360 were registered with MAFF and 228 of them were located in the TSL floodplain. It should be noted that there were two subsequent fishery policy reforms. The first occurred in 2001 when around 56% of commercial fishing lot areas were reduced and given to small-scale fishers. The last reform was in 2012, called the deep fishery policy reform (Thol & Sato, 2015). All the remaining

commercial fishing lots were abolished. Some parts of former commercial fishing lots became public conservation areas, and some became fishing grounds for small-scale fishers. It seems that there are many reasons behind the abolishment of commercial fishing lot system. From the political viewpoint, the abolition of commercial fishing lot system was due to the current government's intention to please people to win the upcoming election. From the economic or development viewpoint, the fishery reforms were a part of a movement to increase the use of neo-liberal economic development mechanisms in Cambodia. They may have intended to help Cambodia achieve Millennium Development Goals in 2015, including poverty reduction and environmental sustainability (Jones & Sok, 2015). From the social viewpoint, it happened because of increasing violence between commercial fishing lot owners and small-scale fishers, little revenue for the RGC, and persistence of poverty in the TSL area (Thol & Sato, 2015).

4.2 Institutional Management of TSL, Cambodia

4.2.1 Institutional Management of TSL at the Local Level

Before and after the fishery policy reforms (the current situation), there are three main actors who engage in or affect TSL management at the local level. Those actors include local people, NGOs, and middlemen[1]. It should be made clear that there were some CBNRM-implemented communities before the fishery policy reforms. However, the number of those communities was not high compared to that after the fishery policy reforms. The CBNRM-implemented communities established before the fishery policy reforms were initiated by NGOs rather than the government. The role of those communities during that time was to cooperate with NGOs that advocated for the cancellation of the commercial fishing lot system. After the fishery policy reforms, the role of CBNRM implemented communities changed from advocacy of commercial fishing lots' abolition to fishery resource conservation and poverty reduction (Kurien, 2017).

[1] There are two kinds of microfinance sectors in the TSL area: formal and informal (most of the cases are middlemen). However, the informal sector is more common than the formal sector since it does not require many procedures and collateral.

Before the fishery policy reforms, the main roles of domestic and international NGOs were to advocate for the abolition of the commercial fishing lot system and test CBNRM by establishing CBNRM-implemented communities to discover if CBNRM could work in the context of fishery resource management in Cambodia. After the fishery policy reforms, the main roles of NGOs somehow shifted from advocating for the cancellation of commercial fishing lots to advocating for more bargaining power for CBNRM-implemented communities to have more rights in fishery resource management and provide financial support for conservation. Some NGOs such as the Fisheries Action Coalition Team and the International Union for Conservation of Nature (IUCN) have also expanded their roles. They have become involved in evaluating changes in governability and analyzing the roles of different actors in some community fisheries in the TSL area (Mak, 2011).

Roles of middlemen did not change much before and after the fishery policy reforms. Those middlemen have acted as fish buyers and loan providers to fishers. Before the fishery policy reforms, middlemen could provide loans to sub-leasers or sub-sub-leasers to buy specific fishing grounds from commercial lots owners or invest in their fishing equipment. However, after the end of commercial fishing lot system, this role automatically disappeared. Before and after the fishery policy reforms, most of the small-scale fishers have depended on middlemen's money to invest in new fishing equipment or repair their old existing fishing equipment. The price of fish depends totally on middlemen.

4.2.2 Institutional Management of TSL at the National Level

In terms of the national level, before the first fishery policy reform, MAFF had a leading role in managing TSL. During that time, fishery resource management in TSL was equated to overall management in the TSL area, including areas for agriculture. Under MAFF, FiA played a critical role in managing fishery resources in the TSL area. Fishery resource management was divided into three main areas: commercial fishing lots, open access, and conservation areas

(Johnstone et al., 2013). It should be highlighted that FiA managed both marine and inland fisheries. However, management in the TSL area made FiA play a vital role in Cambodian economy. FiA was so powerful because without its approval, using the TSL area for any purpose would be considered illegal. FiA had full authority to stop all uses in the TSL area (Mak, 2011). During that time, the TSL area was recognized as a space for commercialization since most of the fishing grounds were privatized to commercial fishing lot owners.

However, after the fishery policy reforms, the power of FiA as well as MAFF were greatly reduced. FiA has a mandate to manage only fishery resources, and fishery resource management in the TSL area has no longer been equated to the overall management of TSL. Other existing[2] and newly created government institutions[3] have started becoming more involved in TSL management (Mak, 2011).

Among those institutions, the Tonle Sap Basin Authority (TSBA)[4] is the most powerful since it plays a direct role as a headquarter of the RGC by doing research, monitoring, and giving feedback to the RGC. Moreover, according to a sub-decree of the RGC, TSBA also has the mandate to work with other stakeholders either within the government institutions or NGOs concerning activities related to management, conservation, and sustainable development in the TSL area (RGC, 2008). Inferred from the sub-decree, every action made in the TSL area is under control of TSBA, and those activities need its approval. TSBA created Tonle Sap inter-ministerial committee to combat illegal fishing by working with each provincial committee around the TSL area (Johnstone et al., 2013).

[2] Most of the government institutions have been involved in the management of TSL except the Ministry of Foreign Affairs and International Cooperation (MFAIC) (RGC, 2007).
[3] A few newly created governments have replaced some institutions created by either regional or global actors.
[4] TSBA is a part of the Ministry of Water Resources and Meteorology (MoWRAM) and under the direct guidance of the RGC.

Besides FiA and TSBA, the Tonle Sap Basin Reserve (TSBR) Secretariat under Cambodia National Mekong Committee (CNMC) is responsible for coordinating and strengthening cooperation with all related stakeholders like government institutions and local communities for protection of Tonle Sap Biosphere Reserve[5] and sustainable management (RGC, 2008). It can be inferred that TSBA and TSBR have to work with other stakeholders from lower to upper levels to sustain TSL management except the fact that TSBA is under the direct guidance of the RGC, while TSBR is under CNMC.

The Ministry of Environment (MoE) has to manage all environmental issues affecting the TSL area, conservation, and ecotourism development. Moreover, it has a mandate to manage inundated forests and protected areas (Jones & Sok, 2015). It can be inferred that since development in the Mekong River will affect the TSL area, and most of ecotourism development is located in core areas of Tonle Sap Biosphere Reserve, MoE may have to work more closely with TSBR and TSBA than it did before the fishery policy reforms.

4.2.3 Institutional Management of TSL at the Regional Level

The Asian Development Bank (ADB) has played an essential role in the management of the TSL area since 1998, before the fishery policy reforms. Before the first fishery policy reform, ADB had a role in providing technical assistance as well as acting as the leading funding agency in the TSL basin. After the first fishery policy reform, ADB started implementing the Tonle Sap Initiative (TSI)[6] in 2002. The TSI aimed at pro-poor sustainable growth and equity in access tonatural resources ("The Tonle Sap River Initiative," 2014). ADB attempted to institutionalize TSI in the RGC since it was less active by establishing the Tonle Sap Basin

[5] Tonle Sap was designated as Biosphere Reserve under the Man and Biosphere Program of United Nations Educational, Scientific and Cultural Organization (UNESCO) in October 1997 and recognized by the RGC in 2001 ("The Tonle Sap River Initiative," 2014).

[6] The initiative has four major projects: 1) Tonle Sap Environmental Management Project, 2) Tonle Sap Sustainable Livelihoods Project, 3) Lowland stabilization Project, and 4) Watershed Management Project, which is still in the pipeline.

Management Organization (TBMO) and integrating it as a part of the Cambodia National Mekong Committee (CNMC). However, TBMO was halted entirely in 2006 since its plans and objectives were found in another government institution, TSBA, which was also in the process of establishment (Mak, 2011).

Since CNMC has a direct linkage with the Mekong River Commission[7] (MRC) (Mak, 2011), and every development in the Mekong River will affect TSL, MRC should also be considered as one of the stakeholders in the regional level of TSL management. However, it seems that there is no change in its roles in TSL management after the fishery policy reforms.

4.2.4 Institutional Management of TSL at the Global Level

To be engaged in the management of the TSL area, global actors have rationalized its engagement for purposes of conservation, specifically the global significance of biodiversity conservation. Those global actors include UNESCO and the United Nations Development Program (UNDP) that have influenced institutionalization of biodiversity including fishery resource conservation in the TSL area by zoning the TSL area into transition, buffer, and core zones (Mak, 2011). Before and after the fishery policy reforms, it seems that there is no change in their roles to support TSL management.

4.3 State Fishery Laws

Before the fishery policy reforms, the state fishery laws in Cambodia were governed by the 1987 state fishery laws that divide access to fishery resources into two systems: open access and commercial fishing lots. Open access was for small and medium scale fishers, while commercial fishing lots were for large-scale fishers. Later on, since the two systems created some confusion and chaos, some modifications were made by dividing users into three groups:

[7] MRC was established in 1995 with four countries as its members: Cambodia, Lao, Thailand, and Vietnam. Its mission is promoting and coordinating sustainable management and development of water and related resources for mutual benefit and well-being of people in its members country (Mekong River Commission, n.d.).

small-scale, medium-scale, and large or industrialized-scale fishers. Despite those law amendments, the state fishery laws during that time still mostly concentrated on state-run fishing. Moreover, it seems that the state fishery laws had no specific regulations for commercial fishing lot operation and conservation (Mensher, 2006). In response to the shortcoming of the state fishery laws in 1987, MAFF implemented new regulations that attempted to decrease conflicts between small and medium scale fishers in 1995. Furthermore, MAFF drafted two five-year plans for fishery sector development. It was the first time that detailed biological and socioeconomic studies and suggestions for changes in habitat, fishing practices, and fish population were included (Posey, 2005).

The latest state fishery laws after the fishery policy reforms were made in 2007. Following the fishery policy reforms, the current state fishery laws divide TSL into two areas: public fishing spaces and conservation areas. Public fishing spaces are for small-scale fishers. Conservation areas are for conservation purposes. These conservation areas are divided into two main categories: public conservation areas and community fish sanctuary. The former is managed by government institutions such as FiA, while the latter is managed by local people. Unlike the previous state fishery laws, the current state fishery laws focus more on conservation as well as microeconomics rather than macroeconomics by focusing on livelihoods. Moreover, compared to the previous state fishery laws, the current state fishery laws acknowledge more roles of local people in fishery resource management. However, there is no law without a loophole. The current state fishery laws have some critical loopholes. For example, there are overlap territories between public conservation and community fish sanctuary areas, resulting in unclear responsibility in management such as combating illegal fishing (Johnstone et al., 2013). Last, some loopholes in the previous state fishery laws remain in the current ones. One vital loophole is a matter of property rights for the CBNRM-implemented communities. There

is still the nature of de facto open access of resources (Jones & Sok, 2015), meaning that fishers from the outside can fish inside the CBNRM fishing grounds without permission.

4.4 CBNRM Implementation in the TSL Area, Cambodia

CBNRM is a strategy that the RGC uses for managing public fishing spaces after demolishing the commercial fishing lot system in TSL at the local level (Mak, 2011). In 2006, there were 175 CBNRM-implemented communities, and it increased to 228 by 2013 in the TSL floodplains (Jones & Sok, 2015; Mak, 2011). It is worth mentioning that one CBNRM-implemented community might cover more than one village or commune.

Although there is no specific process or standard guideline for a community to be recognized as a CBNRM-implemented community (Mak, 2011), an officially recognized CBNRM-implemented community by the RGC is supposed to have certain criteria. Those criteria include: 1) a map or clear boundaries; 2) its own conservation area(s); 3) its own bylaws and internal regulations; and 4) a management committee with support of most of local people.

In terms of boundaries, a CBNRM-implemented community is supposed to have a map or clear boundaries for dividing it from nearby communities. There is no up-to-date data available for how many current CBNRM-implemented communities have both maps and clear boundaries. There was only data in 2006. In 2006, all the CBNRM-implemented communities in Siem Reap had their boundaries and maps delineated by geographic information system (GIS) software and global positioning system (GPS) instruments. For CBNRM-implemented communities in Kompong Thom, 78% of them had boundaries, while only 45% of them had maps. However, most of those in Battambang, Pursat, and Kompong Chhnang did not have boundaries or maps yet (Hawkes, 2006).

A conservation area, which is established and managed by each CBNRM-implemented community, is called a community fishery conservation area. The community fishery conservation area is further divided into three areas: fish sanctuary, protected inundated forest

area, and planting inundated forest area. Conservation areas are under bylaws of each CBNRM-implemented community. Fish sanctuaries and protected flooded areas are places for fish spawning. An inundated forest area is a place for local people to replant inundated trees. In some CBNRM-implemented communities, there is an overlap between their conservation area and the public conservation area managed by government officials.

Bylaws and internal regulations are created to manage fishery resources in each CBNRM-implemented community. Both bylaws and internal regulations are established by not only the community but also by FiA. To get approval, bylaws and internal regulations have to be based on the guideline provided by FiA (RGC, 2005). Among CBNRM-implemented communities, there are some differences in bylaws and internal regulations, depending on their socioeconomic and geographical conditions.

Last, to be officially recognized as a CBNRM-implemented community, it has to be supported by most local people in the community. Usually, local people are enthusiastic about implementing CBNRM after the fishery policy reforms. A part of the reason is that they are convinced that CBNRM implementation may reduce illegal fishing in their communities, which in turn can improve their livelihoods and resource management (Jones & Sok, 2015; Mak, 2011). CBNRM members[8] have to elect committee members to manage fishery resources. The election is held every five years. Those who can vote and stand for the election have to be ordinary members in the CBNRM-implemented community. Each CBNRM-implemented community has a typical structure of management committee: advisor, chief, vice chief, and patrolling, information extension, accounting, and secretarial units. Details of the structure will be explained in Section 4.5.1.

[8] There are two kinds of CBNRM members: 1) ordinary members and 2) committee members. An individual can be a CBNRM member only in one CBNRM-implemented community. Like in the case of those standing for CBNRM election, to be eligible for an ordinary CBNRM member, he or she has to be Khmer, at least 18 years old, and a resident in the community. All types of CBNRM members have to abide by state fishery laws, bylaws, and internal regulations (RGC, 2005). For more details, see Sub-Decree on Community Fisheries Management 2005.

Since one CBNRM-implemented community may not include one village or commune, to effectively manage resources, a CBNRM-implemented community including more than one village may have a committee in each village, which has the same structure as the structure mentioned above. The committee in each village is managed by a cooperative chief and sub-cooperative chief.

4.5 CBNRM in Chivieng Community

To reiterate, Chivieng community is located in Kors Chivieng commune, Eak Phnom District, Battambang province. It covers three out of five villages in the commune. Those villages include Preak Toal, Kompong Prohok, and Ornlong Taour, and there were 1,448 households as of 2014. Chivieng community started implementing CBNRM in 2006, which was the beginning year of CBNRM implementation in the TSL area.

4.5.1 Structure of CBNRM Committee

Chivieng community covers three villages, and there is a CBNRM committee in each village. The CBNRM committee of each village under Chivieng community has a common structure of management committee including an advisor, chief, vice chief, and patrolling, information extension, accounting, and secretarial units. Since Chivieng community covers three villages, there are three CBNRM committees, having the same structure. Below is a detailed description of each management committee member in each village.

There is one advisor in each village under Chivieng community. The advisor is a senior citizen who has lived in the community for a long time and is more knowledgeable in fishery resource management than others. The advisor is not elected or appointed by local people. He is a volunteer to be an advisor. Responsibility of the advisor is to advise on how to manage fishery resources and deal with conflicts.

There is one CBNRM committee chief in each village under Chivieng community. The chief is responsible for: 1) managing all tasks that are related to CBNRM; 2) dealing with problems

or conflicts that arise during working with nearby communities, government officials, or related stakeholders; 3) training, disseminating the information that is related to CBNRM activities to the members, and taking charge of monthly meetings with the members; and 4) amending bylaws and internal regulations. In each village, there is also a vice chief, whose responsibilities include: 1) performing all the tasks of the chief when he or she is absent; and 2) helping the chief deal with all CBNRM-related activities.

Two members in the patrolling unit regularly patrol in each village under the Chivieng community. They take turns to go patrolling depending on availability. Those patrollers are volunteers, and they do not get the salary from the CBNRM committee. However, since there is support from NGOs, they usually can receive food, drink, and other necessary items for patrolling activities like gasoline and mosquito nets. Their patrolling activities are undertaken throughout the year. However, the frequency of their activities increases during the fish-breeding season, that is, the rainy season.[9] Furthermore, since it is significant time for fish to breed, the quantity of illegal fishing also increases. Those patrollers always pay attention to CBNRM conservation areas, while government officials patrol public conservation areas. It should be highlighted that those patrollers have no rights to arrest illegal fishers. The right is in the hands of government officials. When those patrollers encounter any illegal fishing, their job is to report to government officials.

For the information extension unit in the CBNRM committee in each village, there is one person in charge. However, some local people in each village voluntarily disseminate the information to others. The information extension unit regularly disseminates the information regarding fishery resource management at least twice a year: the beginning of dry and rainy seasons. Government officials are the ones who facilitate it. Information dissemination and

[9] The rainy season is also called "closed fishing season." Some kinds of fishing equipment are forbidden during that season.

training related to environmental education are sometimes conducted or facilitated by this unit when there is support from NGOs.

Regarding the accounting unit, there is one person in charge of each village. Only a few members in CBNRM pay annual membership fees of 3,000 riels[10] even though they are obliged to pay membership fees as stated in bylaws and internal regulations. Therefore, there were limited financial sources for the CBNRM committee. Most financial sources were from NGOs for patrolling activities and information dissemination. There is one person in the secretarial unit, whose role is to take minutes and write reports during annul meetings and other CBNRM-related activities. The reports can be distributed among the CBNRM committee and other stakeholders, including government officials.

4.5.2 Bylaws and Internal Regulations for Fishery Resource Management and Financial Sources

Exactly the same as bylaws and internal regulations in other CBNRM-implemented communities, all of local people who would like to become members of CBNRM have to be at least 18 years old. Roles include participating in CBNRM-related activities like meetings and elections, obeying the state fishery laws, bylaws, and internal regulations, helping to conserve fishery resources, and reporting any illegal fishing to the CBNRM committee or government officials. To enroll as a member in Chivieng community, he or she needs to pay 5,000 riels if he or she is 18 years old and 10,000 riels if he or she is older than 18 years old. Moreover, each member is obliged to pay 3,000 riels annually as a membership fee. Membership will be terminated if they would like to stop being CBNRM members, no longer live in the community, become handicapped, do not pay the membership fee for two years, or strongly violate bylaws and internal regulations more than once.

[10] 4,000 riels = 1 US dollar (As of 2015)

Like other CBNRM-implemented communities, Chivieng community established its conservation areas to conserve important or endangered species and increase fish yields in general, while remaining public conservation areas are under the management of government officials. To combat illegal fishing as well as protect protected areas, with financial support from NGOs, they have conducted regular patrolling activities. Their patrolling activities are more frequent in the rainy season since it is the time when illegal fishing increases. It should be highlighted that fishers from the outside can fish inside the community fishing ground according to the state fishery laws, bylaws, and internal regulations as long as they inform the CBNRM committee, make an agreement to obey bylaws and internal regulations, and financially contribute[11] to the CBNRM committee. According to the state fishery laws, the CBNRM committee has a right to terminate their fishing if they violate the state fishery laws or bylaws and internal regulations and report it to government officials[12]. However, they have no right to fine or punish those fishers. The CBNRM committee has a right to solve problems or conflicts related to fishing. However, if problems or conflicts cannot be solved, cases will be reported to government officials.

Financial sources are from membership fees, donations, and fines[13] from illegal fishing. The main financial source is normally NGOs. In order to be transparent, all expenses need to be approved. If the expense is up to 50,000 riels, it needs to be approved by the CBNRM committee's chief. If the expense is up to 400,000 riels, it needs to be approved by all the CBNRM committee members. Last, if the expense is more than 400,000 riels, they need to be approved by the CBNRM committee members and one-third of regular CBNRM members. All expenses are recorded by the accounting unit and reported to regular CBNRM members every

[11] It depends on bylaws and internal regulations of each CBNRM-implemented community.
[12] However, it rarely happens due to bribery between government officials and illegal fishers.
[13] Fifty percent from the fine will be for the government, 20% will be for CBNRM, and 30% will be for those who most actively participate in CBNRM-related activities.

trimester. All financial resources are used for any work or activities related to fishery resource management like patrolling.

4.6 Non-CBNRM-Implemented Communities in the TSL Area, Cambodia

Unlike CBNRM-implemented communities, non-CBNRM-implemented communities have only de facto rights to manage resources. Some of them may be on the way to becoming CBNRM-implemented communities by having a clear boundary for resource management and establishing a conservation area. However, as long as they have not been recognized by the RGC, they are still considered non-CBNRM-implemented communities.

How do those non-CBNRM-implemented communities manage fishery resources? In terms of resource management, those communities can be divided into two kinds: passive and active. Passive non-CBNRM-implemented communities are those that do not take any action for resource management, meaning that they do not care about patrolling resources. Therefore, resource management in their communities depends totally on government officials. Active non-CBNRM-implemented communities are those that have taken actions to manage their resources with government officials and NGOs by patrolling and planting inundated forests. Those communities may have their bylaws and internal regulations for resource management without any approval from government officials.

The chapter aimed at providing the essential background of both past and current institutional management in the TSL areas, Cambodia. First, this chapter reviewed historical and current fishery resource management in the TSL areas. Second, it reviewed the current institutional management in the TSL areas at different levels, including local, national, regional, and global levels. Third, it briefly reviewed modifications to the state fishery laws from the past until the present. Fourth, this chapter reviewed CBNRM implementation in the TSL area. Fifth, it fully described CBNRM implementation in the treatment case, that is, Chivieng community,

including the committee's structure, bylaws, internal regulations for fishery resource management, and financial sources. Lastly, it described non-CBNRM-implemented communities in the TSL areas including their progress to become CBNRM-implemented communities and the way they manage fishery resources in their community boundaries.

Chapter 5: Effect of CBNRM on Fishery Resource Conservation Behavior

This chapter will answer the first research question: "Does CBNRM have a positive effect on fishery resource conservation?" by using fishery resource conservation behavior of local people as a measurement. PSM will be used to analyze the data. This chapter will start with the Introduction, which introduces the background of the research question and will be followed by the Impact Evaluation Methods section. This section will review types of impact evaluation, particularly the ones used in cross-sectional studies. Then, there will be the Data and Method Analysis section, followed by the Results and Discussion section. Lastly, there will be the Conclusion section for the chapter.

5.1 Introduction

CBNRM has been popularly practiced because it promises to achieve both conservation and poverty reduction (Taylor, 1998). Notwithstanding its popularity, there are many criticisms of its assumptions. One of the heavily criticized assumptions is that local people will conserve their natural resources when they can obtain economic benefits from them (Leach et al., 1999; Twyman, 2000). Those benefits are generally derived from activities based on natural resources such as ecotourism. Those benefits act as a financial mechanism motivating local people to conserve their natural resources (Agrawal & Gibson, 1999). However, it is difficult for this assumption to work in the real world since those benefits are too few for local people (Twyman, 2000) and are usually captured by local elites (Chatty & Colchester, 2002) or companies operating ecotourism (Mbaiwa, 2005), making local people less motivated to conserve natural resources.

Moreover, despite the prevalent belief that local people have positive attitude towards resource management when they feel that they have the resource ownership, some scholars argue that the feeling of ownership will not work if economic benefits are not significant enough

to improve livelihoods. Even worse, in some cases, there is no guarantee that local people will reduce their resource exploitation despite getting sufficient economic benefits from natural resource management. They may even use those benefits to upgrade their equipment to exploit more resources (e.g., Bennett et al. 2001).

Despite different findings from the previous studies such as Scholte and De Groot (2010) and Adhikari, Di Falco, and Lovett (2004) focusing on the impact of a natural resource management regime on conservation, most of those studies have two common characteristics. First, most of them focused only on static resources, particularly forests. Second, there were some flaws in the methodology of most of those studies. Some of them used perception or attitudes of local people and remotely sensed imagery to examine the impact of CBNRM or similar resource management regimes on conservation (e.g., Glew, Hudson, & Osborne, 2010, Nhantumbo et al., 2003). Theoretically, to some extent, perception or attitudes of local people do not automatically affect their behavior towards conservation (Fishbein & Ajzen, 1975). This means that although their perception or attitude is positive, their behavior is not necessarily positive towards conservation. Using remotely sensed imagery can lead one to ignore leakage or spillover effects, leading to underestimated or overestimated impact of CBNRM on conservation (Ewers & Rodrigues, 2008). In the case of Cambodia, there are few studies on the effect of CBNRM on fishery resource conservation in the TSL area. Since studies on the effect of CBNRM on the dynamic resources are limited and to avoid flaws in methodology that the previous studies used to study the effect of CBNRM on resource conservation, the present research is conducted on dynamic resources, that is, fishery resources, and uses behavior of local people to measure the effect of CBNRM implementation on fishery resource conservation.

The chapter is arranged as follows. Section 5.2 describes the detail of methods that are used for impact evaluation and shows why the methods are appropriate for answering the research

question. Sections 5.3, 5.4, and 5.5 focus on the data and methods of the analysis, results and discussion, and conclusion, respectively.

5.2 Impact Evaluation Methods

PSM is considered to be an ex-post type of impact evaluation. PSM is not the only type of impact evaluation. It is worth describing the other types of impact evaluation and the reasons why PSM is appropriate for the present research, that is, for studying the effect of CBNRM on fishery resource conservation behavior. Before describing all types of methods for impact evaluation, broad types of impact evaluation should be reviewed first.

5.2.1 Types of Impact Evaluation

In terms of the quantitative method, there are two types of impact evaluation: ex-post and ex-ante. Ex-ante impact evaluation aims at measuring the intended impact of future projects or programs on the condition that the current situation of an area for evaluation is understood. Moreover, it is likely to involve a simulation that is based on assumptions about how the economy works. This kind of impact evaluation is often based on structural models of the economic environment facing potential participants. The models' underlying assumptions can involve the identification of the main economic agents in program or project development to determine its impact. Simply put, the models are used to predict the impact of a project or program (Khandker, Koolwal, & Samad, 2010a).

Meanwhile, ex-post impact evaluation measures the actual impact received by beneficiaries that are attributable to the intervention of a project or program. This kind of impact evaluation has immediate benefits and reflects reality. However, it sometimes misses the mechanism that underlies the impact of a project or program, which structural models and ex-ante impact evaluation aim at capturing, and which can be vital to understand the effectiveness of a project or program, in particular, its effectiveness in a future setting. In addition, doing ex-post impact evaluation is much more expensive than doing ex-ante evaluation. This is because of its

requirement for (a) data collection of actual outcomes for participants and non-participants in a project or program and (b) data that accompanies social and economic factors that are less likely to determine the course of intervention (Khandker et al., 2010a).

5.2.2 Challenges for Impact Evaluations

Before describing different methods for ex-post impact evaluation, it is worth noting the main challenges for doing ex-post impact evaluation. There are two main challenges: counterfactuals and selection bias (Khandker et al., 2010a). These main challenges are described in detail below.

1) Counterfactuals

To evaluate the impact of a project or program correctly, counterfactual reconstruction is a main challenge for researchers because counterfactuals cannot be observed directly (Ferraro, 2009). Counterfactuals refer to what would happen to participants in a project or program if they did not participate in the project or what would happen to non-participants if they participated in a project or program. To evaluate impact, it can be easily calculated by comparing only the mean difference between treatment and control groups (Li, 2013). However, it cannot do so because an individual or a household cannot have two simultaneous existences. This means that an individual or a household cannot be in both treatment and control groups at the same time. Consequently, it is a challenge to find an appropriate counterfactual for comparison. This challenge can be overcome by comparing the pre and post-program outcomes of participants. Another way to overcome this challenge is to compare what would have happened to participants had a project or program not existed. To do so, a proper comparison group (close to counterfactual of participants) in a project or program is needed (Khandker et al., 2010a).

2) Selection Bias

Another challenge for impact evaluation is selection bias. Unlike doing experiments, in observational studies, there is no randomization. Therefore, there may not be equivalent distributions of observed and unobserved characteristics of samples, resulting in selection bias.

Equation (5.1) below presents a basic evaluation problem by comparing outcomes across treatment and control groups.

$$y_{i=}\alpha x_i + \beta t_i + \varepsilon_i, \tag{5.1}$$

where t is a dummy variable in which 1 is for participants in a project or program and 0, otherwise. x is a set of observed characteristics of an individual, an individual household, and local environment. ε is an error term representing unobserved characteristics affecting y. The error term will contain variables that are correlated with dummy variable t. Hence, we cannot measure and account for those unobservable characteristics in the equation (5.1), leading to an unobserved selection bias. That is, $cov(t, \varepsilon) \neq 0$ implies that there is a violation of one of the key assumptions of ordinary least squares (OLS) in obtaining the unbiased estimation, that is, independent of repressors from a disturbance term ε. The correlation between t and ε will bias other estimates in the equation, including the estimation of project or program impact (Khandker et al., 2010a).

A problem with the above equation (5.1) is that the assignment of treatment is not randomly selected, resulting in selection bias. Bias in impact evaluation of a project or program may be derived from two sources. One source is due to unobservable characteristics that are not included in the model or are not easy to measure. Those unobservable characteristics may affect both decisions to participate in a project or program and its outcome. Another source is due to differences in the observable characteristics of samples, that is, lack of common support

between treatment and control groups (Ravallion, 2001) or the positive probability that the sample can be in the project or program (Stata User's Guide Release 14, 2015).

5.2.3 Impact Evaluation Methods in Cross-Sectional Studies

This subsection describes well-known methods that are usually used in impact evaluation in cross-sectional studies, including PSM, instrumental variable (IV), regression discontinuity (RD) design, and pipeline methods.

1) Propensity Score Matching (PSM)

(1) What Does PSM Do?

PSM is used to examine the impact of any project that has no baseline data and when randomization has not been integrated into the design of the project. Moreover, it can help to construct counterfactuals (Rosenbaum & Rubin, 1983) and overcome selection bias that can occur when using OLS (Ravallion, 2007). PSM imputes a missing potential outcome from the project for each sample in the control group [1] by using an average outcome of the similar sample in the treatment group[2] (*Stata User's Guide Release 14*, 2015).

PSM is used to reconstruct the counterfactual by using observed characteristics of the control group that are as similar to those of the treatment group. Observed characteristics of the control group have not been affected by the program or project. Observed characteristics of the treatment group, participants, are matched with those of the large control group, non-participants, who have similar observed characteristics. The impact of a program or project is calculated by comparing the average difference in outcomes across these two groups. As long as it assumes that differences between these two groups are based only on differences in the observed characteristics and the number of available non-participants is sufficient for matching with participants, the impact of a program or project can be measured although there is no

[1] The group has not been in a project.
[2] The group has been in a project.

randomization (Khandker et al., 2010a). Since there are many dimensions where there are many observed characteristics, PSM uses a single propensity score derived from the probability of participation that is conditional on different observed characteristics of both participants and non-participants (Rosenbaum & Rubin, 1983).

(2) PSM in Theory

The approach of PSM is to capture different effects of observed covariates X on participation in an index or a single propensity score based on a model of the probability of participation in the program or project T that is conditional on the observed covariates X or the propensity score: $P(X) = Pr(T = 1|X)$ (Khandker et al., 2010a). According to Rosenbaum and Rubin (1983), under certain assumptions matching on $P(X)$ is the same as matching on X. In order to make $P(X)$ the same as matching on X, two assumptions need to be met: 1) conditional independence and 2) common support.

The similar index or single propensity score of participants and non-participants are used to obtain the impact of a program or project. Participants and non-participants without similar indices or a single propensity score are dropped from comparison (Khandker, Koolwal, & Samad, 2010b). The impact of a program or project is called the treatment effect. There are two kinds of treatment effects: the average treatment effect (ATE) and the average treatment effect on the treated (ATT) (Morgan & Winship, 2007).

ATE is defined as the average effect of both the treatment and control groups if they were in a program or project (Harder, Stuart, & Anthony, 2010). ATE can be written as:

$$ATE = E(Y_{1i}|T_i = 1, 0) - E(Y_{0i}| = 1, 0), \quad (5.2)$$

where E refers to expectation in population. T_i with value 1 denotes the treatment group, that is, those receiving the impact of a program or project, and where value 0 denotes the control group, that is, those not receiving the impact of a program or project.

ATT is defined as the average effect of the treatment group if it were in a program or project compared with if it were not in a program or project (Harder et al., 2010). ATT can be written as:

$$ATT = E(Y_{1i}|T_i = 1) - E(Y_{0i}| = 1). \quad (5.3)$$

In order to ensure that a result from PSM is validated, two assumptions need to be tested: conditional independence and common support.

(3) Pros and Cons of PSM

The main pros and cons of PSM depend on the degree to which observed characteristics drive participation in a project or program. PSM may provide a good comparison with randomized estimation methods if selection bias from unobserved characteristics are negligible. Another advantage of PSM is that it does not need a baseline or panel data although the observed characteristics that are used in a logit model for calculating propensity scores (pscores) would have to satisfy the conditional independent assumption (CIA). This means that those observed characteristics are not affected by participation (Khandker et al., 2010a). Moreover, PSM is a semi-parametric method that imposes fewer constraints on the treatment model's functional form and fewer assumptions about the distribution of the error term. Study observations are dropped to get common support, but PSM increases sensible comparisons' likelihood across treatment and control groups, which can decrease bias in measuring the impact of a project or program (Khandker et al., 2010a).

2) Instrumental Variable (IV) Method

The IV method is used when there is endogeneity in a project or program placement, in individual participation, or in both. This method involves finding an instrument variable that is highly correlated with the project or program placement or individual participation. However, an instrument variable is not correlated with unobserved characteristics that affect outcomes. The IV method uses this extra variable, the instrument variable, as a tool to isolate movements in observable characteristics with the error term, which in turn allows consistent estimation of coefficients of the model. Instrument variables used in the IV method need to be strong and easily found (Stock & Watson, 1994).

3) Regression Discontinuity (RD) Design and Pipeline Methods

Discontinuities and delays in project or program implementation can be very useful in non-experimental project or program evaluation due to eligibility criteria or another exogenous factor. Assuming that an individual or household is similar to another in observed characteristics, an individual or household above and below the threshold can be differentiated in terms of the outcome of the model. However, to ensure comparability, samples would have to be close enough to the eligibility cutoff. Moreover, if an individual or household in an eligible targeting range shows variation in actual take-up of a project or program, unobserved heterogeneity could be a factor that leads to selection bias. In that case, both eligible and non-eligible individuals or households that are close to the eligibility cutoff would be taken to compare the average impact of a project or program. Therefore, the RD design method is similar to the IV method in the sense that they introduce an exogenous variable highly correlated with individuals or households participating in a project or program. Looking at a narrow band of units below or above the cutoff point and comparing their outcomes enables us to evaluate the impact of a project or program. The reason is that individuals or households that are below and

above the threshold may be very similar to each other. The RD design method needs a large data set to find appropriate samples for making a comparison (Khandker et al., 2010a).

The pipeline method exploits variation in the timing of project or program implementation, using as a comparison group of eligible participants people who have not participated in a project or program. The pipeline method can be used, for example, in an infrastructure project like communication networks or transportation by comparing outcomes for eligible participants on different sides of a project or program's boundary when it is phased in. This method involves both the RD design and pipeline methods, which could lead to interesting comparisons over time (Khandker et al., 2010a).

5.2.4 Which Method to Use?

Each method has its application in ex-post impact evaluation, depending on many factors like time and resource constrains, and the nature of a project or program for doing the evaluation (Khandker et al., 2010a; Rogers, et al., 2015). To reiterate, PSM is useful as a method for impact evaluation when participants voluntarily participate in a project or program. The IV method should be used if strong instrument variables can be easily found. The RD design method should be used when a project or program is made available above or below a cut-off point. This means that participants in a project or programs are not on voluntary basis. Therefore, it needs a large data set to find appropriate samples for making comparison. Apart from the RD design method, the pipeline method is normally used in an infrastructure project or program combined with the RD design method.

From the above summary description, it can be concluded that PSM is useful to the research objective for three reasons. Firstly, between PSM and the RD design method, PSM is more appropriate because participation in CBNRM is voluntary, as there are no special criteria for being eligible to become members of CBNRM. The project itself, CBNRM implementation in the research area, Chivieng community, depended on the intention of most of local people to

establish and implement it. Secondly, compared with the pipeline method, CBNRM is far different in terms of the intended purposes. Thirdly, existing impact evaluation studies of diverse natural resource management regimes usually used PSM as their methodology, making it easier to make a comparison between results of the given research and those of other studies.

5.3 Data and Method of Analysis

5.3.1 Data

Data in the present research were collected from two research areas, namely the Chiveing community implementing CBNRM since 2006, and the Preak Sromoach community not implementing CBNRM. The first survey was conducted from July to August 2014 to understand the general situation of the TSL area like active and passive CBNRM-implemented communities, stakeholders in fishery resource conservation and poverty reduction, and challenges in achieving fishery resource conservation and poverty reduction, to find appropriate research areas for answering the research questions and to test the questionnaires. FGDs, key informants, and household interviews were conducted. The second survey was conducted from July to August 2015 to collect data for analyses by interviewing households in both research areas. FGDs and key informant interviews were also conducted. Initially, the sample number of household questionnaire interviews was 500 households. However, because of outliers and incomplete data, 29 household questionnaire interviews were discarded. Therefore, the total sample was 471 households, of which 232 households were from Chivieng community, and 239 households were from Preak Sromoach community. In both research areas, there are two types of fishers. The first type is those who fish both inside and outside the community boundary. The second type is those who fish only inside the community boundary. Acknowledging that local people who depend totally on local resources seem to experience a greater effect from any change in a policy or program in their community than those who do not, the present research examined the effect of CBNRM by looking at its overall effect of

CBNRM on all of fishing households, that is, those who fish inside and outside the community boundary and those who only fish inside the community, and its effect on the group of households depending totally on local resources, that is, those who fish only inside the community. In Chivieng community, out of 232 households, there were 156 households fishing only inside the community boundary. In Preak Sromoach community, out of 239 households, there were 192 households fishing only inside the community boundary.

Fishery resource conservation behavior is the dependent variable in the model. It is measured by 1) whether a household violated the state fishery laws in terms of type of fishing equipment; 2) whether a household violated the state fishery laws in terms of quantity, size, and length of fishing equipment; 3) whether they used to go fishing in the conservation areas; 4) whether a household harvested Non-Timber Forest Products (NTFPs) for home consumption or sale in the market; and 5) whether a household participated in conservation-related activities like planting inundated forests after a household became CBNRM members. One score was given to each measurement. The score from each measurement was summed and became a score index, ranging from 0 to 5.

The model for conservation behavior in the present research was adopted from Fishbein and Ajzen (1975), and Sutinen and Kuperan (1999). According to these studies, there were three factors affecting conservation behavior of local people in the research areas, considered as independent variables in the model: 1) perception of appropriateness of the state fishery laws to fishing, 2) perception of the state fishery laws on fishery resource conservation and poverty reduction, and 3) social influences including peer and other villagers' behavior towards the state fishery laws. Besides variables that could affect conservation behavior suggested by the studies mentioned above, some household characteristics could affect conservation behavior. Those are household head (HH) age, HH education level, HH gender, HH primary job, fishing labor force (number of people engaging in fishing if his or her job is a fisher), and a production

function for fishing[3] (having more than one machinery boat was used as a proxy). These household characteristics are included in the model as independent variables.

5.3.2 Method of Analysis

Based on the aforementioned explanation of the methods of impact evaluation, PSM was chosen for the present research. The outcome of a project or program is fishery resource conservation behavior. PSM in the present research imputed potential fishery resource conservation behavior of each household in the non-CBNRM-implemented community, Preak Sromoach community, by using fishery resource conservation behavior of households that had similar characteristics to those in the CBNRM-implemented community, Chivieng community.

The most accurate evaluation of CBNRM's effect on fishery resource conservation behavior would be a difference in fishery resource conservation behavior of each household before and after CBNRM implementation. However, since there is no baseline data before CBNRM implementation, it is impossible to compare fishery resource conservation behavior of households between before and after CBNRM implementation. Therefore, the present research used PSM to construct counterfactual outcomes for those living in Chivieng community by mimicking what fishery resource conservation behavior of households in Chivieng community would have been if they did not live in Chivieng community but in Preak Sromoach community. Data were analyzed by Stata version 12.1.

According to Maddala (1983), the impact of any project can be estimated as follows:

$$y_i = \alpha + \beta x_i + \gamma p_i + \varepsilon_i,$$

where y is a variable of interest, that is, fishery resource conservation behavior of household; x is a vector of exogenous explanatory variables (household characteristics), p is an indicator

[3] It refers to the input that fishers used to increase their catch.

for treatment ($p = 1$ if the household is in Chivieng community, and $p = 0$ if the household is in Preak Sromoach community); $\propto, \beta, \gamma$ are unknown parameters; and ε is the error term, capturing unobservable factors as well as potential measurement error affecting y.

In order to ensure that results from PSM are valid, three assumptions need to hold true. The first assumption is that Conditional Independence Assumption (CIA) must hold true, meaning that the outcome from a project is independent of participation in the project conditional on a set of observational variables x. If CIA does not hold true, PSM should not be used. There are two inferences from CIA (Smith & Todd, 2005). The first inference is by controlling all the observational variables x, the observed outcome for the control group is the same as the counterfactual outcome[4] for the treatment group. The other inference is that researchers have taken into account all variables influencing potential and assignment outcomes simultaneously, and selection of variables are based on observable characteristics (Khan, Alam, & Islam, 2012). Technically, there is no direct way to test if CIA holds true or not. However, to some extent, CIA can be considered to hold true based on the theory and previous studies. In the present research, variables affecting outcome (fishery resource conservation behavior) and treatment (living in the CBNRM-implemented community, that is, Chivieng community) were based on theory and previous similar studies. Furthermore, CIA can be tested by using Rosenbaum bounds sensitivity analysis (Rosenbaum, 2002). The value of the sensitivity analysis is denoted by Γ. There is no agreement upon how much value of Γ is acceptable in social science. However, in most of the studies that used PSM for analysis, the value of Γ was in the range of 1.1 to 2 as in Bertoli and Marchetta (2014) and Clement (2011). Sensitivity analysis in the present research was tested by using "rbounds" command in Stata.

The second assumption is balancing properties. This assumption implies that two households with the same probability to participate in a project or program have an equal

[4] It refers to the dependent variable of the model.

likelihood to be selected to place in control and treatment groups. Tests of balancing properties are to see whether at each value of pscores, x, has the same distribution for both the groups. Pscores are estimated by using a binary choice model. Either probit or binary logistic regression models are used as long as the dependent variable in the model has two values, that is, 0 and 1 (Rosenbaum & Rubin, 1983). The reason is there is no difference between pscores run by either of these models. Data are split into equally spaced intervals of pscores when pscores are estimated. It implies that within each of these intervals, the mean pscores of each conditioning variable are equal for both control and treatment groups. The balance of pscores is known as balancing properties. When pscores for each block are not different, this means that balancing properties are satisfied (Rosenbaum & Rubin, 1983).

The third assumption is the common support or overlap condition. This assumption implies that households with the same x value have a positive probability of being in the control and treatment groups (Heckman, Lalonde, & Smith, 1999). This assumption can be checked by examining a graph of pscores across the control and treatment groups (Rosenbaum & Rubin, 1983).

There are various matching criteria used to match participants and non-participants in PSM. Matching criteria are used to calculate weight of each set of matched participants and non-participants. Each matching criterion can affect the estimation of treatment effect through its assigned weight (Khandker et al., 2010b). Below is the summary of those matching criteria.

(1) Nearest neighbor matching: It is one of the most popularly used matching criteria in PSM. By using this matching method, a treatment unit will be matched with its comparison unit having the closest propensity score. Matching can be made with or without replacement. Matching with replacement means that the same non-participants can be used more than once to match for different participants. Shortcomings of this

matching method are that there is a chance that difference in propensity score for a treatment group and its closest comparator can be very high, resulting in poor matches.

(2) Radius or caliper matching: This method can solve shortcomings of nearest neighbor matching by imposing tolerance on distance (caliper) of the maximum propensity score. This matching method involves matching with replacement only among pscores in a certain range. However, by doing so, there can be a chance of sampling bias since there may be a larger number of dropped non-participants.

(3) Interval or stratification matching: This matching method divides common support into different intervals or strata. Then, it calculates the impact of a program within each interval. A program effect within each interval is the mean difference between treated and non-treated observations' outcomes. Those average weights of those intervals estimate the overall impact of the program.

(4) Kernel and local linear matching: The methods mentioned above shared a common shortcoming, that is, there is only a small subset of non-participants fall in common support and construct counterfactual outcomes for a program. Kernel matching and local linear matching, a nonparametric matching estimator, solve this shortcoming by using all the non-participants' average weight to construct a counterfactual match for other participants. Kernel matching is comparable to regression based on a constant term, while local linear matching uses a constant and slope term.

(5) Difference-in-difference matching: This method allows unobservable characteristics that have an impact on program adoption, assuming that those characteristics are not different over time.

According to Becker and Ichino (2002) and Khandker et al. (2010), by comparing the result with different matching methods, the result from PSM can be ensured to be robust. Among the methods mentioned above, nearest neighbor with and without replacement, kernel matching,

and radius matching are frequently used methods (Becker & Ichino, 2002). Therefore, the present research uses those methods to estimate the model.

5.4 Results and Discussion

5.4.1 Descriptive Statistics and Assumption of PSM

Tables 5.1 and 5.2 show descriptive statistics of the variables used in the models for all the fishing households and those fishing only inside the community boundary, respectively.

Table 5.1: Descriptive Statistics of All Fishing Households

Type of variable	Name of variable		Mean/Number (Dummy variables)	
			Preak Sromoach (Control N= 239)	Chivieng (Treatment N= 232)
Dependent	Conservation behavior (Scores)		3.07	2.13
Independent (Continuous)	Age (Years old)		39.28	40.77
	Education (School year)		2.35	2.1
	Fishing labor force (Number of people)		0.72	0.85
Independent (Dummy: 1/0)	Occupation	Main	199	196
		Secondary	40	36
	Gender	Male	201	185
		Female	38	47
	Production function	One machinery boat	99	99
		More than one machinery boat	140	133
	Perception of state fishery laws on fishery resource conservation	Positive	236	184
		Negative	3	48
	Perception of state fishery laws on poverty reduction	Positive	231	216
		Negative	8	16
	Opinion on villagers' behavior to state fishery laws	Obey	233	219
		Disobey	6	13
	Opinion on peers' behavior to state fishery laws	Obey	238	219
		Disobey	1	13
	Perception of appropriateness to the state fishery laws	Yes	72	66
		No	167	166

Source: Author (2016)

Table 5.2: Descriptive Statistics of Households Fishing only inside the Community Boundary

Type of variable	Name of variable		Mean/Number (Dummy variables)	
			Preak Sromoach (Control N=192)	Chivieng (Treatment N=156)
Dependent	Conservation behavior (Scores)		3.06	2.01
Independent (Continuous)	Age (Years old)		39.84	40.58
	Education (School year)		1.81	1.92
	Fishing labor force (Number of people)		0.71	0.84
Independent (Dummy: 1/0)	Occupation	Main	192	155
		Secondary	0	1
	Gender	Male	159	128
		Female	33	28
	Production function	One machinery boat	77	65
		More than one machinery boat	115	91
	Perception of state fishery laws on fishery resource conservation	Positive	181	133
		Negative	11	23
	Perception of state fishery laws on poverty reduction	Positive	183	153
		Negative	9	3
	Opinion on villagers' behavior towards state fishery laws	Obey	179	155
		Disobey	13	1
	Opinion on peers' behavior towards state fishery laws	Obey	179	128
		Disobey	13	28
	Perception of appropriateness to the state fishery laws	Yes	134	103
		No	58	53

Source: Author (2016)

Chivieng community was a treatment, and Preak Sromoach community was a control. It should be noted that the unit of dependent variables in Tables 5.1 and 5.2 are a set of scores ranging from 1 to 5. There are two types of independent variables in Tables 5.1 and 5.2: 1) continuous and 2) dummy. For the continuous independent variables, the unit of age is years

old, the unit of education is grades at school, and the unit of the fishing labor force is the number of people engaged in fishing. The unit of each dummy independent variables is either 1 or 0.

As Tables 5.1 and 5.2 show, fishery resource conservation behavior of households in Chivieng community was one score lower than that of those in Preak Sromoach community, while the other variables including age, education, fishing labor, occupation, gender, and production function were similar. Households in Preak Sromoach community were more positive than those in Chivieng community in terms of perception of appropriateness of the state fishery laws for fishery resource conservation and poverty reduction, opinion on the behavior of villagers and peers towards the state fishery laws, and perception of appropriateness of the state fishery laws.

Statistically, a binary logistic regression model needs to be run first before running PSM to get pscores that are used to test the second and third assumptions of PSM. Tables 5.3 and 5.4 show the results of the binary logistic regression models.

Table 5.3 shows that perception of the state fishery laws on livelihoods, perception of the state fishery laws on conservation, and perception of appropriateness of the state fishery laws are significant factors affecting CBNRM participation of both fishing households fishing only in the community boundary and those fishing in and outside the community boundary.

Table 5.3: Binary Logistic Regression Estimation Result of Fishery Resource Conservation Behavior for All Fishing Households

Number of observations = 471
LR chi2 (5) = 60.94
Prob> chi2 = 0.0000
Pseudo R2 = 0.19

Independent variable	Co-efficiency	Standard error
Age	-0.96	0.21
Education	0.01	0.17
Fishing labor force	0.16	0.12
Occupation	-1.34	1.23
Production function	-0.1	0.2
Perception of state fishery laws on livelihoods	2.96***	0.61
Perception of state fishery laws on conservation	2.03*	1.11
Opinion on villagers' behavior towards state fishery laws	0.36	0.7
Opinion on peers' behavior towards state fishery laws	1.82	1.13
Perception of appropriateness of state fishery laws	-0.52*	0.21
Constant	0.89	1.25

Note: Significance level: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author (2016)

Table 5.4 shows that perception of the state fishery laws on livelihoods and perception of appropriateness of the state fishery laws are significant factors affecting CBNRM participation of fishing households who fish only in the community boundary.

Table 5.4: Binary Logistic Regression Estimation Result of Fishery Resource Conservation Behavior for Households Fishing only inside the Community Boundary

Number of observations = 348
LR chi2 (5) = 52.74
Prob> chi2 = 0.0000
Pseudo R2 = 0.11

Independent variable	Co-efficiency	Standard error
Age	-0.29	0.25
Education	0.16	0.22
Fishing labor force	0.16	0.14
Occupation	-1.22	1.2
Production function	-0.015	0.24
Perception of state fishery laws on livelihoods	2.94***	0.62
Perception of state fishery laws on conservation	1.39	1.17
Opinion on villagers' behavior towards state fishery laws	1.58	1.13
Opinion on peers' behavior towards state fishery laws	1.91	1.23
Perception on appropriateness of state fishery laws	-0.81***	0.25
Constant	0.54	0.4

Note: Significance level: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author (2016)

Common support or overlap assumptions are shown in Figures 5.1 and 5.2. Both figures show that common support or the overlap assumption holds true. The reason is both groups of households, that is, those in Chivieng community and those in Preak Sromoach community had a similar probability of being in either of the two communities by being equally distributed along the propensity score.

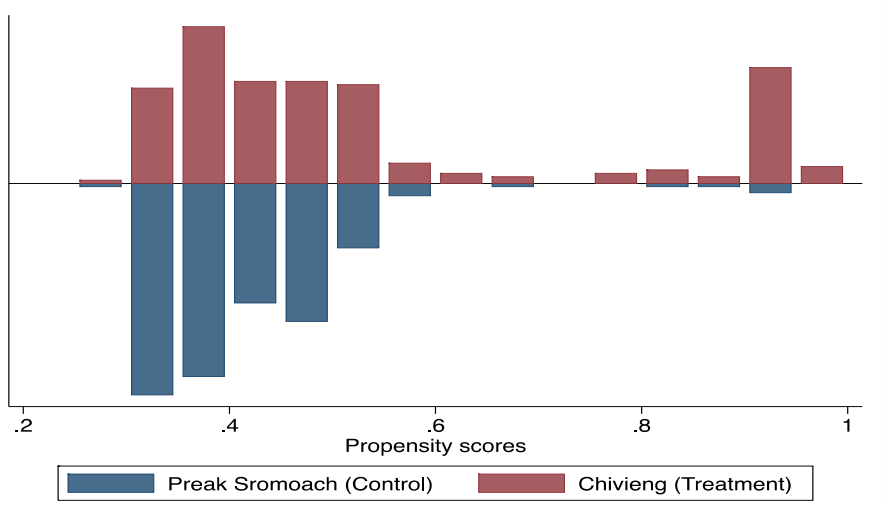

Figure 5.1: Pscores of All Fishing Households

Source: Author (2016)

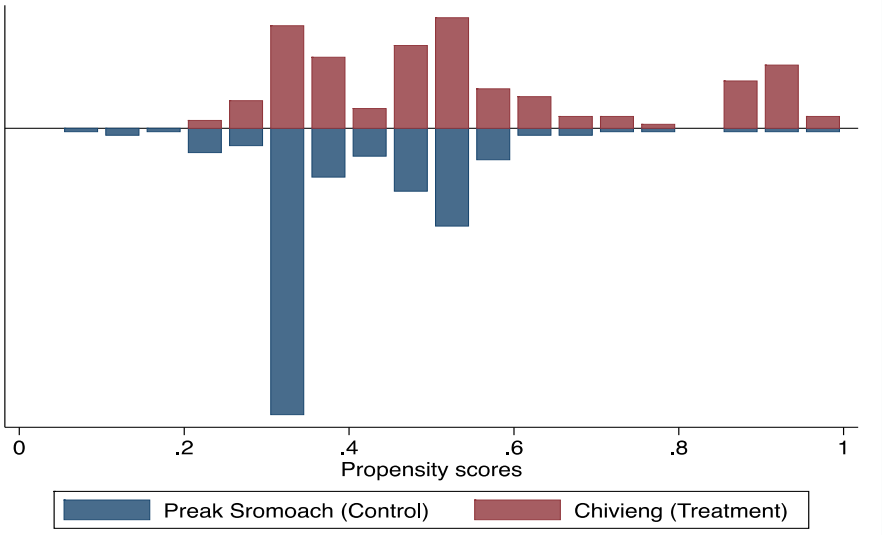

Figure 5.2: Pscores of Households Fishing only inside the Community Boundary

Source: Author (2016)

5.4.2 Empirical Findings and Discussion

1) Empirical Findings

Besides testing common support or overlap assumptions to ensure that PSM's results are statistically valid, sensitivity analysis was also tested to ensure that the results do not violate CIA. The results of sensitivity analysis denoted by Γ are illustrated in Tables 5.5 and 5.6,

showing the results of PSM. According to sensitivity analysis, Γ was more than 2, ensuring that the results of PSM do not violate CIA. Tables 5.5 and 5.6 also show the results of PSM from each method namely nearest neighbor with and without replacement, kernel matching, and radius matching. The results from the methods of PSM were similar, indicating that they are robust. The results from PSM reveal that fishery resource conservation behavior of households in Preak Sromoach community was two scores higher than those in Chivieng community. This indicates that CBNRM has a negative effect on fishery resource conservation behavior of households in Chivieng community.

Table 5.5: Impact of CBNRM on Fishery Resource Conservation Behavior of All Fishing Households

Method		Average treatment effect on treated (ATT)	AI robust standard error	T-statistics	P-values
Nearest neighbor	Without replacement	-2.26	0.11	3.64	<0.01
	With replacement	-2.28	0.12	5.79	<0.01
Kernel		-2.13	0.11	5.87	<0.01
Radius		-2.42	0.095	11.66	<0.01
Sensitivity analysis (Γ)		2.5			

Source: Author (2016)

Table 5.6: Impact of CBNRM on Fishery Resource Conservation Behavior of Households Fishing only inside the Community Boundary

Method		Average treatment effect on treated (ATT)	AI robust standard error	T-statistics	P-values
Nearest neighbor	Without replacement	-2.02	0.14	3.71	<0.01
	With replacement	-2.02	0.16	5.63	<0.01
Kernel		-2.012	0.11	5.95	<0.01
Radius		-2.05	0.098	11.78	<0.01
Sensitivity analysis (Γ)		2.3			

Source: Author (2016)

2) Discussion

According to the results of PSM, there is no difference in the effect of CBNRM on fishery resource conservation behavior between all fishing households and households fishing only inside the community boundary. Theoretically, CBNRM is expected to make local people conserve natural resources. However, in the case of Chivieng community, CBNRM has a negative effect on conservation behavior of households. Therefore, two aspects should be considered to explain the negative effect of CBNRM in the present research. Those two aspects include: 1) indirect effect of CBNRM and 2) main assumptions of CBNRM. There are two reasons for considering these two aspects. The first reason is it is unavoidable that every management approach can have an indirect effect that can affect the intended effect of its approach. The second reason is every management approach has its own main assumptions in order to work successfully.

In terms of the indirect effect of CBNRM, the previous studies find two common reasons CBNRM was unable to achieve conservation objective. The first common reason includes a reduction in local people's access to resources or an increase in time for collecting resources due to the creation of conservation areas (Hori, 2015). The second reason is the creation of buffer areas by CBNRM encourages more migrants to exploit resources in the community (Scholte & De Groot, 2010). This first common reason cannot be the case in the CBNRM-implemented community, that is, Chivieng community. Hori (2015) finds that local people in a CBNRM-implemented community in the TSL area are negatively affected by the establishment of conservation areas. They need to spend more time going fishing since they have to take detours to go fishing as a result of the establishment of conservation areas. Consequently, they are unhappy with CBNRM implementation. However, this scenario did not occur in Chivieng community. According to FGDs, key informant interviews, and household interviews,

establishment of conservation areas in Chivieng community did not affect the way local people go fishing as well as their access to NTFPs.

The second common reason, that is, encouraging more migrants to exploit resources in the community due to the creation of buffer areas found by Scholte and De Groot (2010), can be a reason explaining the negative effect on fishery resource conservation in Chivieng community. Local people in Chivieng community were highly likely demotivated to conserve fishery resources. The reason is they did not gain the desired benefit from fishery resource improvement by establishing conservation areas, patrolling, and replanting inundated forests. They had to compete daily in fishing with fishers from the outside because of its well-protected fishery resources. According to household interviews, 70% of household respondents said that they were not happy to see fishers from the outside fish in their community. Additionally, 90% of household respondents claimed that they were not happy to participate in conservation-related activities like replanting inundated forests or abiding by the state fishery laws because the benefits from fishery resource improvement were taken not only by those who put effort into fishery resource conservation, but also by outsiders who did not put effort into conserving fishery resources. Seventy-nine percent of household respondents in Chivieng community reported that most of fishers fishing in Chivieng community were from the outside. However, only 45% of household respondents in Preak Sromoach community claimed that not many fishers from the outside come to fish in their community. Having many fishers from the outside to fish in the community more or less affected the motivation of local people in Chivieng community for participating in fishery resource conservation-related activities because outsiders also received benefits from fishery resource improvement.

In order to succeed in conservation, CBNRM needs to meet some main assumptions and the most controversial assumptions of CBNRM are: 1) ownership and participation of local people in resource management by having appropriate property rights to exclude outsiders from

exploiting resources in the community and enforce their bylaws and internal regulations (Murombedzi, 1998); and 2) ability of local people to benefit from alternative sources of income created by CBNRM without structural exclusion or poor infrastructure (Saunders, 2011). The first assumption is related to ownership and participation of local people. It requires local people to have property rights to enforce their bylaws and internal regulations and exclude outsiders from exploiting their resources. Weak enforceability of property rights is likely to be the reason that demotivates households in Chivieng community to conserve fishery resources. According to a sub-decree for community fisheries management of Cambodia, access to fishery resources is not exclusively for members in the community. Outsiders also have rights to access to resources (RGC, 2005). Therefore, households in Chivieng community have no right to restrict fishers from the outside to fish inside their community boundary. They have to compete daily in fishing with fishers from the outside. Seventy-nine percent of household respondents in Chivieng community reported that most of the fishers fishing inside their community boundary were outsiders. The reason for fishers from the outsides to come to fish inside Chivieng community is that there are conservation areas in the community, which leads to spillover effects of fishery resources to nearby fishing grounds in the community. Ninety percent of household respondents in the community claimed that they were not happy to participate in conservation-related activities like replanting inundated forests or abiding by the state fishery laws. The reason is benefits from fishery resource improvement were taken not only by those who put effort into fishery resource conservation, but also by outsiders who were free-riders. Besides no right to exclude the others, according to the same sub-decree, local people have no right to punish fishers who do illegal fishing (RGC, 2005). Although the sub-decree on community fisheries management of Cambodia states that non-members of the CBNRM have the right to use fishery resources in the CBNRM-implemented community if they obey bylaws and internal regulations, local people cannot punish them when they violate their bylaws and

internal regulations. They can only report illegal fishing to the nearest FiA and request FiA undertake an intervention (RGC, 2005). As a result, local people cannot manage fishery resources effectively. Ostrom (1990), and Pinkerton and Weinstein (1995) claim that it is unlikely that conservation goals can be achieved if local people are not granted enough property rights to protect benefits from resource improvement derived from their efforts in resource conservation and enforce their bylaws and internal regulations to manage resources.

The second assumption is the ability of local people to benefit from alternative sources of income created by CBNRM without structural exclusion or poor infrastructure. Ecotourism is created to enable local people to have alternative sources of income in Chivieng community. However, it does not generate enough financial benefits to local people, which demotivates them to conserve fishery resources. CBNRM committee members reported that only 3% of the total population at the time of the survey were engaged in ecotourism-related jobs like service provision to tourists in the form of boat operation, cooking, accommodation, and sale of hyacinth-made handicraft. It is worth mentioning that this group of local people were the only better-off individuals in the community who could afford to buy speed boats, own a well build house, or had good skills in Western food cooking in particular. Moreover, financial benefits from those jobs were so limited and seasonal. Average monthly income was 100 US dollars during the peak season that lasted only three months per year from October to December. Uneven and limited financial benefit distribution may have caused households to be reluctant to abide by the state fishery laws or participate in conservation-related activities. Some of the key informants claimed that only a small group of households who were engaged in ecotourism-related jobs were willing to reduce their fishing effort either by changing types or reducing the quantity of fishing equipment during the closed season or by participating in planting the inundated forest. This was because income from those ecotourism-related jobs was not significant for their livelihoods. Additionally, from the structure interviews with households in

Chivieng community, 90% of those who did not earn income from ecotourism-related jobs complained that it was not fair that only a small group of households could earn from ecotourism-related jobs, while they also put their effort into conserving fishery resources. Similarly, Twyman (2000), Kiss (2004), Mbaiwa (2005), Dahlberg and Burlando (2009) find that uneven and limited financial benefit distribution demotivated local people to conserve resources. Worse, Bennett et al. (2001) find that due to ineffective or lack of alternative sources of income, some fishers who lived in those communities were engaged more in illegal fishing and even protested against the establishment of marine protected areas.

5.5 Conclusion

It was found that CBNRM had a negative effect on fishery resource conservation behavior of households in the CBNRM-implemented community, Chivieng community. There are three reasons that may explain the negative effect of CBNRM: 1) more migrants are motivated to exploit fishery resources in the community due to the creation of conservation areas; 2) weak enforceability of property rights to exclude outsiders from fishing inside the community boundary and weak enforceability of bylaws and internal regulations; and 3) ineffectiveness of alternative source of income due to uneven and limited financial distribution.

The present research suggests that local people should be granted more property rights in terms of the right to exclude outsiders from fishing inside the community boundary and enforce their bylaws and internal regulations. As a result, local people will not need to share their benefits from their efforts in fishery resource conservation with outsiders who are considered as free riders. Lastly, more support should be given to the existing alternative source of income, ecotourism, by creating more related jobs and services. Equity in the distribution of financial benefits from existing sources of income should be given special consideration.

Chapter 6: Effect of CBNRM on Household Consumption

This chapter will answer the first research question: "Does CBNRM have a positive effect on poverty reduction?" by using per adult equivalent consumption as a measurement. PSM will be used to analyze data. This chapter will start with the Introduction section, which introduces the background of the research question. After this section, there will be the Data and Method Analysis section, followed by the Results and Discussion section. Lastly, there will be the Conclusion section for the chapter.

6.1 Introduction

Besides its promise to achieve conservation, CBNRM is well-known for poverty reduction of local people. Many theories including new institutional economics and public choice theory (see Cleaver, 1999; Ribot, 2002), and the economic theory of property rights and comparative advantages (see Murphree, 2009) have supported that CBNRM can contribute to poverty reduction of local people. According to those theories, CBNRM can help to reduce poverty when the resource system managed by local people has clearly defined boundaries, which is likely to internalize externalities. Moreover, local people can meet their own needs because they can make their own decisions based on the information about resources (Cleaver, 1999; Ribot, 2002). The economic theory of property rights and comparative advantages support the idea that CBNRM can contribute to poverty reduction (Murphree, 2009). Local people can get financial benefits from private ownership in natural resource management (Jones & Murphree, 2004). From the viewpoint of comparative advantage, local people can earn more financial benefits from nature-based tourism if there are more impressive landscapes and wildlife species in their local area compared with other areas (Child, 1996, 2004). Besides the theories mentioned above, scholars opposing state management regimes like Blaikie (2005) claim that unlike state management regimes that usually cause problems related to open access, CBNRM

can solve such problems. The reason is local people can police more efficiently since they are always on the spot and can quickly realize who rule violators are. Local people can secure their de facto and de jure rights and protect their resources.

However, some scholars argue that CBNRM cannot contribute to poverty reduction. One reason, which is used to support their disagreement, is that CBNRM is just a means powerful rent-seekers use to reinforce or protect their remaining archaic and regressive governance like patriarchy and chieftaincy. Additionally, benefits derived from CBNRM can be obtained by rent-seekers or local elites. Therefore, the local poor remain poor, and the rich remain rich (Chatty & Colchester, 2002; Wells et al., 2001). Those scholars even argue that although benefits from CBNRM can reach the local poor, those benefits may not arrive fast enough to meet their livelihood needs, or those benefits are not as high as those from labor-intensive activities (Chatty & Colchester, 2002; Wells et al., 2001). Besides, those benefits may not be significant enough to reduce poverty when CBNRM is implemented in overpopulated areas (Attwell & Cotterill, 2000). In some cases, it is difficult for local people to gain benefits from CBNRM because some of CBNRM activities are in conflict with their livelihood strategies (Chatty & Colchester, 2002; Wells et al., 2001).

Despite many arguments against the notion that CBNRM can contribute to poverty reduction, CBNRM has been widely implemented, particularly in developing countries after the failure of centralized or privatized resource management. There have been many studies such as Adhikari (2005), Mohsin, Hasan, and Galib (2009), and Suich (2013) about the impact of CBNRM on poverty reduction, but the findings from those studies are mixed. This indicates that the contribution of CBNRM to poverty reduction may depend on the context of the location where CBNRM is implemented. Thus, it is worth critically analyzing the theories supporting CBNRM. Five successful cases of resource management by local people in different settings presented by Ostrom (1990) convince scholars and practitioners that local people can manage

resources and improve livelihoods. Those successful cases include ancient villages of Japan, forests and meadows of Switzerland, Zanjera irrigation in the Philippines, and ancient Huerta irrigation in Spain. According to Araral (2014), those five cases selected by Ostrom have two common resource characteristics, that is, being small-scale and stationary resources. As a result, those resource systems and resource units could be easily unitized, quantified, traded, and feasible to exclude outsiders. In addition to those common resource characteristics, local people in those cases had some forms of property rights in the sense that only members could access to resources, and they could exclude outsiders from accessing their resources due to the feasibility of monitoring and enforcement.

Privatization in TSL came to its end in 2012 after it failed to contribute tax payments to the RGC, had no effective upward accountability, and created violent conflicts between commercial fishing lots owners and local fishers. CBNRM implementation in the TSL area aims at not only fishery resource conservation but also poverty reduction for small-scale fishers in particular. However, whether or not CBNRM implementation in the TSL area can contribute to poverty reduction remains ambiguous for two reasons. The first reason is based on Araral's (2014) criticism on Ostrom's work. That is, Ostrom selected only one type of resource characteristics, namely small-scale and stationary. However, CBNRM implementation in the TSL area may not achieve its objective in poverty reduction because fishery resources are mobile, and TSL is large-scale, spanning national and regional boundaries that cannot be managed easily. Besides challenges due to the nature of TSL, CBNRM implementation may not achieve its objectives. This is due to failures of the RGC in establishing effective alternative sources of income and granting property rights to local people to enforce their bylaws and internal regulations as well as to exclude fishers from the outside from exploiting fishery resources (Jones & Sok, 2015; Thole & Sato, 2014). It is well-known that to manage resources

and improve livelihoods successfully, the abovementioned rights are considered critical factors (Agrawal & Ostrom, 2001).

To assess if CBNRM implementation in the TSL area is successful in terms of poverty reduction, the present research examines the effect of CBNRM on poverty reduction by using per adult equivalent consumption as an indicator of poverty. The present research conducted surveys in two communities in the TSL area, namely Chivieng community (a CBNRM-implemented community) and Preak Sromoach community (a non-CBNRM-implemented community).

The chapter is organized as follows. Section 6.2 provides a description of data and method of analysis. Section 6.3 presents results and discussion, followed by Section 6.4 that is a conclusion for the chapter.

6.2 Data and Method of Analysis

6.2.1 Data

The same data set from Chapter 5 was used to run the model. A model for per adult equivalent consumption was adopted from previous studies that used it to measure the impact of CBNRM[1]. The dependent variable in the model is per adult equivalent consumption. It is calculated by dividing total consumption of a household by the adult equivalent (AE). Total consumption includes food and nonfood consumption such as clothes, communication, and utilities. NTFPs are also included in total consumption. Those NTFPs include fuelwoods and wild vegetables from inundated forests. Reasons for including NTFPs in total consumption as items are: 1) local people considered NTFPs important sources of food; and 2) they are considered a part of fishery resources in the TSL area. Accordingly, any change in fishery resource management may affect inundated forests as well as NTFPs. There are three steps to calculate NTFP consumption. First, NTFPs are categorized into two types. The first type is

[1] See Bandyopadhyay and Tembo (2010), and Silva and Mosimane (2012).

NTFPs that are sold at the market, and the second type is NTFPs that have potential to be sold at the market. Next, NTFPs consumption is calculated for each type. For the first type of NTFPs, the value is calculated by multiplying the quantity (units consumed in each household) with the retail price at the market. For the second type of NTFPs, the value is calculated by multiplying the quantity by the next alternative or substituted price of NTFPs. Finally, the total consumption of NTFPs is calculated by summing all types of NTFP consumption.

To calculate AE, the formula from the Organization for Economic Co-operation and Development (OECD) is used. The OECD scale for AE is written as:

$$AE = 1 + 0.7(N_{adults} - 1) + 0.5N_{children},$$

where N_{adults} refers to the number of adults of a household, and $N_{children}$ refers to the number of children per household (Haughton & Khandker, 2009).

Factors affecting per adult equivalent consumption, considered independent variables in the model, are the number of household members residing in the house over the last 12 months, HH age, HH education, and HH gender, and interaction terms between HH gender and education[2]. The number of household members residing in the house over the last 12 months can affect per adult equivalent consumption because that the larger the household size, the lower per adult equivalent consumption of a household is. Besides, it is likely that the larger the household size, the more labor available to extract natural resources for consumption is (Adhikari et al., 2004). In terms of HH age, some studies find that there is a negative impact of age on deriving benefits from natural resources (Godoy et al.,1997; Mamo, Sjaastad, & Vedeld, 2007). Therefore, HH age can also affect household consumption of NTFPs, affecting per adult equivalent consumption of households in the research areas. However, some studies find that

[2] It was included in the model to satisfy balancing properties. See details in Section 6.2.2.

HH age can have a positive impact on benefits from natural resources. This is because HH age is associated with social capital accumulation and experience in the utilization of local resources (Adhikari, 2007), leading to more chances for collecting natural resources and more consumption. HH education was included in the model since it is generally known that HH education can affect poverty in terms of income and consumption although its effect is varied from one study to another. Moreover, HH gender was included in the model because many studies show that when household heads are female, their income and consumption is lower than male household heads (Haughton & Khandker, 2009; Mamo et al., 2007). In addition to the statistical reasons explained in Section 6.2.2, the interaction between HH gender and HH education was included in the model because in some studies such as Berkes, Gungor, and Tapsin (2015), HH education has a negative association with poverty, but there is a positive association between HH education and poverty when household heads are female.

6.2.2 Method of Analysis

To examine the effect of CBNRM on per adult equivalent consumption, PSM (see the details of PSM in Chapter 5) was used. According to Maddala (1983), the impact of any project or program can be estimated as follows:

$$y_i = \alpha + \beta x_i + \gamma p_i + \varepsilon_i,$$

where y is a variable of interest, that is, per adult equivalent consumption. x is a vector of exogenous explanatory variables (household characteristics that can influence per adult equivalent consumption, y). p is an indicator for treatment ($p = 1$ if local people live in Chivieng community, and $p = 0$ if local people live in Preak Sromoach community). $\propto, \beta, \gamma$ are unknown parameters; and ε is the error term, capturing unobservable factors and potential measurement error affecting y.

To validate the results from PSM, three assumptions, including CIA, balancing properties, and common support or overlap condition, were tested. Initially, independent variables in the model included the number of household members residing in the house over the last 12 months, HH age, HH education, and HH gender. However, while testing the assumptions, it was found that there were no balancing properties in the model, meaning that the model has to be re-specified. According to Li (2013), the model of PSM can be re-specified by adding higher order terms and/or interaction terms between independent variables in the model. When including the interaction term between HH gender and HH education, the model could satisfy balancing properties and meet the assumptions.

As in Chapter 5, nearest neighbor with and without replacement, kernel, and radius matching methods of PSM were used to run the model.

6.3 Results and Discussion

6.3.1 Descriptive Statistics and Assumptions of PSM

Descriptive statistics of variables used in the models for all fishing households, and households fishing only inside the community boundary are shown in Tables 6.1 and 6.2, respectively. As Table 6.1 shows, per adult equivalent consumption of all fishing households in Preak Sromoach community (the non-CBNRM-implemented community) was higher than that in Chivieng community (the CBNRM-implemented community) approximately 10 US dollars per month. There was no difference in age, education, and household size between the two communities. However, there were more male household heads in Preak Sromoach community than in Chivieng community.

Table 6.1: Descriptive Statistics of All Fishing Households

Variables				Mean/Number		Minimum		Maximum	
				Control[1] (239 HHs)	Treatment[2] (232 HHs)	Control	Treatment	Control	Treatment
Dependent		Per adult equivalent consumption (Monthly in US dollars)		91.21	80.91	22.53	18.5	377.58	271.37
Independent	Continuous	Age (Years old)		39.28	40.77	20	20	77	68
		Education (Edu)[3] (School year)		2.35	2.1	0	0	8	12
		Household size (Number of HH members)		5.15	4.07	1	1	10	11
	Category	Gender (Gen)[4]	Male	201	185				
			Female	38	47				
		Edu*Gen	0	220	204				
			1	11	36				

Notes:
1) Control group or Preak Sromoach community
2) Treatment group or Chivieng community
3) Education is 0 for no education and 1 for studying at least one year at school.
4) 0 for male and 1 for female are assigned to indicate Gender

Source: Author (2016)

As Table 6.2 shows, per adult equivalent consumption of households fishing only in the community boundary of Chivieng community was much higher than that in Preak Sromoach community at around 22 US dollars per month. There was no difference in age, education, and household size between two communities. However, the number of male household heads in Preak Sromoach community was slightly higher than in Chivieng community.

Table 6.2: Descriptive Statistics of Households Fishing only inside the Community Boundary

Variable				Mean/Number		Minimum		Maximum	
				Control[1] (192 HHs)	Treatment[2] (156 HHs)	Control	Treatment	Control	Treatment
Dependent		Per adult equivalent consumption (Monthly in US dollars)		33.95	56.4	12.51	15.57	110	138
Independent	Continuous	Age (Years old)		39.84	40.58	20	20	68	77
		Education (Edu)[3] (School year)		1.81	1.92	0	0	7	7
		Household size (Number of HH members)		2.4	2.3	1	1	8	8
	Category	Gender (Gen)[4]	Male	159	128				
			Female	33	28				
		Edu*Gen	0	171	143				
			1	21	13				

Notes:
1) Control group or Preak Sromoach community
2) Treatment group or Chivieng community
3) Education is 0 for no education and 1 for studying one year at school.
4) 0 for male and 1 for female are assigned to indicate Gender.

Source: Author (2016)

Before running PSM, binary logistic regression models need to be run to get pscores for testing balancing properties and common support or overlap assumptions. Tables 6.3 and 6.4 show the results from binary logistic regression of per adult equivalent consumption for all fishing households and that of those fishing only inside the community boundary, respectively.

Table 6.3 shows that household size, age, education, and interaction terms between education and gender are significant factors affecting CBNRM participation in both fishing households fishing only in the community boundary and those fishing in and outside the community boundary. Table 6.4 shows that education is that only significant factor affecting CBNRM participation of fishing households who fish only in the community boundary.

Table 6.3: Binary Logistic Regression Estimation Result of per Adult Equivalent Consumption of All Fishing Households

Number of observations = 471
LR chi2 (5) = 43.42
Prob> chi2 = 0.0000
Pseudo R2 = 0.17

Independent variables	Co-efficiency	Standard error
Household size	-0.66***	0.17
Age	0.27*	0.14
Education	-0.54*	0.2
Gender	-0.16	0.44
Education * Gender	0.93*	0.54
Constant	1.03	0.37

Note: Significance level: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author (2016)

Table 6.4: Binary Logistic Regression Estimation Result of per Adult Equivalent Consumption of Households Fishing only inside the Community Boundary

Number of observations = 348
LR chi2 (5) = 39.43
Prob> chi2 = 0.0000
Pseudo R2 = 0.19

Independent variables	Co-efficiency	Standard error
Household Size	-0.038	0.07
Age	-0.16	0.22
Education	0.48 *	0.23
Gender	0.52	0.48
Education * Gender	-0.48	0.58
Constant	0.39	0.4

Note: Significance level: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author (2016)

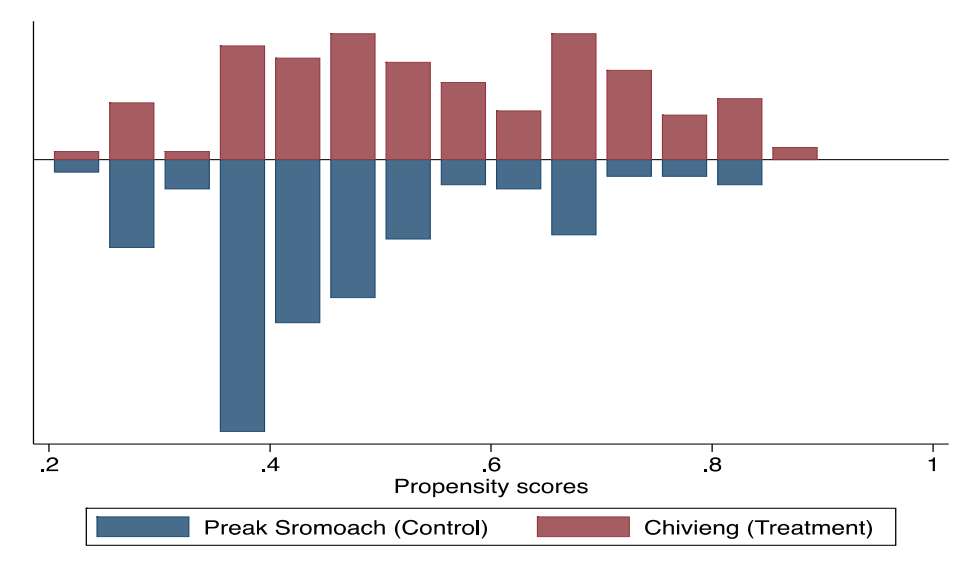

Figure 6.1: Pcores of All Fishing Households

Source: Author (2016)

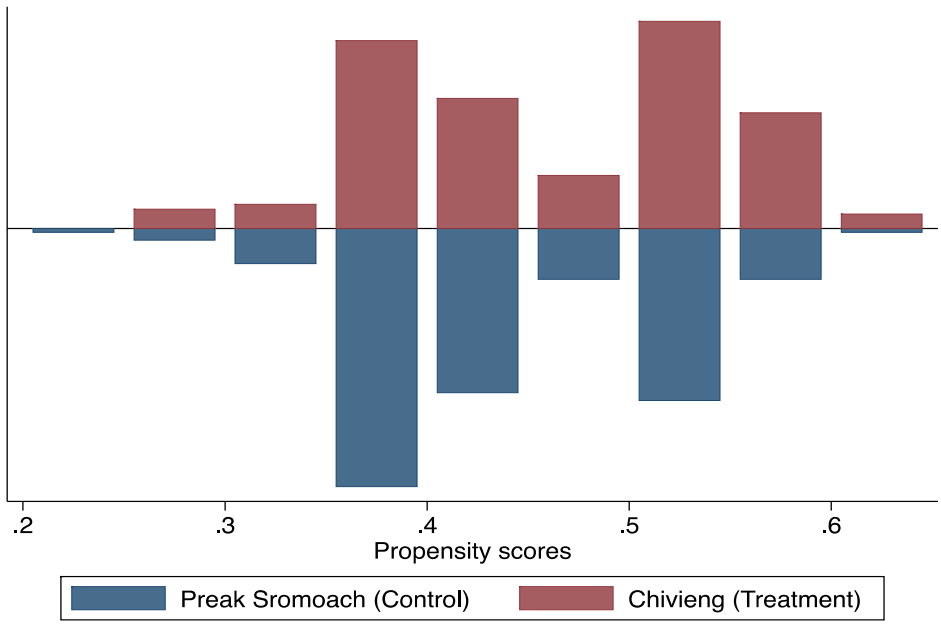

Figure 6.2: Pcores of Households Fishing only inside the Community Boundary

Source: Author (2016)

Common support or overlap assumption are shown in Figures 6.1 and 6.2. They show that the common supports or overlap assumptions hold true since both groups of households in Chivieng and Preak Sromoach communities had a similar probability of being in either of the communities by being equally distributed along the propensity score.

6.3.2 Empirical Findings and Discussion

1) Effect of CBNRM on per Adult Equivalent Consumption of All Fishing Households

(1) Empirical Findings

In addition to testing common supports or overlap assumptions to ensure that the results from PSM are statistically valid, sensitivity analyses were tested to ensure that the results do not violate CIA. Table 6.5 shows the result of sensitivity analysis denoted by Γ and the results of PSM. According to sensitivity analysis, Γ was 2.4, ensuring that the results from PSM did not violate CIA.

CBNRM had a negative effect on per adult equivalent consumption of households in Chivieng community. Table 6.5 shows the results of PSM from nearest neighbor with and without, kernel, and radius matching methods. The results reveal that per adult equivalent consumption in Chivieng community was lower than that in Preak Sromoach community. The numbers in the second column indicate that the amount of money in US dollars for per adult equivalent consumption in Chivieng community is lower than in Preak Sromoach communituy. Per adult equivalent consumption of households in Chivieng community was lower than that in Preak Sromoach community by around 30 US dollars for nearest neighbor matching with replacement and by 26 US dollars for nearest neighbor matching without replacement. For kernel and radius methods, per adult equivalent consumption of households in Chivieng community was lower than in Preak Sromoach community by around 26 and 15 US dollars, respectively.

Table 6.5: Impact of CBNRM on per Adult Equivalent Consumption of All Fishing Households

Method		Average treatment effect on treated (ATT)	AI robust standard error	T-statistics	P-values
Nearest neighbor	Without replacement	-30.23	6.68	5.28	<0.01
	With replacement	-26.12	7.74	1.68	<0.1
Kernel		-25.63	7.74	2.03	<0.05
Radius		-14.68	5.59	6.67	<0.01
Sensitivity analysis (Γ)		2.4			

Source: Author (2016)

(2) Discussion

Findings in the present research are contradictory with those from several previous studies like Bandyopadhyay and Tembo (2010), and Silva and Mosimane (2012) who find that CBNRM has a positive impact on poverty reduction in terms of household consumption. There are two reasons for such a negative effect of CBNRM on per adult equivalent household consumption in the present research (see Table 6.5). The first reason is weak enforceability of property rights to exclude fishers from the outside from fishing in the community and weak enforceability of bylaws and internal regulations. The second reason is an ineffective alternative source of income generated by CBNRM, ecotourism.

First, local people in Chivieng community, that is, the CBNRM-implemented community, could not gain desired benefits due to weak enforceability of property rights despite their efforts in resource conservation like establishing conservation areas, patrolling, and replanting inundated forests. They had to compete daily in fishing with fishers from the outside. In addition, they had no authority to restrict those fishers from fishing in their community or punish them if they did illegal fishing. The reason why those fishers often come to fish inside Chivieng community is because of its well-protected fishery resources. According to household interviews, 79% of household respondents in Chivieng community reported that most of the

fishers fishing in Chivieng community were from the outside. However, only 45% of household respondents in Preak Sromoach community claimed that not many fishers from the outside come to fish in their community. According to Ostrom (1990), local people can manage their resources successfully only when they have enough property rights, including the right to exclude outsiders or non-members from extracting resources in their community and the right to enforce laws. The right to exclude outsiders or non-members and punish illegal fishers is considered a vital mechanism to protect the benefits of local people who have made an effort to conserve resources (Pinkerton & Weinstein, 1995). The sub-decree on community fisheries management of Cambodia states that non-members of the CBNRM have the right to use fishery resources in the CBNRM-implemented community if they obey bylaws and internal regulations. However, local people cannot punish them when they violate their bylaws and internal regulations. They can only report illegal fishing to the nearest FiA and request FiA for an intervention (RGC, 2005). As a result, local people cannot manage fishery resources effectively. Although a study conducted in Chile by Gelcich, Edwards-Jones, and Kaiser (2005) did not explore effect of CBNRM on household consumption, it reveals that local fishers who used to compete in fishing with fishers from the outside before CBNRM implementation expected economic success from CBNRM. This was because they had the right to exclude fishers from the outside and the right to enforce rules on violators for protecting their benefits in the future.

Second, the ineffectiveness of an alternative source of income, that is, ecotourism, was likely to be a reason why CBNRM implementation in Chivieng community fails to achieve its objective in per adult equivalent household consumption. Financial benefits from ecotourism are limited due to the seasonal nature of activities. There were 3% of total households working in ecotourism-related jobs, including boat operations, cooking, and providing accommodation to tourists according to CBNRM committee members. Average income from those jobs was

approximately 100 US dollars during the peak season lasting only three months from October to December. According to Ostrom (1990), resource management by local people cannot succeed without alternative sources of income. This is because those alternative sources of income act as an incentive to motivate local people to conserve resources by reducing their resource exploitation. Moreover, alternative sources of income are an essential means to improve livelihoods and reduce poverty. However, she adds that benefits from those sources of income should be enough to improve local people's livelihoods, leading them to reduce their efforts in resource exploitation. Suich (2013) finds that although CBNRM in Namibia provided financial benefits to local people, those benefits were too few to increase local people's income as well as consumption. As a result, local people were unable to reduce their resource extraction. This means that having only alternative sources of income is insufficient to improve the livelihoods of local people. The more important thing is how the role of these alternative sources of income plays in their livelihoods.

2) Effect of CBNRM on per Adult Equivalent Consumption of Households Fishing only inside the Community Boundary

(1) Empirical Findings

Table 6.6 shows the result of sensitivity analysis denoted by Γ and the results of PSM. According to sensitivity analysis, Γ was 1.8, ensuring the results from PSM did not violate CIA.

Table 6.6: Impact of CBNRM on per Adult Equivalent Consumption of Households Fishing only inside the Community Boundary

Method		Average treatment effect on treated (ATT)	AI robust standard error	T-statistics	P-values
Nearest neighbor	Without replacement	42.69	4.26	10.53	<0.01
	With replacement	58.42	4.13	11.75	<0.01
Kernel		49.49	4.13	11.76	<0.01
Radius		43.13	3.82	11.14	<0.01
Sensitivity analysis (Γ)		1.8			

Source: Author (2016)

In contrast with the effect of CBNRM on per adult equivalent consumption of all fishing households, CBNRM had a positive effect on that of households fishing only inside the community boundary in Chivieng community. Table 6.6 shows the results of PSM from nearest neighbor with and without replacement, kernel, and radius matching methods. Those results reveal that per adult equivalent consumption in Chivieng community was higher than that in Preak Sromoach community. The numbers in the second column indicate the amount of money in US dollars for per adult equivalent consumption in Chivieng community is higher than in Preak Sromoach community. Per adult equivalent consumption of households in Chivieng community was higher than in Preak Sromoach community, around 43 US dollars for nearest neighbor matching with replacement and 58 US dollars for nearest neighbor matching without replacement. For kernel and radius methods, per adult equivalent consumption of households in Chivieng community was higher than in Preak Sromoach community around 49 and 43 US dollars, respectively.

(2) Discussion

Two reasons that could well explain the positive effect of CBNRM on per adult equivalent consumption of households fishing only inside the community boundary. The first reason is that CBNRM implementation in Chivieng community was congruent with the community's conditions in terms of access to NTFPs. Congruence is one of the principles suggested by Ostrom (1990) to manage resources successfully. According to FGDs, key informant interviews, and household interviews in Chivieng community, CBNRM implementation did not modify any access rules to NTFPs that had been used by local people in the community before CBNRM implementation. For example, when the TSL area was under the commercial fishing lot system, local people in Chivieng community could access and make use of NTFPs for their household consumption. After CBNRM implementation, local people could still access and make use of NTFPs without any restriction imposed by CBNRM. As a

result, their NTFPs consumption was not affected. Some previous studies find that a new resource management system such as CBNRM and co-management made local people lose access to natural resources including NTFPs because of its newly imposed rules that were not congruent with local conditions (Gelcich, Edwards-Jones, Kaiser, & Castilla, 2006). Gelcich et al. (2006) find that the Management and Exploitation Areas for Benthic Resources policy, based on the concept of co-management, in the inshore fishery management system in Chile established new rules to access to bull-kelp that were not congruent with the lifestyle of fishers. As a result, those rules negatively affected fishers' access to bull-kelp, income, and consumption. Before policy implementation, fishers could access bull-kelp by using a lottery system that granted them annual access to the harvesting ground. Moreover, their access to bull-kelp was based on seasons. However, after implementing the policy, their access to bull-kelp was modified because fishers had to deal with the bureaucracy, which was imposed by the policy before they could gain access to the harvesting ground. Worse yet, they had to spend money on hiring consultants before they harvested bull-kelp. Consequently, income earned from selling bull-kelp was spent on consultancy services and administration.

The second reason is knowledge of the right to access the resources. Compared with households in Preak Sromoach community with those in Chivieng community, household respondents in the latter had more knowledge of the right to access NTFPs. This can be attributed to awareness-raising workshops and training courses on rights to resource access of local people that were provided from CBNRM committee members, while household respondents in Preak Sromoach community did not get such training courses. According to FGDs and key informant interviews, there were at least five instances of awareness-raising workshops and training courses conducted annually by CBNRM committee members in addition to those conducted by government officials. However, in Preak Sromoach community, there were only two training courses conducted per year by government officials. This reason

is supported by a higher frequency of NTFP collection by households in Chivieng community than that of those in Preak Sromoach community. According to household interviews, 90% of household respondents in Chivieng community who mainly fished inside the community often went to collect NTFPs from inundated forests more than twice per week. However, in Preak Sromoach community, only 29% of household respondents who fished mainly in the community went to collect NTFPs once per month.

6.4 Conclusion

The present research found that although CBNRM did not positively affect per adult equivalent household consumption in Chivieng community as a whole, it did for those who fished mainly inside the community boundary. There are two reasons that may well explain why CBNRM had a negative effect on per adult equivalent consumption in Chivieng community as a whole. The first reason is weak enforceability of property rights, and the second reason is ineffectiveness of the alternative source of income. Congruency with Chivieng community's conditions in terms of access to NTFPs and better knowledge in the right to access to NTFPs are reasons that may well explain why CBNRM had a positive effect on per adult equivalent consumption of households fishing only inside the community boundary.

To improve consumption of local people, there are two aspects that CBNRM has to focus on. The first aspect is that more property rights should be granted to local people in CBNRM-implemented communities, particularly the right to exclude fishers from the outside and the right to enforce their bylaws and internal regulations. Doing so enables local people to gain appropriate benefits from their efforts to conserve fishery resources without competing with fishers from the outside. The second aspect is that there should be alternative sources of income with fair distribution among local people besides the jobs related to ecotourism to reduce the dependency of local people on fishery resources and reduce competition in fishing.

Chapter 7: Root Causes of CBNRM's Failures

This chapter will answer the third research question: "What are root causes of success or failure of CBNRM in fishery resource conservation and poverty reduction?" by using principles of Ostrom (1990). Directed content analysis will be used to analyze the data. This chapter will start with the introductory section, which introduces the background of the research question and will be followed the Qualitative Content Analysis section. This section will review different kinds of qualitative content analysis and explain why directed content analysis is used. Then, there will be the Data and Method Analysis section, followed by the Results and Discussion section. Lastly, there will be the Conclusion section for the chapter.

7.1 Introduction

In Chapters 5 and 6, the effects of CBNRM on fishery resource conservation behavior and household consumption were examined, respectively. It was found that CBNRM had negative effects on fishery resource conservation behavior and poverty reduction, respectively. Although the reasons provided in Chapters 5 and 6 well explain such negative effects of CBNRM on fishery resource conservation and poverty reduction in the TSL areas, the root causes associated with those reasons have not been found yet. Since each resource management regime has its principles to follow to be successfully implemented, including CBNRM, those principles are worth using to find root causes of a resource management regime's outcome. Without understanding whether those principles are well observed or applicable to use in areas implementing a resource management regime, it may be challenging to succeed in resource management.

Some scholars, including Baland and Platteau (1996), Ostrom (1990), and Wade (1988) suggest principles for successful resource management. There are some overlaps in those principles[1]. However, among the principles suggested by those scholars, only those suggested

[1] See Agrawal (2001) for more details.

by Ostrom (1990) have been generally used as a blueprint for robust natural resource management. The reason is those principles cover all the principles suggested by the other scholars and the principles that those scholars have not included such as a conflict resolution mechanism and nested enterprises. In the present research, only principles suggested by Ostrom (1990) cover all the reasons mentioned above for the negative effects of CBNRM on fishery resource conservation and poverty reduction on the research site. Wade (1988) addresses only the principle[2] associated with the first reason for the negative effects of CBNRM (weak enforceability of property rights) while Baland and Platteau (1996) discuss only the principle associated with the second reason (ineffectiveness of alternative sources of income)[3].

Moreover, so far, many studies have used the principles suggested by Ostrom (1990) to analyze whether a resource management regime, in particular decentralized natural resource management like co-management and CBNRM, is successful in either conservation or poverty reduction. However, those studies did not use Ostrom‘s principles to analyze the success in resource management in terms of both conservation and poverty reduction. In the case of Cambodia, there are few studies on which principles of Ostrom are observed to apply in the TSL area, except Kurien (2017) and on root causes of success or failure of CBNRM from Ostrom’s principles. Therefore, the chapter will use Ostrom’s principles to find out the root causes of failures in CBNRM implementation in Chivieng community. However, before using those principles as potential root causes, it is worth knowing what types of Ostrom’s principles are being applied in CBNRM-implemented community, that is, Chivieng community, because it is not logical to assume that all principles will apply.

[2] It is indicated in his work as clearly defined boundaries.
[3] It is indicated in their work as fairness in benefit allocation from common resources.

7.2 Qualitative Content Analysis

7.2.1 Overview of Content Analysis

Content analysis is a research technique for replicating and validating inferences from texts or other materials like art or audio. It provides information for practical actions and new insights while increasing understanding of specific phenomena. Application and analysis of text within a social context is a metaphor in content analysis (Krippendorff, 2004). According to Krippendorff (2004), there are three definitions of content analysis. They are: 1) definitions taking content to be inherent in a text; 2) definitions taking content to be property of a text's source; and 3) definitions taking content to emerge during the process of analyzing a text that is relative to a particular context.

Each definition leads to a specific way of conceptualizing content as well as proceeding of analysis. The firs definition takes the account for only the content that is inherent in a message, which is waiting to be divided from its forms and be described by the analyst. The second definition requires content analysis to encode or decode paradigm that sources of the message are casually linked to the recipient via processes of encoding, channels, messages, and processes of decoding. Content analysis in this definition is used to describe characteristics of communications in terms of what, how, and to whom, and infer to the antecedents in terms of who and why, and the results in terms of with what effects. The third definition prefers content analysis to be flexible in taking into account new concepts emerging during the involvement of the analyst with the text. By doing so, it acknowledges not only theory-driven nature of content analysis, but also its demands for the analytical process that is closely linked to communicators studied (Krippendorff, 2004).

There are two kinds of content analysis: quantitative and qualitative content analyses (Hsieh & Shannon, 2005). However, only qualitative analysis is described here due to the nature of the research questions and the availability of data. Qualitative content analysis is one of the research

methods used for analyzing data in text. Related methods include history, phenomenology, grounded theory, and ethnography research (Hsieh & Shannon, 2005). Qualitative content analysis not only counts words, it also intensely examines language for the aim of classifying a large amount of text into an efficient number of categories representing similar meanings (Weber, 1990). The present research adopted the definition of qualitative content analysis used Hsieh and Shannon (2005). According to Hsieh and Shannon (2005), qualitative content analysis is a research method for interpreting the content of text subjectively via a systematic classification process of coding and identifying patterns or themes. There are three approaches to qualitative content analysis, including directed, conventional, and summative content analysis, each of which will be explained below:

1) Directed Content Analysis

Directed content analysis is used when there is an existing theory, or prior research exists about a phenomenon, but it is not complete or would benefit from further research or description (Hsieh and Shannon, 2005). Hsieh and Shannon (2005) state that directed content analysis' goal is to validate or extend a theory or its conceptual framework. Based on the role of theory, this type of content analysis may be categorized as a deductive use of theory (Potter & Levine-Donnerstein, 1999). Hence, the research question can be derived from the existing theory or research. A variable of interest and relationship between variables can be predicted, helping to determine a coding scheme or relationship between codes. An open-ended question may be used when data are collected primarily via interviews (Hsieh & Shannon, 2005). Its findings provide support and nonsupport evidence for a theory. The evidence can be shown by offering descriptive evidence and presenting codes with exemplars. To meaningfully compare results of coded data, rather than by using statistical tests of difference, the researcher can rank the results in order of frequency (Curtis et al., 2001).

2) Conventional Content Analysis

Conventional content analysis is used with the research design aims at describing a phenomenon. It is appropriate to use when there is limited existing theory or literature on the phenomenon (Hsieh & Shannon, 2005). It is suggested that the researcher avoid using preconceived categories (Kondracki, Wellman, & Amundson, 2002), but the researcher should instead allow names and categories to emerge from the data (Hsieh & Shannon, 2005). This is described as development of an inductive category by Mayring (2000). Open-ended questions should be used if the data are primarily collected from interviews. In most of the cases, results of conventional content analysis are used for model building or concept development (Lindkvist, 1981).

3) Summative Content Analysis

The primary purpose of summative content analysis is to understand the contextual use of words or content by identifying particular words or content in a text. The aim is to explore the usage of words or content rather than inferring their meaning (Hsieh & Shannon, 2005). According to Potter and Levine-Donnerstein (1999), this type of content analysis is considered as manifest content analysis. If the researcher stops analyzing the appearance of specific words or content, the analysis would be considered quantitative because it focuses on counting the frequency of particular words or content (Kondracki et al., 2002). Summative content analysis goes beyond this kind of counting by considering the latent content analysis (Hsieh & Shannon, 2005).

One of the research questions for the present research is “What are root causes of success or failure of CBNRM in fishery resource conservation and poverty reduction?”. To answer this research question, the eight principles of Ostrom (1990) will be used. Therefore, directed content analysis will be used since the eight principles of Ostrom (1990) are assumed to be

predetermined codes that are based on existing theory. In addition, the answer to the research question involves the validation of the eight principles of Ostrom (1990).

7.2.2 Trustworthiness

Unlike quantitative analyses that test different assumptions to ensure that results from those methods are valid, qualitative content analyses generally require trustworthiness to ensure that results are valid and reliable. Trustworthiness of results from qualitative content analysis, including directed content analysis, depends on reliability and validity (Hsieh & Shannon, 2005).

1) Reliability

The procedure for classification must be reliable in terms of consistency by including other people who code the same text, in the same way, to make inferences valid (Weber, 1990). According to Weber (1990), the problem of reliability usually arises from unclear word meanings, different definitions of categories, or other discrepancies in rules of coding. Regarding this matter, Krippendorff (2004) warns the researcher who develops the coding scheme that he or she has often worked so closely on his or her research that he or she establishes hidden meanings for the codes. Therefore, to avoid reliability problems, one of the most important steps is to develop a set of explicit recoding instructions, allowing different coders to be trained until requirements for reliability are met.

There are two types of reliability: intra-rater (stability) and inter-rater (reproducibility). The former refers to whether the same coder can get the same results after coding many times. The latter refers to the extent to which different coders agree with one another (Stemler, 2001). One way to measure reliability is by measuring the percentage of agreement among coders. To measure it, the number of cases that are coded in the same way by different coders will be added up and then divided by the total number of cases. However, the problem with such measurement is that it does not consider that coders are expected to agree with one another by chance some

percentage of the time (Cohen, 1960). Using Cohen's Kappa can help avoid such a problem. According to Landis and Koch (1977), Cohen's Kappa varies from 0 to 1, where:

- 0 indicates that the agreement between the coders is equivalent to chance.
- 0.1-0.20 indicates slight agreement between the coders
- 0.21-0.40 indicates fair agreement between the coders
- 0.41-0.60 indicates moderate agreement between the coders
- 0.61-0.80 indicates substantial agreement between the coders
- 0.81-0.99 indicates near-perfect agreement between the coders

Cohen's Kappa for two coders is calculated as:

$$k = (p_a - p_c)/(1 - p_c),$$

where p_a is a proportion of units on which the coders agree with each other, and p_c is a proportion of units for which agreement between the coders is expected by chance.

There are three assumptions to be upheld when using Cohen's Kappa measurement (Cohen, 1960). The first assumption is that the unit of analysis must be independent, meaning that one code cannot be used for more than one unit of analysis. The second assumption is that the nominal scale categories have to be independent, mutually exclusive, and exhaustive. This means that each category on the scale has to be independent or mutually exclusive from the others. The third assumption is that the coders operate independently, meaning that the coders should not work together to come to a consensus about what rating they will give to each category.

It is worth mentioning that Cohen's Kappa is used when there are two coders, while Fleiss' Kappa, which is an extension of Cohen's Kappa, is used when there are three or more coders.

Cohen's Kappa assumes that the coders are chosen on purpose, while Fleiss' Kappa assumes that the coders are randomly chosen from a population of coders.

2) Validity

To validate inferences made based on data from one analytical approach, the researcher needs to use multiple sources of information. To validate results in qualitative research, the researcher needs to do triangulation by incorporating multiple sources of data, methods, investigators, or theories (Erlandson, Harris, Skipper, & Allen, 1993). To validate the results in the present research, different findings by other scholars have been used.

7.3 Data and Method of Analysis

7.3.1 Data

Data to be analyzed were derived from FGDs and key informant interviews in Chivieng community from March to May in 2014 and 2015[4]. There were ten participants in each FGD, and those participants for the survey in 2014 were different from those for the survey in 2015. The reason for choosing various participants in FGDs is to obtain new information as well as different perceptions from different people. There was no change in the key informants because they were the only ones in charge of the positions, and it was highly likely that no one could know better than them. FGDs and key informant interviews in 2015 were conducted not only to acquire more information and data for the present research that was not collected in the previous survey in 2014, but also to confirm if there was any change in the information from the previous survey in 2014.

Questions regarding the research question were more open-ended. Since it was highly unlikely that participants in FGDs and key informant interviews were knowledgeable of the principles of Ostrom, key words of those principles like the words "nested enterprises" were simplified.

[4] The survey in 2014 was the pilot survey, while the one in 2015 was the main survey.

7.3.2 Method of Analysis

To answer the research question, directed content analysis was used. The process of analyzing data followed the steps in the first strategy suggested in Hsieh and Shannon (2005) due to the nature of the research question, that is, validating or extending theory. According to Hsieh and Shannon (2005), there are two strategies for coding data depending on research objectives and data. If research aims at identifying and categorizing instances of a particular phenomenon, the researcher should use the first strategy by reading the transcript and highlighting all specific words or phrases that appear to represent data that the researcher is collecting. Next, the researcher should code all highlighted words or phrases using predetermined codes. Codes that are not predetermined codes should be given a new code. The second strategy is to begin coding immediately by using the predetermined codes. Regarding data that cannot be coded, the researcher should identify and analyze them later to determine if they represent a new category or subcategory of existing codes. If the researcher aims at ensuring that all possible occurrences of a phenomenon are captured, the first strategy should be used, which may increase trustworthiness. The second strategy can be used if the researcher is confident that his or her initial coding does not bias the relevant identification of the text.

Before following the steps in the first strategy of Hsieh and Shannon (2005), transcripts were translated into English. Next, each step was followed as suggested by the study mentioned above: 1) reading the translated transcript and highlighting all words and phrases related to the eight principles of Ostrom; 2) coding all those highlighted words and phrases by using the predetermined codes according to the principles; and 3) codes that were predetermined were given new codes. Table 7.1 shows the main questions for FGDs and key informant interviews to identify those eight principles and how effective those principles are. Theme, category, code, condensed meaning unit, and meaning unit derived from the transcripts are provided in Table 7.2.

Table 7.1: Main Questions for Identifying Ostrom's Principles and Effectiveness of the Principles

Ostrom's principles		Guiding questions
Clearly defined boundaries (Exclusion)	Users' right boundary	1. What do you think about the rights of local people in exploiting fishery resources and NTFPs? 2. Do only local people access fishery resources and NTFPs in your community? How about outsiders?
	Resource boundary	1. What do you think about the boundaries of the fishing ground in your community? 2. Do you have the rights to exercise your bylaws and internal regulations on rule violators?
Appropriate rules (Congruent)	Congruent between local conditions and rules in resource appropriation	1. What are the fishing rules and regulations do you think appropriate for current resource conditions in your community? 2. Which of those do you feel not suitable to practice in your community?
	Proportion of efforts to benefits	1. Do you think benefits from conservation are proportional to your efforts in conservation? 2. Why do or do you not think so?
Collective choice arrangement		If you attended the previous CBNRM meetings, what rules and regulations do you think the CBNRM committee and government officials have modified according to your or other local people's suggestions?
Graduated sanctions		According to your experience, how serious the sanctions are to fishers who repeatedly violate the laws comparing with those who just violated the laws for the first time?
Conflict resolution mechanism		1. What do you think about the solution dealing with the conflicts in fishing among the local fishers and between the local and outsiders? 2. How cost-effective are they?
Minimum rights recognition		1. How does the government support your community in terms of fishery resource conservation and poverty reduction? 2. To what extent do you think the government supports your community in those aspects?
Nested enterprises		1. How many stakeholders have involved in fishery conservation and poverty reduction in your community? 2. Who are those stakeholders? 3. How do you categorize them in terms of their positions?

Source: Author (2016)

Table 7.2: Theme, Category, Code, Condensed Meaning Unit, and Meaning Unit

Theme	Category	Code	Condensed Meaning Unit	Meaning Unit
Principle 1: Clearly defined boundaries	User rights	Rights to harvest resources for both local people and outsiders	Local people have rights in fishing and harvest NTFPs. Outsiders also have those right.	- We all can fish and harvest the NTFPs. - No one can ban us from fishing as long as we follow the laws. - We are free to fish and collect the NTFPs. - The authority has no rights to ban local people from harvesting fishery resources to if they obey the laws. - Not only use who fish and harvest the NTFPs, but also outsiders.
	Resource boundary	Clear boundaries between the fishing grounds and conservation areas, but no rights to enforce bylaws and internal regulations	Differentiation between the fishing grounds and conservation areas, but rights to enforce bylaws and internal regulations not in the hands of local people	- Our community has demarcated the fishing grounds from conservation areas. - We have known where the fishing grounds and conservation areas are. - The areas for fishing are different from the areas for conservation. It has the demarcation. - We have no right to enforce our bylaws and internal regulations on the rule violators. They are in the hands of government officials.
Principle 2: Appropriate rules	Appropriated bylaws and regulations	Appropriated bylaws and regulations	Bylaws and regulation designed for the conditions of resources in the community	- Bylaws and regulations on the number of fishing equipment are more suitable for the conditions of resources than the ones before. - Some fishing equipment is banned to use in the other communities, but here we can still use some of them. If not, we cannot catch the fish and survive. - They know that we cannot survive if we follow all the state fishery laws, so they have created other laws that are suitable for resources in our community.

Table 7.2: Theme, Category, Code, Condensed Meaning Unit, and Meaning Unit (Cont.)

Theme	Category	Code	Condensed Meaning Unit	Meaning Unit
Principle 2: Appropriate rules	Benefits not proportional to conservation efforts	Benefits not proportional to conservation efforts	Benefits from conservation not fairly distributed in the community	- Only some households in our community can earn from ecotourism, while they are not the only ones helping to conserve resources. - Most people cannot engage in ecotourism related jobs since they don't have enough resource to invest. Those people also engage in conservation-related activities.
Principle 3: Collective choice arrangement	Rule or regulation modification according to local people's suggestions	Changing the rules or regulations according to local people's suggestions	Some rules were adjusted according to their suggestions	- We did not agree with some state fishery laws, and they modified some of them for us like the number of fishing equipment. - We told them in the meeting that we could not pay the membership fee according to their suggestion. Although they still insisted us paying the fee, they have not punished us for not paying the fee.
Principle 4: Monitoring	The responsible patrollers for combatting illegal fishing	The responsible patrollers for combatting illegal fishing	Regular and active patrollers	- The patrollers regularly go to patrol the conservation areas. - The patrollers actively go to patrol both the conservation areas and fishing grounds
Principle 5: Graduated sanction	Different sanctions for different times of rule violations	More severe sanctions for fishers violate the rules again and again	Rule violators are punished according to how often they violate the rules	- Fishers violate the rules for the first time will not get sever punishment except from their second time onward. - We normally do not punish fishers using illegal fishing equipment for the first time because they may not know the rules, but we will punish them if they continue violating the same rules.

Table 7.2: Theme, Category, Code, Condensed Meaning Unit, and Meaning Unit (Cont.)

Theme	Category	Code	Condensed Meaning Unit	Meaning Unit
Principle 6: Conflict resolution mechanism	Low-cost effectiveness in conflict resolutions	Within group conflict resolution and compromise	Dealing the conflict among the groups before reporting to the higher-ranking people and comprising one another	- When there are conflicts in fishing between fishers both inside and outside the community, first we try to ask them to calm down and solve the conflicts without reporting to government officials. Usually, we can deal with conflicts among local people. - Local people usually don't have conflicts with government officials. But when they do, we find the underlying reasons for the conflicts and ask both parties to compromise.
Principle 7: Minimum rights recognition	Support from the government in fishery resource conservation and poverty reduction	Government's facilitation in fishery resource conservation and poverty reduction	Facilitating in fishery resource conservation activities and giving a chance to local people to earn from the ecotourism related jobs.	- The government supports us by facilitating conservation areas' establishment. They also support us by allowing us to establish ecotourism-related jobs without asking us for tax. - There are many government officials from different institutions involving in fishery resource conservation by combating illegal fishing although some of them have engaged in bribery. For poverty reduction, they have not done much, but at least they allow us to earn some money from ecotourism.
Principle 8: Nested Enterprise	Less involvement from government officials with local people in governing activities	Governing activities conducted only by government officials	Only government officials from different government institutions engaged in governing activities. No involvement from local people.	- Most of the governance activities for fishery resource conservation were only undertaken by government officials from different government institutions - They did not allow us to take part in activities like combatting illegal fishing. It seems they ignored our roles in those activities.

Source: FGDs and Key Informant Interviews in Chivieng community by Author (April 2015)

In principle, to have trustworthiness, it is required that qualitative content analysis has reliability and validity. To ensure reliability, one researcher was trained to code transcripts. Two coders, including the researcher, coded the transcripts a few times in a different period of time to ensure intra-rater reliability. To ensure inter-rater reliability, Cohen's Kappa was used. Cohen's Kappa statistic was 0.73, indicating that there was substantial agreement between the author as coder 1 and another researcher as coder 2. The reason for choosing Cohen's Kappa, not Fleiss' Kappa, is due to the following assumption of Fleiss' Kapper. It demands that the coders are randomly chosen from a population of coders. However, the coders need to have good knowledge on Ostrom's principles and CBNRM, which would be difficult to find among a random population. Thus, it is inapplicable for the present research to use Fleiss' Kapper.

Regarding validity, findings from the present research were compared with other studies that focused on the eight principles of Ostrom and the success of CBNRM in either conservation or poverty reduction.

7.4 Results and Discussion

7.4.1 Identification of Ostrom's Eight Principles

After coding multiple transcripts, the two coders substantially agreed that seven of eight principles suggested by Ostrom were observed in the CBNRM-implemented community, Chivieng community, except the eighth principle, that is, "nested enterprises". According to Ostrom (1990), "nested enterprises" refers to governance activities like appropriation and monitoring that are arranged in multiple layers of nested enterprises. From Ostrom's point of view, multiple layers of nested enterprises refers to the vertical level. This means that those governance activities should involve different levels of stakeholders from bottom to upper levels. However, in the case of Chivieng community, multiple layers of nested enterprises likely existed at the horizontal level as most of governance activities involved only government officials from different government institutions. A recently published report by the Food and

Agriculture Organization (FAO) finds that 13 community fisheries (CBNRM-implemented communities) in TSL, the Mekong River, and coastal areas of Cambodia applied most of the eight principles of Ostrom except the eighth principle, that is, nested enterprises. It also finds that there was no engagement of communities in governance activities. Only government officials worked in governance activities (Kurien, 2017).

7.4.2 Root Causes of CBNRM's Failures

The present research found that there were two common reasons why CBNRM failed to achieve its objectives in fishery resource conservation and poverty reduction except the indirect impact, that is, encouraging more migrants to exploit resources in the community due to the creation of conservation areas. The first common reason is weak enforceability of property rights to enforce bylaws and internal regulations and exclude outsiders from fishing inside the community boundary. The second common reason is ineffectiveness of the alternative source of income, that is, ecotourism, in terms of financial benefit distribution (see Chapters 5 and 6). However, these were not the root causes of CBNRM's failure. As to those reasons, the present research found that ineffective practices of the first and second of Ostrom's principles, and ineffective practice of the eighth principle, were the root causes of CBNRM's failures.

The first reason for failures of CBNRM to achieve fishery resource conservation and poverty reduction is associated with the ineffective practice of the first principle (clearly defined boundaries) and the eighth Ostrom's principle (nested enterprises). Since the first principle of Ostrom is quite complicated to understand in terms of weak enforceability of property rights (the right to enforce laws and exclude outsiders) in the present research, it is worth first explaining the details of this principle. The first principle of Ostrom, namely clearly defined boundaries, consists of two parts. The first part is related to clearly defined right that only members should be allowed to collect resources in the community. The second part is related to clearly defined resource boundaries. This means that members have the right to exercise their

bylaws and internal regulations on rule violators to manage resources effectively (Ostrom, 1990).

The sub-decree on community fisheries management states that non-members of the CBNRM also have the right to use fishery resources in the CBNRM-implemented community if they obey bylaws and internal regulations (RGC, 2005). However, according to FGDs, key informant interviews, and household interviews, so far, fishers from the outside have never asked any permission from the CBNRM committee when they fish inside the community although those fishers realize that they need the permission. The committee members cannot ban or do any law enforcement. They can only do patrolling, awareness-raising, and report to the government official if they witness any illegal fishing since according to the same sub-decree, local people cannot ban any illegal fishing or anyone violating their bylaws and internal regulations. They can only report illegal fishing to the nearest FiA and request for them to make an intervention (RGC, 2005). Three CBNRM committee members complained that they have established conservation areas as spawning grounds for fish and regularly go patrolling to combat illegal fishing in their community, but those activities seem to be useless. They could neither ban outsiders from fishing in their community nor arrest illegal fishers when they witnessed them during patrolling. All the power is in the hands of government officials. This complaint is also supported by other scholars like Jones and Sok (2015) and Thol and Sato (2015) who claim that the government fails to empower local people to punish illegal fishers, and only government officials have the power to enforce the laws. As a result, local people cannot manage fishery resources effectively in the TSL area. Hanna, Folke, and Mäler (1995) claim that the clearly defined boundaries are essential for successful resource management, but they also add that nested enterprises are important to make the clearly defined boundaries work effectively.

The root cause of the ineffective alternative source of income is highly likely to be associated with the second principle of Ostrom, namely appropriate rules. This principle covers two key aspects. The first aspect is that there is congruence between local conditions and rules in resource appropriation and provision. The second aspect is that benefits obtained by local people must be proportional to their efforts (Ostrom, 1990). It is worth recalling that in the context of benefit sharing from fishery resource conservation, that is, ecotourism, in Chivieng community, only 3% of local people could earn income from the ecotourism-related jobs, and the earnings were not significant for their livelihoods. They could earn 100 US dollars and only in the peak season lasting from October to December. Only a small number of local people could earn income from their efforts in fishery resource conservation with few benefits. Therefore, local people in Chivieng community did not get sufficient reward for their efforts in fishery resource conservation. Three of the participants in FGDs similarly claimed that most of local people, including them, lost motivation to be engaged in CBNRM-related activities to conserve fishery resources because they could not get any benefits from those activities. It seems that they were the ones who worked while others reaped the benefits. Similarly, other studies find that the second principle of Ostrom plays a significant role in successful natural resource management in terms of conservation and poverty reduction. For example, Klooster (2000) finds that seven communities in Mexico successfully managed logging activities and improved local people's livelihoods by fair and significant distribution of benefits derived from logging among local people who had made an effort to manage forest resources. Each community member received 2,500 pesos (690 US dollars) and other benefits from public infrastructure derived from logging.

7.5 Conclusion

The present research found that seven of eight principles of Ostrom were observed to apply in Chieving community, except nested enterprises. Unlike nested enterprises proposed by

Ostrom that focus on the vertical linkage between different stakeholders from lower to upper levels, in Chivieng community, it was likely a horizontal linkage among government officials from different institutions with less involvement of local people. Moreover, it was found that the root causes of CBNRM's failure in fishery resource conservation and poverty reduction are ineffective practices of the first principle (clearly defined boundaries), the second principle (appropriate rules), and the eighth principle (nested enterprises) of Ostrom (1990).

To improve the performance of CBNRM in terms of fishery resource conservation and poverty reduction in the TSL area, the first and second principles of Ostrom should be implemented more effectively by applying the eighth principle of Ostrom, that is, more involvement of local people (represented by the CBNRM committee) in governance activities. The eighth principle of Ostrom can be introduced to CBNRM-implemented communities in the TSL area by granting the right to local people (represented by the CBNRM committee) to ban and punish fishers from the outside who do not ask permission to fish inside the community or fish illegally.

Chapter 8: Determinants of Local People's Trade-Off Perception between Fishery Resource Conservation and Poverty Reduction

This chapter will answer the fourth research question: "What are the determinants of local people's perception of the trade-off between fishery resource conservation and poverty reduction?" by using local people's perception of the effects of CBNRM on fishery resource conservation and poverty reduction. The PO model will be used to analyze data. This chapter will start with the Introduction section, which introduces the background of the research question and will be followed the Methods for Ordinal Dependent Variable section. This section will review different kinds of methods used for ordinal dependent variable and explain the reason why the PO model is used. Then, there will be the Data and Method Analysis section, followed by the Results and Discussion section. Lastly, there will be the Conclusion section for the chapter.

8.1 Introduction

Chapters 5 and 6 examined the effects of CBNRM on fishery resource conservation and poverty reduction, respectively. Subsequently, Chapter 7 examined the root causes of failures of CBNRM in fishery resource conservation and poverty reduction. Although Chapters 5 and 6 are sufficient for evaluating the effects of CBNRM on fishery resource conservation and poverty reduction, they do not inform us how local people in the CBNRM-implemented community, that is, Chivieng community, actually perceive the effects of CBNRM on both fishery resource conservation and poverty reduction. Results from Chapters 5 and 6 revealed that CBNRM had negative effects on fishery resource conservation and poverty reduction. However, this does not mean that all local people perceived the situation in the same way because the approach used for Chapters 5 and 6 is an objective one. Some people may perceive that CBNRM can achieve both fishery resource conservation and poverty reduction, while

others may perceive that CBNRM can only achieve one of these outcomes. Some people may perceive that CBNRM cannot achieve both outcomes. Perception of local people is significant for the success of project or program implementation. If local people do not feel positive towards the project or program, it is difficult for it to be successfully implemented (Allendorf et al., 2012). Therefore, it is vital to use the subjective approach in the present research to find out their perception regarding CBNRM.

Although theoretically, CBNRM promises to achieve both objectives simultaneously, that is, conservation and poverty reduction, some scholars oppose this idea and claim that it is rhetoric in the real world (Redford et al., 2006). McShane and Wells (2004) suggest that there is the trade-off between the two. Acknowledgement of the trade-off is very important because it can: 1) make the stakeholders well informed of the ultimate impact of a project or program, not just the distinct impact of conservation and poverty reduction; 2) increase the number of studies about the trade-off between conservation and poverty reduction so that knowledge of the trade-off between the two can be broadened; 3) improve trust in a project or program implementation (McShane et al., 2010); 4) improve effectiveness of a project or program implementation (Brechin et al., 2003; Hirsch et al., 2011); and 5) help to make progress toward achieving conservation and poverty reduction (Hirsch et al. 2011).

Ostrom (1990) suggests eight principles to make resource management regimes successful, including CBNRM. Those principles include clearly defined boundaries (exclusion), appropriate rules, collective-choice arrangements, monitoring, graduated sanctions, conflict-resolution mechanisms, minimum recognition of rights by external government officials, and nested enterprises. Those principles were formulated on the assumption that a community is rarely isolated and heterogeneous, which is not the case in the real world. Another assumption of those principles is that resource users are rational, and repeated benefits of cooperation facilitated with enforcement will weed out “rational egotists” and increase the efficiency of

institutional arrangements (Ostrom, 2000). However, this assumption does not work since resource users do not always make a decision based on being rational, and their decision is influenced by many other factors such as social and political factors (Saunders, 2014). Some scholars like Pagdee, Kim, and Daugherty (2006) use those principles explicitly or implicitly to explain the success of a resource management regime without acknowledging the flaws in the assumptions of those principles. Moreover, those scholars used such principles to assess the success in either conservation or poverty reduction but not both of them or the trade-off between the two. It is worth mentioning that success in only one objective cannot determine success of a resource management regime. For instance, the livelihoods of local people may not have improved significantly although fishery resource conditions have improved, which is due to restrictive regulations established to improve fishery resource conditions. Hence, it is likely that using Ostrom's eight principles to assess only one side of success is insufficient to prove that a resource management regime is successful. Moreover, although Ostrom's eight principles are considered by many scholars as a comprehensive guideline for successful resource management, there is also a debate that some of those principles are inapplicable in the real world (Cleaver, 1999), and some of them are not supported by empirical literature (Cox et al. 2010). The eight principles of Ostrom (1990) are derived from successful cases in resource management in which local people cooperated well.

Furthermore, most of the previous studies focused only on the macro level such as the country level by using secondary data. Although it is true that we can generalize from the results of those studies, it is likely that those results are from the perception of the studies' authors rather than local people's, whose perception is vital for the success of a project or program because it can affect their participation and support for it (Allendorf et al., 2012). Therefore, it is vital to examine determinants of successful resource management from the perception of local people rather than from that of a study's authors.

To acknowledge that impact evaluation cannot be successfully completed without taking into account the perception of local people and to overcome the shortcomings of the previous studies mentioned above, this chapter focuses on determinants of the trade-off between fishery resource conservation and poverty reduction in CBNRM by using the perception of local people. Therefore, the present research will contribute more to the ongoing debate by using the principles of Ostrom as determinants of the trade-off between fishery resource conservation and poverty reduction from the perception of local people. Chivieng community, that is, a CBNRM-implemented community, located in a TSL area was used as a case study.

The chapter is arranged as follows. Section 8.2 describes the details of the research method used for ordinal response variables and explains why the PO model is appropriate for answering this research question. Sections 8.3, 8.4, and 8.5 describe the data and method needed in the analysis, results and discussion, and conclusion, respectively.

8.2 Methods for Ordinal Dependent Variable

The binary logistic model is usually used to test the association between a dependent variable and a number of independent variables. OLR is an extension of the binary logistic model. OLR is used to predict the dependent variable having more than two categories with a group of independent variables. There are three types of OLR models that are well known for analyzing the ordinal dependent variable. Those are PO, continuation ratio logic (CRL), and adjacent category logic (ACL) models. Below is a brief description of each of these models.

8.2.1 Proportional Odds (PO) Model

The PO model is commonly used in social science and is the most well-known type[1]. Each association is estimated in terms of an odds ratio. The PO model can be used for: 1) measuring a dependent variable that is on an ordinal scale where the scale from one rank to another is not

[1] In many journal articles, particularly in social science, the word "ordinal logistic regression" normally refers to the proportional odds model.

the same; 2) predicting an ordinal dependent variable when there are one or more independent variables; and 3) determining which independent variable(s) has a statistically significant impact on the ordinal dependent variable (Long & Cheng, 2004). In addition, the PO model takes into account ordering categories of the dependent variable. Moreover, in terms of the relationship between dependent and independent variables, the conclusion is not affected by the category of dependent variable. A particular combination of categories that are examined does not lead to any difference in conclusions of the relationship between the dependent and independent variables (Agresti, 2002).

According to Agresti (2002), supposing that T has K categories, and the probability for category k is given by $P\ (T = k) = \ \pi_k$ for $k = 1, \dots, K$. T also has z independent variables, that is, $x_1, \dots, x_z$. In some cases, there may be T a latent continuous variable for which cut points $C_1, \dots, C_{k-1}$ define K ordinal categories with their associated probabilities $\pi_1, \dots, \pi_K$ (with $\Sigma_k^K = 1\ \pi_k = 1$). A cumulative probability for T is the probability that T is at or below a particular point. For the dependent variable that is an outcome category k, the cumulative probability is $P(T \leq k) = \pi_1 + \cdots \pi_k, k = 1, \dots K$, where $P(T \leq 1) \leq P(T \leq 2) \dots \leq P(T \leq K) = 1$. The logits of the cumulative probabilities are called cumulative logit. The logits of the cumulative probabilities are written as:

$$logit[P\ (T \leq k)] = ln\left[\frac{P(T \leq k)}{1 - P(T \leq k)}\right] = ln\left[\frac{\pi_1 + \cdots + \pi_k}{\pi_{k+1} + \cdots + \pi_K}\right], k = 1, \dots, K - 1. \quad (8.1.1)$$

The cumulative logit model is written as:

$$logit\ [P(T \leq k)] = ln\left[\frac{\pi_1 + \cdots \pi_k}{\pi_{k+1} + \cdots + \pi_K}\right] = \alpha_k + \beta_{k1}x_1 + \cdots + \beta_{kz}x_z, \quad k = 1, \dots, K - 1. \quad (8.1.2)$$

In the case that intercepts α_k is dependent on the category k, but the other regression coefficients for independent variables ($\beta_1 \dots \beta_z$) are not dependent on k, then the model is written as:

$$ln\left[\frac{\pi_1+\cdots+\pi_k}{\pi_{k+1}+\cdots+\pi_k}\right] = \alpha_k + \beta_1 x_1 + \cdots + \beta_z, \quad k = 1, \dots, K-1. \qquad (8.1.3)$$

This is called the PO model. It is the most used type of OLR because it can be simply interpreted. However, the PO model has an assumption about the nature of relationship between the dependent and independent variables. It assumes that $x_1, \dots, x_z$are the same for all categories on a logarithmic scale. This assumption is called the PO assumption or parallel lines assumption. If this assumption is not upheld, the result of OLR can be misleading or have no meaning at all. This assumption must be tested for each independent variable separately and in the final model by using the Brant and Likelihood Ratio tests. In the case that the PO model fits well, to describe the effect of x_z, it requires a single parameter for x_z rather than $K-1$ parameters.

However, if the PO model does not fit well, the partial PO model is an alternative. This model allows some of the independent variables with PO assumption to be modeled. However, for independent variables failing to uphold the assumption, they are augmented by a coefficient (γ), which is the effect associated with each $k'th$ cumulative logic, adjusted by the other independent variables. Moreover, in the partial PO model, some of the coefficients can be the same for all the categories, while the rest of coefficients can be different.

Using cumulative probabilities is not the only option for analyzing models for the ordinal dependent variable. There are two alternative logit models that resemble OLR. Below is a description of those models.

8.2.2 Continuation Ratio Logits (CRL) Model

It is useful to use the CRL model when a sequential mechanism like survival through various age periods determines the ordinal dependent variable (e.g., Tutz, 1991). Moreover, it is preferable to use when we have an intrinsic interest in a particular category of the dependent variable, and not for the sake of an arbitrary grouping of a continuous variable.

The CRL model are written as

$$log\frac{\pi_k}{\pi_{k+1}+\cdots+\pi_K}, \quad k = 1, \dots, K-1, \tag{8.1.4}$$

or as

$$log\frac{\pi_{k+1}}{\pi_1+\pi_k}, \quad k = 1, \dots, K-1. \tag{8.1.5}$$

Let $\omega_k = P(T = k|T \geq k)$. With independent variables,

$$\omega_k(X) = \frac{\pi_k(X)}{\pi_k(X)+\cdots+\pi_K(X)}, \quad k = 1, \dots, K-1. \tag{8.1.6}$$

The CRL model (8.1.4) are ordinary logits of conditional probabilities called $log[\omega_k(X)/(1-\omega_k(X))]$.

At the zth setting X_z of X, let $\{t_{zk}, k = 1, \dots, K\}$ denote response counts of dependent variable, with $m_z = \sum_k t_{zk}$. t_{zk} indicates if the dependent variable is in category k when $m_z = 1$. Let $b\ (m, y; \omega)$ denotes the binomial probability of t success in m trials with parameter ω for each trial. If the multinomial probability is expressed by $(t_{z1}, \dots, t_{zK})$ in the form $p(t_{z1})p(t_{z2}|t_{z1}) \dots p\left(t_{zK}\middle|t_{z1}, \dots, t_{z,K-1}\right)$, the multinomial mass function has factorization that can be shown as follows:

$$b[m_z, t_{z1}; \omega_1(X_z)]\, b\,[m_z - t_{z1}, t_{z2};\ \omega_2(X_z)] \ldots b\big[m_z - t_{z1} - \cdots - t_{z,K-2}, t_{z,K-1};\ \omega_{K-1}(X_z)\big]. \quad (8.1.7)$$

Multinomial mass functions from different X_z values produce the full likelihood. Therefore, log likelihood is a sum of terms that various ω_k enter into various terms. To maximize each term separately will maximize the full log likelihood when parameters in the model specification for logit (ω_k) are different from those for logit (ω_j) whenever $k \neq j$. Therefore, the results are the same for simultaneous fitting when separate fitting of models for various CRL. An overall goodness of fit statistic is related to the simultaneous fitting of $K-1$ models that is provided by the sum of $K-1$ that separates G^2 statistics. Separate fitting can be used with methods for binary logit models because these logits are a binary response that one category combines levels of the original scale. This also applies to CRL in 8.1.5 even though those logits and the subsequent analyses do not provide the same results.

8.2.3 Adjacent Categories Logits (ACL) Model

The ACL model is

$$logit[P(T = k|T = k\ or\ k+1] = log\frac{\pi_k}{\pi_{k+1}}, \quad k = 1, \ldots, K-1. \quad (8.1.8)$$

These logits are a basic set equivalent to baseline category logits, and the connections are

$$log\frac{\pi_k}{\pi_K} = log\frac{\pi_k}{\pi_{k+1}} + log\frac{\pi_{k+1}}{\pi_{k+2}} + \cdots + log\frac{\pi_{K-1}}{\pi_K}, \quad (8.1.9)$$

and

$$log\frac{\pi_k}{\pi_{k+1}} = log\frac{\pi_k}{\pi_K} - log\frac{\pi_{k+1}}{\pi_K}, \quad k = 1, \ldots, K-1. \quad (8.2.1)$$

Either equation determines logits for all $\binom{K}{2}$ pairs of categories of the dependent variable.

Models that use ACL can be written as baseline category logit models. For example, consider the ACL model

$$log\frac{\pi_k(X)}{\pi_{k+1}(X)} = \alpha_k + \beta' X, \quad k = 1, \dots, K-1, \tag{8.2.2}$$

with common effect β. From adding $(K-k)$ terms, the equivalent baseline category logit model is

$$\begin{aligned} log\frac{\pi_k(X)}{\pi_{k+1}(X)} &= \sum_{j=k}^{K-1} \alpha_j + \beta'(K-k)\, X, k = 1, \dots, K-1 \\ &= \alpha_k^* + \beta' u_k, \qquad k = 1, \dots, K-1, \end{aligned}$$

with $u_k = (K-k)X$. The ACL model corresponds to a baseline category logit model with adjusted model matrix. Furthermore, it corresponds to a single parameter for the predictors. Order of T categories is recognized by the construction of the ACL model. It requires appropriate specification of a linear predictor to benefit from this in the model parsimony. For instance, if an effect from an independent variable is similar for each logit, the benefits can be obtained from having a single parameter instead of $(K-1)$ parameters that describe that effect. When it is used with the PO form, the model (8.2.2) with the ACL model will fit well in a similar condition as model (8.1.2) with the cumulative logits. Both models imply stochastically ordered distributions for T at values of various predictors.

8.2.4 Which Model to Use?

Use of each type of model depends on the purpose of analysis. It is suggested that the researcher may find it hard to choose between the PO and ACL models or between the PO and CRL models. Below are the reasons for how to choose between the models.

1) PO Model vs. ACL Model

It is recommended that the choice of model, that is, the PO or ACL models, depends more on whether effects are from each category of the dependent variable (provided by cumulative logits of the PO model) prefer to those of the goodness of fit (provided by the ACL model). Because cumulative logit models' effects refer to the whole scale, they are usually larger. However, the ratio of the estimate to standard error is usually similar for both models. A benefit of using the cumulative logit model is that it has the number of categories of the dependent variable and the approximate invariance of effect estimates to the choice (Agresti, 2002). To put it in another way, both the PO and ACL models tend to fit or not fit for a particular set of data. However, the latter is used if one prefers to know effects on individual categories of the dependent variable, and it depends on the distance between those categories, meaning that this model recognizes the ordering of scales' categories of the independent variable. The former model is used if one would like to use the entire scale for each logit, likely leading to larger effects for PO because the entire scale is used or hypothesizes an underlying continuous latent variable. An advantage of the PO model is that it is not affected by choice and the number of categories of the dependent variable.

2) PO Model vs. CRL Model

To estimate the cumulative probability of being at or below a specific level of the dependent variable or its complementary, that is, the probability of being beyond a particular level, it is better to use the PO model than the CRL model. However, if the research interest is in a particular category rather than being at or below that category, on the condition that an

individual has to pass through a lower category before moving to a higher category, the CRL model is preferred to the PO model (Hardin, Hilbe, & Hilbe, 2007; Long & Freese, 2001). To put in another way, the CRL model is used when the individual needs to achieve the lower level before reaching to a higher stage like educational attainment or job advancement (Liu, 2010). To answer the research question, the PO model was used to analyze data.

8.3 Data and Method of Analysis

8.3.1 Data

Initially, the total number of interviewed households was 232 in Chivieng community. However, since answers from some households were not reliable, and some households did not actively participate in CBNRM-related activities one year before the survey, the number of sample households for data analysis for this research objective was 188. The dependent variable is the perception of the trade-off between fishery resource conservation and poverty reduction in CBNRM. Since the number of sample households that perceived either a win-lose or lose-win level was so small, these two levels were combined and named as win-lose and *vice versa*.

As shown in Table 8.1, the first group of questions (Questions 1 to 4) were aimed at understanding the effect of CBNRM on fishery resource conservation. The second group of questions (Questions 5 to 8) were aimed at understanding the effect of CBNRM on poverty reduction. The third group of questions (Questions 9 to 12) were aimed at checking the consistency of answers of respondents to the previous questions (Questions 1 to 8). Additionally, they were used to decide which level of the trade-offs between fishery resource conservation and poverty reduction those respondents perceived. Additional notes were written down during the interviews when the respondents provided any extra information related to the effects of CBNRM on fishery resource conservation and poverty reduction.

Table 8.1: Questions and Measurements for Dependent Variable

Aims	Questions	Measurement
Fishery resource conservation	1. Do you think those conservation areas are efficient to conserve fishery resources? 2. Why do you think so?* 3. Do you think the patrolling conducted by the local patrollers are useful to reduce illegal fishing? 4. Why do you think so?*	No = 0, Yes = 1
Poverty reduction	5. Have your livelihoods improved after CBNRM implementation? 6. Why do you think so?* 7. Do you think the conservation areas established by CBNRM committee have affected your livelihoods or fishing? 8. Why do you think so?*	No = 0, Yes = 1
Consistency checking & level of trade-off	9. Do you think CBNRM has improved both your livelihoods and fishery resource conservation 10. Why do you think so?*	No = 0, Yes = 1
	(If the answer for Question 9 is No) 11. Between livelihoods and fishery resource conservation, which one do you think CBNRM has helped to improve? 12. Why do you think so?*	1. Livelihoods only 2. Conservation only 3. Neither livelihoods nor conservation

Note: * The Why question was asked to know the reason(s) making the respondent answer the previous question.

Source: Author (2016)

Table 8.2 shows definitions and measurements of independent variables. Independent variables were divided into two groups: HH's socioeconomic characteristics and CBNRM members' perception of elements included in Ostrom's eight principles. Main variables are perceptions of the elements included in Ostrom's eight principles. However, some HH's socioeconomic characteristics like HH education level, HH age, HH occupation, and experience that the respondents had in the previous management may somehow affect his or her perception. To control and find out if any of those characteristics affect the perception, those variables were included in the model.

Table 8.2: Definitions and Measurements of Some of Independent Variables

Variables*	Definitions	Measurements
Experience with the previous management (Exp)	If the household head has had positive experiences in the previous management before CBNRM implementation	No =0, Yes =1
Exclusion (Exc)	If the respondent thinks that he has clearly defined rights to fish or harvest resources	No =0, Yes =1
Appropriate rules (Rul)	If the respondent thinks the fishing rules and regulations are suitable for current resource condition	No =0, Yes =1
Collective choice arrangement (Col)	If the respondent could modify any fishing rule or regulation during previous CBNRM meetings	No =0, Yes =1
Monitors (Mon)	If the respondent thinks the patrollers or monitors are responsible for their work in terms of combatting illegal fishing	No =0, Yes =1
Graduated sanctions (San)	If the respondent thinks that illegal fishermen have been punished according to seriousness of violations	No =0, Yes =1
Conflict-resolution mechanisms (Con)	If there is any low-cost conflict resolution mechanism for the conflicts related to fishing	No =0, Yes =1
Minimum rights' recognition from the external government officials (Rec)	If the respondent thinks the government effectively support their community in conservation and livelihood improvement	No =0, Yes =1
Nested enterprises (Nes)	If the respondent thinks that there are different stakeholders involving in conservation and livelihood improvement in their community	No =0, Yes =1

Note: * Variables on community and resource boundaries were excluded from the analysis as 99% of the respondents said that their community had clearly defined boundaries for both.

Source: Author (2016)

8.3.2 Method of Analysis

The PO model was used to examine determinants of perception of local people on the trade-off in Chivieng community, CBNRM-implemented community. However, the PO model is not the only model that can be used when the dependent variable has more than two categories. It is warranted to describe other models and reasons the PO model was chosen to use in the present research.

The PO model was used because: 1) the dependent variable in the model is ordinal; 2) each level of the dependent variable, that is, the level of perception, is not the same; 3) the present

research pays more attention to estimation of the probability of being at, below, and beyond one level of the perception of the trade-off; and 4) local people do not need to perceive a specific level of the trade-off, for example, they do not need to perceive the loss in fishery resource conservation and poverty reduction before perceiving gains in the two. Based on these reasons, the PO model is preferred to the ACL and CRL models.

Below is the empirical model of the PO model used in the present research.

The empirical model used in the present research is expressed as follows:

$$t_i = \alpha + \beta_1 x_1 + \beta_2 x_2 + \varepsilon,$$

where t_i is the dependent variable representing the level of the perception of the trade-off in CBNRM. x_1 is a set of household socioeconomic characteristics, and x_2 is the perception of household regarding Ostrom's eight principles. β is the coefficient of the regression interpreted as log odds, and ε_i is an error term.

In the PO model, there are three necessary steps to run the model. The first step is that the model fits well with each independent variable before it fits well with all the independent variable (Long & Freese, 2001). The second step is that models for each independent variable, including the omnibus model (full model), meet the PO assumption. It assumes that the distance between each category of the dependent variable is proportional. There are two types of tests that can be used to test this assumption: The Brant Wald and likelihood ratio tests. The assumption is not violated if Chi-square of the tests is not significant (Long & Cheng, 2004; Long & Freese, 2001). The third step is that the post estimation tests needs to be run (by using Stata subcommands, fit statistics (FITSTAT and LISTCOEF). This step is conducted to know if the models better fit than the null model without independent variable and know the odds of

being at or beyond a specific category, and AIC and BIC of the fit statistics are used for comparison of the model fit (Long & Freese, 2001).

8.4 Results and Discussion

8.4.1 Descriptive Statistics and Assumptions of PO Model

Table 8.3 describes descriptive statistics of the variables used in the PO model.

Table 8.3: Descriptive Statistics of Variables Used in PO Model

Independent variables		Dependent variable (Trade-off perception)			Frequency
		Win-win (38)	Win-lose & vice versa (56)	Lose-lose (94)	
Age (Years old)	20-35	7	11	14	32
	36-51	18	16	39	73
	52-68	13	29	41	83
Education (Grades)	0	21	30	57	108
	1-6	16	22	28	66
	7-12	1	4	9	14
Occupation (Fisherman)	Main	2	0	1	3
	Secondary	36	56	93	185
Exp	No	33	45	75	153
	Yes	5	11	19	35
Exc	No	17	15	6	38
	Yes	21	41	88	150
Rul	No	2	2	1	5
	Yes	36	54	93	183
Col	No	18	36	60	114
	Yes	20	20	34	74
Mon	No	14	6	4	24
	Yes	24	50	90	164
San	No	23	40	69	132
	Yes	15	16	25	56
Con	No	1	7	3	11
	Yes	37	49	91	177
Rec	No	22	21	29	72
	Yes	16	35	65	116
Nes	No	13	26	43	82
	Yes	25	30	51	106

Note: Age and education variables are continuous. The rest of the variables are dummy (1/0).

Source: Author (2016)

As Table 8.3 shows, the number of households in "lose-lose" level is much more than that in the other levels. Therefore, it can be inferred that most households in Chivieng community felt that CBNRM did not contribute to both fishery resource conservation and poverty reduction.

Table 8.4: PO's Results for Each Independent Variable and Full Model

Variable	PO's result			Tests for PO assumption				Post estimation tests		
	LR x^2	Prob> x^2	Pseudo R^2	Brant test		Likelihood ratio test		Listcoef[1)]	Fit statistics	
				x^2	P>x^2	x^2	Prob>x^2	e^b	AIC[2)]	BIC[3)]
Age	2.29	0.06	0.00	2.86	0.09	2.85	0.09	1.16	403.98	423.77
Education	2.01	0.03	0.00	1.37	0.54	0.42	0.52	0.98	404.27	424.06
Occupation	2.37	0.049	0.00	6.88	0.35	0.58	0.45	0.95	403.91	416.7
Exp	3.22	0.041	0.006	0.32	0.57	0.35	0.55	1.17	398.85	418.59
Exc	28.65	0.00	0.07	0.54	0.46	0.59	0.44	0.161	375.62	485.41
Rul	2.96	0.016	0.005	0.13	0.72	0.15	0.7	0.32	402.32	422.1
Col	2.81	0.02	0.005	1.63	0.2	1.62	0. 2	0.69	402.47	422.2
Mon	22.64	0.002	0.057	2.25	0.133	2.16	0.142	0.26	378.42	488.19
San	23.19	0.014	0.055	0.86	0.35	0.83	0.36	0.643	402.09	421.88
Con	2.24	0.026	0.0031	2.45	0.118	3.48	0.06	0.57	403.04	422.87
Rec	7.95	0.005	0.02	1.69	0.194	1.71	0.19	0.451	396.32	416.11
Nes	1.46	0.049	0.003	0.74	0.39	0.77	0.38	0.831	403.82	423.61
Omnibus model	47.69	0.00	0.12	18.15	0.11	19.56	0.17	See in Appendix	370.19	415.58

Notes:
1) The odds of being at or beyond a particular category.
2) and 3) Although the odds of being at or beyond a particular category of each independent variable are different in omnibus model, there is no different between the values of AIC and BIC in the models for each independent variable and those in the omnibus model

Source: Author (2016)

To ensure that the results from the PO model are valid, the assumptions of the PO model needs to be upheld. In order to run the PO model, there are three necessary steps. First, the model needs to fit well with each independent variable before it fits well with all independent variables (Long & Fress, 2001). There are twelve independent variables in the model. Therefore, there should be twelve PO models.

Table 8.4 shows the results of the PO for each independent variable. As Table 8.4 shows, all the p-values of each independent variable are significant. Their p-values are less than 0.05,

indicating that each independent variable has a significant relationship with the dependent variable. Hence, the first assumption is upheld.

The second step is the models of each independent variable including the omnibus model meet the PO assumption. The PO assumption assumes that the distance between each category of the dependent variable is proportional. In Table 8.4, the results of the Brant Wald and likelihood ratio tests were insignificant since the p-values of the Brant Wald and likelihood ratio tests are higher than 0.05. Therefore, the PO assumption is met.

The third step is the post estimation tests need to be run in order to know if the models better fit than the null model without the independent variable and knowing the odds of being at or beyond a specific category, and AIC and BIC of the fit statistics are used for comparison of the model fit (Long & Freese, 2001). In Table 8.4, values of AIC and BIC of the omnibus model were lower than those of the models of each independent variable, indicating that the omnibus model fits the data better than the models of each independent variable.

8.4.2 Empirical Findings and Discussion

Table 8.5 shows the results from the PO model. Most of the independent variables, except nested enterprises variable, positively affected the perception of the trade-off between fishery resource conservation and poverty reduction. However, only three out of the eight principles of Ostrom were significant determinants of the perception of the trade-off. Those variables include exclusion, monitoring, and nested enterprises.

Table 8.5: Determinants of Trade-Off Perception

Number of observations = 188
LR chi2 (12) = 47.69
Prob> chi2 = 0.0000
Pseudo R2 = 0.1223

Independent variable	Trade-off perception	
	Co-efficiency	Standard error
Age	0.2	0.3
Education	0.39	0.27
Occupation	0.3	0.11
Exp	0.07	0.39
Exc	1.51***	0.41
Rul	0.52	0.92
Col	0.2	0.36
Mon	1.39***	0.4
San	0.09	0.61
Con	0.31	0.56
Rec	0.04	0.62
Nes	-0.63*	0.37
Cut 1	2.86	0.61
Cut 2	1.14	0.51
Brant Wald test	Chi2 (12): 18.15; P> Chi2: 0.11	
Likelihood ratio test	Chi2 (12): 19.56; Prob> Chi2: 0.17	

Note: Significance level: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author (2016)

Exclusion was a significant determinant for the perception of the trade-off in CBNRM. This finding was similar to other previous studies like Ostrom (1990) and Pinkerton and Weinstein (1995), but the explanation for this finding is quite different from those studies' explanations. In the context of Chivieng community, this community indeed had its clearly defined boundaries for their resources and community. However, in reality, the local fishers and those from the outside did not focus on the boundaries. The reason is they thought that fish could move everywhere, and it was not practical for them to fish only in a specific fishing ground. Hence, a likely explanation for this finding is that the clearly defined right to withdraw

resources for local people in Chivieng community refers to the fairness that everyone could go fishing in various fishing grounds regardless of the boundaries. Cleaver (1999) also mentions a similar scenario where local people could have ad hoc negotiation with one another to access resources.

Moreover, monitoring is another significantly positive determinant for the perception of the trade-off in CBNRM. This finding mirrored that of Ostrom (1990). The patrollers were local people in Chivieng community, and they were active in patrolling. Therefore, this determinant was positive. In the context of Chivieng community, the patrollers had no right to arrest or punish the illegal fishers. However, approximately 85% of household respondents reported that the patrolling activities could at least reduce some illegal fishing, which was much more effective than government officials.

The nested enterprises variable is in conflict with most of the previous studies' findings such as the findings from Cox et al. (2010) due to its negative sign. In the context of Chivieng community, the nested enterprises variable did not refer to a vertical linkage among local people and government officials as referred by Ostrom (1990). However, it refers to a horizontal linkage among government officials themselves. There are many government officials from different government institutions, and their duties and responsibilities overlap with one another and are unclear. Consequently, some of them seek rent from fishers, and are negligent in their duties and responsibilities, causing more illegal fishing (Thol & Sato, 2014). Therefore, there is no doubt that the nested enterprises were perceived by local people as a negative determinant of the perception of the trade-off between fishery resource conservation and poverty reduction.

8.5 Conclusion

This chapter found that seven out of eight principles of Ostrom (1990) were positive determinants of the perception of the trade-off in CBNRM except the nested enterprises

principle. Among the seven principles that were found as positive determines, exclusion and monitoring were the two principles that were significantly positive.

The negative finding of the nested enterprises principle suggests that a large number of different stakeholders in resource management is insufficient to manage resources successfully if their roles are ineffective. This means that not only the number of various stakeholders is important, but the effectiveness of their roles is also important to manage resources successfully. To make their roles more effective, their duties and responsibilities in resource management should be clear cut.

Chapter 9: Conclusion

The present research aims at answering four research questions. Those research questions are: 1) Does CBNRM have a positive effect on fishery resource conservation? 2) Does CBNRM have a positive effect on poverty reduction? 3) What are root causes of success or failure of CBNRM in fishery resource conservation and poverty reduction? and 4) What are the determinants of local people's perception of the trade-off between fishery resource conservation and poverty reduction? This chapter will summarize answers to these four research questions, suggest policy implications in the context of fishery policy in Cambodia, and explain the academic contribution of the present research.

9.1 Key Findings

9.1.1 Effect of CBNRM on Fishery Resource Conservation Behavior

PSM was used to analyze the effect of CBNRM on conservation behavior of all fishing households and that of those fishing only inside the community boundary. Since the results from PSM are the same for both groups (all fishing households and those fishing only inside the community boundary), the key findings for both groups will be summarized in the same section.

The results from PSM revealed that conservation behavior of all fishing households and that of those fishing only inside the community boundary in Preak Sromoach community was two scores higher than that of those two groups in Chivieng community. Therefore, this indicates that CBNRM had a negative effect on conservation behavior of households in Chivieng community. Three reasons that may explain the negative effect of CBNRM on fishery resource conservation in Chivieng community. Those reasons include: 1) more migrants are motivated to exploit fishery resources in the community due to creation of conservation areas, 2) weak enforceability of property rights to enforce bylaws and internal regulations and exclude

outsiders to fish inside the community, and 3) ineffectiveness of alternative sources of income due to uneven and limited financial distribution.

More migrants are motivated to exploit fishery resources in Chivieng community due to the creation of conservation areas is the first likely reason to explain the negative effect of CBNRM on fishery resource conservation in Chivieng community. A similar scenario is also found by Scholte and De Groot (2010). They found that buffer area establishment encouraged more migrants to exploit resources in their study area. Because of its well-protected fishery resources by establishing conservation areas, patrolling, and replanting inundated forests, fishers from the outside often come to fish in Chivieng community. Consequently, local people in Chivieng community had to compete against them daily in fishing activities. Seventy percent of household respondents in Chivieng community reported that they were not happy to see fishers from the outside fish in their community. Ninety percent of them claimed that they were not happy to participate in conservation-related activities because the benefits from fishery resource improvement were taken not only by them who tried to conserve fishery resources, but also by fishers from the outside who did not make an effort.

Weak enforceability of property rights is likely to be another reason that demotivates households in Chivieng community to conserve fishery resources. Murombedzi (1998) claims that to make CBNRM successful, local people need to have appropriate property rights to enforce bylaws and internal regulations and exclude outsiders from exploiting resources in their community. According to the sub-decree for community fisheries management of Cambodia, access to fishery resources is not exclusively for members in the community. Outsiders also have rights to access resources (RGC, 2005). Therefore, households in Chivieng community had no right to restrict fishers from the outside to fish inside the community boundary and the right to punish them in the case those fishers do illegal fishing. They had to compete daily with fishers from the outside.

Lastly, the ineffectiveness of alternative sources of income due to uneven and limited financial distribution is a reason that explains the negative effect of CBNRM on fishery resource conservation in Chivieng community. Saunders (2011) claims that ability of local people to benefit from alternative sources of income created by CBNRM without structural exclusion or poor infrastructure is one of CBNRM's assumptions that need to be met. Ecotourism is established to enable local people to have alternative sources of income in Chivieng community. However, it does not generate enough financial benefits for local people, which demotivates them to conserve fishery resources. Only 3% of local people in Chivieng community could benefit from their engagement in the ecotourism-related jobs. Moreover, financial benefits from those jobs were limited and seasonally based. The average monthly income was 100 US dollars during the peak season lasting only three months per year, that is, from October to December.

9.1.2 Effect of CBNRM on Household Consumption

PSM was used to analyze the effect of CBNRM on per adult equivalent consumption of all fishing households and that of those fishing only inside the community boundary. Due to different results of PSM between the effect of CBNRM on per adult equivalent consumption of the former and that of the latter, the summary of the key findings for both groups will be described in different sections.

1) Effect of CBNRM on per Adult Equivalent Consumption of All Fishing Households

The result from PSM revealed that CBNRM had a negative effect on per adult equivalent consumption of all fishing households in Chivieng community. Per adult equivalent consumption in Chivieng community was lower than that of those in Preak Sromoach community which was 30, 26, and 15 US dollars per month, respectively. Two reasons may well explain the negative effect of CBNRM on per adult equivalent consumption in the present

research. They are: 1) weak enforceability of property rights to exclude fishers from the outside from fishing in the community and weak enforceability of bylaws and internal regulations; and 2) ineffectiveness of alternative sources of income created by CBNRM.

First, local people in Chivieng community could not gain desired benefits despite their efforts in resource conservation due to weak enforceability of property rights. They had to compete daily with fishers from the outside who came to fish inside their community boundary. Furthermore, they did not have any authority to punish fishers from the outside if they did not follow bylaws and internal regulations. According to Ostrom (1990), local people can manage their resources successfully only when they have enough property rights, including the right to exclude outsiders or non-members from extracting resources in their community and the right to enforce laws. Pinkerton and Weinstein (1995) also claim that the right to exclude outsiders or non-members and punish illegal fishers is a vital mechanism to protect benefits for local people, making an effort to conserve resources.

Furthermore, the ineffectiveness of the alternative source of income, that is, ecotourism, was also likely a reason making CBNRM implementation in Chivieng community fail to achieve its objective in fishery resource conservation. As the third reason why CBNRM had a negative effect on fishery resource conservation in Chivieng community, financial benefits from ecotourism were limited due to the seasonal nature of the activities. Only 3% of the total households working in ecotourism-related jobs with average income of approximately 100 US dollars during the peak season lasting from October to December. Ostrom (1990) states that resource management by local people cannot succeed without alternative sources of income. The reason is those alternative sources of income act as an incentive to motivate local people to conserve resources by reducing their resource exploitation

2) Effect of CBNRM on per Adult Equivalent Consumption of Households Fishing only inside the Community Boundary

Different from per adult equivalent consumption of all the fishing households, CBNRM had a positive effect on that of households fishing only inside the community boundary. The result of PSM showed that the amount of per adult equivalent consumption in Chivieng community was higher than that of those in Preak Sromoach community. Per adult equivalent consumption of households in Chivieng community was higher than that in Preak Sromoach community, around 43 US dollars for nearest neighbor matching with replacement and 58 US dollars for nearest neighbor matching without replacement. For kernel and radius methods, per adult equivalent consumption of households in Chivieng community was higher than that in Preak Sromoach community at around 49 and 43 US dollars, respectively. Two reasons may explain the positive effect of CBNRM on per adult equivalent consumption of those fishing only inside the community boundary. Those reasons include: 1) congruence; and 2) better knowledge of the rights to access resources.

First, CBNRM implementation in Chivieng community was congruent with the conditions of the community in terms of access to NTFPs. Congruence is one of the principles suggested by Ostrom to manage resource successfully. According to FGDs, and key informant and household interviews in Chivieng community, CBNRM implementation did not modify any access rules to NTFPs that were used by local people before CBNRM implementation. Some previous studies like Gelcich et al. (2006) find that a new resource management system such as CBNRM made local people lose their access to natural resources, including NTFPs, because of its newly imposed rules that were incongruent with local conditions. Consequently, their household consumption of natural resources was negatively affected.

Furthermore, household respondents in Chivieng community had better knowledge of the rights to access resources than those in Preak Sromoach community. Their knowledge can be attributed to awareness-raising workshops and training courses on the rights of resource access

of local people provided by CBNRM committee members. However, households in Preak Sromoach community did not get such workshops and training courses. Based on FGDs and key informant interviews, awareness-raising workshops and training courses were conducted at least five times per year by CBNRM committee members, excluding those conducted by government officials. However, in Preak Sromoach community, there were only two training courses conducted per year by government officials. This explanation is supported by the fact that 90% of households in Chivieng community who mainly fished inside the community boundary went to collect NTFPs more than twice per week, while only 29% of those in Preak Sromoach community went to collect NTFPs once per month.

9.1.3 Root Causes of CBNRM's Failures

Directed content analysis was used to analyze data from FGDs and key informant interviews. The main research question is "What are root causes of the CBNRM failures in the TSL area in terms of fishery resource conservation and poverty reduction?" However, before answering this question, we must first understand which of the Ostrom's principles were observed in the TSL.

1) Identification of Ostrom's Eight Principles

Seven of eight principles of Ostrom were observed to apply in the CBNRM-implemented community, Chivieng community, except the eighth principle, namely nested enterprises. According to Ostrom (1990), nested enterprises refer to the governance activities such as appropriation and monitoring, and are arranged in multiple layers of nested enterprises at the vertical level. However, nested enterprises in the case of Chivieng community were not at the vertical level, but at the horizontal level because most of the governance activities involved only government officials from different government institutions without involvement of lower level local people.

This is not the first finding in the case of Cambodia that found that out of the eight principles of Ostrom, only the nested enterprises principle was not observed to apply at the vertical level.

A recent report published by FAO conducted in thirteen community fisheries (CBNRM-implemented communities in the present research) located in the TSL, the Mekong River, and coastal areas of Cambodia also finds that most of the time, only government officials were engaged in the governance activities (Kurien, 2017).

2) Root Causes of CBNRM's Failures

It is worth mentioning that there were two common reasons for CBNRM failing to achieve its objectives in fishery resource conservation and poverty reduction in the present research besides its indirect impact, that is, encouraging more migrants to exploit resources in the community due to the creation of conservation areas. The first common reason is weak enforceability of property rights to enforce bylaws and internal regulations and exclude outsiders to fish inside the community. The second common reason is the ineffectiveness of alternative sources of income due to uneven and limited financial distribution. However, these were not the root causes of CBNRM's failure. The root causes of the failure of CBNRM is the ineffective practices of the first, second, and eighth principle of Ostrom in Chivieng community.

The first reason for the failure of CBNRM to achieve fishery resource conservation and poverty reduction is associated with ineffective practice of the first principle (clearly defined boundaries) and the eighth principle of Ostrom (nested enterprises). The sub-decree on community fisheries management of Cambodia states that non-members of the CBNRM also have the right to use fishery resources in the CBNRM-implemented community if they obey bylaws and internal regulations. However, local people cannot ban them when they violate their bylaws and internal regulations or any illegal fishing. They can only report illegal fishing to the nearest FiA and request them to make an intervention (RGC, 2005). Therefore, all the power is in the hands of the government. Similarly, other scholars like Jones and Sok (2015) and Thol and Sato (2015) also find that the government fails to empower local people to punish illegal

fishers, and only government officials have the power to enforce the laws in the TSL area. As a result, local people cannot manage fishery resources effectively. Hanna, Folke, and Mäler (1995) claim that the clearly defined boundaries are essential for successful resource management. However, they also add that nested enterprises are essential to make the clearly defined boundaries work effectively.

The root cause of the second reason for CBNRM's failure is highly likely to be associated with the second principle of Ostrom, namely appropriate rules. Only 3% of local people could earn income from the ecotourism-related jobs, and the earning was not significant for their livelihoods since they could only earn 100 US dollars per month in the peak season lasting from October to December. Therefore, it is clear that it is not worth the efforts of local people in Chivieng community to help conserve fishery resources. Three of the participants in FGDs claim similarly that most of local people, including them, lost motivation to be engaged in CBNRM-related activities to conserve fishery resources because they could not get any benefits from them. Moreover, it seems that they were the ones who worked, and while the benefits were reaped by the others. Other studies found that the second principle of Ostrom plays a significant role in successful natural resource management in terms of conservation and poverty reduction. For example, Klooser (2000) finds that because of fair distribution and substantially significant financial benefits from forestry resource management, seven communities in Mexico successfully manage logging activities and improve the livelihoods of local people.

9.1.4 Determinants of Local People's Perception of the Trade-Off between Fishery Resource Conservation and Poverty Reduction

To identify the determinants of the perception of local people on the trade-off between fishery resource conservation and poverty reduction in CBNRM, the PO model of OLR was used. Among the eight principles of Ostrom, only three principles were significant determinants of the perception of the trade-off. Those variables include: 1) exclusion, 2) monitoring, and 3)

nested enterprises. The former two were positively significant, while the latter was negatively significant.

In terms of exclusion, Chivieng community had clearly defined boundaries for their resources and community. However, both the local fishers and fishers from the outside did not focus on the boundaries since they thought that fish could move everywhere, and it was not practical for them to fish only in a specific fishing ground. Hence, a likely explanation for this finding is that the clearly defined right to withdraw resources for local people in Chivieng community refers to the fairness that everyone could go fishing in various fishing grounds regardless of the boundaries. Cleaver (1999) also mentions a similar scenario that local people could have ad hoc negotiation with one another to access resources.

In terms of monitoring, it was a significantly positive determinant. This finding mirrored that of Ostrom (1990). The patrollers in Chivieng community were local people, and they were active in patrolling activities. Approximately 85% of household respondents reported that the patrolling activities could at least reduce some illegal fishing, which was much more effective than government officials.

Lastly, the nested enterprises variable was a significantly negative determinant. In the study context, it was reported that there were many government officials from different government institutions, and their duties and responsibilities overlapped with one another and were ambiguous. As a result, some of them seek rent from illegal fishers, and are negligent in their duties and responsibilities, leading to more illegal fishing (Thol & Sato, 2014). Therefore, clearly, the nested enterprises principle was perceived by local people as a significantly negative determinant.

9.2 Academic Contributions

Since the present research focuses on Ostrom's principles (1990) by using them to explain the findings, the academic contributions of the present research will be made with respect to

those principles. It is worth mentioning that since the present research was conducted in the TSL area that is a large-scale setting with dynamic resources, fishery resources, the academic contributions of the present research focus only on CBNRM in a large-scale setting with dynamic resources.

There are two types of academic contributions from the present research to Ostrom's principles (1990). The first type of academic contribution is the present research confirms some of Ostrom's principles, namely clearly defined boundaries[1] in terms of the clearly defined right to collect resources, appropriate rules, monitor, and nested enterprises. The present research confirms the claim of Ostrom (1990) that without clearly defined rights to collect resources, it is unlikely that a resource management regime (CBNRM, in the present research) can be successful both in terms of conservation and poverty reduction. Moreover, the present research confirms Ostrom's principle related to appropriate rules for both benefit sharing and access to resources. The present research found that without appropriate rules, despite an alternative source of income, conservation and poverty reduction cannot be achieved if the earnings from that alternative source of income are not significant for livelihoods and not equally distributed. Furthermore, in terms of access to natural resources, the present research found that as long as the rules in the previous management regime are congruent with local conditions and cause no harms to conservation, the new resource management regime should not make any significant change. Any change can disrupt local people's livelihoods as well as their motivation to conserve resources. The present research also confirms the Ostrom's principles related to monitoring that as long as monitoring is conducted by local resource users, and they are accountable for their work in monitoring, local people will have a positive perception of that resource management regime. Lastly, the present research confirms that without nested

[1] The clearly defined boundaries principle consists of two parts: 1) the clearly defined right to collect resources of members in the community; and 2) clearly defined resource boundaries.

enterprises from the lower to top levels, it is difficult for a resource management regime in a large-scale setting with dynamic resources to be successful.

The second type of academic contribution from the present research is that there should be a rejection of as well as a modification to the principle related to clearly defined boundaries. Although Ostrom (1990) claimed that there should be both clearly defined rights to collect resources and resource boundaries, the present research proves that in the large-scale setting with dynamic resources, clearly defined resource boundaries are difficult to apply where fair access to resources is practiced. Moreover, the present research found that in a large-scale setting with dynamic resources where there is much involvements from different stakeholders, there should be less overlap in duties and responsibilities among those stakeholders by having more clearly defined boundaries in each stakeholder's jurisdiction.

9.3 Policy Implication

Based on the research findings, some amendments to property rights should be made for fishery policy management in Cambodia, particularly the sub-decree on community fisheries management. Below are suggestions based on the research findings.

One reason CBNRM fails to contribute to fishery resource conservation and poverty reduction is local people in Chivieng community possess weak enforceability of property rights in terms of excludability and bylaw and internal regulation enforcement. Although local people have rights to manage resources, it has no meaning if local people, right holders, are incapable of excluding fishers from the outside, non-right holders, to fish in the community boundary and enforce their bylaws and internal regulations. Without adequate enforceability of property rights, fishery resource conservation and poverty reduction in the TSL area cannot be achieved. Adequate enforceability of property rights can ensure that benefits from local people's efforts in fishery resource conservation will be obtained mostly by them. As a result, this will make local people feel more motivated to conserve fishery resources and ultimately lead to success

in fishery resource conservation and poverty reduction in the long run. Therefore, to ensure that CBNRM can achieve both fishery resource conservation and poverty reduction in the TSL area, the RGC should strengthen enforceability of property rights in terms of excludability and bylaw and internal regulation enforcement. In terms of the excludability, fishers from the outside should only be allowed to fish inside the community boundary when they have obtained permission from the CBNRM committee and have paid an entry fee to fish in the community. Not only would this enable the CBNRM committee to earn more to support their conservation related activities, it would also reduce competition in fishing between local people and fishers from the outside. Local people represented by the CBNRM committee should be granted institutional backing from the RGC to sanction fishers from the outside who fail to ask for permission to fish inside the community. In terms of bylaw and internal regulation enforcement, there should be more collaboration between local people represented by the CBNRM committee and government officials. At the low levels of bylaw and internal regulation violations, the CBNRM committee should have a right to sanction violators (illegal fishers) by fining them, while at the severe levels of violations, government officials should be in charge. A part of the fine should be used to support all CBNRM-related activities. The rest should go to government institutions.

Since congruency of CBNRM with Chivieng community's conditions in terms of access to NTFPs and better knowledge of local people in Chivieng community regarding the right to access NTFPs are the reasons contributing to the positive effect of CBNRM on per adult equivalent consumption of households fishing only inside the community boundary, conditions of communities should be taken into consideration when implementing CBNRM. Moreover, there should be the dissemination of knowledge related to the right to access natural resources in CBNRM-implemented communities to local people so that they can know and use their rights properly.

The present research also found that CBNRM failed to contribute to both fishery resource conservation and poverty reduction due to the ineffectiveness of an alternative source of income from CBNRM, that is, ecotourism. To make ecotourism effective, that is, by increasing and equally distributing its financial benefits to local people, the RGC should help local people create more alternative sources of income by using available resources in the community, just as a NGO in Chivieng community, Osmose, trained local people to use the local resources, that is, hyacinth to produce handicrafts to sell to tourists. Moreover, the RGC should help to increase markets for the existing alternative sources of income. For example, the RGC should help to expand the market of the hyacinth-made handicraft to not only tourists coming to visit the community, but also to people in other areas of the country.

The present research lastly found that the nested enterprises principle was negatively associated with the perception of the trade-off between fishery resource conservation and poverty reduction. This is likely because there were many government officials from different government institutions without the involvement of local people, and their duties and responsibilities overlapped with one another and were ambiguous. The present research suggests that the geographically different government institutions should work differently. FiA should be responsible for fishery resource conservation in CBNRM-implemented communities including inundated forests and conservation areas created by CBNRM-implemented communities. MoE should be responsible for inundated forests that are not located in CBNRM-implemented communities and protected areas created by the RGC. TSBA should help to conserve fishery resources by combatting illegal fishing in the fishing grounds outside CBNRM-implemented communities since it is more powerful than FiA and MoE. To avoid confusion among local people and reduce the chance that some government officials seek rent from them, there should be more awareness-raising for local people to understand duties and responsibilities of each government institution.

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Appendix

Appendix 1: Results of Listcoef of the Full Model

Variable	b	z	P > |z|	e^b
Age	0.02	0.07	0.94	0.98
Education	0.39	1.44	0.15	1.5
Occupation	0.03	0.31	0.75	1.04
Exp	0.07	0.19	0.85	1.08
Exc	1.51	3.71	0.00	0.22
Rul	0.52	0.56	0.57	0.6
Col	0.2	0.56	0.58	1.22
Mon	1.39	3.5	0.00	0.25
San	0.09	0.15	0.89	0.92
Con	0.31	0.54	0.59	0.74
Rec	0.04	0.07	0.94	1.045
Nes	-0.63	-1.69	0.09	0.53

Source: Author (2016)