



The Establishment of a Community-based Mangrove Forest Management Plan: Lessons Learned from Mangrove Forest Conservation in the Nernkhor Sub-district, Rayong Province, Thailand

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Abstract

This study aims to investigate key elements of community-based ecological management (CBEM) in a rural area with plentiful mangrove resources. The investigated elements of CBEM include stakeholders' benefits from sharing ecosystems services provided by the mangrove forests, stakeholders' roles in ecological conservation, and their participation in decision-making processes at each stage of the ecological management process. Additionally, the study intends to reveal factors that determine the success of CBEM creation processes, including agenda setting, matching, restructuring, clarifying, and the routinizing stage. Semi-structured interviews and group discussions were conducted with relevant stakeholders, such as community leaders, typical villagers, fishermen, and local businessmen residing in the Nernkhor sub-district of the Rayong Province, Thailand. The results of content analyses demonstrated that the success of CBEM creation processes in the Nernkhor sub-district was related, to a great extent, to stakeholders' awareness of ecological values, the perceived legitimacy of ecological resource management efforts, and active communication among stakeholders. In addition, it was found that CBEM was successfully implemented due to stakeholders' perceptions of political equity, cost-sharing for conservation activities and the socioeconomic benefits of sharing the ecosystem services provided by the mangrove forest.

Keywords: Community-based ecological management; Stakeholders; Bottom-up approach; Mangrove forest conservation

Introduction

Since the 1980s, the natural resource management approach used in developing countries has tended to incorporate local people's interests and perspectives. This type of approach is often called community-based natural conservation (CBNC) [1]. It is believed that the management of natural resources using a community-based approach can sustainably conserve local natural resources while helping local people to receive sufficient ecosystem services. In addition, the implementation of the CBNC approach can prevent some adverse environmental impacts caused by human activities [2-3] and enhance community empowerment [4]. According to the core principle of CBNC, local people, who understand their local environment and have specific knowledge related to local ecological management, are encouraged to be highly involved in each part of the management process, ranging from problem identification, goal- and objective-setting to alternative plan making, making planning decisions, implementation, and outcome monitoring. The application of a community-based approach to forest management in Benin, Western Africa, for instance, resulted in various positive outcomes: besides the improvement of the forest's quality, the population's annual income also increased by 25% [5]. Sudtongkong and Webb [6] provided concrete evidence that a mangrove conservation project managed by a local community in Trang Province, Thailand yielded significantly better biological outcomes than the conservation efforts managed by the state.

The Nernkhor sub-district of the Rayong Province is located near the coast in eastern Thailand. It is a part of the Prasae River Delta, where the Prasae River drains from the upland to the sea. The river is also connected to many canals in the Nernkhor sub-district. Nernkhor is an area of plentiful natural resources, including water, mangrove forests, fertile agriculture land,

and a rich diversity of plant species. The majority of the land in the district, approximately 77%, is devoted to agriculture; aquatic farming accounts for approximately 31% of the total area (almost half of all agricultural land). About 12% of the land is made up of mangrove forests, and water resources such as canals and rivers, occupies 5% [7]. Valuable natural resources benefit local villagers in a variety of ways, such as their careers, recreational activities, daily living, and health. A majority of the villagers' careers are related to the use of local natural resources, as they work in agriculture and fisheries. However, the use of those resources has its own limitations and requires effective management, especially since natural resource consumption has increased due to the area's increasing population.

In the last twelve years, the Nernkhor sub-district has faced a serious deterioration of its mangrove forest ecosystem due to villagers' exploitation of the mangrove resources and encroachment into forest areas. Among the growing food manufacturing industries, farmers tended to harvest aquatic animals with the purpose of supplying them to commercial industries, rather than for household consumption and family-run businesses. Consequently, several types of aquatic animals, such as krill, oysters, mangrove crabs, and blue manna crabs, have been overharvested and their populations dramatically decreased. Moreover, villagers and business investors have also invaded mangrove areas, and some parts of the forests were transformed into shrimp farms. The rapid expansion of shrimp farming has led to pollution of the Prasae River, because wastewater produced from farming activities has been regularly discharged into it.

The growing population and massive demands of aquatic harvesting without effective ecological management measures have posed a serious threat to the mangrove forest systems. In response, local villagers, fishermen, and community leaders established a community-based

ecological management plan in 2004, and villagers were encouraged to become fully engaged in the mangrove ecosystem management project. The main goals of CBEM are to recover and conserve the mangrove forests; to maintain the presence of aquatic animals, in terms of quantity and diversity; and to enable local villagers to access mangrove resources. In addition, CBEM emphasizes the involvement of relevant stakeholders in decision-making processes at each stage of the ecological conservation project. After the project's implementation, the quality of the mangrove forest ecosystems became as plentiful as it was before.

This study aims to investigate factors that contributed to the successful implementation of a community-based ecological management plan in the Nernkhor sub-district of the Rayong Province. The key elements of CBEM are investigated, as are the factors determining its success. Semi-structured interviews and focus group discussions were conducted between February and May 2016, followed by a content analysis of the same. The findings provide some implications for the development of CBEMs that can be applied to other cases.

Theoretical Contexts

1) Community-based ecological management

Community-based ecological management (CBEM) is a management approach in which communities are responsible for managing natural resources within a specific area. CBEM allows local communities to fully or partially make decisions on how the resources can be utilized and/or managed [7]. Those ecological resources include water, mangrove forests, pastures, communal lands, and fisheries. Abensperg-Traun [9] stated that by applying the CBEM concept, local ecological resources must be managed by local institutions and local benefits are emphasized. The engagement of local people in all processes of ecological management is significant; their demands and notions

are deliberatively considered in all processes and goals of ecological resource management. In implementing CBEM, local people are encouraged to assess ecological situations, to identify their needs and concerns, to be involved in every decision related to the management, to implement relevant projects, and to monitor outcomes. In this way, CBEM contributes to local capacity building as well as community empowerment. To create CBEM, four major components are necessary: understanding of stakeholders' perceptions of ecological values, patterns of social interactions among the stakeholders, leadership and powers, and organizational arrangements and managements [10-11].

To successfully establish CBEM, Rogers [12] identifies five stages or CBEM creation processes. The first is agenda setting and it refers to a local community's awareness of problems in ecological systems that require effective solutions. The second stage is matching, which means community decisions on the function of CBEM in response to identified ecological problems. The third stage is restructuring or community decisions on CBEM rules and management structures. The fourth stage is a clarifying process or clarifying community rules. These rules should be enforced at least at a rudimentary level. The last stage is routinizing, which means CBEM has been routinely implemented and has become normalized in the community. Three important factors contribute to the success of CBEM: the local people's perceived legitimacy of ecological resource management because people will be more involved in CBEM if they have this; the second factor is communal support or community members' support for the idea as without communal support, it is hard to receive public acceptance of the rules; and the last factor is the characteristics of the rules should correspond to the community's capability to monitor and enforce them [13-14]. The success of CBEM shows that ecological

systems can be conserved while also providing some ecological services to local community.

2) Stakeholder participation in ecological management projects

Due to the complexity and uncertainty of ecological problems, a flexible and transparent environmental decision-making process is necessary; this allows diverse sets of knowledge, concerns and values to be taken into consideration. To achieve this expectation, stakeholder participation should play a significant role in ecological decision-making processes [15].

According a review of the literature, the concept of stakeholder participation mainly describes the degree of stakeholders' engagement. As proposed by Arnstein [16], the ladder of participation, for instance, demonstrates degrees of increasing involvement, from "manipulation", referring to the passive dissemination of information, to "citizen control", which means active engagement. Bigg [17] defines the degree of stakeholder participation as different levels of relationships, including contractual, consultative, collaborative, and collegiate. In contrast, Rowe and Frewer [18] emphasize communication characteristics rather than the degree of participation; namely, communication flows among parties are used to identify different types of stakeholder engagement. For instance, only disseminating information to passive recipients is classified as "communication". If the information or feed-back is gathered from participants, it can be classified as "consultation". The "participation" level represents two-way communication between participants and the mutual exchange of information through a communication dialogue. In another approach, Tippett [19] distinguishes the degree of engagement based on methods in the decision making processes that can be classified into five types: informing, designing active engagement processes, consulting, implementing management plans, and monitoring and learning from

the outcomes of the participatory practice. In CBEM, stakeholders are highly encouraged to be involved in the processes of implementing and monitoring. Villagers are also one of the groups of decision makers in ecological management projects.

3) Equity in community-based ecological management

Political equity and the allocation of socioeconomic benefits among stakeholders are important elements of CBEM [20]. Jacobs [21] indicates two types of equity: economic and political. Economic equity refers to benefit and cost allocations. All stakeholders must be allowed to receive fair benefits from the outcomes of ecological resource management decisions. At the same time, stakeholders' cost sharing efforts should also be taken into consideration. "Costs", in a CBEM context, refers to time used in group meetings or the labor costs of operating ecological management projects. Stakeholders must be allowed to receive fair benefits, and they must contribute necessary costs, such as their time, money, or labor. Another type of equity is political equity, which refers to stakeholders' access to decision-making bodies and their ability to express their concerns. Stakeholders must be able to influence final decisions [21]. Marginal groups are those whose voices should be greatly considered, due to having less political power to influence the decision-making process [22]. To sustain CBEM, political equity and socioeconomic benefits allocation among stakeholders must be taken into consideration.

4) Conceptual idea of the study

The study is divided into two aspects. First, the study aims to explore how CBEM was initiated and successfully implemented in the Nernkhor sub-district of the Rayong Province of Thailand. The five stages of the CBEM creation process, proposed by Rogers [12], are em-

ployed to explain this. The stages are: agenda setting, matching, restructuring, clarifying, and routinizing. Factors contributing CBEM creation processes are analyzed, in order to investigate those that contribute to the success of the project's implementation.

The first element to consider is stakeholders' benefits from sharing the ecosystem services provided by the mangrove forest. As Abensperg-Traun [9] stated, to sustain CBEM, stakeholders must be allowed to receive ecological services from natural resources, and benefit allocations must be fair for each stakeholder [21]. Second, to implement CBEM successfully, stakeholders must contribute to some costs of the ecological conservation practices [21]. These costs are, for instance, time, opportunity cost, money, and/or labor. The third important element to consider is stakeholders' participation in decision-making processes during each stage of ecological management. The degree of participation can demonstrate a stakeholder's political power in CBEM. As Jacobs [21] noted, equity in politics allows all relevant stakeholders to express their concerns and feelings and to influence final decisions. Therefore, diverse knowledge, concerns, and values can be taken thoroughly into consideration. The results of this investigation will provide some implications for CBEM development based on lessons learned from the case study.

Data and Methodology

1) Case study

The Nernkhor sub-district of the Rayong Province (Figure 1) consists of nine small rural communities. Its total area is about 36.08 km², with 1.7 km² of mangrove forest and 13.5 km² of agricultural land; only 1.4 km² are residential lands [7]. The mangrove forest has been classified as a riverine mangrove forest, as the forest is situated alongside the Prasae River (Figure 2). The area is a floodplain that is flooded by most high tides and dry during most low tides. Its sa-

linity levels are diverse, depending on the seasons (such as the dry and wet seasons). The area is not exposed to storms or ocean waves, but it is situated so that it receives water runoff from upland areas. The mangrove trees in Nernkhor thrive because of the nutrient influx from the river flows, and because they are not under threat from ocean waves or storms.

Currently, the mangrove forests in Nernkhor and the surrounding areas are plentiful and contain diverse levels of tree species, such as *Rhizophora apiculata*, *Sonneratia caseolaris*, *Ceriops decandra*, and *Xylocarpus moluccensis*. The forests are also home to many types of aquatic animals, such as mangrove crabs, krill, and oysters. The mangrove ecosystem has provided many benefits to villagers, such as careers related to mangrove resources and recreational activities. For instance, villagers produce various seasonings, including fish sauces and shrimp paste, from the aquatic animals found in the area. Many villagers utilize the plentiful mangrove ecosystems for aquatic farming in the river running through the forests. The villagers' culture and lifestyles are deeply connected with the mangrove ecosystem's resources.

Considering the socio-economic aspects of the Nernkhor sub-district, the population is 4,653 people in 1,251 households [23]. Most villagers are agriculturalists and fishermen [7]. Villagers who live near the river are typically involved in aquatic farming activities such as fish and oyster farming. The average household income per month is approximately 20,000 baht, or US\$578. Communities in the area have worked together collaboratively in order to achieve socio-economic and environmental sustainability. Recently, one community in the area, Ban Jamrung, became well-known because of the success of collaborative community development, as evidenced by residents' happiness and satisfaction in life. Each year, the community welcomes visitors from around the country

to learn about successful development in a rural community.

2) Investigating CBEM

As previously mentioned, this study explored five stages of CBEM creation processes: the agenda setting, matching, restructuring, clarifying, and routinizing stages. It also explored significant factors that contributed to CBEM success. Then, three important elements of

CBEM, stakeholders' benefit from the sharing of ecosystems services provided by the mangrove forest, stakeholders' roles in ecological conservation, and their participation in the decision-making process at each stage of ecological management, were investigated. To gather data for analysis, the authors conducted semi-structured interviews and focus group discussions using relevant topic guides. The questions related to the topic guides were:

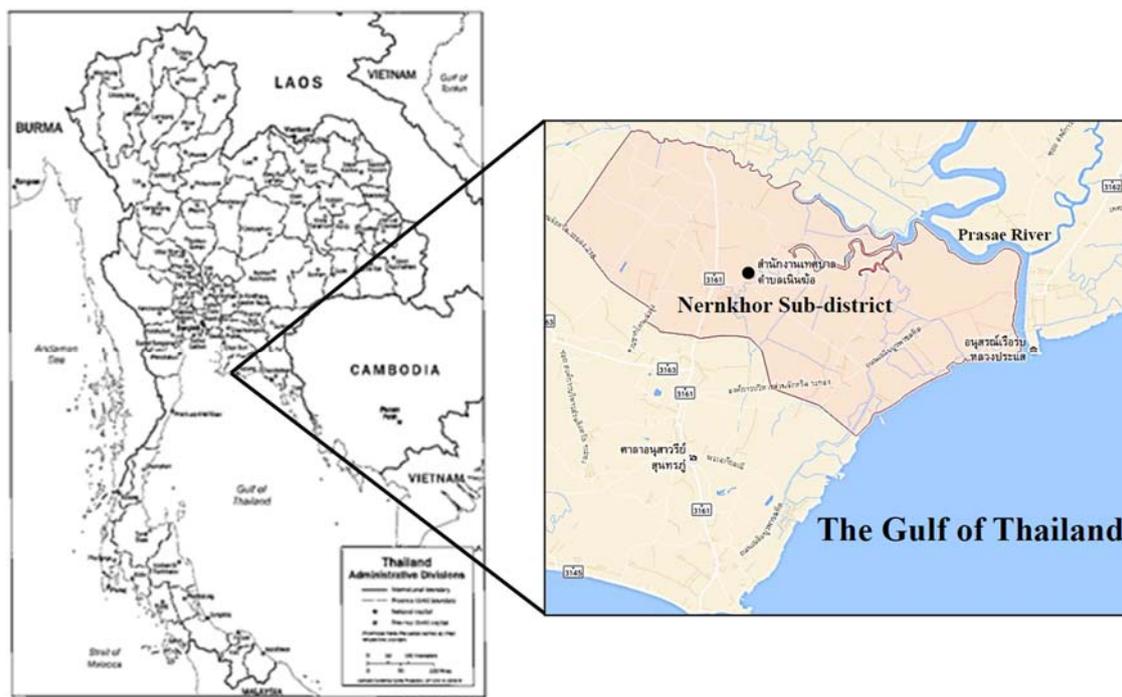


Figure 1 Study area



Figure 2 Mangrove forests in Nernkhor sub-district

Source: Taken by author in March 2016

- Please explain how CBEM was first established.

- Why did you decide to become involved in CBEM?

- What kinds of problems have been faced in the community when conducting CBEM?

- Are you encouraged by community leaders or other groups of people to participate in CBEM?

- Do you have a chance to share ideas or ecological concerns with other groups?

- Have you participated in the decision-making process on ecological conservation projects?

- How does the mangrove forest benefit your life?

- If the mangrove forest no longer existed, how would your life be affected?

- How has the mangrove forest been conserved by the roles of the community members?

- Do you have to follow any rules?

- Do you receive support from the government?

All collected data were analyzed based on the conceptual idea of the study.

3) Data collection and analysis

To analyze CBEM, the authors employed semi-structured interviews that followed a judgment sampling strategy [24]. Thirteen villagers, including one formal community leader, two informal community leaders, four typical villagers, two local businessmen, and four fishermen, were asked to participate in interviews. These interviewees were stakeholders who were impacted by and who also made an impact on the CBEM efforts in the study area. In addition, focus group discussions with five local villagers and four fishermen were conducted. The discussion was conducted separately between a group of villagers and fishermen. The discussions raised the same issues as those addressed in the interviews.

Regarding the demographic characteristics of the participants, nine were female and thirteen were male. Only two participants, one villager and one businessman, held a Bachelor's degree. Other participants held junior and senior high school diplomas. The interviews were conducted between February and March 2016, and group discussions were conducted in May 2016 in the Bang Jamrung and Nernsay villages in the Nernkhor sub-district of the Rayong Province. To explain the five stages of the CBEM creation processes and to explore the key elements of CBEM in the Nernkhor sub-district, a content analysis was performed by summarizing the data gained from the semi-structured interviews and focus group discussions.

Results

1) Stages of CBEM creation processes in the Nernkhor sub-district

The results of the semi-structured interviews and focus group discussions demonstrated issues related to the five stages of the CBEM creation process in the Nernkhor Sub-district and shed light on the factors contributing to the success of the project's establishment. Figure 3 details the five stages of the CBEM creation process.

The first stage of the CBEM process ("agenda setting") refers to stakeholders' recognition of ecological problems. In the Nernkhor sub-district, CBEM was initially established by the collaboration among fishermen, villagers, and community leaders in 2004. Many fishermen and villagers recognized the significant population decline of several types of aquatic animals, such as mangrove crab, krill, and fish. They assumed that overharvesting and the alteration of the environmental quality around the mangrove forest were the major causes for these changes. The villagers also indicated that deteriorating mangrove ecosystems had a negative impact on the community's identity and lifestyle. Namely, some people had

to change jobs, due to the scarcity of aquatic animals. As a consequence, local wisdom related to fishery activities was lost. The villagers and fishermen's awareness of the deteriorating mangrove ecosystem and its impact on the community's culture, identity, and well-being contributed significantly to their motivation to recover and conserve the mangrove ecosystem.

The second stage, of the CBEM process "matching", refers to the public's recognition of the necessity to apply a new ecological conservation strategy and, possibly, to apply the CBEM concept to cope with their ecological problems. Interviews with stakeholders revealed that villagers, fishermen, community leaders, and local businessmen had expressed the significance of stakeholder engagement in conservation activities, so as to enhance public awareness of ecological values and the public's understanding of the interconnection between local cultural contexts and mangrove ecosystems. For instance, one community leader said, "Some new residents did not recognize the relationship between mangrove resources and [the] community's livelihoods; thus, they were not aware of [the] ecological deterioration". Similarly, the villagers' perspective was that if people have ecological awareness and a sense of place related to the mangrove forests, they will feel more responsible for the ecosystem's conservation and will commit to sustainable behaviors. A local businessman stated, "The CBEM approach, which emphasizes the involvement of stakeholders in decision making on mangrove resource conservation programs, could constitute information sharing among one another and could enhance people's ecological awareness and self-responsibility". Furthermore, stakeholders insisted that local ecological problems could not be solved by the mere management of governmental institutions, which mostly impose strict rules and intensive conservation strategies. Such a management system would

not constitute self-responsibility and environmentally friendly behaviors.

The results of focus group discussions with villagers also reflected their perceptions of the significance of stakeholder engagement in ecological conservation and its ability to enhance public awareness of ecological values. They realized that top-down conservation approaches destroyed public responsibility; thus, mangrove resources had been extensively destroyed. Overall, the results of the interviews revealed that stakeholders realized the weakness of top-down approaches and understood the potential of CBEM as a means of sustainably addressing and correcting the deterioration of the mangrove resources in the Nernkhor sub-district.

Taking another perspective, stakeholders felt that, if based on management by government actors, the villagers would not be allowed to use the mangrove resources in any way. This would not have benefitted the local community at all, and would have potentially destroyed the local economy. The cultures and rural lifestyles related to the use of mangrove resources would, potentially, have been destroyed. A community leader said, "The mangrove forest and other mangrove resources couldn't be conserved by the mere role of governmental institutions due to insufficient understanding of social-ecological relationships". A fisherman added, "Our lives are related to the mangrove forest. The responsibility to manage the mangrove should be laid with us as well". This corresponds to the results of an investigation conducted by Berkes [25], who argued that the link between social and ecological systems needs to be understood, in order to build social ecological resilience and successfully conserve ecological systems; thus, stakeholders' engagement is significant. In the Nernkhor sub-district, villagers and community leaders collaborated in 2004 and came up with the ideas for their community-based ecological management plan.

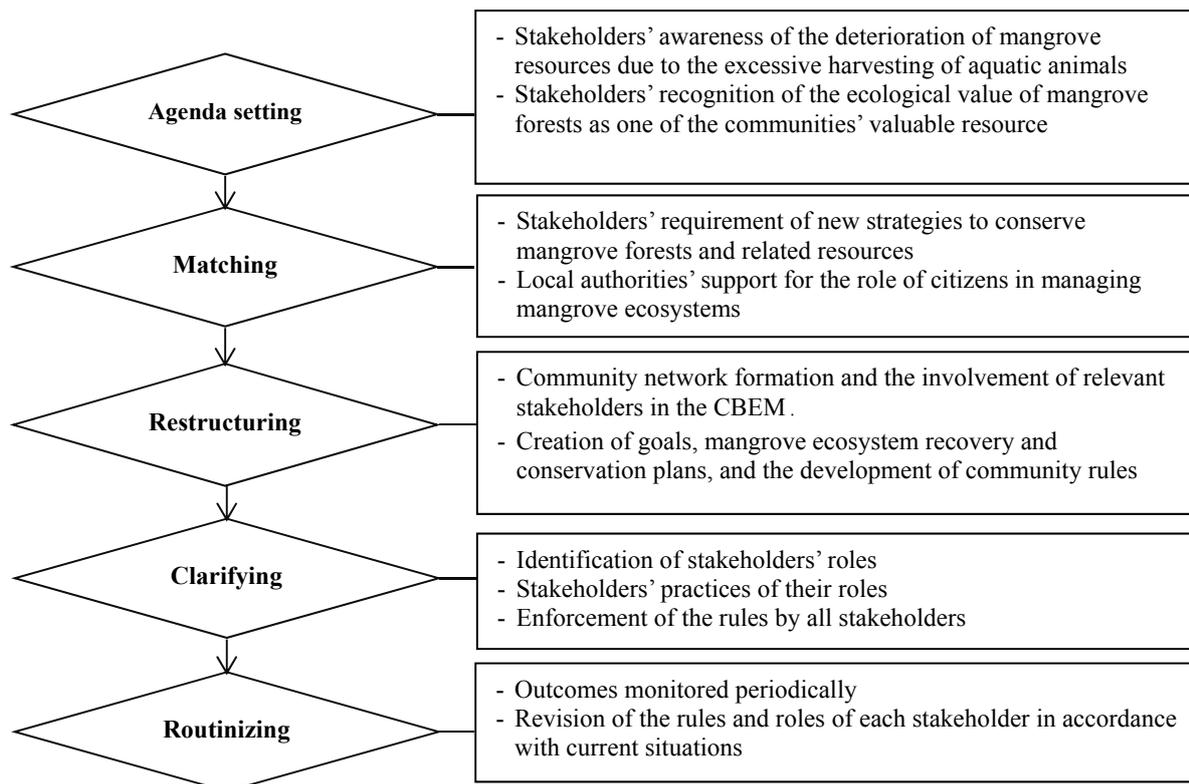


Figure 3 Five stages of CBEM creation processes in the Nernkhor sub-district

The third stage of the process is “restructuring”, which calls for the development of management structures and the establishment of rules. In this stage, the identification of relevant stakeholders, the creation of a network among social actors, and community rules for mangrove resource conservation developed. According to the interviews, it was clear that, since Nernkhor’s villagers realized the significance of their engagement in the success of the conservation efforts, they established a community network aimed at recovering and conserving the mangrove resources. Several groups of stakeholders, such as fishermen, typical villagers, and local businessmen, were encouraged to become involved in the network. A community leader noted, “We tried to include more relevant stakeholders whose roles were significant to the success of ecological conservation protects”. A number of fishermen from the area were also encouraged to become involved. One explained, “Though some fishermen live outside the district, they, however, could come and harvest

aquatic animals around this area. Therefore, they should be involved in the project”.

The network was extended and strengthened by frequent and intensive communication among actors during 2004-2005. As a villager reported, “We have quite frequent communication. We have a meeting almost once a month”. After the network was established, all stakeholders worked corroboratively to design a way to practice CBEM. In 2007, rules for practicing mangrove forest conservation and protecting aquatic animals were created based on stakeholders’ agreement. A group of villagers shared, “Any decisions on conservation projects, including community rules, were made based on stakeholders’ agreement”. The rules can be seen in Table 1. Provincial Governmental institutions also support these rules. In addition, the community network occasionally receives monetary support from the industrial sector in the form of cooperative social responsibility projects, so the conservation projects can endure even without governmental support.

Table 1 Analysis of the systematic CBEM in Nernkhor sub-district

Stakeholders	1. Benefit sharing of ecosystem services provided by mangrove forests	2. Roles and rules in ecological conservation	3. Participation in decision-making processes
Fishermen	<p>-Fishermen receive direct benefits from the existence of mangrove forests, which are the habitat of various aquatic animals, particularly mangrove crabs.</p> <p>-Fishermen can harvest mangrove crabs and fish and earn money by selling their harvests.</p>	<p>-Since fishermen receive direct benefits from the mangrove forest, and their activities significantly contribute to the quality of the forest, this group is required to participate in ecological conservation activities, ranging from awareness creation and ecological knowledge sharing to rule compliance.</p> <p>-Fishermen are not allowed to harvest crabs near the mangroves.</p> <p>-Once pregnant and baby crabs are found, fishermen must put them in the protected area.</p>	<p>-Provide necessary information and share ideas and concerns</p> <p>-Influence final decisions</p> <p>-Implement ecological conservation plan.</p>
Local business sector	<p>-The local business sector can receive indirect benefits from mangrove conservation. This group mostly purchases harvested aquatic animals from fishermen at a reasonable price, and processes those into products such as cooking foods, dried foods, and seasonings. Their income is generated from selling those processed products.</p> <p>-The plentiful mangrove also attracts many tourists and visitors; they can also buy these products.</p>	<p>-This group always supports local fishermen .The local business sector is, however, asked not to purchase pregnant and/or baby crabs and fish from fishermen.</p> <p>-The local business sector will not support any mangrove resources that are illegally obtained.</p>	<p>-Share ideas and concerns</p> <p>-Influence final decisions</p> <p>-Monitor CBEM outcomes</p>

Table 1 Analysis of the systematic CBEM in Nernkhor sub-district (*continued*)

Stakeholders	1. Benefit sharing of ecosystem services provided by mangrove forests	2. Roles and rules in ecological conservation	3. Participation in decision-making processes
General community members	<ul style="list-style-type: none"> - Benefit from the mangrove forest in several ways: they may cut mangrove trees for household use, but not business purposes. - Indirectly, the plentiful mangroves provide community members with a great environment for recreational activities and a good living environment. 	<ul style="list-style-type: none"> - When community members cut a mangrove tree for household use, they are required to plant at least five trees to replace it. - Community members play a role in monitoring the quality of mangrove forests and the populations of related aquatic animals. - Community members should not support any products produced from illegally harvested mangrove resources 	<ul style="list-style-type: none"> - Be informed about ecological activities regularly - Share ideas and concerns - Influence final decisions on community rules related to CBEM - Monitor CBEM outcomes
Community leaders	<p>The same as general community members.</p>	<ul style="list-style-type: none"> - Community leaders organize meetings and gathering relevant stakeholders - Community leaders and all stakeholders establish and enforce the rules. - Community leaders play an important role in monitoring the quality of mangrove forests. - Community leaders increase people's awareness of ecological conservation, and encourage all sectors to engage in CBEM. - Community leaders promote products from local business sectors as well as fishery goods. 	<ul style="list-style-type: none"> - Disseminate information relevant to ecological conditions and management strategies - Facilitate CBEM - Influence final decisions on community rules related to CBEM - Monitor CBEM outcomes

The fourth stage in the process is “clarifying”, which refers to the enforcement of rules and the identification of stakeholders’ roles. Rule enforcement began started in 2008 with the support of the entire community. According to the interviews, each stakeholder could clearly indicate his or her role and the community rules for mangrove resource conservation. All reported that they enthusiastically comply with the rules. Fishermen reported that they have followed the rules strictly, because their careers are related to fishery activities, which have a tremendous effect on the quality of the mangrove forest’s ecosystem. They would easily be blamed if new problems manifest themselves. Members of the local business sector reported that they follow the rules by not supporting any illegal or prohibited fishery goods. This could decrease the illegal harvesting of mangrove resources.

To date, there is no specific penalty if one does not follow the rules, but social sanctions seem sufficient for enforcing them. If one engages in an activity that contradicts the community’s rules, he or she will not be accepted. In addition to formal rules, each stakeholder also has roles they must follow. For instance, all stakeholders have a role in monitoring the mangrove ecosystem conditions, and they are expected to participate in the network’s meetings. The roles of each sector complement one another.

The last stage in the process is “routinizing”. This is the stage when CBEM is routinely practiced, and it is recognized as the normal, strategic way to achieve mangrove resource conservation. All stakeholders reported that they have routinely been involved in the activities held by the community network. One villager shared, “We receive sufficient benefits from the ecosystems provided by the mangrove forest, while the mangrove forest is sustainably conserved. This is why we accepted CBEM and have often engaged in community activities”. A local businessmen added, “We are frequently involved in

any discussions on mangrove ecosystem conditions and relevant problems, and have been involved in the decisions on conservation activities”. According the results of the interviews and group discussions, it can be said that CBEM has obtained support from villagers, governmental institutions, and the business sector. All stakeholders have practiced their roles enthusiastically. In addition, through their satisfaction with the current condition of the ecosystem, villagers have remained aware of unpredicted threats to the forest. Thus, the community rules are revised when necessary. The rules and roles of each stakeholder are also monitored from time to time, in order to ensure the proper response is made to current ecological conditions.

2) Factors contributing to the success of CBEM creation processes

Three significant factors contribute to the success of CBEM creation processes. These are stakeholders’ ecological awareness, the perceived legitimacy of ecological resource management efforts, and active communication among stakeholders. Concerning stakeholders’ ecological awareness, sampled groups such as villagers, fishermen, and community leaders demonstrated high awareness that the deterioration of the mangrove ecosystems was caused by intensive fishery activities, shrimp farming, and the expansion of food manufacturing industries. As a result, these people were motivated to play a role in protecting the mangrove resources. They expressed the urgent need for a new strategic approach to recover and conserve the resources; thus, the community network was created.

The second factor is the perceived legitimacy of ecological resource management efforts. Legitimacy refers to the right of a person or social group to rule and the perceptions of general public regarding this right [26]. Legitimacy can be acquired not only via formal means, but also by lending effectiveness in contributing to outcomes [27]. In the Nernkhor sub-

district, all stakeholders exhibited high perceived legitimacy in governing the mangrove resources. For instance, a community leader said, “We are responsible for managing the mangrove resources; thus, we have to create rules for controlling the resource use”. A villager added, “It is our responsibility to take care of the mangrove resources, and those resources are [the] community’s assets, which we have to take care not only for us but also our successors”. Though a public authority currently owns the mangrove forest area, villagers are allowed to use and manage its resources. All sampling groups reported their involvement in the rule-making process. High levels of perceived legitimacy enhanced stakeholders’ involvement. Today, the general public accepts the rules for mangrove resource management that were launched by the community network, and each stakeholder has complied with and enforced these rules enthusiastically.

The last factor is active communication among stakeholders. As the interviews with community leaders revealed, a great deal of emphasis is placed on the development of communication among stakeholders, which they recognized as one of the most important components in CBEM”. We had frequent communication by organizing meetings after all parties [had] awareness of the deterioration of the mangrove forest; thus, the network could be gradually developed”, stated one community leader. A fisherman confirmed, “We had many opportunities to talk and share our notions and feelings among one another; therefore, we understood how the use of mangrove resource is very much important to each specific group”. Another villager recalled, “We were encouraged to join several activities hold by the network, and were frequently informed about the situation related to mangrove forests”. Active communication among stakeholders contributed to the successful stakeholder engagement in CEBM.

3) Key elements of CBEM

Table 1 depicts the key elements of CBEM in the case study. The community derives its own systematic benefits from sharing the ecosystem services provided by the mangrove forest, and stakeholders have their own roles to perform. In this case, the mangrove forest area is protected by community rules that were drafted by all communities in the Nernkhor sub-district. However, fishermen are still allowed to harvest aquatic animals that live outside the protected area. Those animals living inside the protected area can be harvested only during specific times, such as once every two months, depending on the community’s agreement. In addition, mangrove trees may be cut for household use, but when a tree is cut, five young mangroves must be planted to replace it. All interviewees expressed satisfaction with these rules. A fisherman, for instance, said, “Because of the enforcement of the rules, the quality of [the] mangrove forest [has] become better than before, and the population of aquatic animals steadily increases”. A local businessman noted, “Local ecological resources are valuable and well known by outsiders. The plentiful mangrove forest attracts tourist, thus we can sell our products produced from local aquatic goods”. The results of this investigation demonstrated that each stakeholder has the opportunity to gain significant socio-economic benefits from the implementation of CBEM practices. Fishermen and local businessmen gain economic benefits, while typical villagers, community leaders, and visitors are satisfied with the good quality of ecological conditions, which contribute to livable communities.

As a condition of access to these benefits, each stakeholder has roles and rules to follow. This represents their in-kind cost contribution to CBEM. For instance, villagers may cut mangrove trees, but they must plant replacements, too. In doing this, villagers are contributing their labor and costs to the planting of young trees.

Similarly, fishermen may harvest crabs near the protected areas, but if pregnant or baby crabs are found, they must place them in the protected area. Though they harvest a great number of crabs, they must be release some back to nature. This represents the fishermen's labor contribution.

Considering stakeholders' participation in CBEM, all interviewees stated that they were fully encouraged by one another to engage in the process. A community leader, for instance, said, "All consensuses in each stage of CBEM must be made based on stakeholders' agreement; otherwise, any ecological practices would not be accepted and implemented by all sectors", and a villager added:

We were enthusiastically encouraged by community leaders to be involved in CBEM. We were often informed about ecological conservation activities. In the meeting, community leaders always asked members to express opinions and/or concerns. We could freely talk and expressed our thoughts and feelings.

Fishermen also indicated their active involvement in ecological management. For instance, one commented:

We are the group who should be responsible for ecological conservation because we have directly exploited ecological resources more than the others. This is why we always participate in ecological conservation activities. We consider other people's concerns. Though, we, sometimes, did not agree with other groups' opinion, we still accepted the majority voices.

The results of this investigation indicate that all stakeholders have engaged in CBEM at a significantly high level; namely, they can influence final decisions and have implemented CBEM by performing several ecological practices. This shows stakeholders' political power in CBEM.

CBEM's Implications for Development

This study has demonstrated the five stages of the CBEM creation process in the Nernkhor sub-district and the factors contributing to its success. The results of the content analyses demonstrated three significant contributing factors: stakeholders' awareness of ecological degradation, the perceived legitimacy of the resource management efforts, and active communication among stakeholders. Stakeholders' awareness of the area's ecological value significantly contributed to their desire to apply a new ecological management approach. As previously mentioned, the ecosystem of the Nernkhor sub-district has provided diverse resources necessary for people's well-being, and they have influenced communities' lives in many ways: professionally, as a venue for recreation, and in terms of the historical memory related to the sites. When people realize the scarcity of their resources, they have an incentive to take action to rehabilitate and conserve them. However, this motivation depends on people's perceptions of the level of resource degradation; it cannot be allowed to exceed the point of feasible improvement [28-29].

All stakeholders were dependent on the ecosystem services provided by the mangrove forests for supplementation of their livelihoods, and in the absence of protection and conservation measures, threats to the mangroves, such as the overharvesting of aquatic animals and wastewater discharge from shrimp farming and illegal logging, the public became concerned about resource scarcity. In short, the threat of scarcity of future ecosystem services such as fish, shellfish, and mangrove crabs significantly contributed to stakeholders' awareness, giving them the motivation to take action to conserve their resources [30].

Stakeholders' perceived legitimacy of mangrove resource management efforts were also significant for the CBEM's success. According to the 2007 Thailand Constitution, local autho-

rities have the right to manage natural resources, and citizens have the right to engage in environmental and natural resource management in their communities and to receive benefits from their communities' resources [31]. Therefore, local authorities and citizens can create appropriate systems to govern the use of mangrove resources [32]. Legitimacy is an important component of CBEM [13]. It influenced stakeholders' decisions to become involved in the decision-making processes and to accept the conservation rules [33-34].

The last factor for success is active communication among stakeholders. As Gruber [35] noted, community is an important component of CBEM because communication among social actors contributes to social learning, which enables each actor to mutually understand the values and needs of each sector [36]. Thus, decision-making in an ecological management context relies on the considerations of all stakeholders' interests and concerns. These factors must be taken into consideration during the CBEM creation process.

Moreover, this study investigated how equity in politics, cost-sharing for conservation activities and socioeconomic benefit sharing of an ecosystem's services contribute to the success of a CBEM effort. Overall, the results demonstrated that all stakeholders were involved fairly in the cost and benefit sharing of the resource rehabilitation and conservation efforts, and engaged in all stages of CBEM. They were satisfied with their current benefits and their involvement in cost sharing and working projects. These three factors contributed to the success of the CBEM efforts in the Nernkhor sub-district. As Kellert [20] noted, to succeed in implementing community-based natural resource management, benefits must be fairly allocated, so as to maintain stakeholders' motivation and support. Abensperg-Traun [9] and Datta [2] also concluded that CBEM must allow community members to manage their own ecological resources, and to utilize those resources for the fulfillment of their

needs. In addition, the participation of each stakeholder in decision-making processes, ranging from problem identification to solution selection, community rule designs, rule enforcement and compliance, and outcomes monitoring, is also imperative [37-38].

The results of this study revealed that each stakeholder has equitable political power, and all can influence final decisions. This equity, Jacobs [21] notes, is one of important factors contributing to the success of CBEM efforts, as it potentially increases the perception of each stakeholder of the fairness of environmental decisions and ensures that diverse values and needs are taken into consideration [38]. In short, political equity and cost and benefit sharing must be taken into consideration to ensure successful long-term CBEM implementation.

Conclusion

This study presents two important aspects related to ecological management in a rural area. First, the study investigated the five stages of the CBEM creation process and success in the Nernkhor sub-district of the Rayong Province, Thailand. Second, the study explored the three key elements of CBEM. Semi-structured interviews and focus group discussions with relevant stakeholders, such as villagers, community leaders, fishermen, and local businessmen, were conducted; the results revealed that the Nernkhor sub-district has its own mechanism for managing its ecological resources. Three main factors contribute to the success of CBEM: stakeholders' awareness of ecological degradation, the perceived legitimacy of mangrove resource management efforts, and active communication among stakeholders. Moreover, the results of this investigation also revealed the significance of equity in politics, cost-sharing for conservation activities, and the sharing of socioeconomic benefits derived from the ecosystem's services. These were essential for the successful CBEM implementation.

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