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The Typical Intervention Systems of Natural Resource Management in Tonle Sap Lake, Cambodia: The Community Based and Modern Approaches

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Abstract

Tonle Sap is the largest freshwater lake in Southeast Asia, locating in the central floodplain of Cambodia. Owing to its special phenomena of reverse flow and hydrological patterns influenced by Mekong system, the lake is very rich in biodiversity, especially capture fishery resources. Furthermore, the lake is the main source of livelihoods for more than three million people inhabiting the area. Because of its importance for capture fisheries and other economic lucrative activities, and because there is a lack of immediate and appropriate management measures in place, the natural resources of the lake is degrading at a remarkable rate. One of the management issues clearly recognized is a poor enforcement of an active management intervention system that is able to provide regular and timely decision making measures for effective management of natural resources in the lake. This paper examines the typical intervention systems being practiced in Tonle Sap Lake, including the modern and local management approaches directly linking to natural resource management. What managers (government, NGOs officials and local communities) should do with the existing practices of decision making in order to enforce sustainable management of natural resources within the lake. By employing the participatory approach, approximately ten local and modern interventions were identified and assessed. The modern management interventions are being practiced by government agencies, namely rangers and fisheries officers, whilst the local ones are being conducted by the local community. Both categories of interventions were considered for further improvement to have effective and efficient applications suitable to the local context with an attempt to build capacity of the local community and government managers actively engaged in the protection of natural resources in the Tonle Sap Lake. The paper also outlines the challenges being encountered by the two systems of intervention.

Keywords: Local management intervention; Modern management intervention; Decision making, Participatory action; Natural resource management, Tonle Sap

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1. Introduction

The Tonle Sap Lake, situated in the central flood plain of Cambodia, is known as the largest freshwater lake in Southeast Asia. The lake is naturally influenced by the Mekong river hydrological patterns, causing seasonal reverse flows and providing a wide range of exceptionally productive habitats for aquatic fauna and flora (Lim et al., 2000; Lamberts, 2006). Likewise, the lake is home to a high biodiversity of fish (149 species), reptiles (Siamese crocodile which is nearly extinct), birds (11 globally threatened and 6 nearly threatened species), mammals and plants of approximately 200 species (Campbell et al., 2006; van Zalinge et al., 2011). The lake provides direct economic benefits to approximately three million people residing in the floodplain and indirect benefits to several million people in the country (Matsui et al., 2005). In terms of direct benefits, the lake yields capture fisheries with an annual production of approximately between 180,000-250,000 tones (DoF, 1999; Lamberts, 2001, 2006; van Zalinge, 2002). Because of the pool of diverse economic benefits, the lake now increasingly faces severe threats due to overfishing, destruction of flooded forests for agricultural and settlement purposes and fuelwood gathering, widespread of alien exotic species (Lim et al., 2004), pollution, and sedimentation which causes by upland deforestation (Neou and Lane, 2002).

In order to tackle the problems, the Royal Government of Cambodia (RGC) has made considerable efforts to conserve the lake's resources as well as its environment through several legislative instruments. These instruments include the designation of the lake as a World Biosphere Reserve (Mok et al., 2001), identifying multiple land use areas, establishing the National Biodiversity Strategy and Action Plan adopted in 2002 (MOE-RGC, 2002), enacting the sub-decree of community fisheries and establishment of Tonle Sap Authority (Taylor and Bouy, 2008). These legislative instruments have explicitly given a basic framework for concerned government agencies and a wide range of stakeholders to sustainably manage natural resources by applying the available management measures in the lake (Matsui et al., 2005).

Consequently, management is very challenging for the lake as the management systems are more centralized, although decentralized power has recently been devolved to the local community (FACT and EJF, 2002). The local community is seen to have less power contributing to the management of the lake due to poor arrangement and implementation of the decentralized policy (DoF and IMM, 2004). Further, the government has set up and deployed its line ministry staff to manage and exercise the management measures on the natural resources in the lake. The operational staffs consist of fishery technical officials and environmental rangers to manage fishery area and core area of the biosphere reserve respectively (Neou, 2001). These officials and rangers have conducted the

management interventions as well in the form of law enforcement such as crackdown of illegal activities, and awareness raising only (ADB et al., 2004), but have considered little the existing local interventions practiced by local community living on the lake.

However, for over a decade there have been conflicts and issues on the management of fishery resources among government official managers, fishing lot operators and local fishers in the lake (Baran and Myschowoda, 2008). The government managers have exercised their power and duty in the form of patronage system like suppression of anarchic activities, reporting to their line ministry on resource situation, protection of fish sanctuary, record of fish yield of commercial fishing lots during open season, and carrying out awareness raising. Although, local fishers are given the rights to manage the fishery resources, they still find that their right and responsibility are limited and not actually recognized by the relevant officials on the lake (FACT, 2001; FACT and EJF, 2002). Moreover, co-management approach was also exercised, but it has remained slow progression due to new practices of community-based resource management and a lack of coordinated fashion among the stakeholders

With regard to strengthening law enforcement mechanisms and the implementation of the National Biodiversity Strategy and Action Plan adopted in 2002, the RGC initiated two projects for management of Tonle Sap Lake. These projects are entitled “Tonle Sap Environmental Management and Tonle Sap Conservation” funded by an ADB loan and UNDP respectively and implemented by the Ministry of Environment from 2005 to 2011 (TSCP-UNDP, 2005). The two projects have included management intervention and monitoring programmes, which are being executed in the lake. For the former, the management intervention programme was concentrating on five features - vegetation, fish, wildlife, land use change, and sanitation and solid waste management. The project worked with fishery officers and selected members of local commune councils, and community fisheries. The latter worked with environmental rangers and community-managed protected areas, particularly located in core areas of Tonle Sap Biosphere Reserve with the backup support of WCS (Wildlife Conservation Society), which has been working in Prek Toal core area for protection and conservation of waterbirds and natural resources. From 2009 onwards, the conservation activities were expanded to two other core areas, namely Boeng Tonle Chhmar and Stung Sen. With project support, WCS has developed monitoring protocols for a number of biodiversity features such as invasive species, birds, snakes, turtles, and crocodiles, as part of management intervention implementation into which the monitoring produced the data. Data collection was undertaken by paid rangers recruited from the local people (WCS, 2007; Clements et al., 2007) with guidance and backup support by WCS experts through regular visitation to the core areas. The data from the monitoring were used for various purposes, such as management interventions, but with a lack of standards.

Consequently, intervention measures being practiced in the lake were reportedly ineffective because there have been no appropriate intervention mechanisms in place and the projects were in its pilot phase (Seak et al., 2011, 2012). In addition, different strata of local community people have not been involved in every phase of the design and implementation of management intervention processes. However, community people from community fisheries and community-managed protected areas were also informed of the interventions being implemented in the boundary of their community areas. Their local knowledge systems, useful for interventions, were not included; community people expressed difficulty in applying and adopting the new systems, which they have never practiced (Ishikawa et al., 2008). Many case studies in developing countries around the world plausibly ascertain that local management interventions are useful for natural resource and biodiversity conservation and protection (Andrianandrasana et al., 2005; Danielsen et al., 2005, 2007, 2010; Steinmetz, 2000; Gray and Kalpers, 2005; Uychiaoco et al., 2005; Rijsoort and Zhang, 2005; Steinmetz et al., 2006). Involvement of locals for the implementation of these interventions appeared to have been great success and sustained over longer-term period (Danielsen et al., 2007, 2010). For Tonle Sap Lake, there have not been such studies to explore and comparatively assess these management intervention systems as to whether the systems could generate the firm guideline, tools and techniques of efficient decision making, and lead to produce firm management interventions which can be implemented for the purpose of sustainable natural resource management in the Tonle Sap Lake.

Therefore, this research study aimed to enhance management mechanisms through exploring the existing interventions being practiced by government, NGOs and local communities in Tonle Sap Lake, particularly the study site (Boeng Tonle Chhmar core area). Each existing local interventions were also assessed based on the perspective of meaningfulness, effectiveness, efficiency, suitability (social, political, ecological and livelihood), satisfaction, and benefit, and constraints and opportunities for execution.

2. Research Methods

2.1 Study Area

This research study was undergone in Boeng Tonle Chhmar lake (BTC), covering an area of 14,560 ha officially designated as one of Tonle Sap Biosphere Reserve's core areas (MOE et al., 2002) (Figure 1). Administratively, the study site is situated in Peam Bang commune, Stuong district, Kampong Thom province. The lake was considered as the targeted research area because of its unique and richness in fishery and bird diversity, economic

activities and conflicts of resource uses between government institutions, fishing lot owners and the local community. Moreover, a system of community based natural resource management existed in the area, in which three community fisheries and one community-managed protected area, was legally formed in 2001 and 2005 (Seak, et al., 2005, 2011), and some form of government officers-based management interventions supported by UNDP funned Tonle Sap Conservation Project.

With regard to natural resource endowment, Boeng Tonle Chhmar Lake is characterised by open water area and its creek systems associated with lowland flooded vegetation, providing for an excellent habitat for aquatic fauna with high reproductivity. BTC has three different and overlapping management zones: the core area of World Biosphere Reserve, Ramsar site, and fishing lots (lots 4, 5, 6 and 7). With funding support from UNDP for Tonle Sap Conservation Project, a ranger post was built in 2006, aiming to protect the lake in terms of patrolling and raising awareness on biodiversity conservation, and sustainable resource use to local fishers.

Of course, Peam Bang commune, the study site which is divided into five registered villages, namely Peam Bang, Pov Veuy, Daun Sdeung, Balot and Pichakrei. Pov Veuy and Pichakrei are situated outside the boundary of BTC core area, but villagers have used the lake extensively for livelihood activities, above all being fishing (Figure 1). As of 2009, there were 559 households in this commune, of which 193 are in Peam Bang, 98 in Daun Sdeung, 105 in Pov Veuy, 87 in Balot and 76 Pichakrei villages with a total population of about 3,000 people. During fishing season (November-May) the population may triple. Ethnic Khmer are predominant in this commune, followed by Vietnamese; here are around 30 Vietnamese households in Peam Pang village. Villagers live on floating houses made of boat and bamboo rafts, which are moveable according to seasonal water level changes influenced by Tonle Sap hydrological patterns. The major livelihood activity is largely reliant upon fisheries and other aquatic resources for which several community fisheries have been established to conserve these important resources.

Community based natural resource management was established during the 2000s after the Royal Government of Cambodia conducted large scale fishery reform, resulting in a release of more than 50% of commercial fishing concession for community use and management. Communities in Peam Bang, Daun Sdeung, Pov Veuy and Pichakrei villages are called community fisheries, which are under support of fishery officers and control of Ministry of Agriculture, Forestry, and Fisheries (MAFF) through Fisheries Administration (FiA). Whilst, community in Balot village was officially named as community-managed protected area that is supported by rangers and controlled by Ministry of Environment (MOE). Role, responsibility and general organization of community fisheries is governed by Law on Fisheries (passed in 2007 and Sub-decree on Community Fisheries

Management (passed in 2005) (FiA 2008). On the other hand, Community-Managed Protected Area is under Law on Protected Area Management (passed in 2008) (MOE 2008). Each community must produce by-laws and certain regulations for their administration and resource management, and then submit them to their line ministries for final approval. Some of management interventions were also outlined in the by-laws and regulation. During 2006-2010, these communities were financially supported by ADB-funded Tonle Sap Sustainable Livelihoods, and UNDP-funded Tonle Sap Conservation Projects. The technical support was given through the rangers and fisheries officers stationing in the area.

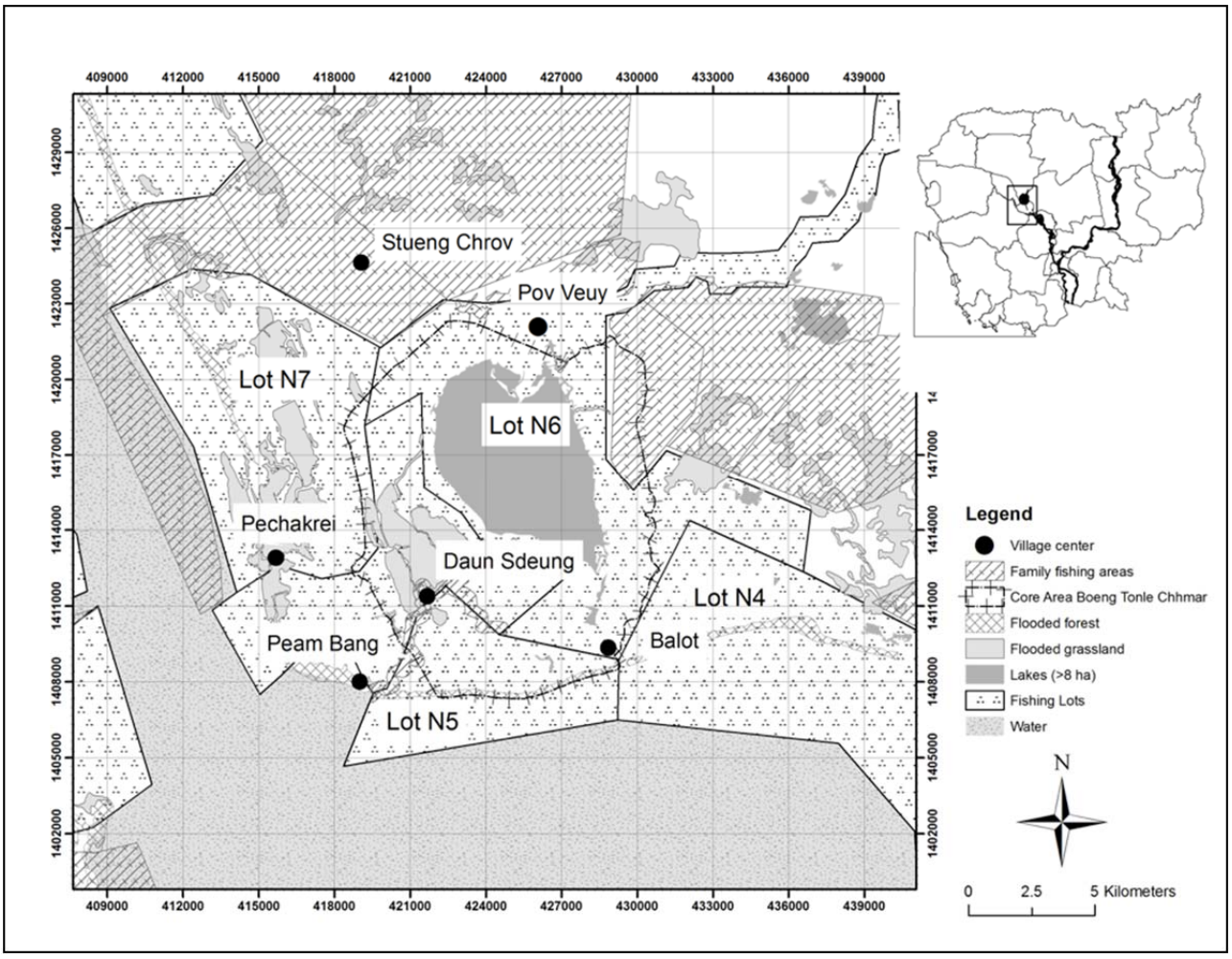

Figure 1. Boeng Tonle Chhmar core area: flooded forest cover, different management zones (core area, commercial fishing lots, community fishing ground) and village centres.

Source: Seak et al. (2012)

In addition to community-based organizations, there are two government agencies that have been deployed for day-to-day management of natural resources in the lake. MAFF through its line agency of FiA has established a

unit called “Peam Bang Sangkat Fisheries” (the smallest unit of FiA)[†] and assigned about five fisheries officers for this unit to control and manage the commercial fishing concessions and fishing related activities within the lake. The implementation of management interventions and relevant activities by fisheries officers was governed by the Law of Fisheries. MOE has placed approximately ten rangers to control the core area. The major roles and responsibilities of rangers are to manage and carry out conservation related activities within the boundary of core area alone, but they may need cooperation of inter-agencies as well. MOE rangers exercise management interventions based on Law on Protected Area Management.

2.2 Data Gathering and Analysis

In response to the analysis of the research objective, the study employed both qualitative and quantitative methods, using the following tools in a step-wise process: 1) key informant interviews; 2) focus group discussions; 3) household questionnaire interview; and 4) researcher observation. The field work was conducted in 2009, involving with several groups of stakeholders in the study site.

Key informant interviews were held in the first quarter of 2009 with 54 key informants selected through purposive sampling to represent five groups of stakeholders like rangers, fisheries officers, village heads, elderly villagers (fishers), and community members. Five rangers and four fisheries officers were chosen for interview on the general status of natural resource management, modern management interventions, constraint on implementation of these interventions (measures), and their technical assistance for community organizations in the study site of BTC. Ten key informants were the heads and vice heads of the five villages, providing information on natural resource management, traditional management interventions, and their support extended to communities in various capacities related to implementation of management measures. Twenty key interviewees (four from each community), which consisted of the heads of community fisheries/managed protected areas, were purposively selected from the five villages and interviewed concerning types of local management interventions (decision makings), enforcement, administrative structure of community-based organizations, by-laws and regulations, and community operation. Fifteen elderly villagers (older fishers, three from each village) were interviewed on traditional interventions, practices, and their experiences of participating in natural resource management in the study site. Furthermore, each group of stakeholders was carefully consulted about management measure tools and techniques for specific activities of natural resource management, as well as about labour, and time involved in

[†] MAFF is a mother agency of FiA, which is then hierarchically divided into inspectorate, cantonment, division and Sangkat fisheries.

the application of each measure, opportunities and constraints of the respective measures, local conditions, history of study site, ethnicity, population, assessment criteria and sustainability of local measures (management interventions).

Focus group discussions were held in the second quarter of 2009 with the primary purpose to synthesize the data on management interventions and assessment criteria gathered from each group of stakeholders and carried out in the key informant stage. To undertake this exercise, group meetings were held in each village with the three stakeholder groups combined: village heads and vice heads, active community members (from community fisheries and community-managed protected areas), and elderly people. Discussions with rangers and fisheries officers were arranged separately for their assessment and agreement on modern management interventions and criteria.

Household questionnaire survey was carried out with 149 sampled households including rangers and fisheries officers in the study area. The households were randomly selected from the fisher population within five studied villages using simple randomly sampling techniques. The purpose was necessarily employed to evaluate the degree of importance and practice of each interventions being practiced by local community. Furthermore, the questionnaire was also used to perceptively assess the management interventions against the six criteria and to determine which interventions have met these criteria and suggested for further improvement and greater implementation.

Researcher's observations were employed to verify and validate data collected and to detect hidden data on the status of natural resource management, types of management interventions and their practices, participation and cooperation of various stakeholders for suppression (intervention) that respondents were afraid to show up during interviews and group discussions. For this purpose, during three separate visits in March, April and June 2009, I spent time with fishers from each community, participating in their fishing, hunting, patrolling activities, and intervention enforcement processes in order to explore additional interventions and constraints.

2.3 Criteria for Evaluation of Local Management Interventions

In order to have logical thinking on each intervention by respondents, six criteria were proposed for perceptive evaluation. The criteria were designed based on literature review and discussion with rangers, fishery officials, and community people. The main purpose was to identify how many interventions were met with these criteria

and could be recommended for further improvement and implementation. By using the following criteria each proposed management intervention was assessed through participatory and household survey methods. These criteria are defined below:

1. Meaningfulness (Mf): It refers to the degree to which the interventions are understood and believed to be important for people (stakeholders) in the area (BTC Lake) and they are worth applying.
2. Effectiveness: (Ef): It refers to the degree to which the intervention actions are taken seriously with satisfied outcome and impact following formation until they are implemented on the ground.
3. Efficiency (Eff): It refers to the degree to which the interventions are easy to apply, ease of use with current capacity of concerned stakeholders, specially, in BTC Lake core area.
4. Suitability (Su): It refers to the degree to which interventions are suitable when taken into account the social, political, ecological and livelihood aspects of the study area.
5. Satisfaction (Sat): It refers to the degree to which interventions are satisfied by the concerned stakeholders (local community, ranger, fishery officer, and local authority).
6. Benefit (Ben): It refers to the degree to which interventions are perceived that they provide benefit to the stakeholders in terms of livelihood gain, social status, skill and knowledge, and empowerment.

Data on importance and practice of each intervention were analysed using the simple spreadsheet to find out percentage value corresponding to each intervention. In addition, data on perceptive assessment against the six criteria were analysed using a statistic test of Chi-square method (Fowler et al., 1999).

3. Results

The following results were analysed and classified into two major parts: local management interventions and modern management interventions. The local management interventions are being practiced by the community, while modern interventions by government officers (rangers and fisheries officers) in the study site. The findings are representatives of management interventions being practiced in the Tonle Sap Lake of Cambodia.

3.1. Local (traditional) Interventions (Management Actions or Decision Makings)

The local management interventions were drawn from the real practices of local community fishers in the study area (BTC lake) through participatory assessment. Moreover, these interventions were also consulted with several stakeholders such as environmental rangers, fisheries officers and NGOs workers in the area, providing reasons to distinguish between traditional and modern interventions. However, these two complement each other in real practice. These interventions have been practiced via a wide range of modalities, from individual person to collective action, by community fishers as they are given a legal status as local organization like community fishery and community-managed protected area. The collective action mostly applied for the interventions of suppression of illegal activities, demarcation of conservation area, etc. Table 3.1 lists the ten common interventions provided by the local fishers in practice in the study area. Each management interventions are arranged pursuant to its importance and practice as rated by respondents and discussed hereunder.

3.1.1 Locally based awareness raising to encourage fishermen to participate in protection and conservation activities

Large majority of the respondents (74%) reported this intervention, as it is effective in terms of handling the data/information emanated from the monitoring activities. It is crucially clear that the awareness raising would, however, require a great dimension of what are happening in the area so that one is able to make fishers believe to take part in conservation as well as protection of scarce biological resources. At this stage it is very useful that awareness raising could orient villagers about importance of natural resources (fisheries) upon which their livelihoods are reliant. The awareness raising is frequently undertaken during the village meeting with information not only coming from monitoring activities, but also from different sources that would enable the awareness campaign very strong and effective. Each fisherman who goes fishing every day is aware about fish and other resources declining in the area. Thus fishermen are willing to take part in conservation and management activities.

The conservation and management activities of natural resources can be effective only after some efforts. In order to be effective, typical awareness raising materials should be produced. Such materials include: poster and pamphlets of biodiversity (fish, bird, mammal, reptile that are being endangered) and showing that those are the sources of their livelihoods and prosperity. For the case in my study area, the community management team used reports of biodiversity and status of resource exploitation generated by monitoring during village meeting and

presented verbally to fishermen about trend, disturbance and natural resource management related activities in their territory.

Table 3.1. Local management interventions that were assessed by respondents in relation to its importance and practice

	Management Interventions	***% Respondents***
1	Locally based awareness raising to encourage fishermen to participate in protection and conservation activities	74
2	Locally based suppression of illegal activity	56
3	Locally based demarcating conservation area	37
4	Locally based improving cooperation with competent authority and adjacent communities	34
5	Locally based reporting	31
6	Locally based diversifying livelihood options	25
7	Locally based planning (including for patrol and surveillance)	24
8	Locally based conflict resolution	22
9	Locally based preparing regulation for benefit/resource sharing among community members	15
10	Locally based advocacy scheme and action	6

Note – the figure represents the relative percentage of respondents rating each local management intervention based importance and usual practice.

Source: Field Survey, 2009

Through belief, some other species are not harvested such as Giant Mekong catfish, fish eagle. They do not go for fishing close to the location of influential spirit (Neak Ta) by which it is respected by the fishers. Prior to fishing season, the adjacent villagers celebrate the festival for the spirit, asking for healthiness, prosperity and good catch of subsequent fishing seasons. For the effective conservation, it is also necessary to promote environmental awareness, education and outreach through schools and communities, for they are the ones who will take care of local natural resources. The awareness raising activities have been carried out by community organization, NGO, fisheries officer and ranger in the core area since the onset of establishment of community based organizations in early 2000s.

3.1.2 Locally based suppression of illegal activity

This intervention was also reported by the majority of the respondents of as many as 56% after the awareness raising, and it is common purpose of local community this intervention is undertaken in part with patrolling activities. The patrolling activities provide the factual and on-the-spot evidences leading to carry out an effective crackdown of illegal activities, as local fishers are aware of what are happening in their localities. During patrolling if the community people find any illegal activity of natural resource exploitation, they inform or report to the concerned competent authorities (ranger or fishery officer) for further action. After that the related officers will take necessary action (which will be discussed in Modern Interventions section of this manuscript). For small-scale anarchic offenses, community themselves is authorized to execute this activity on the scenes.

Nonetheless in some cases, they gather the community people to chase out the offenders from committing anarchic activity in their locality. By doing so they immediately suppress the illegal activities in their community fishing ground. In this regard, suppression of anarchic activity was formally developed and is being implemented in the study area with great success. The procedures of immediate suppression commonly practiced by local community in the lake are briefly simplified in the following and some of these were also adapted from modern interventions:

- *Giving advice or education:* This is applied to individual offenders who commit the first time illegal activity when being encountered during patrolling route or reported. At this stage, the offenders obtained brief advice and explanation by the community members (who are on a patrol route or at community centre) about applicable law and awareness raising on protection and conservation of natural resources. The offenders are not necessarily seized for further prosecution.
- *Dismissal of their membership in the community:* In case that the same offenders are found committing illegal activity several times after rehabilitation, they must not be allowed to retain their membership in the community, including preventing access to community fishing ground. However, this case rarely happens as noted in the study site.
- *Report in writing to competent authority:* It is applied to those who failed to abide by the above said procedures. S/he is filed to competent authorities such as rangers, fishery officers for further legal prosecution. That officer can apply their intervention procedures as discussed in a section of Modern Intervention. The community is not in a position to file complaint directly to the court, because they are given no status as judicial police by Cambodia applicable laws.

3.1.3 Locally based demarcating conservation/protection area

In order to have effective conservation effort of biodiversity and natural resources for sustainable utilization, there is a need to establish a site protection (in-situ measure). The site protection is believed to host broodstocks of fish, reptile and related resources to reproduce. Therefore, the demarcation plays a very important protective measure as a physical distinction of fishing ground and conservation area. It also helps ease of management purpose, since fishers easily realize once they enter the protected zone accidentally. 37% of fisher respondents claimed that this intervention was one of inevitably important measures to protect biodiversity and natural resources from outsider encroachment and disturbance. For instance, in Balot community-managed protected area (same as community fishery, supported by Ministry of Environment), a 27 ha conservation area was demarcated and community leader has arranged the active members for guarding the area. They guard the area by rotation, allowing other members to contribute equal time and resources for protection of an already demarcated area.

Similarly, other three communities (Peam Bang, Daun Sdeung and Pov Veuy) have also tried to follow the experiences from Balot Community-managed protected area. MoE and MAFF delineated the boundary of each community on the map since early 2000. But it is still limited in the map only; the demarcation on the ground was not carried out yet due to lack of financial and technical support. With information and data from patrolling, each community fishery is planning to delineate the boundary on the ground with support of Tonle Sap Conservation Project.

3.1.4 Locally based improving cooperation with competent authority and adjacent community fisheries/managed protected areas

Since the local fishermen and community people join hand together during the suppression and relevant management activities it is helpful in enhancing the cooperation within community and with external agencies and outsider/adjacent communities as well. By establishing community fishery/managed protected area, fishers as well as leaders have regular meeting and cooperation with local authorities (village, commune and district), ranger and fishery officer in the area to share information and resources, to devise management initiatives and take real action of what have been discussed and agreed upon among the community people and government officials. They need support from each other on specific aspects of resource management and exploitation. Each local organization needs to mutually share information for improvement of their management modalities and reporting.

For instance, transboundary conflicts of bordering communities over utilization of resources can be solved effectively and the case was not observed during the research period.

As a result, fishermen get the chance to receive technical and financial support from government agency, NGOs and donors. Fishermen also have the equal chance to meet and share their experiences and challenges with outsider community fisheries/managed protected areas. For instance, with support of ADB and UNDP projects, it gives an unprecedented opportunity for the government officials (rangers, fishery officers and line agencies) and local community to work together, through meeting, workshop, joint patrol, awareness raising, and joint conservation effort.

3.1.5 Locally based reporting

Patrolling activities by local community provide the basis of reporting as well. In accordance with sub-decree on community fishery/managed protected area, it requires that each community must produce a regular report (quarterly, bi/annual) and submit to line agencies for record of progress, addressing conservation and management, livelihood, and challenges encountered in their community, and how they could address the concerns. They sometime report orally to their community members during village gathering at village office. However, its importance of this intervention was fortunately rated by 31% (Table 3.1) of fisher respondents based on their current need and practice. It is because the reporting task was mostly handled by management team of community fisheries/managed protected areas and ordinary members are likely to be excluded from this action. In spite of having slightly low importance for daily practices, the local communities (fisheries and managed protected areas) need to report their activities together with resource conditions to their line ministries.

3.1.6 Locally based diversifying livelihood options

Another aspect of management intervention is a diversifying livelihood option for the community people in order to collectively divert the strong dependency on natural resources. Since, this management action is intimately linked with information on decline of natural resources largely due to anthropogenic disturbance. Further, as villagers in the area are largely dependent upon fishery resources and they live on the water year round, they hardly find any alternatives. Because the fishery resources have tremendously declined over the past years and fishers find difficulty to live on this single resource, they have come up with a wide range of alternative livelihood options such as, aquaculture, floating home garden, family scale animal husbandry, and micro enterprises.

With the glorious initiative of Tonle Sap Conservation Project, fishers are strongly encouraged to diversify their livelihood sources, such as floating home garden, animal husbandry, mushroom growing using water hyacinth biomass, and raising cage culture. As seen at the project site, many of fishers commenced applying the newly introduced schemes at the beginning. But small number of fishers still practiced the old method as the new method takes long process and slow production compared to capturing fish and directly selling to meet certain needs in the short term.

Other diversifications in the livelihood were promoting villagers to raise pig on floating houses, while sources of food from fish and aquatic vegetable are freely available in the area that are editable nutrient for pig raising. Many of fishers have purchased farmland in the nearby upland area in order to supplement the food shortage.

3.1.7 Locally based planning (including for patrol and surveillance)

This management action is frequently used in a coordinated fashion of data obtained from monitoring like patrol and community focus group discussion (meeting) that is used for management plan and daily plan for patrol and surveillance. This measure is also used to guide the management actions in their community fishing ground where strict protection is legally enforced. The surveillance was found practicing by Balot community-managed protected area and the activity is positioned in a delineated 27 ha conservation area for reproduction of fish, feeding and refuge of broodstocks (mother fish).

Similarly, as a result of monitoring, a comprehensive management plan of BTC core area was prepared by UNDP/GEF funded project in cooperation with Ministry of Environment, and Ministry of Agriculture, Forestry and Fisheries in December 2007 with the participation of local community. It was made with various interventions being practiced in the study area. The management plan also firmly emphasized the resource assessment and monitoring by which subsequent activities are correctly envisioned.

3.1.8 Locally based conflict resolution

Another locally practiced management intervention is related to conflict resolution. As in the study site, this action is very competitively useful for daily coordination and management of natural resources by the community since they are primarily pertinent to resource extraction. The conflicts commonly arise from detrimental encroachment of outsiders into community fishing ground, and among the fishers themselves on claiming space

for fishing as well as usage of fishing gear. Based on common practice and mutual understanding, local people informally solve the conflict with outside fishermen, who used to fish in the area before creation of community fishery or community-managed protected area. When outsiders fish, unintentionally, in community fishing ground, community people at the first stage inform and explain them about the boundary of their community fishing ground and conservation zones. They request not to invade any more, and inform that some part of this is allocated for strict conservation, i. e. broodstocks for reproduction.

Similarly, the local people create fine system for any illegal persons who destruct flooded forest whereas. They provide education to those people and equip with materials for fire protection.

3.1.9 Locally based preparing regulations for benefit/resource sharing among the community members

In the community regulation (statute or by-law), they have already identified and set out certain regulations. But those regulations are not so clear and the appropriate procedures to implement the regulations are not given, because they were produced with limited experiences of what is definitely meant by community fishery and community-managed protected area in their context. This management intervention is also closely linked with resource extraction chiefly based on capacity of individual fishers to exploit natural resources. For instance, fishers (rich) with better gear are able to capture large amount of fish, whilst fishers (poor) with traditional gear are unable to get more. Therefore, limitation on use of gear among them was informally defined, as rich fishers are obliged to go fishing at open lake (Tonle Sap Lake) and the poor to go fishing around village centre. The execution of this intervention is especially related to monitoring that provides information for updating the old regulation and to gain understanding on how to implement the regulations in reality.

From the traditional practices, fishers have information on resource allocation among their fisher folks. For instance, they recognize and share a location to lay the fishing gear. Fishing gear means location of fishing ground controlled by one fisher, and others could not invade if there is no suitable negotiation.

3.1.10 Locally based advocacy scheme and action

Advocacy scheme and action are necessary for the community people to gain proper power and rights for access to certain resource use and management. For instance, before 2000s community people in the study area as well as all over Cambodia carried out large-scale campaign on claiming the fishing ground, because they had had very

small ground to support the steadily growing family members. Because of the concerted efforts of fishers, government released approximately 50% of commercial fishing ground for community use and management. Nevertheless, this intervention is supported by the data and information generated by monitoring which is very much essential to construct this measure, because to be strong on advocacy issue required all pieces of information available in the area. In this regard, local people have real data and information about resource decline to argue with higher-level government officials and obtain secured access towards both financial and technical support. Many agencies have already supported different projects such as Tonle Sap Conservation, Tonle Sap Sustainable Livelihood projects, which were funded by UNDP and ADB, respectively.

Local people, supported by necessary information obtained from monitoring process, are brave enough to claim their rights over resource use. Similarly, they also claim to enlarge fishing areas for community and open access to community to travel across the fishing lots as in a case of fishing lot No. 6 covering the whole Boeng Tonle Chhmar Lake.

3.2 Modern Interventions (Being Practised by Ranger and Fishery Officer)

Fishery officers and environmental rangers design and implement several interventions based on information emanated from monitoring and based on the applicable laws and regulations. Such interventions are regarded as modern interventions as they are entirely based on the promulgated regulations and laws governing the natural resource management in the country. However, the set of terms of modern interventions are similar to those of traditional ones, the way of implementation is based on regulation and law and they are solely undertaken by government officers, for this case ranger and fishery officer. The modern interventions practiced by the fishery officers and rangers are discussed hereunder.

3.2.1 Awareness raising to encourage fishermen and other stakeholders to participate protection and conservation of natural resources

This intervention also goes along with monitoring activities, patrol. The awareness raising comprises of mainly environmental education, protection of natural resources, and importance of these resources for their livelihoods in the BTC Lake. It is carried out by ranger and fishery officer for community fishermen at each village and during patrol. The awareness raising is also conducted for those people who commit illegal activities. For this purpose, ranger and fishery officer used dissemination materials covering relevant law, sub-decrees and

regulations, and field guide. They often make the posters including such kind of materials and presenting the message for the conservation and management of natural resources and their rights of involvement. In addition, relevant NGOs that are working in the Lake have delivered a series of informal training for local communities and stakeholders about importance, status, and management of biological resources in the area. This action was carried out, preferably with community fisheries and community-managed protected area.

3.2.2 Law enforcement (suppression of illegal activity)

The law enforcement is the key component of designated duty of fishery officers and environmental rangers generally who are holding a status of official judicial police. The law enforcement is conducted as part of patrol or on the case-by-case basis depending upon the available information about illegal activities reported. Therefore, their role is to ensure that there is no illegal activity occurring in their jurisdictional area, while maintaining proper management processes. Data from patrolling such as incidence of illegal activity at the site, and resource disturbance are used for immediate crackdown and awareness raising/education, respectively.

The Law of Fisheries (passed in 2007) has provided the standardized procedure for the immediate suppression upon encountering illegal activity on the ground (see chapter 14 of the law: procedures for solving fishery offense) (FiA, 2007, 2008). Similarly, other laws and regulations like Protected Area Management (passed in 2008) (chapter 9: law enforcement and offense resolution; and chapter 10: natural resource offense and sentence) has also included such provisions (MOE, 2008), enabling the respective government agencies to implement each provision mentioned in the law. The procedures of immediate suppression commonly practiced by both administrations in the lake are discussed below:

- *Promise or warning letter*: This can be applied to any individual offenders who were found committing first time illegal activity when encountered during patrolling or reported. The degree of illegal activity is subject to be evaluated by on-duty guards, but not so serious, causing minimal damage to biological resources. Hence, the offenders have to declare in writing by affixing thumbprint before the head of division that they would not commit such an activity again. During the process of promise letter preparation, the offenders obtain brief advice and explanation about applicable law and awareness raising on protection and conservation of natural resources upon which they depend. Various advices on the morale and behavioural modes of legal resource exploitation by the officials were also made to offenders in such a way that helps rehabilitate the offenders.

- *Penalty or transactional fine*: If the same offenders are found committing illegal activity repeatedly, regardless degree of illegal activity, they must pay fine with certain amount as stipulated in articles 92 to 97 (Law on Fisheries), and 58-59 (Law on Protected Area Management). The fine is transferred to the national treasury office and certain amount of commission is deducted for use by division that administers the case. As practiced on the lake, 50% commission was allocated to the authority/officials involved in execution of the case, and used for operation of other interventions as well.
- *Court case for punishment (heavy fine or imprisonment):* This is applied to those who failed to abide by the aforementioned procedures and degree of damage to biodiversity is severe. The head of division who plays a role of judicial police has to make a minute about illegal activity with formal standard guideline of each administration. The complaint is filed attached with minutes of actual evidence seized from offenders and submitted to respective court for further judgment. Each administration has its own lawyers to administer the case with support of technical staff to defend the case. This procedure has several sets of legal documents for filing a complaint: 1) minute of offenses including list of competent officers joining the mission; 2) minute to arrest and confiscation of evidential equipment at the site of illegal activity occurring; 3) short curriculum vitae (CV) of offenders, detailing how many times he/she committed illegal activities; and 4) photos of offenders, physical evidence, and place of such activity occurs. Rangers or fisheries officers as judicial police can hold this case for up to 48 hours at the site. If the case could not be sent to provincial court for follow-up action, the responsible officer has to inform in writing the provincial prosecutor for necessary delay, describing the reason for such a delay.

3.2.3 Planning (including for patrol and annual action plan)

Planning is the first step of natural resource management and conservation initiatives. With no clear planning, it is likely impossible to achieve the goal of management effort. For implementation of this measure, various types of data and information need are obtained from different monitoring activities and are specifically used to improve management plan in BTC core area. The concerned agencies use the data obtained from the patrol as input for formulating the monthly monitoring activities. And these are also used to form the annual action plan by each agency (like environmental ranger and fisheries officer). By implementing this management action, the five year formal management plan of BTC lake was produced, chiefly concentrating on the key components such as protection of endangered species of bird, fish, reptile, mammals and favourable habitats; building capacity of rangers; and awareness raising and livelihood improvement for local community in order to divert heavy pressure on biological resources in the area (MOE and MAFF, 2007).

With information from the patrol, the MIST procedure (Management Information SysTem) was developed and has been used to record data on human use (including illegal activities), habitat damage and observable trend of biodiversity for analysis, which are then used to improve the MIST and management of the core area, including annual action plan and reporting. The rangers and fishery officers received extensive training during 2007-2009 by WCS experts before they were permitted to implement the MIST procedure. Furthermore, they have been foreseen by WCS experts in terms of technical support until 2012.

3.2.4 Technical Reporting

Under this measure, the reporting is not necessary producing immediate tangible action on the ground, but it serves as storable medium for what have been happing on the site. It provides a time series document for many actions to be taken by concerned government's agencies. For the case of rangers and fisheries officers in BTC, they use the data from the monitoring activities to prepare the periodic reports to their higher authorities. It is compulsory requirement of each agency that field officers must make reports whether monthly, quarterly, biannually or annually. Normally, fisheries officers, and environmental rangers produce monthly reports as requirement to their line ministries. The report doesn't only include the status of biodiversity, human use and habitat losses, but also their staff management, challenges and opportunity in fulfilment of field activities under their responsibilities. In this way, the information on natural resources of the particular area is compiled in the concerned ministry headquarters. The report is used as national database resources for further planning and decision making that the central government have taken seriously as could be seen for the case of large scale fisheries reform carried out by government in 2000. The reform resulted in release of more than 50% commercial fishing lots to local communities for subsistent livelihood and restoration of fish stock in the Lake (DoF and IMM, 2004).

3.2.5 Demarcating fishing lots, core area and conservation/protection area (fish sanctuary)

Clearly distinguishing boundary of exploitative ground and conservation area is also extremely important for effective management and apparent avoidance of chronic conflict among stakeholders. The demarcation activities were undertaken by rangers and fishery officers with participation of local community. The action to demarcate, not only the boundary of conservation area, but also fishing lots and core area, because there has been no clear boundary physically set up between each designated zone in the study area before 2008. There have been several cases of dispute per year related to boundary by which fishers accidentally entered the restricted zones. In BTC

core area as well as conservation zone the ranger and fishery officer assist community fishery/managed protected area to mark the zone and community fishing ground away from fishing lots. The frontier marking would effortlessly assist monitors to carry out their tasks smoothly, since they are able to easily identify any disturbance activities in the prohibited area.

The boundary of this core area was not physically marked on the ground since its establishment in 2001. But because of monitoring effort, the demarcation was rampantly done, especially for the fishing lots as noticed during the course of field survey in early 2009.

3.2.6 Preparing and updating regulations to improve management processes

In case of BTC core area, in general the rules and regulations regarding use and conservation of core area are created at ministry level. By carrying out the aforementioned interventions, they help to update the laws and regulation in order to tackle with newly emerging issues and problems. To guide the conservation effort, a five-year management plan (2008-2012) of BTC core area was formally produced with both financial and technical support of UNDP funded Tonle Sap Conservation Project (MoE and MAFF, 2007). Therefore, information fed up from execution of management actions would necessarily provide regular update of the plan in order to achieve its stated goal. It was fortunately reported that ranger and fishery officer do not always share data and joint activities between themselves prior to kick-off of donor initiated projects. By implementing the intervention programme, each agency has an opportunity to work together and gather similar information.

3.2.7 Conflict resolution for local community

Government agencies are involved in conflict resolution as well in their capacity as judicial police or mediator for the two conflicting parties. Conflict resolution is mostly half formal and informal, depending upon which mediators play role. The conflicts are those between fishing concessionaires and local community fishers, and with seasonal fishers, local authority, and ranger and fishery officer. The commonly used conflict resolution mechanisms explored in the area are preferably those of administrative and alternative dispute resolution (ADR), which was ranked to be highly effective mechanism. Local fishers are unaffordable to the court services, which require huge amount of budget to operate.

Through consultation with rangers, fishery officers and local community people, many of them supported the ADR mechanism as a conflict resolution process, because they are easily accessible whenever they need. This mechanism is mostly operated at local level, i. e. by local authorities and community. The common ADR mechanism being practiced in the study area is those of 1) Public consultation, 2) Negotiation, 3) Mediation, and 4) Arbitration as outlined by Mitchell (2002).

3.2.8 Improving cooperation amongst agencies and local communities

Government agencies, mainly rangers and fishery officers, are strongly encouraged to enhance cooperation with local authority, local fishermen and community people for the purpose of enforcing intervention process. They share information and concern with them. It helps them to come up with collaborative action such as suppressing illegal activity, meetings, hand on trainings, and workshops. Similarly, they need support from each other on different aspects of resource management and use. Government agencies also provide some support to the local fishermen. Through the project support, ranger, fishery official and local fisher have worked closely for the sake of protection and conservation of biodiversity. There has been an increase of remarkable events that these institutions have cooperated with each other on meeting, workshop and joint activities such as suppression of anarchical activities, tree planting, patrol, etc.

3.3 Local Management Interventions Applicable for All Concerned Stakeholders

Based on group discussion with community people, rangers, and fishery officers at the field, several interventions are proposed (Table 3.2) and each was already discussed in the previous sections. They were then addressed again in the questionnaire survey in order to obtain the reality and appropriateness on the typical interventions identified during the group exercise. For the purpose of this assessment, I converted the term management interventions from “locally based” to “participatory” as this significantly reflects the perspective, opinion and practices of all stakeholders in the lake.

Based on the value of Chi-square statistical test for each intervention we are able to identify the most important interventions that could be implemented favourably by all the stakeholders in the study area. Out of ten, the first five interventions are considered more applicable for implementation at local level than any others, since they almost fulfil the requirement of six criteria. These interventions are selected based on the lower value of Chi-square test, meaning that it is good fit of each criterion. Respondents rated each criterion with almost identical

value of intervention. However, the remaining interventions are also important and should not be ignored in the process of implementation, because they complement with one another.

Table 3.2. Proposed management interventions and assessment based on identified criteria

	Management Intervention	***Mf***	***Ef***	***Eff***	***Su***	***Sat***	***Ben***	***Total X^2***
1	Participatory improving cooperation with competent authority and adjacent communities	0.93	0.15	1.11	0.15	0.18	0.18	2.69
2	Participatory demarcating conservation area, fishing lots and fishing ground	1.39	0.60	1.89	0.03	0.26	0.39	4.57
3	Participatory diversifying livelihood options	2.13	0.32	1.88	0.32	0.27	0.27	5.18
4	Participatory awareness raising to encourage fishers to participate in protection and conservation activities	1.15	0.02	3.60	0.02	0.44	0.20	5.43
5	Participatory planning (including for patrol and surveillance)	2.14	0.18	2.26	0.32	0.01	0.75	5.66
6	Participatory reporting	2.30	2.50	1.09	0.06	0.50	0.41	6.85
7	Participatory advocacy scheme and action	4.21	1.40	1.74	0.06	0.42	0.00	7.84
8	Participatory preparing regulation for benefit/resource sharing among community members	5.99	1.36	1.73	0.14	0.06	0.41	9.68
9	Participatory conflict resolution	5.11	1.21	6.67	0.01	0.15	0.85	14.01
10	Participatory suppression of illegal activity	6.16	0.39	8.79	0.10	0.12	1.28	**16.85 a**

Note:

- Mf-meaningfulness, Ef-effectiveness, Eff-efficiency, Su-suitability (social, political, ecological and livelihood), Sat-satisfaction, and Ben-benefit.

- The values of Chi-square test presented in above table are not statistically significant at both 1% and 5% levels of significance for interventions 1 to 9 (Critical value of Chi-square at 1% is at 11.07 and 5% at 15.09).
- Therefore, Null Hypothesis (Ho) is not rejected, i.e. respondents had given equal value to all criteria and these management interventions carry same interests expressed by respondents (these management interventions significantly fulfil the criteria rated by respondents).
- **a**- it is statistically significant, thus Ho is rejected. Number of respondents rating each criterion is significantly different from one criterion to another. Therefore, this management intervention (suppression of illegal activity) meets only a limited number of criteria such as meaningfulness and efficiency to wide out the anarchic activities in their area.

Source: Field survey, 2009

The five interventions considered more applicable for implementation at local level are discussed hereunder.

3.3.1 Participatory improving cooperation with competent authority and adjacent community fisheries/managed protected areas

Table 3.2 shows that intervention 1 (participatory improving cooperation with competent authority and adjacent community-based organizations) has met all criteria, meaning that it is the best option for all stakeholders in the research site, because it is the primary requirement before any action of conservation and protection of biodiversity and natural resources can be carried out. To achieve this, it needs the smooth and active cooperation and coordination among the stakeholders working in the area. It was noted that there was previously a lack of cooperation platform between agencies (among rangers, fisher officers, local authorities and community people). This has brought a negative atmosphere over management of natural resources, protection as well as enhancement of livelihood issues for local fisheries. Before UNDP supported project, each agency rarely share data or information with each other, or undergo joint actions together. Because of this, many respondents admitted that there was an inextricable need of close cooperation with main stakeholders in the area. Through the project intervention as observed during the field survey, these agencies has gradually changed their modalities of work, i.e. they started working together on a number of initiatives like patrol, suppression of illegal activities, and awareness raising campaign.

3.3.2 Participatory demarcating conservation/protection area, fishing lots and community fishing ground

Regarding this intervention also, overwhelming majority of the respondents had given similar value to each criterion that it comes after intervention No. 1. It was assessed to be meaningful, worthy and efficient to apply in the context of Tonle Sap Lake. Most of the respondents were satisfied with this intervention and consider that this intervention will provide benefits to the local people and related stakeholders as well, because conflicts over natural resource management, use and protection came from the non demarcation of different zones like community, fishing lot and strict protection. Because of this, the stakeholders believed that this intervention should be carried out immediately and it is one of much needed mechanisms they were waiting for. This is suitable while considering various aspects such as ecological and livelihood aspects and not so difficult to implement with the involvement of the various stakeholders. As noticed during field work, demarcation of boundary for fishing lots, protected zones and community fishing ground were apparently being conducted actively with support of Tonle Sap Conservation Project.

3.3.3 Participatory diversifying livelihood options

Livelihood of local people is one of the major concerns, which to some extent depends on the natural resources of their areas where the resources are gradually declining largely due to overfishing/hunting, habitat destruction and pollution. Since livelihood of local community wholly depends upon natural resources (above all fisheries), they have no alternative sources of income they have placed strong pressure on such resources by maximization of as much benefit as possible. Thus the executed intervention of diversifying the livelihood was also rated highly with almost same value of each criterion by majority of the respondents, while reducing strong reliance on fisheries. It was considered as meaningful intervention as it is very important for the local people and provides direct benefits to them, as these would necessarily help them take more income opportunity with less dependency on natural resources in their locality. Community people as well as government officials and NGOs workers firmly supported this intervention, for they all realized that depending upon a single source of income like fish could not possibly feed them for the long future to come. Some of fishers in BTC lake reportedly bought farmland at upland area for rice growing, and others received the income restoration program and livelihood diversification program supported by ADB and UNDP projects in forms of floating home garden, family-scale animal husbandry, small scale aquaculture of herbivorous fish species, and skill provision.

3.3.4 Participatory awareness raising to encourage fishermen to participate protection and conservation activities

Based on Chi-square test value (Table 3.2), it shows that this intervention was also efficient, meaningful and worthy to apply. It also captures the aspects of effectiveness and suitability in its implementation. Similarly, the respondents expressed that they are satisfied with this intervention and they consider that it provides various benefits in terms of knowledge and opportunity to involve with conservation activities. Thus, awareness raising intervention could be the most effective one to encourage fishermen to participate in protection and conservation activities. As mentioned earlier, local villagers have had low level of education or knowledge about the importance of biodiversity upon which their subsistent livelihoods depend. They now realize that the resources are declining because their catch is reduced immensely, although their fishing effort was considerably increased. Therefore, fishers expressed their willingness to be trained on importance of biodiversity, conservation techniques, and various environmental issues in their localities and beyond.

3.3.5 Participatory planning (including for patrol and surveillance)

Planning is the key to any kind of management, use and conservation. Majority of the respondents suggested planning as one of the most applicable interventions. A large majority considered this intervention as meaningful; especially it results into overall management plan and daily plan for patrol and surveillance, for local community people have some prior skill on planning since their community was established. The planning for patrol and surveillance are very much required by rangers, fishery officials and community organizations in the study area, because with no planning these two activities cannot be undertaken efficiently. The planning would locate specifically the sensitive areas (with illegal activities, species with special protection or under endangered status, etc.) to be monitored, and estimate cost, set up schedule for involved members to carry out their task; while these organizations have limited resources, both financially and technically.

In regard to planning for patrol and surveillance, any illegal activity that directly/indirectly affects the biodiversity of the species must be controlled. Due to this reason majority of the respondents rated this intervention as the applicable intervention. It is highly meaningful as it is equally important for the concerned stakeholders to safeguard the natural resources in the area. Similarly, this intervention also benefits the various stakeholders in different ways such as increase catch for local community and commission for government officials (ranges and fishery officers) who conducted the tasks.

4. Discussion

The management intervention systems of natural resources in Tonle Sap Lake, Cambodia have been elaborated on the two types: local interventions and modern interventions. The distinction between these two systems is practically elucidated on basis of who carries out the systems. The local interventions are in fact being practiced by local community, but at any circumstance they need backed up support or legitimate cooperation of government agencies. While, modern interventions are practiced by government officers who have a designated role of judicial police. Yet, these two systems sometimes are reliant upon one another, depending on the specific situation and context in which these interventions are implemented. For the suppression of illegal activities, local communities apparently need a backup support of government officers, because communities are not specially given a status of judicial police. Similarly, for a case of "locally based livelihood diversification" also requires partial support from outsiders like NGOs and concerned government agencies, but decision to seek outsider support entirely depends on the dimension of newly created livelihoods. On the other hand, government officers do require labour and witness support of local communities in order to achieve their intervention goal, for there has been insufficient manpower to tackle with substantiated deteriorative issues and problems in relatively large area. It is agreed that many of interventions emanated from the monitoring activities that community people and government officers are engaged separately, but some others like law enforcement, planning and conflict resolution, etc. do not actually come from the monitoring, instead they were already constructed and formalized by central government agencies. The assigned officers are obliged to undertake these interventions with little deviation.

Based on Table 3.1, intervention No. 1 definitely obtains the highest preference by villagers in terms of current importance and necessity, immediately followed by No. 2. It is because in order to accomplish the common goal of sustainable management of natural resources, all stakeholders (villagers) have to understand the importance of resources upon which they depend and their participation and contribution are inevitably required as a priori condition. Also, the suppression of anarchical activities is urgently needed, as this intervention highlights the sharp and simultaneous actions to save the declining resources, and attracts greater public recognition and involvement. Other interventions remain critically important, since they are crucially beneficial to people's livelihoods, and are societally and practically sound measures. Indeed, the local management interventions inherently derive from traditional practices of artisanal fishers and hunters for generations, they are soundly meaningful and justifiable for localized context and practice. However, several others like suppression of illegal activities, reporting, planning, etc. are fairly partially adopted from modern ones with minimal justification

according to their context and practice. Their implementation practically requires coaching from outsiders (rangers, fisheries officers or external experts) at the kick-off phase, because local community has low educational background, for instance writing and reading technical reports or documents, design contents of report and plan, etc. The practices of interventions vary from one community to another wholly depending upon their capacity, resource, social cohesion and agreement among the active members of community. In this regard, local interventions are reasonably flexible and tolerable for case-by-case characteristics, particularly among the community members and recognized immigrant fishers. In other circumstance, the implementation may eventually hamper by the so-called external interference of influential people (government officials), and ownership they are granted to the community fishing ground. In general sense, in order that implementation of the local interventions to be successful and sustained over long-term aspects, their practice should be aligned with livelihood activities of local stakeholders, and especially the benefit offloads cost, including societal value and being proud of involvement in the executive actions (Danielsen et al., 2007, 2010).

Modern intervention system is overall relatively excellent for government executive structure of natural resource management in Tonle Sap Lake. It was reportedly modified from the French system and was begun practicing in Tonle Sap Lake for several decades, but has been updated corresponding to currently prevailing political and social situations that Cambodia has undergone several sudden shifts of regimes since 1970s. Many of interventions were not clearly spelled out in relevant regulations and laws, but they were integrated with roles and responsibilities of concerned officers, and required additional elaboration for proper and valid implementation. Subsequent ministerial Prakas (ordinances) and Sub-degrees of government on implementation of specific interventions are noticeably adopted thereafter. Of the above said interventions, the well-known one is law enforcement (suppression of illegal activities), as every government officer memorizes very well and intimates the already prepared procedural forms and practices from one regime to another since its adaptation (around 1960s). Other interventions appear to have had little interest, even though they were suggested. The implementation has not been coordinated in a formalized manner, many officers are intentionally directed to desperate effort on a measure of “suppression of anarchical activities of natural resource exploitation” in whatever way orientated to personal gain rather than natural resource management goal. As noted during the field work, the conduction of interventions varied from officer to another, although the implementation already precisely stipulated in the relevant laws (such as Law on Fisheries, Law on Protected Area Management). It is because that their work depends on execution of a particular intervention like “crackdown of illegal activity” with expectation of gaining commission for survival and amenity.

For the assessment of local management interventions applicable for all stakeholders in Tonle Sap Great Lake, I modified the terms from “locally based to participatory” as the assessment intended to receive perception as well as opinion from government officers in the studied area. Our chief purpose was to up-scale the local measures through participatory action which is likely to have greater success than do individual stakeholders carry out interventions separately. Hence, the participatory intervention means that it requires fair involvement and judgement of all relevant stakeholders on the common goal. Based on Table 3.2, five interventions have greater goodness of fit with almost all criteria assessed by all stakeholders in study area. The intervention No. 1 (participatory improving cooperation with competent authority and adjacent communities) has obtained best fit of all criteria. It is clear that the culture of cooperation among stakeholders has been very week and they all expressed the urgent needs to bridge the gap of inter-stakeholder cooperation as a high priority at current situation in Tonle Sap Lake before any interventions can be enforced successfully. Other interventions are also crucially significant and subordinately supportive to one anther.

Among the local and modern intervention systems, only has suppression of illegal activity had an already designed procedure for implementation by government officers. Others for both systems have not been documented clearly in the practical form, and their implementation depends on willingness and intention of community leaders and government officers. Therefore, the concerted effort should be paid on design of formal procedure for implementing interventions in each system. Further research, if possible, should be conducted to test the effectiveness and success of each management intervention in the real practices.

5. Conclusion

Both systems of management interventions are very useful for protection and conservation of natural resources and biodiversity in Tonle Sap Lake, as the Royal Government of Cambodia has recently undertaken a serious reform of the fisheries sector. The chief shift is a cancelation of commercial fishing concessions in Tonle Sap Lake, which are now set for local community uses and conservation. In order to ensure the sustainable management of natural resources in this new context, both local and modern interventions are urgently needed and well institutionalized into community based organization (community fisheries and community-managed protected area). The local management interventions discussed in this study are seen to be vital to serve this purpose.

Each management intervention practiced in the study area had its unique characteristics of protecting and conserving the natural resources. The local interventions were used by local community for all circumstances to protect all types of biodiversity features ranging from fish and birds, to reptiles, mammals and vegetation, whilst modern ones do similarly as well, but they are conducted by government officers. However, the applicability may have been limited for the specific situation of natural resources and biodiversity under protection. Moreover, each measure helped serve the purpose of natural resource management and biodiversity conservation. When properly designed and well enforced, these interventions were capable of being employed as an excellent model for long-term management and strategic planning requirements when many sites adopted the methods of good practices derived from Boeng Tonle Chhmar Lake.

Based on the analysis, five management interventions were considered more applicable for implementation at the local level of stakeholders, not only at the study site, but also the whole Tonle Sap Great Lake. These interventions included improving cooperation with competent authorities and adjacent community-based organizations (community fisheries and community-managed protected area); demarcating conservation and protection areas; diversifying livelihood options; awareness raising to encourage fishers to participate in protection and conservation; and participatory planning (including patrol and surveillance). These interventions are very vital and necessary at this stage in order to protect and conserve biodiversity and natural resources in the area by the time they are being under severe threat and need immediate measures. However, other interventions are considered to be slightly applicable as well, but their implementation needs careful consideration, and sufficient back up support in terms of technical, financial and legal aspects from the government, NGOs and relevant research institutions.

However, each management intervention has its own particular weaknesses and constraints, which may partially hamper implementation. For instance, the local interventions discussed earlier have been practiced by local community with little support by government officers, and community key members are not granted a status of judicial police. When implementing such a serious intervention like crackdown of anarchical activities, community sometimes receive considerable intimidation and serious aggressiveness by the offenders. The modern interventions have faced some limitation for implementation since there has been a lack of central government support in terms of funding and facilities used for the purpose. The government officers on duty are reliant on the commission allocated from confiscation of illegal activities. In general practice, the implementation of each intervention is wholly dependent upon the willingness and common practices of local people, government officers and specific ecological settings. In other circumstances, the continuation of intervention implementation needs

external support including finance and technicality. These constraints and weaknesses could be accomplished through the following: 1) compilation and manipulation of each intervention with assistance from experts in order to polish each intervention for easy conduction in the form of the design of logical procedure, enhancement of method, and time intervals for implementation; 2) requirement of producing regular reports on the situation of natural resources and biodiversity by individual communities and government agencies as required by current regulations; 3) improve cooperation and exchange of data of interventional results and interventions among and between communities, government officers and interested individuals who want to apply them in their areas; and 4) provision of appropriate backup support on technical and financial aspects to the communities and government officers by donors, universities, government and charities.

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