Incorporating Fisheries Management into Biodiversity Conservation Policies to Enhance Effectiveness of MPAs: A Case Study in Cu Lao Cham MPA, Vietnam

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A Marine Protected Area (MPA) was established in Cu Lao Cham in central Vietnam in 2005 with the main objectives of conserving the marine biodiversity; protecting and effectively exploiting the ecosystems, natural resources, environmental and cultural-historical values for sustainable development; and improving the livelihoods of households in and around Cu Lao Cham Marine Protected Area (CLC MPA). Cu Lao Cham, which is part of the Cham Islands, is located in the South China Sea and administered by the Municipality of Hoi An in Quang Nam Province of central Vietnam.

In order to assess the efficiency and effectiveness of an MPA, it is necessary to understand the extent of involvement and the perceptions of the stakeholders regarding the establishment and management processes of MPAs. A case study was conducted to assess the effectiveness of the Cu Lao Cham MPA. This was done by carrying out face-to-face interviews to ascertain as a social indicator, the perceptions of local communities of the objectives of establishing the CLC MPA, and to subsequently evaluate its effectiveness. In order to verify and confirm the results of the perception survey, the four-year time series data from the area's logbook program was used to determine the trend of catch per unit effort (CPUE) as a biological indicator and net profit derived by households from fishing as an economic indicator. The results of the analysis indicate that there exist some forms of linkages between the ecological, social and economic issues which may give insight into the direct and immediate consequences of MPA management. Furthermore, based on the performance of the ecological, economic and social indicators it could be gleaned that the CLC MPA may be achieving some level of success and may also be one of the few well-managed marine protected areas in Vietnam.

Marine Protected Areas

Marine protected areas (MPAs) can serve as examples of an integrated approach to the management of coastal and marine areas. However, the success of MPAs in terms of management, may be determined if the management objectives are essentially and appropriately defined (Ward and Kelly, 2009). In addition, Claudet *et al.* (2006) cited that regular monitoring of the operations of an MPA to determine whether objectives are met is essential to evaluate the effectiveness of an MPA. The use of indicators (measurable quantities), reference points (benchmark values), and performance measures for each MPA (Sainsbury and Sumaila, 2003) are necessary to achieve the objectives.

It should be noted that many studies have attempted to measure the biological and ecological influences in local waters within and around an MPA, as shown in the rapidly increasing application of bio-economic models in MPA management (Sumaila and Charles, 2002; Grafton *et al.*, 2005). However, aside from the biological and ecological aspects, an MPA also involves socio-economic and management performance (Himes, 2007). Furthermore, the objectives behind the establishment of MPAs often include ecosystem preservation, fisheries management, and development of recreational non-extractive activities such as "ecotourism" (Alban *et al.*, 2008). Therefore, it is critical

Map of Vietnam showing Cu Lao Cham

to properly take into account the many human dimensions of MPAs in evaluating their effectiveness (David, 2002; Pomeroy *et al.*, 2004).

One of the most crucial aspects of sustainable fisheries management is the need to reduce fishing pressure on coral reefs, which requires intensified implementation and evaluation of incentive-based conservation strategies such as enforcement, conservation rewards, and alternative income programs (Bruner *et al.*, 2001). An MPA could address such concerns as it may provide opportunities for increased employment and improved livelihoods of coastal communities from supplementary activities such as tourism that emanate from the establishment of MPAs (Ward *et al.*, 2001). The effective results from such livelihood opportunities could lead to the development of positive attitudes of local communities towards the establishment of MPAs. A significant linkage between the local people's attitudes and their perceived benefits has been established by Sekhar (2003) and Hans (2003) while McClanahan and Mangi (2000) and Sesabo *et al.* (2006) also showed that positive attitudes and perceptions towards protected areas could enhance compliance and participation in the management by local residents. Additionally, Sanchirico *et al.* (2002) cited that the reaction of fishers towards the management objectives of MPAs will have an influence in the effectiveness of the MPAs. Nevertheless, many marine parks and other similar programs have been promoted to assist small-scale fishers but failed to achieve their social objectives because of inadequate understanding of the complex livelihood strategies and socio-economic conditions of the fishers (Cinner *et al.*, 2010). As a result, efforts to support the fishers through alternative livelihood activities could also bring about negative impacts to the fisheries resources and ecosystem. As exemplified by Walsh and Groves (2009), agricultural subsidy led to increased fishing effort in some households in Kiribati instead of decreasing it as planned. It is therefore necessary to investigate whether alternative income generation programs implemented in MPAs could create inverse impacts on the MPAs.

Many fishery scientists believed that MPAs could be one of few management tools that could ensure the sustainability of fish stocks and support reef fisheries, considering that the concept of MPAs is founded on the premise that fish population levels recover once fishing activities have stopped (Holland and Brazee, 1996). McClanahan and Mangi (2000) also indicated that one of the most important roles of MPA is to enhance the local fishery through the "spillover effect" to adjacent protected areas since enhancement could occur through natural dispersal of larvae from the protected spawning grounds (Bohnsack, 1998), and migration of juveniles and adults (McClanahan and Mangi, 2000). Many studies have been conducted on the role of a "spillover effect" of MPAs in enhancing the fisheries surrounding the MPAs. The popular theory of the "spillover effect" indicates that when fishing pressure from specific areas is removed and fisheries in the surrounding waters are regulated, the biomass will build up rapidly, and given the limited space within a marine reserve, fish will eventually 'spill over' into the areas surrounding the reserve, contributing to increased biomass in nearby fishing grounds and boosting fish catch in the fishing zones bordering the no-take zone (Polacheck, 1990; Alcala, 1998), eventually increasing the catch per unit of effort (CPUE) in that zone. A case-study of a marine reserve in the Philippines suggested the existence of a positive effect on catches in adjacent fishing zones (Russ and Alcala, 1996). Another study showed an increase in the CPUE in the St. Lucia Islands in eastern Caribbean, by comparing the CPUE of artisanal fishers before the creation of the reserve and five years later (Roberts *et al.*, 2001).

Enhancement of fisheries could also be understood in the context of the generation of positive economic rent or profits of managed fisheries by the fishers (Guzman, 2004). The results of the study conducted by Guzman (2004) indicated that only a small profit from fisheries was earned in the Baliangao Marine Reserve in southern Philippines. According to Pomeroy *et al.* (2006), the results from implementing an MPA should be considered in terms of increased income, food security and improved infrastructures in local communities. The economic effect from MPAs could also be demonstrated by a combination of increased in revenues when switching to more valuable forms of products and the changes in catch composition from smaller to larger fish (Sanchirico *et al.*, 2002).

It is therefore expected that the establishment of MPAs would bring about socio-economic benefits to local communities by sustaining fish stocks. Thus, in order to assess whether MPAs have created a positive impact on the

surrounding coastal fisheries, the use of social, biological, and economic indicators such as the perceptions of local communities on the MPA objectives, as well as on the possible increase in catch-per-unit of effort and net profit of local fishers who fish in areas adjacent to the marine reserves, should be taken into consideration.

The case study of the CLC MPA was intended to answer several relevant practical questions as to whether alternative livelihood activities in MPAs in Vietnam could be addressed by the MPA objectives and what impacts has the CLC MPA had upon the surrounding local communities; what objective should the CLC MPA focus on; and whether the CLC MPA enhanced the fish catch of the surrounding fishing grounds and generated intra-marginal profit. In addition, a question had also been raised as to whether establishing MPAs in Vietnam could be the right approach for the promotion of sustainable fisheries in Vietnam considering that MPAs are supposed provide direct benefits to the ecosystems through their contribution in the restoration of the overfished stocks, abate the risk of fish stock collapse, and provide an alternative to conventional fisheries management tools, which are closely linked to the benefits of ecosystem protection.

The Case Study of Cu Lao Cham MPA

Establishment of MPAs in Vietnam started in 2000 when the Government instructed the former Ministry of Fisheries to develop a master plan for an MPA Network for the whole country. Thus, a list of proposed 15 sites in the whole the country was created, but up to now only four MPAs have been established, these being the Nha Trang Bay MPA, Phu Quoc MPA, Con Co MPA, and Cu Lao Cham MPA. The establishment of the CLC MPA was made possible through decision No 4680/QD-UBND dated 19/12/2005 of the Provincial People's Committee of Quang Nam. The said establishment was also supported by the Danish Government through its two projects, namely: Support to MPA Network in Vietnam from 2003 to 2006, and Sustainable Livelihoods in and around MPA (LMPA) from 2006 to 2010.

The CLC MPA covers an area of 6710 ha and comprises both protected marine waters and an island nature reserve. The terrestrial area includes 595 ha of protected and 790 ha of rehabilitation forests while the marine component embraces approximately 165 ha of coral reefs and 500 ha of sea grass beds. Coral reefs, sea grass beds, rocky shore, sandy bottom are the important habitats in the waters around Cu Lao Cham Islands, of which, coral reefs and sea grass beds are considered the most productive ecosystems.

The Cu Lao Cham archipelago comprises eight islands but only the main island Hon Lao is inhabited. The population of Cu Lao Cham is about 3000 in 600 households clustered in Hon Lao Island (Hien *et al.*, 2006) and distributed in four villages, namely: Bai Lang, Thon Cam, Bai Ong, and Bai Huong. The inhabitants on Cu Lao Cham are very vulnerable as their only source of income comes from the natural (mostly marine) resources. More than 85% of the households earn their living directly from the marine resources or providing services to marine exploitation activities (McEwin, 2006).

The fisheries in Cu Lao Cham can be characterized as multi-species and multi-gear. Fishing is by far the most important socio-economic activity on Cu Lao Cham, where over two thirds of the households in Bai Lang community and approximately 87% in Bai Huong considered fishing as their main occupation, and in fact approximately 90% of all Cu Lao Cham households earn some of their incomes from fishing (McEwin, 2006). Over half of the fishing households on Cu Lao Cham own boats with engines (McEwin, 2006), which are very small and in general with horsepower capacity ranging from 6 to 20 Hp while only two vessels have 125 and 150 Hp capacity, respectively (Tilde, 2005). The average engine size of the boats is relatively small at 10 Hp (McEwin, 2006).

Different strategies are used by the fishers in Cu Lao Cham, such as operating with different combinations of gears, targeting different species, and going to different fishing grounds throughout the year. Since there are at least 14 main types of gears in the existing 215 fishing boats, many different combinations of gears are possible. Based on the Manual developed by the program on Assessment of the Living Marine Resources in Vietnam (ALMRV) in 1996, specifically on the definition of fleet by construction and fishing strategy, the main fishing fleets in Cu Lao Cham can be grouped into four main fleets, namely: driftnet (120

fishing boats), lift-net (33 fishing boats), long-line (54 fishing boats), and diving (7 fishing boats).

In order to manage the Cu Lao Cham MPA and achieve the objectives, Zoning Plan and Management Regulations were issued through Decision No 88/2005/QD-UBND dated 20/12/2005 by the Provincial People's Committee of Quang Nam. Under this decision, specific zones are regulated as extremely protected zone (core zone), ecological rehabilitation zone, and controlled development zone. Therefore, activities such as those that disturb the environment and ecosystem; create negative impacts on the marine species community, habitat, breeding and growing areas; and the use of dynamite, chemicals, electricity, poisonous chemicals and other destructive activities, are prohibited in the CLC MPA. In support of the biodiversity protection objective, alternative livelihoods have been introduced in the Cu Lao Cham MPA such as environmental quality improvement, tourism development, fish sauce and dried fish production, handicraft production, agriculture development, and public awareness raising activities.

Perceptions of the Local Communities towards the Objectives of MPAs

How the fishers respond to the management objectives of the MPAs will have an influence on the effectiveness of the MPAs (Sanchirico *et al.*, 2002). Alban *et al.* (2008) summarized the general objectives of establishing MPAs as: (i) ecosystem preservation; (ii) fisheries management; and (iii) development of recreational non-extractive activities such as "ecotourism". Many studies have been conducted on the perceptions of stakeholders towards the objectives of MPAs. In the study conducted by Mangi *et al.* (2008), the perceptions of stakeholders towards the objectives of MPAs in Southern Europe were ranked in accordance with the importance of the objectives of MPAs. In the case of Vietnam, the most common reasons for MPAs establishment were conservation and livelihood improvement, where it had been expected that livelihood improvement would support the conservation objective and reduce the fishing pressure near the MPAs. Therefore, the questionnaire used for this case study was aimed at assessing the perceptions of local people on the importance of the livelihoods improvement objective of the CLC MPA and evaluate its effectiveness. The survey employed the Likert scale techniques (Pomeroy *et al.*, 2004; Shafer and Benzaken, 1998) where the responses on attitudes and perceptions of local people were quantified. The questions included in the survey concerning the objectives of marine protection, had provided the respondents with a list of five specific objectives, whether (1) MPAs protect the marine biodiversity from destructive activities; (2) prevent over-exploitation of marine aquatic species; (3)

improve or sustain yields in adjacent areas; (4) promote the development of tourism; and (5) improve the livelihoods of local communities. The respondents were asked to rank how they perceive the objectives of Cu Lao Cham MPA in terms of importance by using the cardinal number 9 for the most important objective, 8 for second most important, and so on, and 1 for the least important objective. Furthermore, additional questions were asked to look into the perceptions of local people on the values and effectiveness of the Cu Lao Cham MPA.

Semi-structured and key informant interviews were carried out with 90 household respondents of the total 600 households in Cu Lao Cham Islands, to examine the perceptions of the local communities on the establishment of the CLC MPA. The 90 households was the sample size which corresponded to the level of $\alpha = 0.1$ and the acceptable Margin of Error of 0.03 for a continuous data set (Bartlett *et al.*, 2001).

The information collected one year before the establishment of the CLC MPA in 2005 and until the end of 2008, which included the quantity of fish catch using selected fishing gears, starting and ending day of the fishing boats' trips, fishing effort levels, prices of fish, types of target species, variable cost for each trip, and other pertinent data on the CLC MPA, was obtained from the Log Book System of the Cu Lao Cham Islands, and considered as part of the

secondary data for the case study. The Log Book system of Cu Lao Cham Islands was started in 2005 to collect information that include the names of boat owners, capacity of fishing boats in horsepower, fishing gear used, variable costs for each trip, starting day and ending day of the trips, fishing grounds, water depth, species caught, production quantity in kg, and selling price. The logbooks were provided to 80 households of the total 600 households in 2005 and 2006 but this was reduced to 40 households from 2007 up to now. The samples were distributed randomly for fishing fleets which have the same gear and horsepower.

The data in the logbooks were collected monthly and stored in a database. Additional surveys were also carried out from 50 households to gather information on investment costs and fixed costs of categorized fishing fleets in Cu Lao Cham Islands, the economic situation in general and total fishing days, 40 of which had been selected as samples for the Log Book Program and 10 households were selected on a random basis.

After the survey, the perceptions of the local people of the objectives of the Cu Lao Cham MPA were ranked by averages as shown in **Fig. 1**. The results specifically showed that there was a significant difference in the scoring of the different objectives of MPA (ANOVA: F-value = 27.97, p-value = 9.63E^{-21}) among all respondents. While the objective on tourism development for establishing an MPA was scored the highest with mean of 7.19 out of 9.00, biodiversity protection was ranked the second most important objective with a mean score of 7.01, while livelihoods improvement was ranked the least important with a mean score of 5.60 out of 9.00. Moreover, in terms of importance the scores given by the local people for over-exploitation prevention and yield improvement were also low with mean scores of 5.80 and 5.50, respectively, although these were higher than the normal score. The result of weighing the importance of the objectives of Cu Lao Cham MPA is surprising, since the objectives of the CLC MPA emphasized on biodiversity conservation and livelihoods improvement. Although the local people ranked biodiversity conservation as a major objective of establishing the MPA, the objective of livelihoods improvement was ranked as the least important. This reality could be due to the fact that community development activities attached to awareness raising programs have been implemented strongly in Cu Lao Cham (Trinh, 2006) participated in by two-thirds of the total residents on Cham Island, especially with regards to education-related activities on MPAs (Completion Report, 2006).

Moreover, almost all local people in Cu Lao Cham are aware of the role of MPAs in terms of biodiversity conservation as reflected in their high level of awareness

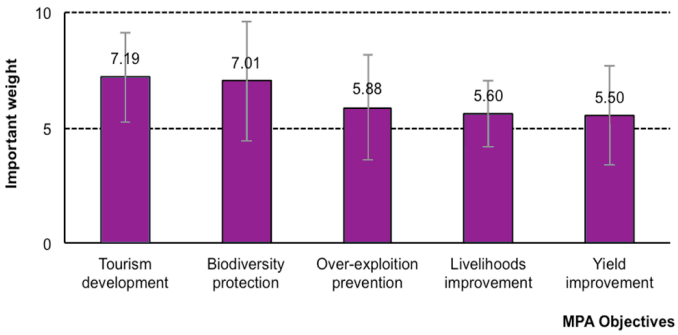

Fig. 1. Comparison of weights given by local people on the objectives of CLC MPA compared with normal score
Source: Perception survey of 90 households

and reaffirmed by about 53% of the respondents who also considered that enforcement and control were the most important factors that could promote the effectiveness of MPAs, while only 20% of the respondents thought that alternative income generation was the main factor that contributed to the effectiveness of MPAs. Consistent with the result of the survey, when the respondents were asked about the success of Cu Lao Cham MPA, only 44% agreed that livelihood improvement was a factor that led to the main success of the CLC MPA while 57% and 27% of the respondents agreed that the establishment of CLC MPA brought about stream of benefits in terms of increased tourism value and fish yield improvement, respectively.

Even with more than 80% fisher respondents who indicated their perceptions of the CLC MPA objectives, the result is contrary to those obtained from research conducted on perception of stakeholders towards objectives and zoning of marine-protected areas in Southern Europe. Fishers in Europe ranked fisheries management including over-exploitation prevention and yield improvement in adjacent areas as the most important objectives of establishing MPAs (Mangi and Austen, 2008).

The variation between the perceptions among the European fishers and those in the CLC MPA could be due to the fact that the approach of MPA establishment in Vietnam focused on biodiversity protection and livelihood improvement while not on fisheries management as in the MPAs in Europe. Nevertheless, although livelihood improvement is one of two objectives in the establishment of the Cu Lao Cham MPA, the result from the survey showed that the perception of local people with regards to the livelihood objective was very low, which suggested that local people on Cu Lao Cham Islands had no idea about the kind of livelihood activities they would like to be involved in, while simultaneously not considering fishing as a sustainable livelihood. This should be a main concern for MPA management in Vietnam as the success of MPA establishment depends on its objectives, and the perception of people towards the objectives of MPA is an important

indicator to measure the success of MPAs. Moreover, as expressed by 27% of the respondents, they will invest in fishing activities only when they can see that it is an alternative livelihood which will create increased income for their families and support livelihood opportunities even if fishing might not bring positive impacts on the improvement of the fisheries resources.

These issues bring back the question as to whether the objective of fisheries management has been overlooked when establishing MPAs in Vietnam since MPAs are supposed to enhance fisheries management in terms of providing direct benefits by contributing to the restoration of overfished stocks (Bohnsack 1996; McClanahan and Mangi, 2000), reducing the risk of fish stock collapse (Fogarty *et al.*, 2000), and providing an alternative to conventional fisheries management tools, which are closely related to the benefits of ecosystem protection. It is widely known that well-managed fishing activities could be a sustainable livelihood, in fact many research studies recognize the role of MPAs and fisheries management in increasing yields in adjacent fishing zones that include enhanced stock recovery and improved financial returns for artisanal fishers from trawl ban introduced in the Gulf of Castellammare in northwest Sicily (Whitmarsh *et al.*, 2002).

Fish Catch and Fishing Effort

Currently in Vietnam, it would be difficult to obtain very detailed fishing effort data, therefore "Boat-Fishing-Days" as effort unit has been used instead because this information could be readily available (ALMRV, 1996). Thus, CPUE was calculated for each fleet in 2005, 2006, 2007 and 2008 using the formula: $CPUE = H_{(ij)}/E_{(ij)}$, where CPUE is catch per unit of effort measured in kg/day, H_{ij} is the total catch by specific gear in the fleet in year i with the sample size j of log-book program, and E_{ij} is the equivalent for fishing effort measured by "Boat-Fishing-Days".

The annual catch of specific fleet was found by multiplying the mean CPUE of that fleet with total fishing effort which is measured as "fishing-days" in a year and the number of boats of the respective fleets. The annual catch of the fleet is described by the following equation:

$$H = Mean\ CPUE\ *e\ *n$$

where H is the annual catch in kg of a specific fleet; *Mean CPUE* is the average CPUE of the fleet in a year measured in kg/day , e is the total number of fishing days of the fleet in a year; and n is the total number of fishing boats of such a fleet.

Nevertheless, the present case study did not capture the spillover of individual species nor the whole assemblages from and into the MPA, which are important factors often considered in the planning of reserves. However, the increase in Mean CPUE of long-line and driftnet fleets from 2006 to 2008, specifically the increase in Mean CPUE of long-line from 21.97 kg/day in 2005 (before the CLC MPA was established) to 30.53 kg/day in 2008 (P values for driftnet, lift-net and long-line were 2.66 E^{-40}, 1.89 E^{-08} and 4.3 E^{-13}, respectively) obtained in this study suggested that catch from fish corals may be improving slightly in Cu Lao Cham Islands (**Fig. 2**).

Such findings could possibly have been the result of an improvement in the fish stocks brought about by increased availability of juveniles and adult fish, and presumably from improved recruitment due to the protection of the broodstock in the MPA. This result concurred with those from some studies on the trend of CPUE in MPAs such as the study conducted by Galal (1999) which showed that increased CPUE at fished sites within Nabq Managed Resource Protected Area, South Sinai, Egyptian Red Sea was observed two years after the establishment of No Take Zone and was statistically significant after five years, suggesting the No Take Zones may be benefiting the fishery through spillover (Ashworth *et al.*, 2005).

The annual fish yield per area in km^2 of Cu Lao Cham fishing grounds estimated in this study was 16.9 mt/km^2/yr. Although there is no data on the annual fish yield per km^2 in the MPAs in Vietnam, many studies conducted in marine reserves in the Philippines having similar tropical fisheries features as Vietnam, such as Apo Island (central Philippines) for example, one of the first marine reserves in the Philippines, it was reported that the fish yield was from 15 to 30 mt/km^2/yr (Alcala, 2001), Sumilon Island (southern Cebu in central eastern Philippines) could

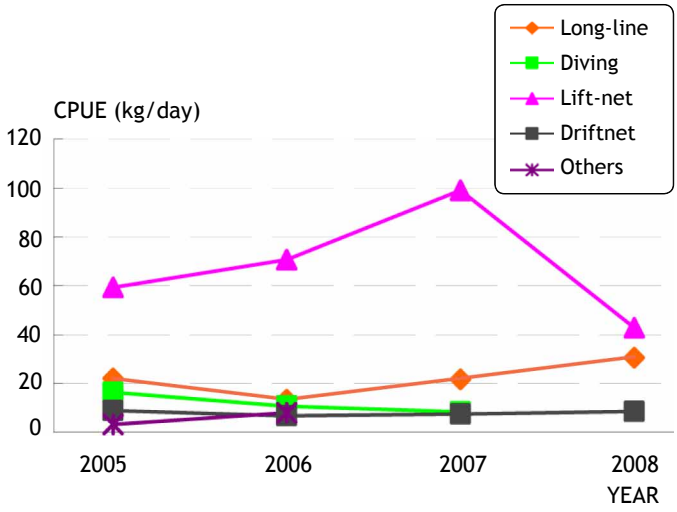

Fig. 2. Mean CPUE of main gear used in fishing fleets in Cu Lao Cham (2005-2008)
Source: *Cu Lao Cham logbook data*

sustain fish yield between 14 and 37 mt/km^2/yr (White and Trinidad, 1998), while the yield values from other marine reserves in the Philippines such as in the Selinog Island (Zamboanga del Norte in southern Philippines), Pamilacan Island (southern Bohol in central Philippines) and San Salvador Island (western Zambales in northwestern Philippines) were reported to be 6.0 mt/km^2/yr, 10.7 mt/km^2/yr and 14.0 mt/km^2/yr, respectively (Guzman, 2004). These figures seemed to indicate that the estimated fish yield by main fleets in Cu Lao Cham is a little higher than the lower limit of Apo Island's and Sumilon Island's fish yields, and much higher than the yields of other marine reserves in the Philippines.

Although no reliable data could be used to examine the change in abundance of the fishery resources around Cu Lao Cham Islands prior to the establishment of the CLC MPA, looking at the conclusion made by Tuan *et al.* (2004) and comparing their findings on fish yields with that of Cu Lao Cham waters, it can be gleaned that the Cu Lao Cham fishing grounds had been heavily over-exploited by local villagers and by 'outside' fishers. Furthermore, the marine resources in the coral reefs were also heavily exploited and as a matter of fact many of the commercially important species have now been declared as rare, endangered and critically endangered as supported by results of the survey conducted by McEwin (2006) which showed that the quantity of fish caught in Cu Lao Cham waters had been declining for several years while some species had completely disappeared. Also, 86% of the fishers reported that there had been a decline in fish catch during the last 5 years with most of them estimating a 30-50% decline.

In addition, the increase in annual CPUE of long-line fleet and driftnet fleet from 2006 to 2008, (**Fig. 2**) considering no substantial change in technological capacity (it was observed that the oldest fishing boats were built in 1990s and the newest was built in 2005) and comparing the annual fish yield per km^2 in Cu Lao Cham with other marine reserves in Philippines, seems to reflect that coastal fisheries of Cu Lao Cham could be on a transition path towards becoming a viable and sustainable characteristic of a well-established tropical MPA.

Incomes from Fishing

The annual fishing incomes by major fleets in Cu Lao Cham were estimated by subtracting the total annual variable costs, investment costs and fixed costs from the annual revenues. **Fig. 3** suggests that all major fleets had been operating profitably and that some fleets' operations had been more profitable than others'. Vietnamese fisheries has the characteristic of being open-access with no entry limitations, therefore the positive net profits from fishing in Cu Lao Cham from 2005 to 2008 are interesting. The findings could be explained by the fact that first, awareness raising programs for local communities and alternative income generation like tourism development has been implemented well with support from Government of Vietnam and the Danish Government through the project "Support to MPA Network in Vietnam" even before the establishment of Cu Lao Cham MPA in 2005 (Trinh *et al.*, 2006). This may have led to the fact that fishing boat numbers in Cu Lao Cham have not increased during the period 2005 to 2010. Secondly, the positive net profit within fleets in Cu Lao Cham could be explained by the concept of intra-marginal rent in open-access fisheries. This concept comes from the fact that an average vessel, in a group of heterogeneous vessels, could have higher fishing

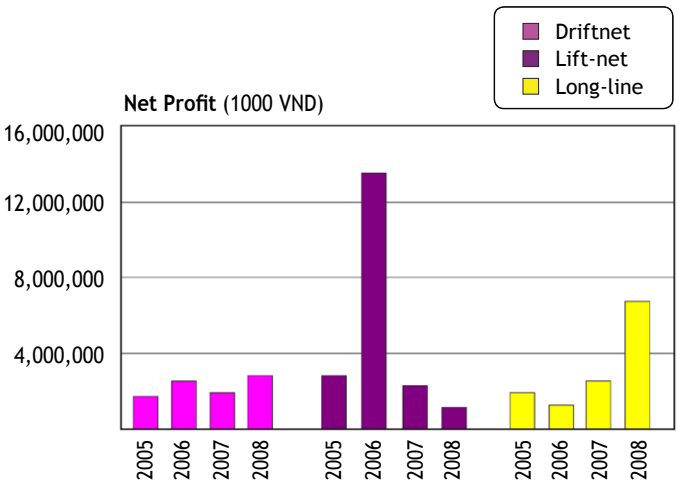

Fig. 3. Net profit of main fishing gears in Cu Lao Cham (2005-2008)
Source: *Logbook data and investment and fixed cost survey*

efficiency than that of marginal vessels with zero-profit (Long *et al.*, 2008).

Thus, the average net profit of driftnet, lift-net and long-line could be positive without contradicting the theory of open-access fisheries (Copes, 1972). The positive incomes from fishing activities together with the high perception of the local people in Cu Lao Cham on the tourism values that CLC MPA has brought to local community led the local people to believe in the effectiveness of the CLC MPA. This is reflected in the result of the survey which indicated that about 75% of the local people agreed that Cu Lao Cham MPA was effective, although only about 9% of the local respondents thought that the effectiveness of CLC MPA was "very good", but 66% ranked the effectiveness as "good". This can be confirmed with the findings of Sekhar (2003) and Hans (2003) that attitudes of local people were significantly related to perceived benefits.

With more than 85 percent of 3000 people living in Cu Lao Cham depending on fishing activities, the rough average monthly incomes from fishing of all gears per person was about VND 165,000 in 2005, VND 565,000 in 2006, VND 217,000 in 2007, and VND 347,000 in 2008. These figures show that the monthly income of fishers in 2005 and 2007 were below the poverty threshold of VND 200,000 and VND 260,000, respectively while the monthly income in 2008 (GSO 2005, 2006, 2007, 2008) was a little bit higher than the poverty threshold of VND 300,000 for rural communities in Vietnam. Although the monthly income in 2006 was more than double the poverty threshold, such income was not sustained over the years. This indicates that although MPAs had been established, the monthly income of people who depend on fisheries was still minimal. This completely matches the low perception of local people of Cham Islands with regards to the objectives of MPAs, especially objectives related to prevention of over-exploitation and fisheries resources improvement.

Discussion and Way Forward

Marine and coastal resources are among the most important renewable natural assets of Vietnam. However, these resources are under increasing pressure from the nation's rapid development, as the abundance and richness of marine species continue to steadily decline with marine habitats increasingly being degraded or lost. The fallout from these impacts on the marine resources and marine biodiversity are numerous and serious. Fish populations are declining throughout Vietnam's coastal areas and almost all inshore areas are overexploited, leading to economic hardships for millions of Vietnamese. Indications that marine biodiversity is in decline are widespread. Twenty-five percent of Vietnam's coral reefs are classified as

being "at very high risk" from degradation and habitat loss—the highest rate of more than 10 countries surveyed in Southeast Asia. Sea grass beds are similarly declining, threatening the livelihoods of the communities that depend on such resources. Mangrove forests, central to the biodiversity of marine and estuarine ecosystems as natural nurseries for a wide range of aquatic species, have declined from 400,000 ha in 1943 to 59,760 ha in 2008. Marine turtle populations have declined dramatically from the cumulative impacts of fisheries by-catch, coastal development and direct harvesting. Looking into the future, there is every likelihood that the pressure on marine and coastal resources will continue, with coastal populations expected to rise (population of Vietnam is expected to grow by tens of millions in the next decades), and with national and provincial plans that continue to put high premium on maximizing production outputs.

Overall, the approach to marine biodiversity conservation interventions in response to such challenges had tended to be opportunistic and independent rather that strategic and coordinated. While generally, progressive and enabling policies and strategies relating to a range of effective conservation and sustainability tools have existed, on the overall these have been underutilized or poorly implemented. For example, while Vietnam has made notable progress in developing marine protected areas

(MPAs) network plan and establishing a few individual MPAs, to date relatively less attention has been paid to their application in biodiversity conservation or sustainable fisheries management. Despite these limitations, the urgency of developing individual MPAs may be driving poorly-informed decisions, with the end result being that Vietnam's MPA network will not meet the optimum levels of biodiversity conservation or long-term economic effectiveness. Similar challenges are being faced in the implementation of relevant national action plans and strategies. While the importance of an ecosystem-based approach has been increasingly recognized in marine and coastal programs and plans as also highlighted in the country's National Biodiversity Strategy, there are very few real examples where such an approach had altered the production-based models that typify planning and management in the marine realm.

The baseline scenario is that continued limited effectiveness, applicability and/or under-utilization of marine spatial management and marine species protection, and lack of mainstreaming of biological conservation and sustainable use in marine fisheries, will only lead to continued degradation of biological diversity and unsustainable use of marine and coastal resources. Therefore, there is a need for the countries in the Southeast Asian region to support the improved understanding of ecosystems through better information collection and management; protecting marine species of special concern through innovative measures that properly consider the incentives and disincentives of the stakeholders influencing their status; optimizing the approach with parallel efforts to implement innovative measures in the production sector to improve fishing practices; accelerating the capacity in monitoring and evaluating key biological and sustainability indicators; and providing reference points for developing and testing strategies for co-management, job diversification and capacity reduction.

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