Evaluation of Rehabilitation Strategies and Management Schemes for the Improvement of Mangrove Management Programs in Lingayen Gulf

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ABSTRACT

We evaluated the mangrove rehabilitation strategies and management schemes in five municipalities in Lingayen Gulf (Bolinao, Anda, Bani, Alaminos and San Fernando). Mangrove planting appears to be the first and only option used in the area, ignoring other recommended management strategies, e.g. conservation, landscaping, and sustainable production. All planting sites were located in coastal fringes and are mostly monospeficic stands of the species *Rhizophora mucronata*. The planted mangroves were constrained by low seedling survival and stunted growth as probably caused by poor species-substrate matching, mono-species planting and pest infestations. Three management schemes were noted: community-managed (Bolinao and Anda), local government unit (LGU)-managed (Alaminos and San Fernando), and co-managed between the LGU and the community (Bani). The community-managed mangrove areas have the benefits of voluntary efforts from community-based organizations in conducting daily management activities but were constrained with budgetary and logistical concerns. In contrast, both LGU-managed and co-managed areas received institutional and logistical supports from their respective municipal governments, but lacking community participation made mangrove management difficult. Almost two decades of mangrove management indeed helped improved the mangrove forest condition, at least in terms of forest structure. These projects demonstrated some level of success but also encountered several setbacks. Several lessons can be derived from these areas that can help improve the mangrove rehabilitation and management approaches in Lingayen Gulf. Among the recommendations are: (1) provide ordinance enacting the remaining natural secondary growth mangroves as marine protected areas, (2) promote planting in former mangrove areas by reverting abandoned, idled and unproductive aquaculture ponds to mangroves; (3) improve management schemes by formulating resource management plan, institutionalizing annual budget allocation, enhancing community participation, and enhancing tenurial instrument; and (4) incorporate periodic project evaluation.

Keywords: Mangrove, planting, rehabilitation, management, community participation, tenurial instrument

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INTRODUCTION

The Philippine mangrove forests declined from 500,000 has in the early 1900s (Brown and Fisher, 1920) to only about 117,700 has in 1995 (DENR Statistics, 1998), and further decreased to 109,700 has in 2003 (FAO, 2003). Mangrove destruction was aggravated in the 1960s due to the adoption of government's policy intensifying aquaculture production that paved way for clearing vast mangrove areas (Primavera, 2000). Such destruction may have aggravated the decline of coastal fisheries that consequently contributed to poverty especially among marginal fishers.

Coastal Resources Management Programs including mangrove rehabilitation projects were initiated by various institutions in the 1980s aiming to restore the natural ecological structure and functions of mangroves. Most mangrove rehabilitation projects however failed due to various technical, social and institutional concerns. Among these constraints are lack of technical knowledge and expertise in mangrove management, lack of awareness and poor community participation in project management, and lacking policy support on institutionalization and financial sustainability of the project (Fortes, 1995). In Lingayen Gulf for example, various groups implemented mangrove rehabilitation projects since the late 1980s. Most projects however, have low success as manifested by low survival and stunted growth of seedlings. Similar with most reforestation cases in the Philippines, the mangrove planting projects in the area was constrained by inappropriate technical design and lacking socio-institutional support mechanisms. This case study therefore aims to evaluate the rehabilitation strategies and management schemes, and provide recommendations for the improvement of mangrove rehabilitation programs in Lingayen Gulf.

MATERIALS AND METHODS

Site Information

Lingayen Gulf is a semi-circular embayment in the northwestern coast of Luzon and is one of the most important fishing grounds in northern Philippines. It is comprised of 18 municipalities with a total population of about 1,000,000 (NSO, 2000), of which 40% are concentrated in coastal villages (McManus and Chua, 1990). The mangrove forests in Lingayen Gulf are largely secondary growth stands of *Avicennia*, *Sonneratia* and *Rhizophora* in coastal fringes with nipa swamps in some riverine areas. In Pangasinan, mangrove forests were reduced from about 9.9 km^2 in 1978 to 4 km^2 in 2002 (MSI, 2002). The decline in mangrove forests can be attributed to conversion into fishponds, pollution from mine tailings, and cutting for domestic uses. In Anda for example, mangroves were drastically reduced from 394 has in 1932 to only 22 has in 2003 (Table 1; SLGP, 2003). Presently, the only relatively intact remaining secondary growth mangroves in Lingayen Gulf are in Anda (Tondol) and Alaminos (Pangapisan-Mona) having 22 has and 11 has, respectively (Table 1; Figure 1; SLGP, 2003). Among the recorded species are *Avicennia marina, A. officinalis, Aegiceras floridum, Bruguiera cylindrica, B. gymnorrhiza, Ceriops tagal, Excoecaria agallocha,*

Municipality/ City	Old growth natural mangroves (ha)*	Secondary natural mangroves (ha)**	Reforested area (ha)	Proposed rehabilitation area (ha)	CBFMA areas (#)	Age of plantation (yrs)
Bolinao	-	3	32	25	8	11
Anda	394	22	48	18	10	9
Bani	-	1	42	10	0	19
Alaminos	-	11	9	22	0	7
San Fernando	-	1	4	10	0	5

* - NAMRIA, 1932

** - MERF - Sagip Lingayen Gulf Project, 2004

Table 1
Mangrove plantation profile of five selected municipalities in Lingayen Gulf.

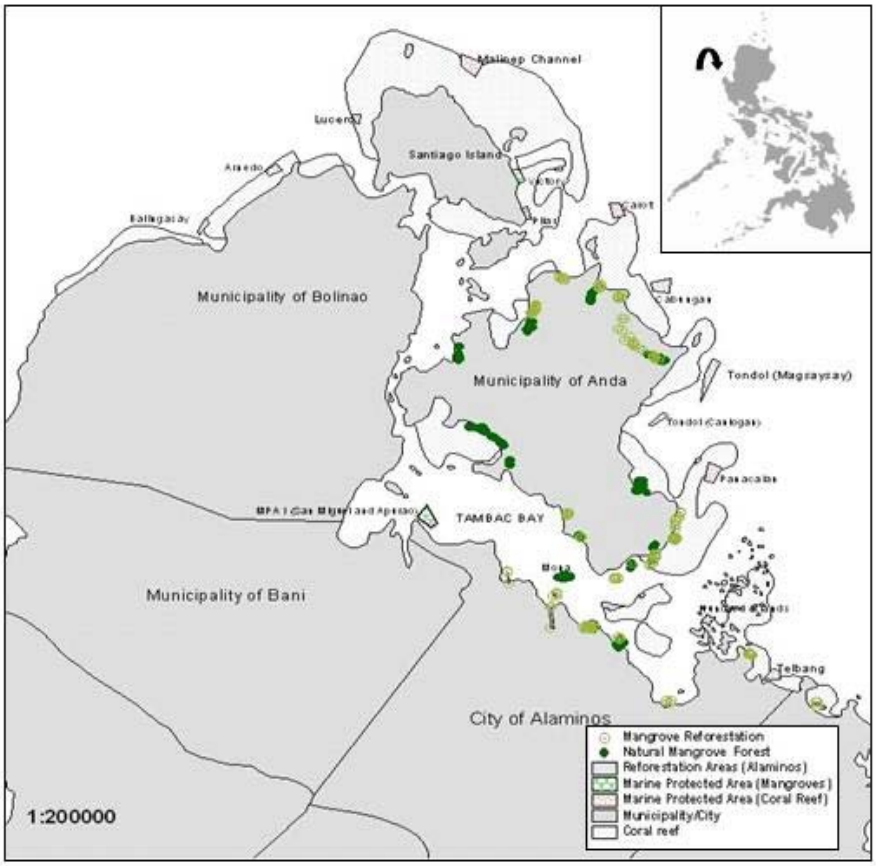

Figure 1. Mangrove distribution map in western Lingayen Gulf (Bolinao, Anda, Bani and Alaminos) showing the location of remaining natural secondary growth mangroves, location of rehabilitation sites, and proposed rehabilitation sites (inset: map of the Philippines).

Rhizophora apiculata, R. mucronata, R. stylosa, Sonneratia alba, Sonneratia caseolaris and *Nypa fruticans.* The mangrove plantation in Bani have a basal area of 4 $m^2.ha^{-1}$ with mean stem density of 1,500 $trees.ha^{-1}$ (SLGP, 2005). These mangroves support a total of 88 species of birds: 47 species are residents, 36 species are either winter or passage visitors, and 5 species are both migratory and resident populations in the Philippines (Manamtam, 2005; unpublished data). The largest and oldest mangrove planting site is located in Bani (42 has; 19 years) and is being co-managed by the municipal government and people's organizations (PO) since the late 1980s (Municipal Government of Bani, 2003). The community-managed mangrove rehabilitation projects in the municipalities of Bolinao and Anda (Municipal Government of Bolinao, 1999; Municipal Government of Anda, 2002) started in 1995 and 1997, respectively. Most sites in Bolinao and Anda are primarily managed by POs who are comprised mostly of marginal fishers. The mangrove planting site in Pilar, Bolinao earns the distinction of the first area awarded with Community-Based Forest Management Agreement (CBFMA) on mangrove areas in Lingayen Gulf (Salmo et al., 1999). Mangrove rehabilitation projects in Alaminos and San Fernando are primarily managed by the respective municipal governments and were initiated in 1999 and 2001, respectively (Table 2).

Assessment of Mangrove Rehabilitation Strategies and Management Schemes

Mangrove rehabilitation strategies and management schemes from each municipality were documented and reviewed through Focus Group Discussions in 2003 (SLGP, 2003). Periodic ocular inspections in all planting sites were conducted (at least once every three months) from March 2003 to January 2006. This was

complemented with reviews and evaluations of municipal fisheries ordinances, coastal resources management plans and CBFMA documents. To assess community participation, a survey questionnaire was randomly distributed among mangrove managers composed of members of POs, LGUs, NGOs and NGAs in all sites to determine their roles in the establishment, maintenance and development in mangrove management (20 respondents per municipality).

Municipality/ City	No. of NGOs	No. of POs involved	% Active member-ship in POs	% Fishers in POs
Bolinao	2	8	50	70
Anda	2	14	50	70
Bani	2	3	43	50
Alaminos	2	1	30	40
San Fernando	1	1	20	30

Table 2
Number of Non-Government Organizations (NGO) and People's Organizations (PO) engaged in mangrove management in five selected municipalities of Lingayen Gulf.

RESULTS AND DISCUSSION

Mangrove Rehabilitation Strategies

Since the late 1980s, mangrove planting was used as the main management strategy, involving an estimated costs ranging from P10,000 – P40,000.ha^{-1}. The respective coastal management plan of each municipal government indicated that planting would likely remain as the main management strategy for at least until five years. Mangrove planting appears to be the primary option and the only management strategy used in the area. However, planting is only one of four recommended management strategies, others are conservation, landscaping, and sustainable production (see Field, 1999). But these options were not yet seriously considered in the area. Lewis (2005) further suggested that mangrove planting should be considered as the last option and only upon carefully determining that natural regeneration does not occur.

All planting sites are mono-specific stands located in coastal fringes, using almost exclusively *Rhizophora mucronata* species. Planting distance between seedlings is usually at 1.5 x 1.5m and 2 x 2m. From late 1980s to 1990s, *Rhizophora mucronata* propagules was preferred since it is easier to collect and a lot cheaper (P1-2.propagule^{-1}) compared to nursery-grown seedlings (P10-15.seedling^{-1}). The planted seedlings were observed to have higher longevity compared to propagules. Only the municipalities of Bani and San Fernando ventured into planting in riverine and creek areas. Planting period almost occurred all throughout the year. Seedlings were tied to bamboo sticks of at most 1m height to help enhance vigor and reduce the dragging effects of coastal currents. Except in Bani (and partly in San Fernando), all planting sites have bamboo fences with nets that aims to reduce the entry of debris that could strangle the seedlings. The local communities undertook cleaning and other maintenance activities, albeit quite irregular and inconsistent (i.e. once a week). The growth and survival of mangroves particularly the younger and newly planted seedlings are constrained by gleaning activities and frequent passing of boats. Monitoring of growth and survival of seedlings were initially conducted in Bolinao, Anda and Bani but were not subsequently sustained.

In all planting sites, seedlings suffered high mortalities (sometimes reaching >90% as early as six months after planting) and stunted growth. In addition, mangroves planted along coastal fringes are subjected to frequent stresses caused by coastal currents and wave actions and smothering by marine algae (e.g. *Sargassum spp.* and *Ulva spp.*) that strangles the seedlings (*pers. obs.*). Seedlings planted during high tidal conditions (e.g. March – August) usually have higher mortalities. The high mortalities and stunted growth could be attributed to poor substrate-species matching, pest infestations, and failure to recognize natural species zonation of mangroves (i.e. as proposed by Agaloos, 1994). Trying to avert high seedling mortality, multi-species planting was practiced starting in year 2003 incorporating the species *Avicennia marina, Sonneratia alba, Ceriops decandra,* and *Nypa fruticans,* among others. Survival improved a bit at least one year after planting, but afterwards, the problems on high mortalities and stunted growth again recurs.

Among sites, only Bani enacted its mangrove reforestation site as a Marine Protected Area (Municipal Government of Bani, 2001) prohibiting poaching and harvesting of marine resources. It is the only plantation that has an effective patrolling system conducting regular surveillance and arrest of poachers. Several livelihood projects were pilot-tested at experimental scale in Bani that aims to provide supplemental income to local mangrove managers. These projects have shown potential good harvests but they are not yet fully implemented at a scale that could significantly increase the income of the communities. In 2005, apiculture was introduced in selected mangroves in Anda. Preliminary reports showed high yields and could potentially demonstrate a suitable livelihood project in the long run.

Mangrove Management Schemes

Three management schemes were noted: community-managed (Bolinao and Anda), local government unit (LGU)-managed (Alaminos and San Fernando), and co-managed between the LGU and the community (Bani). All mangrove sites were part of the Integrated Coastal Resources Management Program of each municipal government. The community-managed and co-managed mangrove areas capitalized on voluntary efforts from community-based organizations in conducting daily management activities despite budgetary and logistical constraints. In contrast, LGU-managed areas received institutional and logistical supports from their respective municipal governments, but weak community participation made mangrove management difficult (Figure 2).

The community-led mangrove management scheme highlights the voluntary engagement of the communities in doing regular maintenance activities (Salmo and Torio, 2004). However, the downside of having the PO members of the community exclusively leading the project is the limited representation of other community stakeholders particularly those that are not members of the POs. Community-led mangrove management projects also exhibit poor linkage with other institutions, as well as weak capabilities in deterring mangrove forest violators since there was no legitimate patrolling and enforcement mechanisms. On the other hand, LGU-led scheme have centralized management. This scheme could realize some level of success as demonstrated in the Visayas (Primavera and Altamirano, 2001). But because of its diverse and broad management objectives, LGU-managed mangrove management programs are difficult to monitor. There may also be lack of sense of community ownership largely due to its highly government-centralized nature.

In this case study, the most beneficial scheme could be the co-management mode that shows collaboration between the communities and the LGU (Salmo and Torio, 2004). It was observed that there was also a more legitimized collective decision making process and a strong sense of ownership by the communities. Both community- and co-management schemes may also be more resilient, since the continuity of mangrove management program is relatively more assured should changes in political leadership occur. Institutional linkages were also formed by both the communities and the LGU.

The factors that could help enhance success in resource management projects were listed in several case studies (see Primavera, 2000; Baticados, 2004; Walters, 1997; Ellison, 2000; Lewis, 2005; Field, 1999). For this study, we identified and focused on three aspects that could contribute to a successful mangrove management in Lingayen Gulf. These were: (a) resource management plans, (b) community participation, and (c) tenurial instrument.

Resource Management Plan

Resource management plans are practically lacking in all municipalities. Among sites, only Bani have the *de facto* mangrove management plan by virtue of its action plan emanating from the enactment of the Mangrove Protected Area. But such plan was not yet comprehensive and systematic enough to effectively use as management guide. A detailed and systematic resource management plan would help the proper implementation of daily management activities. At the least, the plan should contain project objectives, strategies, time frame, estimated budget and expected outcome. The Local Agenda 21 Planning Guide (ICLEI, 1996) particularly the sections on the planning process and development of performance indicators could be adapted. Moreover, the formulated resource

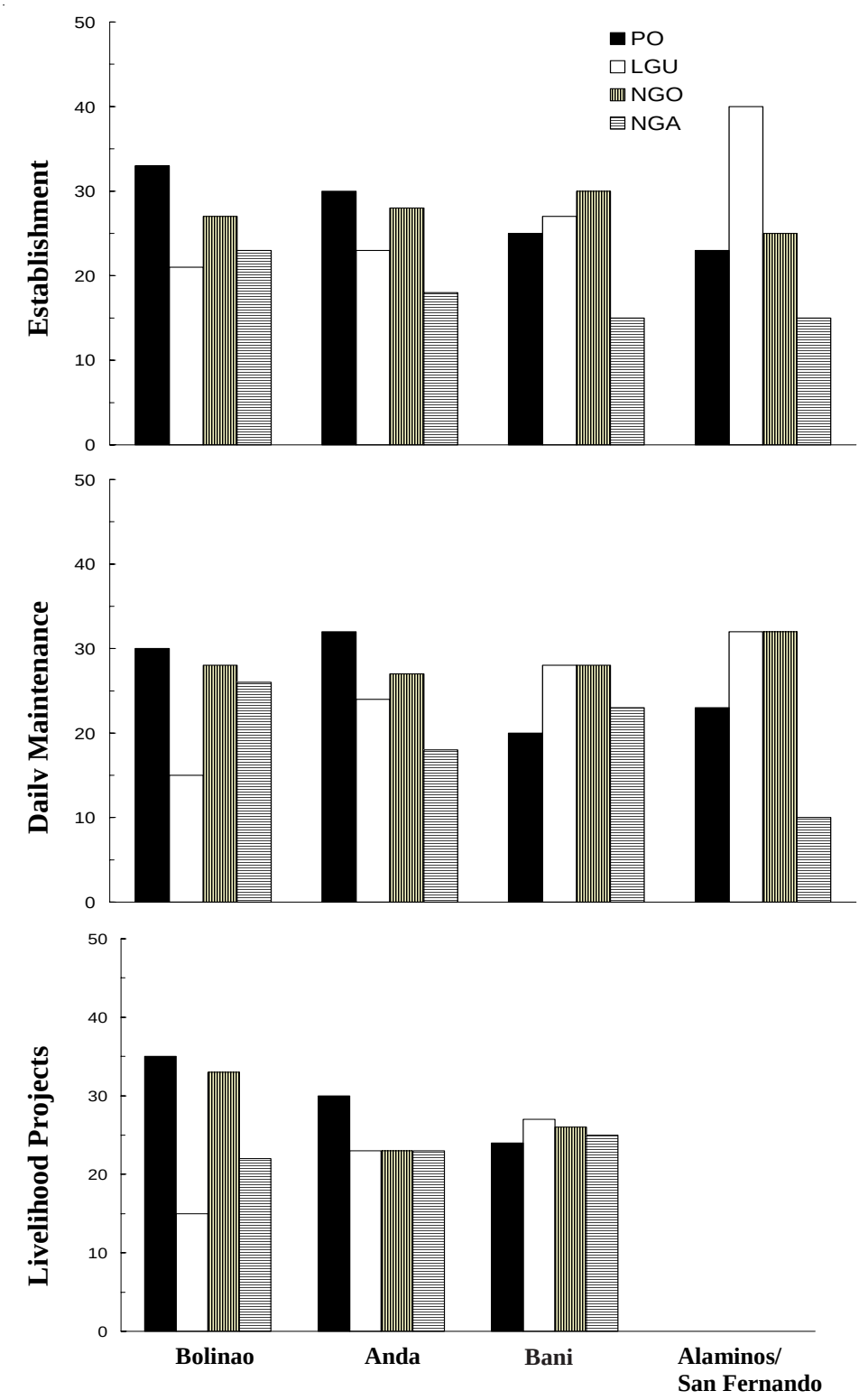

Figure 2. Relative degrees of involvement expressed in percent (%) of mangrove managers (PO - people's organization; LGU - local government unit; NGO - non-government organization; NGA - national government agencies) in the establishment, maintenance and development of mangrove plantation.

management plan should be complemented by an institutionalized and allocated annual budget. Rather than acquiring funds on a per activity basis as have been practiced, an institutionalized allocated budget could help systematize regular operations and maintenance activities. Moreover, having a resource management plan and allocated budget could help in periodically evaluating the progress and cost-effectiveness of the mangrove management projects.

Community Participation

The role of the communities in the planning and implementation contributes to the success of resource management projects (Ferrer et al., 1996; Field, 1999; Pollnac, 1994; Wells, 1996, IIRR, 1998; Baticados, 2004). In Bolinao and Anda, the communities through the PO have been the primary institution in charge of doing the daily maintenance activities (e.g. replanting, cleaning, monitoring) since 1995. Their voluntary engagements may have been the result of community organizing and capability building programs facilitated by the CBCRM Programs sponsored by the Marine Science Institute - Marine Environment and Resources Foundation (MSI – MERF) in Bolinao and the University of the Philippines Social Action for Research and Development Foundation, Inc. (UPSARDFI) in Anda since 1995. If given monetary value, these voluntary community efforts are of considerable amount and highlight the need for evening of the social equity gap in sharing the costs of management by local governments for the public welfare benefits derived from the environmental services of the mangroves. Sustaining such level of shared responsibilities pose a challenge to the mangrove managers.

Tenurial Instrument

Like community participation, tenurial instrument such as Community-Based Forest Management Agreement (CBFMA) could contribute success in mangrove management projects (Farnsworth and Ellison, 1997). The CBFMA encourages communities to participate and assume responsibilities in conducting regular management activities (Katon et al., 1998). Bacalla (2006) stressed the importance of CBFMA in attaining sustainable forest management. Eighteen sites were under CBFMA (SLGP, 2005) which are all located in Bolinao and Anda, coincidentally where relatively stronger POs exists. These sites showed the critical role of the communities as caretakers and resource managers doing regular maintenance activities. In 2006, the mangrove site in Macaleeng, Anda was recognized as the best CBFM site in Region I.

While CBFMA is a good tenurial instrument, sustaining financial and technical supports from municipal government and concerned national government agencies (NGA) remains to be a challenge. After the ceremonial awarding of CBFMA, the communities are left on their own initiatives in managing the project. Fortunately, the communities are resourceful enough in soliciting financial and technical assistance. Most sites in Bolinao were able to solicit at least P 5,000 per year from their respective barangay councils. In addition, sites with CBFMA have been recipients of considerable financial support from external funding institutions. Recently, the acquisition of CBFMA has been one of the requirements of the provincial government in selecting recipients of multi-species mangrove seedlings.

SUMMARY, LESSONS LEARNED AND RECOMMENDATIONS

Almost two decades of mangrove management in Lingayen Gulf yielded 130 hectares of planted mangroves in 23 sites. There were indeed improvements in mangrove forest conditions, at least in terms of forest structure. Likewise, there were also perceptions from the communities that harvests from fisheries and gleaning activities improved due to the planted mangroves. The mangrove plantation in Bani have high populations of wetland birds and includes the endemic Philippine Duck (*Anas luzonica*). Because of these avifauna, the mangrove plantation became a popular tourist destination site. Similarly, the mangrove sites in Bolinao and Anda were favorite learning destination areas among environmental groups that wanted to draw lessons on mobilizing communities to participate in resource management projects. Most sites already earned local and national recognitions because of their impressive mangrove management. For example, Bani was granted Likas Yaman award in 1996, Anda was cited as the best CBFMA in Region I

in 2006, and Alaminos as the most outstanding coastal local government for mangrove development initiative in Pangasinan in 2006. Clearly, these projects demonstrated some level of success but also encountered several setbacks most notably the low survival and stunted growth of the planted seedlings. Several lessons can be derived from these areas to improve the mangrove rehabilitation and management in Lingayen Gulf that could potentially serve as management model in Region I and in northwestern Luzon.

Improving Rehabilitation Strategies

Mangrove planting have been the primary if not the only management strategy used in all sites that ignores other recommended strategies (i.e. as proposed by Field, 1999). Instead of focusing on planting, priority attention should be given in immediately declaring the remaining secondary natural mangrove stands in Anda and Alaminos as a Marine Protected Area which should be properly guarded against encroachers. These stands were already subjected to small-scale cutting and other forms of disturbances. Failure or delays in providing protection could significantly reduce the only remaining and most intact mangrove cover in Lingayen Gulf and may also limit the viable sources of propagules and seedlings for future mangrove planting. In addition, mangrove planting should only be conducted as the last strategy (see Lewis, 2005) after correcting hydrological problems (to determine causes of blocking of propagule dispersal that's limits natural seedling recruitment) and determining that natural regeneration does not occur. Unfortunately, these two basic information were not available. But despite lacking information, the communities are still doing perpetual planting, thereby almost regularly repeating management failures. It is therefore imperative to determine and establish the hydrological patterns and natural regeneration rate prior to continuing any mangrove planting activities. The information could also eventually help in estimating the total plantable area and locating viable plantation sites.

Planting sites were mostly located in coastal fringes except in few instances where plantings are conducted along riverbanks (in Bani and San Fernando). For almost fifteen years, the sites have practiced monospecies planting using *Rhizophora mucronata* species. The species used for planting should have been chosen following the natural mangrove zonation pattern (see Agaloos, 1994). The inappropriate choice of species could have caused high seedling mortalities. Attempts to use multi-species seedlings (i.e. *Avicennia sp., Sonneratia sp., etc.*) only slightly increased the survival rate and prolonged the lifespan of the planted seedlings. However, seedlings still died a year after planting as probably caused by barnacle infestation, strong currents, and disturbances from gleaning activities. Considering these setbacks and huge costs incurred in the past, the rehabilitation strategies should be carefully evaluated. It is recommended to abjure planting in coastal fringes, at least temporarily, and instead prioritize planting in former mangrove areas that are in higher elevation which may have higher chances of survival. Compared to coastal fringes, former mangrove areas may offer freely available propagules and seedlings, have relatively more stable substrates, and have natural defense against coastal currents and debris which could save significant amount that could have been otherwise spent for growing seedlings and establishing fences. Aside from saving costs, planting in former mangrove areas could also enhance the natural regeneration of mangroves. However, like in most parts of the country, former mangrove areas were converted to aquaculture ponds (Primavera, 1995). Reverting idled, abandoned, and unproductive ponds to mangroves have long been advocated in the past (see Primavera, 2005; Lewis et al., 2005) and is also legally mandated in the Philippines (Sec. 46 and 49; R.A. 8550). Reverting aquaculture ponds into mangroves are rarely undertaken in the country and posed a great challenge to mangrove managers. In Lingayen Gulf, only the municipal government of Anda have taken the initial step by taking an inventory of all existing and abandoned fishponds in preparation for mangrove reversion.

Improving Management Schemes

The mangrove management schemes varies among municipal governments. The municipal governments of Alaminos and San Fernando have more pro-active roles thus ensuring financial sustainability. Conversely, the municipal governments of Bolinao and Anda rely on active community participation of people's

organizations in conducting establishment and maintenance activities. In Bani, there was a co-management arrangement between the municipal government and the communities. As demonstrated in this case study, and as proposed in several studies (Farnsworth and Ellison, 1997; Primavera, 2000; Walters, 1997; Field, 1999; Katon et al., 1998), community participation and tenurial instruments could facilitate the success of mangrove management programs. If these two aspects can be incorporated in Alaminos and San Fernando, the mangrove management may likely contribute in realizing success. It is therefore a challenge for the mangrove managers to sustain such level of participation and optimize the benefits provided under the CBFMAs. Sustaining community's interests may be made possible when they realize tangible benefits, e.g. in terms of food and cash. In terms of gleaning harvests, the macrofaunal abundance and biomass in reforested mangroves may start to provide food benefits 7-10 years after planting (e.g. 2,750 kg.ha^{-1} of macroinvertebrates; Salmo, 2005). Thus, it is important that while waiting for that period, some forms of livelihood projects or financial support should be provided to the communities. The municipal government of Bani employed few mangrove caretakers as a form of incentive. This approach could also be use in Bolinao and Anda whose community members have been voluntarily taking care of the planted mangroves for already more than ten years.

Project Evaluation

The success (or failure) of a mangrove management program should be periodically monitored and evaluated. Unfortunately, most mangrove management programs do not have a monitoring and evaluation component (Ellison, 2000; Bosire et al., 2003; Ha et al., 2003; Crona and Ronnback, 2005). Ellison (2000) suggested that mangrove management should be quantitatively evaluated containing at the least the following minimum parameters: tree stand structure, tree abundance, species richness and diversity, invertebrate abundance, species richness and diversity, primary production (biomass and litter), nutrient export, and hydrologic patterns. The biophysical parameters should be complemented with socio-economic parameters to help determine if the living status of the communities have improved with improving mangrove forest conditions (e.g. see Salmo et al., 2004). Lastly, the importance of the active participation of the important stakeholders and decision makers are crucial to the success of rehabilitation from selection of sites and the choice of their strategies. A systematic evaluation would help track the progress of the program, draw lessons, and ultimately incorporate the lessons as management and policy inputs and contribute to the overall success of the mangrove management program.

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