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MANGROVE RESTORATION IN A DEGRADED PERI-URBAN SITE IN CENTRAL VIETNAM: Variable Success in Different Villages

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ABSTRACT

The city of Quy Nhon in central Vietnam is expanding towards the nearby Thi Nai Lagoon. The Rockefeller Foundation supported restoration of mangrove forests along the shore of the lagoon to protect it from erosion, and help limit urban development in these areas. Mangrove forests were planted in 5 villages. In Vinh Quang village seedling survival was about 80%, in Diem Van 50% and in Nhan An there were no surviving seedlings after two years. This paper describes mangrove seedling plantation and protection activities implemented by these three communities, and compares their experience to explain why there were significant differences in outcomes. Similar co-management approaches were employed in each case, but there were significant differences in the prior familiarity of villagers with mangroves, their dependence on aquatic harvesting, the consistency with which informal tenure rights of different groups were recognized, the quality of local leadership for mangrove planting and protection, and the quality of habitat for mangrove seedlings. Results showed that simply adopting consistent processes for co-management did not secure consistent outcomes, and that local forest management authorities failed to adopt a mechanism for long-term benefit sharing.

Key words

Mangrove
Disaster risk Reduction
Climate Change
CCCO Binh Dinh
Peri Urban

INTRODUCTION

Mangroves serve an important protective function for vulnerable coasts and river deltas composed of unconsolidated sediments that are easily eroded (Adame et al., 2009). Mangroves are also a valuable carbon sink, protecting not only the carbon in living biomass, but also large volumes of carbon sequestered in organic sediments that will oxidize if disturbed (S. Bouillon et al., 2003; Alongi, 2014). Rapid expansion of coastal cities in major river deltas is further threatening mangrove habitat that has already been greatly reduced in SE Asia due to clearing for agriculture and aquaculture ponds. The pressure to fill shallow coastlines for construction of high value infrastructure and urban development further undermines the capacity of mangrove ecosystems to serve as buffers for extreme climate events (e.g. typhoons, storm surge; or other floods) and can add to the vulnerability of adjacent urban areas (McLeod and Salm, 2006).

Quy Nhon city in central Viet Nam is expanding into the floodplain of the Ha Thanh / Kon river system north of the central city's current location. This leads to pressure to fill the shallow waters of the Thi Nai lagoon in this area, and to destroy the remaining areas of mangrove forest. While the province of Binh Dinh has designated a large zone along the shores of Thi Nai lagoon for mangrove protection and conservation, there has been limited investment in mangrove restoration. This paper describes an ambitious project to reforest several sites on the edge of Thi Nai lagoon, and to introduce new co-management institutions to build community support for mangrove forest protection and conservation.

MANGROVES LOSS NEAR QUY NHON CITY

Quy Nhon city in central Vietnam is situated between the sea and Thi Nai Lagoon. The lagoon has a total surface of over 5,000 hectares. Mangrove ecosystems in Thi Nai lagoon were once very rich with about 1,000 hectares of mangroves and 200 hectares of sea grass along the shallow margins of the lagoon. Archival information shows that there was 561 hectares of mangroves in 1973, 137 hectares in 1988 but only about 50 hectares in 2003 (Vo Si Tuan, 2015).

In the period 1980 – 2000, Thi Nai lagoon was heavily exploited for shrimp aquaculture to strengthen household incomes. In the 1980s aquaculture cooperatives were established in the lagoon area. Cooperatives managed all the water surface. Households became members of the cooperatives and participated in digging shrimp ponds. Then cooperatives assigned pond(s) to groups of households to manage. In the 1990s during the period of economic reforms, individual households were allocated water surface rights for 20 years. During this period households cleared mangrove forests for shrimp ponds. The government offered tax exemption and other incentives for shrimp farmers in their first year. Also during this period, shrimp farming enterprises were given the right to transfer their surface leases to people from outside the village. In 2000-2001, intensive and semi-intensive shrimp farming was booming in the entire coastal region of Vietnam and Thi Nai Lagoon. But the following year, many intensive shrimp ponds in Thi Nai were decimated by diseases and many farmers' operations were bankrupted and abandoned. But it was too late for the mangroves. Mangrove ecosystem

were basically gone. There was only some small tracts of scattered mangrove trees left near the coast line.

Since 2011, there have been many efforts to regenerate and restore mangrove ecosystems in the lagoon through planting and protection of mangrove seedlings, which need at least three years to mature to a hardy size. One of the largest projects to date was funded by the Rockefeller Foundation under the Asian Cities Climate Change Resilience Network (ACCCRN). However, the effectiveness of planting and protection activities was markedly different at different sites. This paper describes the reforestation process in this project and identifies factors that influenced the regeneration of mangroves in Thi Nai. The paper focuses on 3 villages that participated in the same co-management project but had different outcomes.

MANGROVE CO-MANAGEMENT IN VIETNAM

The integration of co-management in mangrove forest protection is very difficult in Vietnam.

Co-management means that local communities participate in and benefit from management decisions for sustainable resource use, but the forest tenure law defines all mangroves as “protected” forests, which cannot be accessed or used. There were very few cases of mangrove restoration based on co-management in Vietnam. Review of those cases reveals that mangrove forests could be replanted and restored successfully if they were planted in well-protected areas, where potential tenure conflicts between forest protectors and small-scale fishermen and clam collectors could be controlled.

SOC TRANG EXPERIENCE

In Soc Trang, the forest has been divided into 4 zones with different management conditions: the protection zone, 2 restoration zones (inner and outer) and a sustainable use zone. In this area, more than 300 households, mainly ethnic Khmer, are allowed to use coastal protective forests to collect fuel wood and forest resources for their livelihood, but only in the sustainable use zone. The participating households are issued forest-entrance cards to identify their eligibility to harvest forest and aquatic products. The co-management regulations allow households to collect baby clams, small crabs, goby fish, and other aquatic products. These resources have provided increased income, but only as long as the forest remains in good condition. This has led to recognition that limiting the use of the forest also means protecting their livelihood. Community co-management partners can request more attention from the authorities to support their management efforts. But local leaders report that as the quality of the aquatic habitat has improved with mangrove protection, there is more illegal harvesting by outsiders.

XUAN THUY NATIONAL PARK

Xuan Thuy has received funding from the Wetland International Alliance for a pilot project on contracted exploitation, management and use of forests for the community in Giao An commune. The park managers worked with the community to develop regulations for use and exploitation of mangroves; to establish management boards, core groups, teams, exploit team in association with the community rights and responsibilities in mangroves exploitation and protection. The Nature Reserve Management Board

determined jointly with communities how exploitation of resources would be shared and controlled.

In this model, 21 households contracted to plant and protect mangroves. They built huts for daily care and manually exploited aquaculture resources under the mangrove forest canopy. If they detected external intruders or destructive exploitation, they informed local authorities and forest officials for prompt intervention. Local authorities and community organizations participated in patrol activities and resolved conflicts if they happened. Forest protection became more effective in the Reserve.

In the case of Soc Trang, co-management was applied in forest protection. Forest managers and local people agreed on regulations that allow local people to fish in “sustainable use” areas while protecting others. The local people get sustainable benefits and by following the regulations they protect the mangroves. The case of Soc Trang is different from the case of Thi Nai lagoon, where the mangrove area is so small there is no area that can be designated for sustainable use, and where reforestation takes place in an area that was not previously mangroves. In other words, in Thi Nai, mangrove reforestation impinges on areas already used for clam harvesting.

The co-management model in Xuan Thuy Nature Reserve was based on a household contract system. Households signed individual contracts with the Nature Reserve Management Board to plant and protect mangroves. As a Nature Reserve, Xuan Thuy Management Board has legal power to decide all terms of access and exploitation within the Reserve boundary. This is a major different from the case of Thi Nai lagoon, where the project area is not part of a protected reserve.

THI NAI LAGOON AND CO-MANAGEMENT ARRANGEMENTS

Since 2000, official development plans for Binh Dinh province encouraged infrastructure construction and development along the shores of the lagoon. This was spurred by the 2006 completion of the Thi Nai bridge across the lagoon from Quy Nhon city to the new Nhon Hoi industrial zone. On both sides of the lagoon, major urban and industrial development projects were planned on sites created by filling the shallow mud flats. Along the causeway connecting the city with the new bridge, on the western shore of the lagoon, development activity increased in intensity with expectations it would gradually move further northward along the shore of the lagoon. It was in this context that the ACCCRN project (funded by Rockefeller) was initiated in an effort to begin to restore some of the lost mangrove habitat and stem the continued development of the vulnerable western shore which consists of a long flood plain delta at the mouth of several branches of the Ha Thanh / Kon river system.

The Rockefeller-funded project was the first major commitment to mangrove reforestation in Thi Nai lagoon after many decades of forest destruction. Between 2012 and 2015, the project planted a total of 33 ha of mangrove seedlings in 5 different villages of Phuoc Thuan and Phuoc Son communes in Tuy Phuoc district, just north of the current boundary of Quy Nhon city on the western shores of the lagoon. In addition, the project introduced greater awareness of mangrove ecosystem benefits, and provided Community-based Disaster Risk Management (CBDRM) training to the villages. A central part of the project was the collaborative development of new tenure arrangements for rights to harvest aquatic

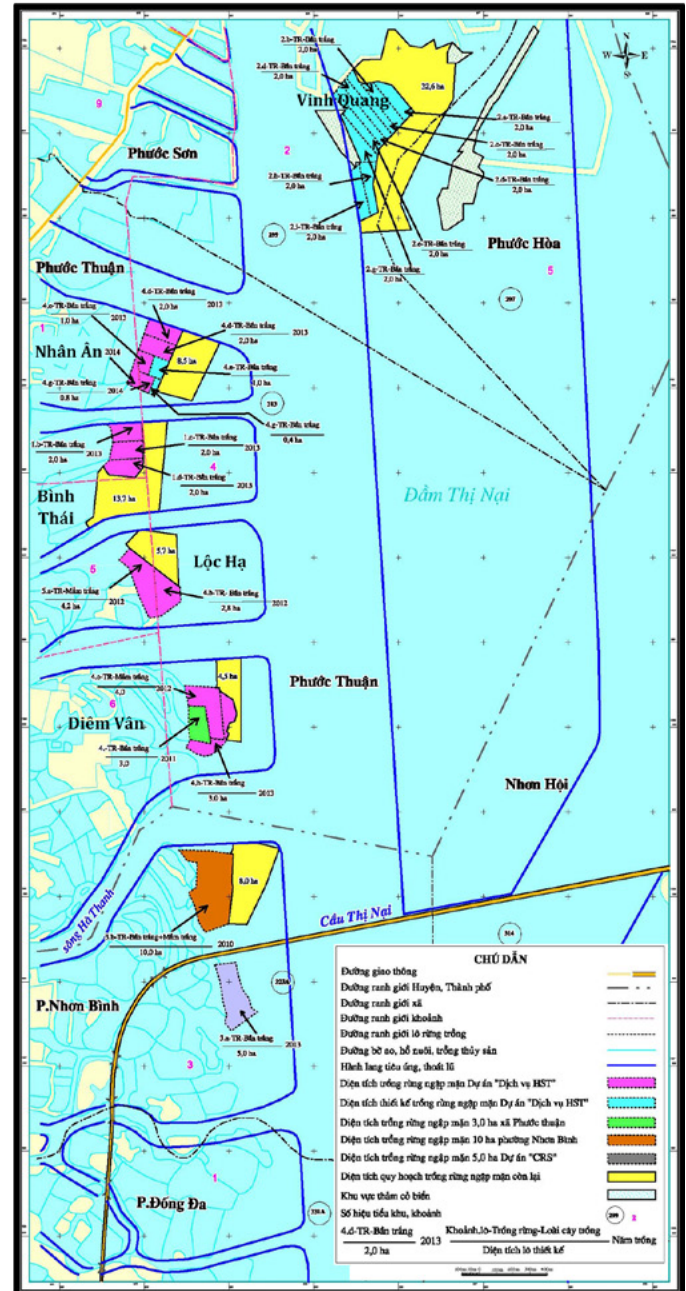
species in the replanted areas through community co-management agreements and household contracts, intended to ensure that poor and vulnerable households would benefit from mangrove planting and protection

The results of survival rates of mangroves till the end of the project life are different among the project sites, especially among the 3 villages of Diem Van, Nhan An and Vinh Quang. Diem Van has a survival rate of 50%, Nhan An 0% and Vinh Quang 70-80%. This paper explores the reasons for such different outcomes.

The coordinator of the project was the Climate Change Coordination Office of Binh Dinh province (CCCO). Sub-contractors implementing the project components included Ban Quản lý Khu sinh thái Côn Chim (Con Chim Ecological Zones Management Board - Con Chim EZMB), Nha Trang Institute of Oceanography (IO), and the Research Center for Environment and Rural Development (RECERD) an NGO.

Nha Trang IO was responsible for evaluation of the ecosystem and site selection for reforestation. RECERD was responsible for development and implementation of co-management models in villages engaging in mangrove reforestation and protection, and was also responsible for alternative livelihood activities. Con Chim EZMB provided technical advice on mangrove ecology, supplied seedlings and supported CCCO Binh Dinh in project management and cooperation with local governments, agencies, associations and unions for mangrove reforestation, and also supported the establishment of mangrove safeguard teams. There were 5 villages participating in the project (see Figure 1 for location of the villages).

FIGURE 1. LOCATIONS FOR MANGROVE REFORESTATION OF THE PROJECT



The project sites had no previous experience with co-management, and over the previous decades there had been occasional conflicts between some local communities and the forest managers over forest clearing for shrimp raising.

There were three key elements to the co-management process introduced in Thi Nai:

1. village-level agreements and regulations that were approved by both commune and Con Chim EZMB;
2. contracts between selected households and Con Chim EZMB to plant and protect the mangrove seedlings, and to receive payment that was pro-rated based on the survival rate of the seedlings (providing an incentive for protection)
3. contract teams of contracted households in each village were formed to share and allocate responsibilities for mangrove seedling protection, cleaning, oversight, etc. Sometimes the teams would assign most of the responsibilities to a small number of households who were able to devote more time to these tasks.

The contracting of households to plant and protect mangrove seedlings was a common practice of the Forest Development Division (under DARD),

and governed by standard cost norms established nationally. There were a number of innovations in the case of the project, however. Consultations with the community succeeded in building broader support for mangrove protection, so that in most of the villages, more households than were needed expressed interest in this task. This required a village-led selection process, but still typically resulted in more households than were needed. While the village was typically comfortable with the resulting large group, the Con Chim EZMB was not. They wanted to identify specific individual households responsible for specific areas of the lagoon. The result was that while a small number of household names appeared on the contracts, there were typically a larger group of households involved in mangrove management. In each village, the contract households established a mechanism to share the payments with a larger group. These larger groups formed “contract teams”.

In each of the three villages, the process followed these steps:

OBJECTIVES	MAIN ACTIVITIES
1. Development of household contracting mechanism	1. Contracting households were selected by local residents in the villages based on criteria agreed by the village leaders and Project Management Unit
	2. The Commune People’s Committees proposed representative households from villages to obtain contracts for planting, care, and protection of mangrove seedlings
	3. Signing contracts between the Project Management Unit and selected households agreed by Commune People’s Committees
	4. Establish contracting teams by village unit (upon contract signing with the Project Management Unit) and ask for acknowledgment from the Commune People’s Committees
2. Development of community regulations and co-management relating documents	5. RECERD worked with commune representatives, forest rangers, police, forest development division to develop regulations for cooperative management, protection of mangrove forests and aquatic resources in Thi Nai lagoon of Phuoc Thuan and Phuoc Son communes
	6. CCCO and Con Chim EZMB developed conventions on management, protection and development of mangrove forests in Diem Van, Binh Thai, Nhan An, Loc Ha and Vinh Quang 2 villages
	7. Develop regulations for groups of contracting households in Diem Van, Binh Thai, Nhan An, Loc Ha and Vinh Quang 2 villages
3. Monitoring and evaluation of co-management implementation results	8. Con Chim EZMB guide dissemination of cooperative regulations, community conventions, and regulations for contracting teams
	9. RECERD monitor and evaluate the implementation of co-management, cooperative regulations, community conventions, and regulations for contracting teams
	10. RECERD and CCCO summarize, report and hand over results to the Project Management Unit and relevant stakeholders

VILLAGE EXPERIENCES WITH CO-MANAGEMENT AND REFORESTATION

The three villages all have different characteristics. Diem Van village is located closest to the city of Quy Nhon, and near the shore of Thi Nai Lagoon. It has 327 rural households but members of 27 households have left for Saigon to work as laborers or vendors. Of the 300 remaining households, roughly 200 households traditionally worked in small scale salt production. However, since the Vinh Thanh and Thanh Hoa hydro-electric dams were built in the upstream area of the river basin, dry season river flows are much higher and salinity levels in the lagoon are lower, so the number of salt-making households dropped drastically as natural evaporation ponds became less viable. About 50 households earn most of their income from shrimp pond aquaculture and 40 households from fishing. Another 40 households gain most of their income from one of several industrial timber factories nearby. Around 40 households earn most of their income as commercial painting contractors. There are about 100 households harvest clams and crabs in the tidal flats.

Nhan An's population spreads over 6 hamlets. The villagers located on the mainland live mainly on rice farming, with a small number of households also having members work in timber factories and as construction workers. These hamlets are located about 1.5 km from the shore of the lagoon. Villagers in Tan An cluster near the dike depend on small-scale fishing for livelihoods as they have very little rice land. Most of these residents are older in age and mainly collect clams and oysters.

Vinh Quang village is farthest from the city of Quy Nhon and has more than 250 households in total,

of which about 60 are located on a small island 5-10 minutes by boat from the mainland. The island residents do not have farmland so all depend on shrimp aquaculture and fishing. This hamlet has an area of over 150 hectares of water surface for shrimp, fish and crab culture. As it is located right next to the core Con Chim Ecological Zone the villagers have participated in many mangrove reforestation and forest protection activities. The people here understand the value of mangroves and support restoration of mangrove forests to improve aquatic habitat.

DIEM VAN VILLAGE (NEAR-SHORE VILLAGE)

Before planting seedlings, the villagers consulted with commune officials and experts from Nha Trang Oceanography Institute, who were contracted by the project for ecological assessment, in order to choose preferred sites for the initial reforestation. Concerns were expressed by the community about the suitability of the proposed site and species selection, but the reforestation proceeded on the advice of experts from Con Chim EZMB.

Fourteen (14) households were selected by the villagers to participate in mangrove planting and protection based on criteria they determined in consultation with the project Management Unit, including:

- local residents
- Healthy and enthusiastic
- Engaged in fishing and clam harvesting
- Available to participate
- Poor and/or disadvantaged

However, Con Chim EZMB insisted that they would only sign contracts with 8 households, and designate the area each was responsible for, so that accountability for outcomes would be clear.

In 2012, the villagers planted 4 hectares of *Sonneratia alba* (bần trắng) seedlings, at the advice of Con Chim mangrove experts. In 2013, an additional 3 ha of mangroves were planted but this time the villagers chose *Avicennia alba* (mắm), which in their opinion was better suited to this site. The survival rates improved substantially. The project organized additional planting in 2014 to replace seedlings that had not survived from the previous plantings. Monitoring in 2016 showed that the overall survival rate of the seedlings was about 50%. Surviving trees grew evenly and had good root systems. The seedlings planted in 2012 had reached an average height of 2.5m, a diameter of 15cm, and canopy of about 2.5-3m in width. The seedlings planted in 2013 had an average height of 1 m and diameter of 7 cm.

Seedling survival was negatively affected by a number of factors including site conditions. The sloping site was exposed to significant tidal range, inundating the smaller seedlings on the lower area. Incoming tide also brought with it debris such as weeds and plastic which caught in the branches of the seedlings and caused damage when the tide receded. In addition, the salinity conditions have changed near the mouth of the Ha Thanh River since the completion in 2009 of the Phu Yen hydropower plant upstream. Because of the reservoir operation, the freshwater flow in the lagoon during dry season (Dec – May) increased substantially, lowering salinity levels. High nutrient levels in the water from agricultural areas upstream also led to increased growth of algae, coating the seedlings and reducing growth. In addition, some seedlings in this site were initially lost to theft.

The seedlings were planted in an area that had previously been used for clam harvesting. Some of this harvesting stopped as the households involved were under contract to protect the new seedlings. But other households continued to harvest clams under the

supervision of the contract households, as a result of collective agreements negotiated between the village and the contract teams. To provide further incentive for protection, contract households were given exclusive rights to raise crabs in cages in the reforested areas. The mangrove seedlings clearly interfered with the previous harvesting practices, although both the contract households and harvesters tried to reach a mutual accommodation.

Of the three groups of households involved in mangrove protection in Diem Van, one was led by a very enthusiastic, well-organized and respected local leader. This group was much more active under his direction, and achieved better results, while the other groups were less interested in the benefits of mangrove restoration and preferred to focus on their other livelihood activities. The households re-organized into 2 groups, under the general direction and guidance of this more active leader.

In order to provide additional incentive for the contract households to protect the growing seedlings, and to reduce their clam harvesting activities, DARD consulted with the households to subsidize the introduction of oyster cultivation. Four of the contract households took advantage of the offer of technical and financial assistance from DARD to try this new approach within the reforestation area they were assigned to protect. The households were provided with training and oyster seed, and reported good results in terms of survival (97%) and growth (about 1 gram / month per oyster). The biggest concern of the oyster growing households was theft of mature oysters prior to harvest, when they were vulnerable at low tide because outsiders would come to harvest clams in the tidal flats. Part of the problem seemed to be that ownership of the oysters was difficult to enforce outside of the village, as it was linked to the co-management regulations and use rights of the contract households, which had been

negotiated by the village and agreed by the commune but were difficult to enforce with outsiders.

NHAN AN VILLAGE (INLAND VILLAGE)

The criteria for selecting contract households were modified in Nhan An from those used in Diem Van village, after community discussion, to include these considerations:

- Priority given to households located near restoration sites, as much of the village is located 1.5 km inland from the coast.
- Select households with members who demonstrate a sense of responsibility and capacity for collaboration through discussions at community meetings.
- Do not select households who are engaged in government jobs as they are busy with their jobs and cannot give priority to forest maintenance.

In Nhan An, villagers are mainly rice farmers. With mechanization and new production techniques they have more spare time and extra labor. Harvesting clams and other products is easy and has no barriers to entry, and the resource is open access, so it is popular to go to the newly planted forest more often and harvest products there. Nhan An villagers planted 3 ha of mangrove seedlings in 2013. Six households were chosen to manage the seedlings. The project implemented alternative livelihood activities in Nhan An in May 2014. Three households expressed interest in oyster cultivation, but in the case of Nhan An, these households not only accepted the support of the fisheries department, but then also invested their own funds to increase the oyster grow-out by a factor of ten times. With a large personal investment now at stake, the households were more concerned with the success of the oyster cultivation venture and wanted to extend the grow-out period to increase profitability. As the

oysters matured, they became increasingly worried about security and built a fence around the mangrove seedling area, which thus enclosed their oyster frames. But they did not have permission from the village to enclose this area, or to exclude other households harvesting clams or small fish in this part of the tidal flats. This created a high level of resentment within the village against these three households. Unlike in Diem Van, the regulations governing mangrove protection and household rights had also not been sanctioned by the commune People's Committee, so they were disputed and more difficult to enforce.

A group of about 30 households protested the enclosure of this mangrove seedling area, uprooted some of the seedlings, and took their protest to the District People's Committee, which had never dealt with a similar issue, and was confused about the situation. After many meetings and discussions involving the project managers, the local government and the villagers, a decision was made to terminate the household protection contracts and effectively to abandon reforestation efforts at this site.

VINH QUANG VILLAGE (ISLAND VILLAGE)

Vinh Quang planted 9 hectares of mangroves. The first planting was in 2013 and the second in 2015. CCCO organized 4 village meetings with the villagers and organized a survey with villagers to select sites for plantation. By this point in the project, local opinions for site and species selection were given more credibility.

Nine households were selected by the community to sign contracts for plantation and protection. Learning from the other villages, the household selection criteria were modified one more time, to state: households live near the reforestation site, have low income but with available labor, preferably female-headed, have aquaculture experience and have a strong sense of

FIGURE 2. VINH QUANG VILLAGE 2



responsibility (based on judgment from previous experience). Selection of contract households in Vinh Quang was difficult and suffered long delays for 2 reasons:

1. The village head suggested that eligible households should reside on the island near Con Chim where the mangrove plantation would be located, but villagers on the mainland also wanted to participate. In the end, it was agreed that all of the contracted households would be from the island as they live near the plantation area and have more experience in planting and protecting mangroves.
2. There were a total of about 30 households (roughly half of the village) interested in supporting mangrove reforestation. This village had often participated in previous reforestation and protection efforts with Con Chim reserve and residents were enthusiastic and experienced, including offering to share some of the costs of replacing seedlings that died in the initial year. However, it took some time to select the 9 specific households who would sign contracts with Con Chim Management Board and assume legal responsibility for mangrove management, while sharing payment with the other participating households.

Eventually, the villagers reached agreement and drafted specific regulations with Con Chim EZMB, which were also approved by Phuoc Son commune People's Committee. The project originally anticipated planting 18 ha of mangroves in Vinh Quang, but after surveying the proposed sites and considering the compensation, the village agreed only to 9 ha. One year after planting, the survival rate of seedlings was close to 80%. Site conditions appear to be suitable for continued growth, and the community has not had any conflicts that would jeopardize their management commitments.

DISCUSSION

The differences among the 3 villages result from both natural and social aspects as follows.

Process of community consultation, engagement and regulation to build local consensus and commitment: the regulations were effective in Diem Van and in Vinh Quang, even when there was relatively little local interest as in Diem Van; but there was never strong consensus in Nhan An. And in Nhan An the contract households violated the terms of their contract by building a fence around the place they raised oysters, raising a much bigger volume of oysters than agreed in the contract and kept them for a longer

time than specified in the contract, excluding other harvesters. As a result, the whole agreement in Nhan An broke down, leading to loss of all newly planted seedlings.

Local leadership and commitment to mangrove restoration was an important contributing factor. In Diem Van, although most households were not interested in mangroves, a key local leader provided commitment, inspiration and direction for the contract households to treat their responsibilities seriously. In Vinh Quang, households were familiar with mangroves and recognized their beneficial effects in creating habitat for valuable aquatic species.

Poor site selection was one of the reasons that caused a low survival rate in Diem Van village. As the majority of the alluvial flats near Diem Van village were already used for aquaculture ponds or scattered mangroves, the selected area was characterized by relatively deep water that was sub-optimal for the seedlings. Local knowledge of mangrove site conditions was given more consideration in subsequent choice of sites and species for replanting, especially in Vinh Quang, which was the final village engaged in the project.

Failure to follow community advice on selection of mangrove species was another cause that led to high initial losses. At first Mắm trắng (*Avicennia alba*) was planted in Diem Van. But most of the seedlings died. The villagers explained that the conditions were not suitable for that species. After repeated consultation and verification with local residents, the project managers switched to Bần trắng (*Sonneratia alba*) and Bần chua (*Sonneratia caseolaris*). High survival rates in the most recently planted site shows the new options are indeed better suited to the environmental conditions.

Process of selecting households to receive benefits: It is hard to get community consensus on who will be

selected to participate in the project. On the other hand, the interest of households in planting and protection depends on their knowledge of mangroves and trust in the forest division/Con Chim, as well as their engagement in other livelihood activities. The more they were involved in agriculture or urban livelihoods, the less committed they were to mangrove protection.

There was limited long term commitment by the communities to mangrove habitat restoration and no commitment by forest managers to long term benefit sharing. The household contract provisions specified payment and responsibilities for the initial three-year seedling protection period, but were unclear about how long contracted households could exploit aquatic products from the protected mangrove area, and it appeared that Con Chim Nature Reserve expected to take over exclusive management at some indeterminate time in future. The co-management provisions that are in place in Soc Trang or Xuan Thuy do not seem to fit the context of Thi Nai lagoon, and so Con Chim claims they have no legal precedent for long-term benefit sharing. On all sides, these arrangements encouraged short-term thinking rather than long-term collaboration for habitat restoration.

Settling the issue of tenure is vital to forest protection. The conflict in Nhan An between oyster growers and clam harvesters is an example. When the seedlings were planted and the area fenced off to protect the oysters being grown there, fishermen complained about being excluded. The problem was that neither group had clearly defined and recognized tenure. By virtue of the support received from DARD for mangrove protection and oyster cultivation, and the high level of private investment that the oyster cultivating households put into this venture themselves, they felt they were justified in enclosing the area used for oyster cultivation (and seedling

protection). But the clam harvesting households, accustomed to using this area, had not agreed to this arrangement and felt that they had been unfairly deprived of their previous open-access rights. Neither side held formal tenure, each side felt their own claim was legitimate, and there was no local mechanism for resolving this dispute. The dispute was not specifically about mangrove seedlings, it was about exclusion of the clam harvesters, but the seedlings became collateral damage. This compared with Diem Van where there was internal agreement, and consistent interpretation within the village on limited access rights by harvesters in protected areas – but no way to enforce these internal agreements with outsiders who continued to treat the mangrove seedling areas as open access.

CONCLUSION: IMPLICATIONS FOR CO-MANAGEMENT BASED MANGROVE PLANTATION AND PROTECTION

The results in the three villages demonstrate that adopting consistent processes for co-management does not necessarily secure consistent outcomes. There were a number of differences in the character of the villages themselves that contributed to the different results, including the relative proportion of households in the village dependent on lagoon-based aquatic livelihoods, the familiarity of households with mangrove ecosystem benefits, and the commitment of leaders at both the village level and at the level of household contract teams.

The results also showed that when introducing new co-management arrangements, a high level of local consensus and commitment is important, even if it is time-consuming to obtain. In both Diem Van and Vinh

Quang, this strong local commitment was reached, but the collective commitment to mangrove protection was much lower in Nhan An, which was mainly an agricultural village. In all cases, a key stumbling block to local consensus was the selection of households who were to benefit from mangrove protection and aquatic species harvesting.

Not surprisingly, where tenure arrangements were not explicitly agreed, and then enforced, between all the parties using the resource base, conflicts arose that led to failure of the restoration effort. Lack of experience and leadership, and lack of conflict resolution mechanisms, in the implementation of the co-management arrangements in Nhan An contributed to this result.

In Thi Nai lagoon, the livelihoods of villagers were diverse and increasingly influenced by the expanding urban economy of nearby Quy Nhon city. This has several implications for mangrove protection and ecosystem restoration. As incomes transition to urban, and harvesting pressure on aquatic resources declines, conflicts may decline – but so too will community interest in mangrove protection. Where livelihoods are less secure or more dependent on aquatic resources, there may be more community interest in mangrove reforestation.

Co-management of mangrove forests requires both the commitment of the local community, but also the commitment of forest managers to long term benefit sharing. Without long-term benefit sharing arrangements, co-management is reduced to agreements about selection and payment of service contracts to households. This may suit the multi-livelihood model of households on the urban periphery, but it encourages a short-term approach to ecosystem management. Particularly in the case of Vinh Quang, where community residents recognized

the long-term value of healthy mangrove forests, they should be able to share in those benefits and continue a long-term co-management arrangement.

Mangrove restoration in a peri-urban site is particularly challenging because livelihood patterns are changing rapidly and household incomes are rising. The economic interests of community members may shift towards short-term benefits, weakening the argument for them to support long-term ecosystem restoration. Community support is further weakened when forest managers have no legal precedents for long-term benefit sharing under collective co-management agreements. These cases demonstrate the need for such legal provisions in the long-term management of reforested mangrove sites, especially when they are close to urban areas, in order to help compensate for the short-term exploitation interests of households who have no long-term stake in the value of the resource base.

REFERENCES

- Alongi, D.M., 2014. *Carbon cycling and storage in mangrove forests. Annual review of marine science*. Vol. 6, pp.195-219. DOI: 10.1146/annurev-marine-010213-135020.
- Bouillon, S., Dahdouh-Guebas, F., Rao, A.V.V.S., Koedam, N. and Dehairs, F., 2003. *Sources of organic carbon in mangrove sediments: variability and possible ecological implications*. *Hydrobiologia*, 495(1-3), pp.33-39.
- Fernanda, A. M., Neil, D., Wright, S. F., & Lovelock, C. E., 2009. *Sedimentation within and among mangrove forests along a gradient of geo-morphological settings*. *Estuarine, Coastal and Shelf Science*, 86(1), pp.21-30.
- McLeod, E. and Salm, R.V., 2006. *Managing mangroves for resilience to climate change*. IUCN, Gland, Thụy Sĩ. 64pp.
- Tuấn, V. S., 2015. *Tổng quan Điều kiện Môi trường và Phục hồi Rừng ngập Mặn Đầm Thị Nại (Review of Environmental Conditions for Mangrove Rehabilitation in Thi Nai Lagoon)*. Special report for Binh Dinh Department of Fisheries.

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