STATUS, ISSUES AND CONCERNS OF MANGROVE ECOSYSTEMS: RETHINKING THE ROLE OF THE UNIVERSITY IN CRAFTING A SUSTAINABLE MANAGEMENT AND CONSERVATION STRATEGY

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Abstract: The paper reviews on the status, issues and pressing concerns of the Philippine mangroves. It presents species inventory update, their taxonomic classification and utilitarian value by the surrounding community. A total of 39 true mangrove species distributed to 16 families and 18 genera had been documented in studies. Sustained decline of the mangrove forests had been noted resulting to disruption of ecosystem services. During this era of alarming global climate changes, rethinking the role of a university in crafting a sustainable management and conservation strategy for the mangrove ecosystem is emphasized such as, 1) the possibility of establishing a university committee or technical working Group (TWG) on estuary research and/or training, 2) the lending of expertise in the construction of biodiversity corridors to rehabilitate the severely degraded mangrove forest, 3) the sustained assistance to LGU in implementing policies and ordinances and 4) the sustained mangrove biodiversity education. It is envisioned that in the future, there will be the 1) coexistence of mangrove forests and humans, 2) that the mangrove ecosystem will become a productive ecotourism village and that 3) there will be sustained provision of mangrove ecosystem services to surrounding human communities.

Keywords: ecotourism, estuary, landscape corridors, mangrove forests, sustainable management

Introduction:

Mangroves are very important tropical ecosystems bridging the coastal and the terrestrial habitats (Lillo and Buot 2016, Martinez and Buot 2018; Sinfuego and Buot 2014; Doydee and Buot 2014; Almazol et al. 2013; Primavera et al. 2004; Primavera 2000; De la Cruz 1979). They serve as breeding grounds for fishes and home to many aquatic organisms and even local and migratory birds (Macintosh et al. 2002a, 2002b). They are known as the sentinel of the sea since the marine life is well protected during flash floods. The mountains of debris are prevented from invading the seas. Similarly, the mangroves are also the guardians of the inland communities. This is well

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demonstrated when tsunami comes. With the intact mangrove ecosystem, impact of tsunami and the alarming global climate change could be minimized.

Some published studies on mangroves at hand, include those of Fernando and Pancho (1980), Buot (1994), Palis et al. 1997, Superales et al. (2008), Sinfuego and Buot (2008), Doydee et al. (2008) and Tinh et al. (2009). The work of Fernando and Pancho (1980) describes the mangrove trees of the Philippines. The studies of Sinfuego and Buot (2014, 2008), Doydee and Buot (2014), Almazol et al. (2013), Tinh et al. (2009) and Doydee et al. (2008), were focused on assessments and inventory of mangrove forests in the Philippines, Thailand and Vietnam, respectively. Hopefully, there will be more studies that will soon be published on the zonation patterns of these mangrove forests as affected by various environmental factors with the goal of formulating a sustainable management and conservation strategy that would enhance mangrove ecosystem services for the surrounding local communities.

But what agency should be taking care of the mangrove ecosystems? The environment agency, the agriculture and fisheries agency and the university of course share the burden in taking care of the mangroves. It should be very clear that it is the prime obligation of a university to be the caretaker of our nation's unique and prime ecosystem types. Research is one of the essential and must functions of a university. The case of some researchers and professors from the University of the Philippines Los Baños, had been reported to have been involved into several studies geared towards safeguarding our diverse ecosystem types. Several taxa (ferns, gymnosperms and angiosperms), life forms (herbs, shrubs and trees) and forest formations had been studied (Pancho 1983; Buot and Okitsu 1998, 1999; Luna et al. 1999; Lasco et al. 2001; Buot 2001, 2007, 2008a, 2008b, 2008c; Banaticla and Buot 2004, 2005; Fernando et al. 2004; Fernando et al. 2008a; Fernando et al. 2008b; Pancho and Gruezo 2006; Mallion et al. 2001 and many others). It might be worth mentioning that despite tight research budget allocated, university staff are trying their best to fulfill the mandate of the university by studying various ecosystem types.

It seems however, that only few works had been done yet on mangrove ecosystem and its sustainable conservation and management. This could be partly due to the inherent difficulties and inconveniences that researchers will have to cope with in doing field works in the muddy estuaries and tidal flats. It is therefore the aim of this paper to firstly review the current works, problems and concerns on mangroves in the Philippines. Specifically, the paper presents:

- an inventory of the Philippine mangrove species, their distribution and ethnobotany;
- determine the current issues and pressing concerns of the Philippine mangrove ecosystems;
- identify and recommend appropriate sustainable strategies in managing the Philippine mangrove resource so as to sustain the ecosystem services for the marginal populations in the surrounding communities;
- rethink the role of a university in crafting a sustainable management and conservation strategy.

Materials and methods:

Published literature on mangroves in the Philippines were reviewed, particularly those in journals and books. Mangrove inventory, distribution and ethnobotanical studies were documented. The status, issues and concerns of the ecosystem, were noted and assessed. Then a discussion on the possible role of the university in crafting sustainable management strategy of this ecosystem followed.

Results and discussion:

Inventory of the Philippine true mangrove species

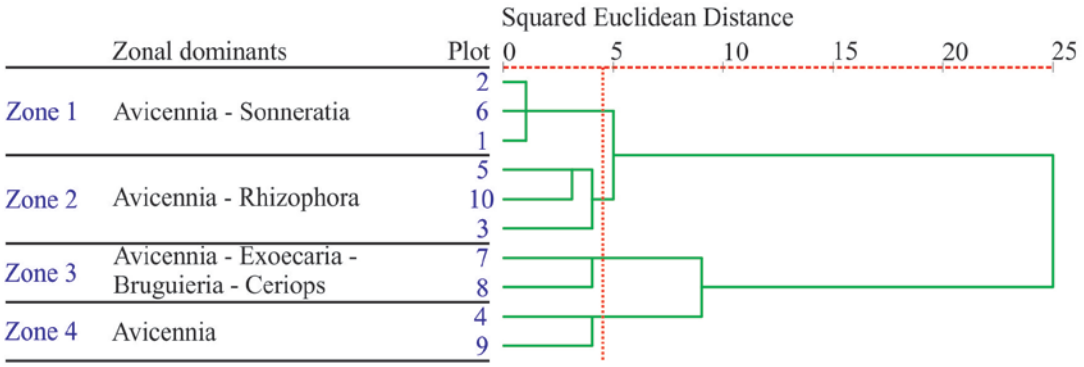
There are two categories of mangroves, the true mangroves and the mangrove associates. True mangroves are those found exclusively or almost exclusively in intertidal habitats (Primavera et al. 2004). The mangrove associates on the other hand refer to those species which are not found exclusively in intertidal zones. They may be distributed in other habitats adjacent to the mangroves.

A total of 39 species of true mangroves have been recorded for the Philippines (Sinfuego and Buot 2008) (Tab. 1, Annexes) out of the world total of 70 (Spalding et al. 1997). Other sources pointing almost same number included Brown and Fishcher (1920), Arroyo (1979), Fernando and Pancho (1980), Tomlinson (1986), Buot (1994), Melana and Gonzales (1996), Aragones et al. (1998), Primavera (2000) and Primavera et al. (2004).

The 39 species are distributed to 16 families and 18 genera. This attests to the megadiverse conditions of our estuaries. The most highly represented family is Rhizophoraceae with 11 species followed by Avicenniaceae with 6 species. In this paper I included the true mangrove ferns, *Acrostichum aureum* and *Acrostichum speciosum* which are usually intentionally omitted by others, maybe owing to their growth habit (e.g., Primavera et al. 2004), thus the varying number reported in different publications. But Primavera et al. (2004) emphasized that in the Philippines there are around 35-40 species of true mangroves.

In a field study in Ajuy and Pedada Bays in Iloilo, Philippines (Sinfuego and Buot 2014), *Avicennia* was found most frequent and most dominant (Fig. 1). It was occurring in all zones.

Figure no. 1 Dendogram of the ten sampling plots in Ajuy and Pedada Bays constructed by average linkage clustering (between groups) using data on species richness (S). Four zones were classified: Zone 1 with plots 2, 6, 1; Zone 2 with plots 5, 10, 3; Zone 3 with plots 7 and 8; and Zone 4 with plots 4 and 9 (Sinfuego and Buot 2014)



This study has a similar result with our field study in Mui Ca Mau National Park in Vietnam (Tinh et al. 2009). *Avicennia* was dominating in the Southeastern Coast Zone facing South China Sea and in the Western Coast Zone as well facing Thailand Gulf. In the Inland Zone, *Rhizophora* in addition to *Avicennia* were dominant. Generally, sites near the seaward zone are dominated by *Avicennia* and to a certain extent by *Sonneratia* as in our Pedada and Ajuy study.

In another work Doydee and Buot (2011) in Ranong, though *Avicennia* was frequent, it was only dominant in 3 of the 7 sites. In contrast, *Rhizophora* was dominant in 5 sites. These mangrove species are distributed where conditions favor and there is a very distinct zonation (Primavera et al. 2004). *Rhizophora*

zone is usually found in the lower intertidal habitats. Their complex knee roots are good adaptations in this unfriendly environment. *Bruguiera cylindrica* and *Ceriops decandra* form zones in the mid to high intertidal areas, while *Lumnitzera racemosa*, *Xylocarpus* spp., *Heritiera littoralis* and *Excoecaria agallocha* occupy upper intertidal zones. *Pemphis acidula* has prominent stands as well on rocky shores and the upper beaches beyond *Avicennia marina* and *Sonneratia alba* zones.

Mangrove ecosystems are found throughout the Philippine islands (Fig. 2, Annexes) where the fresh and marine waters meet. The country is indeed blessed with the favorable conditions leading to the formation of a huge track of mangrove ecosystem. Most species are found nationwide. Mangroves had been used by people since time immemorial (Tab. 2, Annexes). Aside from the fishery products in the mangroves, some of the utilitarian value include firewood, animal feed, medicine, food (*Nypa* fruit), wine (*Nypa*), oil, cosmetics (*Xylocarpus*, *Sonneratia*), pesticide (*Avicennia*), source of tungog (as dye, retardant etc.) (*Ceriops*) especially in Visayas and Mindanao, vegetable for coastal folks (*Sonneratia*), thatching materials (*Nypa*), furniture, chopsticks etc. A mangrove tree species (*Heritiera*) was also used in the construction of *balanghai*, those large boats in the olden times used in trading goods throughout Southeast Asia before 1521 carrying around 60-90 persons. Additionally, Pringgenies et al. (2017) reported that *Rhizophora mucronate* leaf and bark have been used as dye for batik in Indonesia. Punrattanasin et al. (2013) also wrote that *Rhizophora apiculata* has been used for dyeing silk fabric. Indeed, people had been so attached to the mangroves that they name places after the species (Tab. 3, Annexes).

Issues and concerns on Philippine mangroves

Massive land conversion and over-utilization. There are around 18M hectares of mangrove forests worldwide (Primavera et al. 2004) and the Philippines have about half a million hectares in the early 1900s. In 1988 however, the National Forest Resource Inventory disclosed a very rapid and sharp decline (Pulhin 2003; PCARRD 1991). This is because of the accessibility of the mangrove ecosystem as a resource. Massive land conversion to salt ponds, urban development and industry, residential, nipa plantations and especially fishpond culture were very rampant then. Primavera (2000) had shown that indeed, the major factor in the decline of the mangrove forest is the unregulated fishpond culture. In Ranong, Thailand, urbanization and the development of coastal shrimp farming had been the cause of the decline in Ranong mangrove forests (Macintosh 1996). In Vietnam, it is the increasing population in the mangrove forest over-utilizing the resource (Tinh et al. 2009).

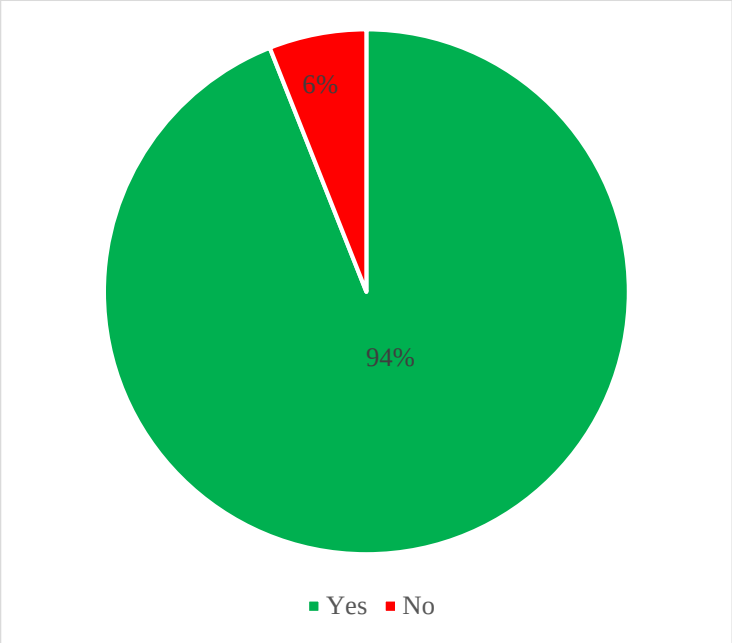
Of course, there are other causes of the decline of the mangrove forest in the Philippines. This includes payment of taxes by mangrove residents or even non-residents as a strategy to acquire land and the claims of ownership are handed over even to the succeeding generations or are sold to people residing outside of the mangrove forest.

Dwindling ecosystem services in mangrove forests.

With the decline of the mangrove area, there is the subsequent decline of the mangrove ecosystem services as well. The provisional service is greatly affected. Therefore, in many surveys, people could only reminisce in telling us of the grand history of fish catch, the size of the crustaceans, the oysters, the shells and the rest of the biodiversity. In our study in Ajuy and Pedada, Iloilo (Sinfuego and Buot 2014), the respondents have significantly shown to be aware of these mangrove services (Fig. 3). They have frequently mentioned its provisional function that traditionally an intact mangrove ecosystem would ably provide an array of services to the coastal communities. The fisherfolk of Ajuy and Pedada Bays have depended on the mangroves, from women gathering shells on the mudflats and gathering fuel wood, to men doing off-shore fishing activities.

Ajuy and Pedada communities also recognized the protective roles of the mangroves, serving as a buffer against storms and strong winds and control of coastal erosion. They have also recognized the mangrove supporting function acting as a breeding ground and habitat/shelter for diverse fauna. Indeed, the mangrove decline has a devastating effect on the lives of people especially those in the coastal communities. They are always the first ones to sense and experience the impact of the slightest disturbance of the ecosystem.

Figure no. 3 The proportion of the respondents' knowledge on the benefits provided by the mangrove ecosystem



Implementation of Philippine mangrove legislation.

As is always the case, a number of laws and policies are available regarding mangrove protection and management. As a matter of fact, there are around 19 Philippine laws on mangrove jurisdiction, zoning and fishpond conversion, 18 laws on mangrove protection, and 11 laws on mangrove use, tenure, and rehabilitation. The clamor is always on the strict enforcement and implementation of the legislation.

In the Philippines, Primavera (2000) recommended policies that would influence sustainable mangrove ecosystem management to include community-based efforts and government programs such as the 1984 Central Visayas Regional Project. These recommendations include conservation of remaining mangroves, rehabilitation of degraded sites including abandoned ponds, mangrove-friendly aquaculture, community-based and integrated coastal area management, and provision of tenurial instruments. In another paper, Primavera (1991) recommended strict enforcement of existing government guidelines (e.g. ban on mangrove forest conversion), institution of new policies on the use of groundwater, seawater and public credit, diversification of cultured species, and emphasis on semi-intensive farming parallel with brakes on further intensification of prawn farming.

In Africa and West Asia, Bene (2005) tried to revisit the mangrove ecosystems through a policy analysis of the ongoing debate on shrimp farming aquaculture. It describes the changes in policy orientations that have taken place in recent years, and tries to relate them to the advocacy strategies developed by different networks and policy communities. The analysis revealed in particular, the crucial contribution of the 'power of expertise' and shows how it has been instrumentalized by certain advocacy networks to depoliticize the debate. This has allowed a number of key stakeholders to refocus the debate on technical solutions. However, it has also prevented other groups concerned with more intractable social and political issues from engaging successfully in the policy process, thus leaving the long-term sustainability of aquaculture still a contentious issue.

In Vietnam, Tinh et al. (2009) outlined the very strict policy in the mangrove forest of Ca Mau Cape National Park. There is the zoning which allows only human activities in the buffer and economic zones. In the core zone, there is strictly no occupancy. Relocation is resorted to immediately in case anyone will be found. And in the buffer and economic zones, recommended multiple cropping practices are introduced for the shrimp growers to strictly follow. The multiple cropping system comprise a row or two or three of a certain mangrove species followed by a shrimp pond and so on. The policy stipulates minimal external chemical inputs so as to simulate natural system.

Government policies on mangrove forests in Mui Ca Mau province (6 provincial level policies and 13 national level policies) have promoted the mangrove-shrimp farming system in the buffer zone of Mui Ca Mau National Park (Tinh et al. 2009). Instruments to implement these policies include land allocation, low interest loan, infrastructure, provision for training, and distribution of free mangrove tree seedlings. Based on field observations, I could see the strong political will in the implementation of the policies and hence, the success of the project in the locality.

With the increasing trend of human population, decision makers at the local level are always faced with a paradox though. *Shall we sustain the extensive mangrove land conversion and pond development to artificially meet the immediate economic needs?* Or *shall we go for a full swing mangrove conservation and rehabilitation for long term benefits but which may not be able to supply initially the quantity of badly needed fish or shrimps of the burgeoning public?*

Many have become pessimistic of the future of the mangrove forest. With the present mangrove ecosystem pressures, conservation and rehabilitation are indeed tough herculean tasks. Many however, tried to do replanting of degraded estuaries (Tinh et al. 2009; Primavera et al. 2004; Sinfuego and Buot 2014; Doydee et al. 2008).

Unfortunately, some do it the wrong way (Primavera et al. 2004) due to ignorance and lack of information and education campaign (IEC). Many have wasted their reforestation efforts by planting available propagules of certain species in the wrong habitat or zone causing poor growth and subsequent death of the seedling.

In order to have a successful rehabilitation and conservation, a very strong will of the local leadership, community resident empowerment as well as an active IEC program will be necessary.

Rethinking the role of a university in crafting sustainable management and conservation strategy in Philippine mangrove ecosystems

It appears that an intervention from the university as a neutral entity is urgent to address the current state of the mangrove ecosystems which endanger lives of many coastal dwellers. After all, one of the thrusts of many universities is ecosystem management which should include mangrove ecosystem or the estuaries. Thus, the university can contribute to mangrove ecosystem management through the following strategies:

Establishment of Estuary Research and Training Center or Technical Working Group. One urgent intervention would be through the establishment of an Estuary Research and Training Center which will be tasked among others to:

- formulate *science-based sustainable management and conservation strategy* for mangrove species and ecosystem through conduct of relevant research studies;
- prevent species and ecosystem from becoming at risk through carefully planned steps like proper coordination, interagency cooperation, local empowerment and shared stewardship;
- monitor and maintain the diversity of native mangrove species and habitat types and prevent encroachment of invasive organisms;
- produce appropriate IEC materials and conduct regular IEC activities including training of researchers, technicians, teachers, LGUs and community purok leaders, youths and kids to ensure proper dissemination of evidence-based information;
- serve as the nucleus and coordinating body of the various organizations involved in estuary research and training.

Cognizant of the budgetary constraints of the university, the Center could start from a simple committee or task force or a technical working group (TWG). The committee or the TWG will then identify all sectors working on mangroves and estuaries. Sectoral meeting will have to be scheduled to delineate functions. The TWG will have to ensure proper representations by the various sectors and disciplines having concerns of the urgent rehabilitation and conservation of the mangrove estuary resources. The university can do basic studies while the environment agency can conduct applied studies. LGUs, NGOs and POs can help disseminate evidence-based information to coastal communities. The TWG and ultimately the Center will have to be the nucleus and the coordinating body in the conduct of activities by various organizations related to estuary research and training. This will ensure concerted effort towards sustainable management, conservation and rehabilitation of mangrove ecosystems.

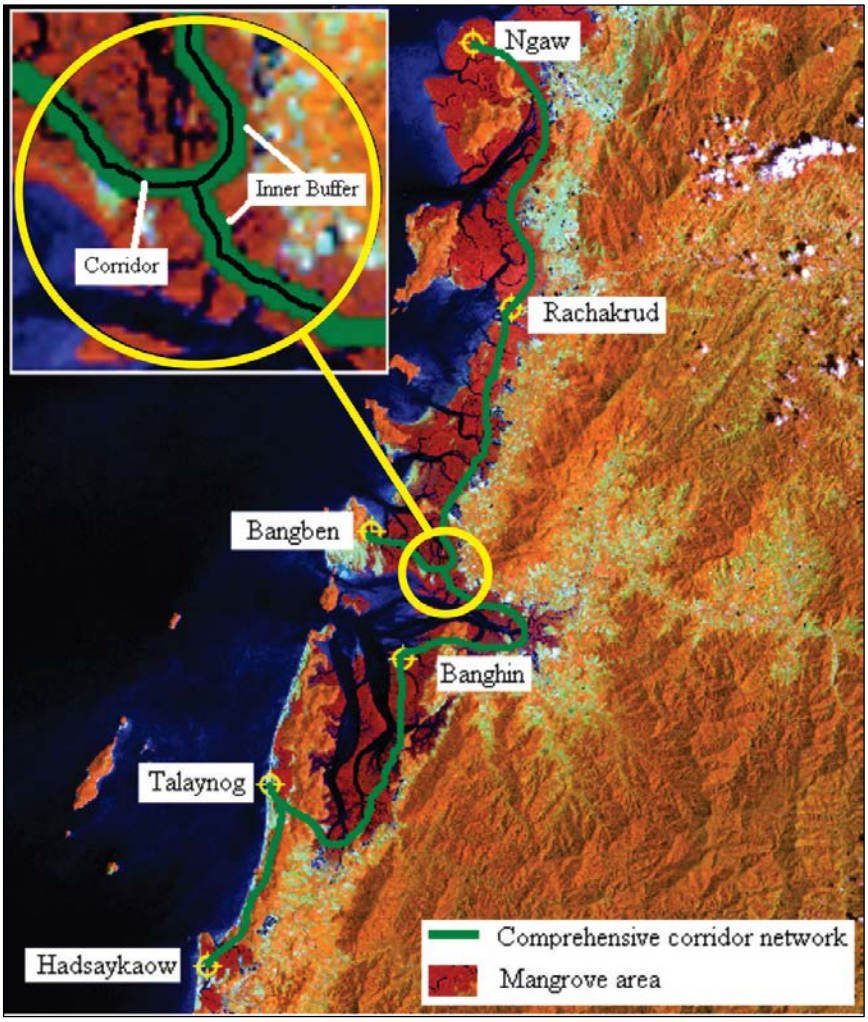
Lending technical expertise in spearheading rehabilitation work.

Constructing biodiversity corridor. The university is a community of scholars and so is the Estuary Research and Training Center or the Technical Working Group as well. The elite community should have the technical expertise in addressing the seemingly hopeless mangrove ecosystem problems. The severely deforested and degraded mangrove landscape can still be rehabilitated. In the study of Doydee and Buot (2014) in Ranong mangrove forest in southern Thailand, a biodiversity corridor (Fig. 4) was proposed to connect terribly fragmented mangrove landscape that aggravated the horrifying death toll during the tragic tsunami in December 2004.

Biodiversity corridor is a continuous belt or strip of vegetation that shelters plants and animals and other forms of life while traveling from one ecosystem patch to another (Ong et al. 2002). It provides links and connectivity of the otherwise isolated and possibly endangered organisms. The practical types of corridor to connect the mangrove patches depend on the severity of destruction. Landscape corridors are resorted to in case of extensive fragmentation like that of Ranong and Ajuy and Pedada bays (Doydee and Buot 2014; Sinfuego and Buot 2014). Linear or stepping stone corridors could be proposed in habitats with disturbances of lesser-scale. When mangrove patches will be connected, there will be sure protection against giant waves. The studies of Chotthong and Aksornkoae (2007) reported that along the shoreline of Ranong Province, where Kasetsart University's Coastal Resource Research Station is located, many villagers were saved from tsunami because the mangroves are thriving and quite dense in the area. It has been suggested that, in order

for mangroves to effectively provide protection against waves, the width of the forest should not be less than 100 m from coastal shores (Chotthong and Aksornkoae 2007). Corridors should provide habitat as well as a pathway for movement of mangrove animals. They should link core areas and must be surrounded by buffer zones.

Figure no. 4 The comprehensive corridor network in Ranong mangrove landscape (Doydee and Buot 2014(



Choosing the appropriate reforestation species.

After delineating the corridor network, the next question would be the most appropriate reforestation species considering zonal preferences of the mangroves. As mentioned earlier, mangroves have specific habitat and ecological and zonal preferences. Certain mangrove species would thrive best in low intertidal zones (*Rhizophora apiculata* and sister species). Others prefer mid- to high intertidal (*Bruguiera cylindrica* and *Ceriops decandra*) or upper intertidal zones (*Xylocarpus*, *Lumnitzera* etc.).

Therefore, it is a must that this should be well considered before deciding on the planting material in the constructed biodiversity corridor. There had been many

instances that *Rhizophora* seedlings had been planted in *Avicennia marina* and *Sonneratia alba* zones in fringing mangroves. In the not-so-severely degraded mangrove landscapes, local communities may gain insights from the ecologically dominant mangrove species in the area if they are not so familiar with zonal preferences of species. Natural dominants could be the guide as to what particular species should be planted in a locality.

Enjoining LGUs in implementing policies geared towards sustainable mangrove ecosystem conservation and management.

Through the Estuary Research and Training Center, the university can help or assist LGUs to properly carry out policies or maybe craft one urgently needed ordinance geared towards sustainable mangrove ecosystem conservation and management. We have very good laws and policies (Primavera et al. 2004; Primavera 2000) relating to mangrove ecosystem zoning (BFD Cir. 95), utilization (PD 705, DENR AO 3/9), protection (PD 705, PD 1586, DENR AO 76, LOI 917, RA 7161, DENR AO 16) and rehabilitation (DENR AO 77, DENR Memo Cir. 15, DENR AO 15, EO 263, DENR AO 30, RA 8550). Implementation now rests on the strong political will of the LGUs to enhance sustainable mangrove ecosystem rehabilitation, conservation and management. These laws, policies and guidelines should be translated into sustainable practices.

In the study of Tinh et al. (2009) in the mangrove forest of Vietnam, they noted that there was a very strict implementation of the policy on zoning in Ca Mau Cape National Park (Decision No. 116/QD-TTG). Several families were relocated after the area had been classified as Protected Zone. No human activity is allowed except management for sustainable conservation. At the buffer zone, only sustainable shrimp or fish farming practices were allowed. This consists of a pond of shrimp or fish in between 3-5 rows of mangrove stands (e.g., *Rhizophora* if the area is suited to such species). No input as fertilizers for the planktons are provided. The goal is to simulate natural mangrove ecosystem conditions where the detritus food chain will enhance the ecosystem functioning. In the economic zone, however, people are allowed to use external inputs and to intensively practice fish or shrimp farming.

The same mangrove-friendly aquaculture (MFA) is practiced in the Philippines. The Southeast Asian Fisheries Development Center (SEAFDEC) is the driving force behind this initiative. They launched the Mangrove-Friendly Aquaculture Project in 1997 which include the aquasilviculture of the mud crab *Scylla* in field sites in the provinces of Aklan and Palawan.

MFA may be applied on two levels:

a) silvofisheries or aquasilviculture where the low-density culture of crabs, shrimp and fish is integrated with mangroves, and

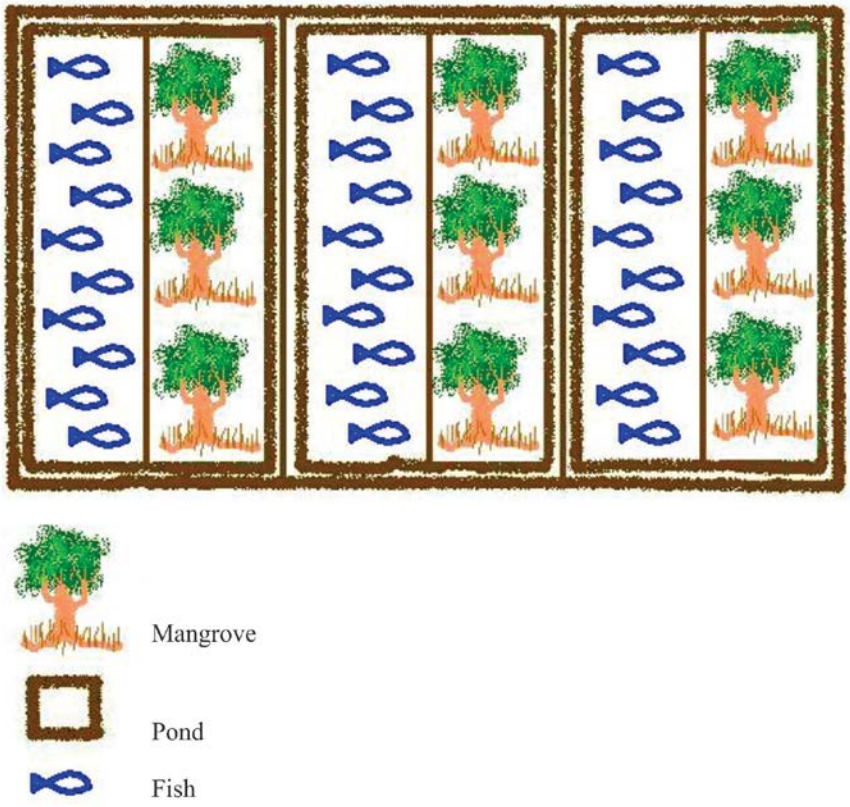
b) mangrove filters where mangrove forests are used to absorb effluents from high-density culture ponds (Primavera 2000).

An aquasilviculture cropping pattern is also recommended by Sinfuego and Buot (2014) in Ajuy and Pedada Bay fishpond owners. For big dominant *Avicennia* and *Sonneratia* trees, 1-3 rows alternating with a pond may suffice (Fig. 5).

The LGUs with assistance from the University Estuary Research and Training Center can explore this technology and should feel free to modify according to local scenarios and habitat requirements. Mangrove aquasilviculture should be viewed as a good initial step in changing the mangrove landscape and could possibly be replicated in other areas in the near future.

Other laws, policies, department orders, circulars and guidelines can be revisited and the same can be implemented and translated into sustainable management practices to enhance mangrove ecosystem functioning for the benefit of the coastal communities.

Figure no. 5 Proposed model for mangrove aquasilviculture drawn from the concept of Sinfuego and Buot (2014)



Sustaining biodiversity education and community awareness drive among adults, youths and kids.

The best of the laws and policies, the best of the research results and the best of the sustainable plans will just be nothing if there is no efficient IEC campaign and advocacy. Hence, one of the tasks of the University Estuary Research and Training Center is to produce appropriate IEC materials and conduct regular IEC activities including training of researchers, technicians, teachers, LGUs and purok leaders, youths and kids in coastal communities to ensure proper dissemination of evidence-based information.

According to Chotthong and Aksornkoae (2007), any effort in mangrove reforestation and rehabilitation will not be successful if it is neglected by the locals. But the locals will only be interested if they are aware of the benefits that can be generated from the activity. If the locals can fully understand the significance of mangroves, then they shall be more than willing to take part in the conservation efforts. Local people deserve the best information about the mangrove forest, its resources and its ecological and economic benefits. They should be aware of the beneficial and destructive activities in the mangrove forest landscape (Macintosh et al. 2002a, 2002b).

Biodiversity IEC focused on mangroves (Bilbao et al. 2009a, 2009b) should be planned carefully well knowing that it plays a critical role in mangrove rehabilitation, conservation and management. All forms of media should be tried, be it print, audio, video and multimedia targeting an audience covering all age brackets. Alaman (2008) found a unique and effective biodiversity IEC strategy that addresses adults, youths and kids all at the same time. He requested a parish priest to discuss biodiversity of Mt. Malindang in Mindanao during a church

homily. This is indeed surprising and results of the interviews indicated a very effective dissemination of an evidence-based information. This strategy can be replicated as well in chapels and churches of various denominations near coastal and mangrove communities. People could be very receptive and open-minded during a church gathering and more so if the religious leader himself, a person of high respect and authority, is the one advocating on mangrove ecosystem rehabilitation, conservation and sustainable management.

The Philippine mangrove ecosystem in the years ahead

Coexistence of mangrove forest and sustainable fisheries.

When all the issues and concerns of the mangroves will be well addressed and when the University Estuary Research and Training Center will be able to take off and start reaping the gains of sustainable conservation and management of the estuaries, we can expect a mutualistic relationship between the mangrove forest and sustainable fisheries. In the paper of Camacho et al. (2010), they emphasized that indigenous forest management approach adopted by local people, treats forest as a 'lifeshed' where human existence is connected with land, forest and water.

With that, we expect benign fishing technologies (Fig. 6 and Fig. 7) that will enhance productivity and sustainability of the mangrove resource. This can only be made possible though, if people can feel they are co-stewards of the resource. Therefore DENR AO 77, the Philippine environment agency's administrative order, has to be implemented well. It is about the Integrated Social Forestry Program providing incentives for co-management through provision of legal tenure.

Mangrove ecosystem: an ecotourism village.

One of the least explored ecotourism sites in the Philippines and even in Southeast Asia at present is the mangrove ecosystem. However, the mangrove forest should be one of the best ecotourism destinations (Fig. 8 and Fig. 9). With proper mangrove IEC, we can convert many mangrove areas in the country into ecotourism villages. People would love to visit productive ecosystems, ecosystems with food, medicine, wine, fruits and fuel wood and ecosystems which display nature's bounty and a bizarre of morphological and eco-physiological wonders.

The University Estuary Research and Training Center can assist the community in converting the resource into an ecotourism destination. LGUs can be mobilized especially the education sector from pre-school to university level to visit and learn many at the mangrove ecosystem. Interagency cooperation and coordination can also be a big help. When we can convert many local mangrove areas into ecotourism villages, we can be assured of the support from the surrounding coastal communities.

Sustained provision of mangrove ecosystem services for the surrounding communities.

Sustained provision of mangrove ecosystem services is the ultimate goal of the University Estuary Research and Training Center and of any mangrove conservation framework for that matter. This is difficult to attain though, but when one does, it implies that the actors of this ecosystem type have fully taken into account holistic and sustainable practices necessary for proper ecosystem functioning.

Such sustainable practices rest not only on strict biophysical principles as observance of the carrying capacity, observance of zoning, engaging in mangrove friendly aquaculture, maintenance of mangrove species and habitat diversity and continuous construction of biodiversity corridors among others BUT on socio-cultural and politico-economic considerations as well. This means that man as a socio-political animal has to be well studied and understood if we are to sustainably manage the mangrove ecosystem.

Figure no. 6 Benign traps for crabs made mainly of nylon (left side) and local bamboo (right) in Ajuy, Iloilo (Photo by K. Sinfuego)

Figure no. 7 A fisherman trapping crabs in the mangrove forest in Pagbilao, Quezon (Photo by A. Almazol)

Figure no. 8 Information map at the entrance of the Pagbilao Mangrove Project (Photo by A. Almazol)

Figure no. 9 A kilometer or so board walk for ecotourists in Pagbilao Mangrove Project (Photo by A. Almazol)

Rezumat:

STAREA, PROBLEMELE ȘI PREOCUPĂRILE PRIVIND ECOSISTEMELE DE MANGROVE: REGÂNDIREA ROLULUI UNIVERSITĂȚII ÎN ELABORAREA UNEI STRATEGII DE MANAGEMENT ȘI CONSERVARE DURABILĂ

Lucrarea trece în revistă starea, problemele și preocupările urgente privind pădurile de mangrove din Filipine. Sunt prezentate un inventar actualizat al speciilor, clasificarea lor taxonomică și valoarea utilitară pentru comunitățile din zonă. Au fost semnalate un total de 39 de specii de mangrove adevărate aparținând la 16 familii și 18 genuri. A fost observat un declin accentuat al pădurilor de mangrove, care are ca efect întreruperea serviciilor ecosistemice. În această eră a schimbărilor climatice globale alarmante, regândirea rolului unei universități în elaborarea unei strategii de management și conservare durabilă pentru ecosistemul de mangrove este argumentată prin: 1) posibilitatea înființării unui Comitet Universitar sau a unui Grup de Lucru Tehnic (TWG) în cercetarea estuarelor și / sau ca zone de instruire, 2) acordarea de expertiză în construcția de coridoare de biodiversitate pentru reabilitarea pădurilor de mangrove grav degradate, 3) asistența susținută către Unitățile Guvernamentale Locale (LGU) în punerea în aplicare a politicilor și ordonanțelor și 4) educația susținută privind biodiversitatea pădurilor de mangrove. Se prevede că în viitor va exista 1) coexistența pădurilor de mangrove și a oamenilor, 2) că ecosistemul de mangrove va deveni un sat de ecoturism productiv și că 3) va exista furnizarea susținută de servicii ecosistemice din pădurile de mangrove pentru comunitățile umane din jur.

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Annexes:

Table no. 1 Elements of the major or true mangrove vegetation in the Philippines showing respective families, scientific and common names (modified from Sinfuego and Buot 2008)

Family name	Species name	Common name
Acanthaceae	*Acanthus ebracteatus* Vahl	Tigbau
	Acanthus ilicifolius L.	Diliuariu
	Acanthus volubilis Wall.	Lagiwliw/Ragoyroy
Arecaceae	*Nypa fruticans* van Wurmb.	Nipa
Avicenniaceae	*Avicennia alba* Blume	Bungalon-puti
	Avicennia eucalyptifolia (Valeton) Moldenke	Bungalon-sahing
	Avicennia marina (Forsk) Vierh	Bungalon
	Avicennia marina (Forsk) Vierh var. *rumphiana*	Pi-api
	Avicennia officinalis L.	Api-api
	Avicennia rumphiana Hall. f. (formerly *A. lanata*)	Api-api, Miapi/Bungalon
Bombacaceae	*Camptostemon philippinensis* (Vidal) Becc.	Gapas-gapas
Combretaceae	*Lumnitzera littorea* (Jack.) Voigt.	Tabau
	Lumnitzera racemosa Willd	Kulasi
Euphorbiaceae	*Excoecaria agallocha* L.	Buta-buta
Lythraceae	*Pemphis acidula* J.R. and G. Forst.	Bantigi
Meliaceae	*Xylocarpus granatum* Koen.	Tabigi
	Xylocarpus moluccensis (Lam.) M. Roem. (formerly *X. mekongensis*	Piagau
Myrsinaceae	*Aegiceras corniculatum* (L.) Blanco	Saging-saging
	Aegiceras floridum Roem. and Schult.	Tinduk-tundukan
Myrtaceae	*Osbornia octodonta* F. Muell.	Taualis
Plumbaginaceae	*Aegialitis annulata* R. Brown	Data not available
Pteridaceae	*Acrostichum aureum* L.	Lagolo
	Acrostichum speciosum Willd.	Lagolo
Rhizophoraceae	*Bruguiera cylindrica* L. (Blume)	Pototan-lalake
	Bruguiera gymnorrizha (L.) Lam	Busain
	Bruguiera parviflora Wight and Arn. Ex Griff.	Langarai
	Bruguiera sexangula (Lour) Poir.	Pototan
	Ceriops decandra (Griff.) Ding Hou	Malatangal
	Ceriops tagal (Perr) C.B. Rob	Tangal
	Kandelia candel (L.) Druce	Bakauan Baler
	Rhizophora apiculata Blume	Bakauan-lalake
	Rhizophora x lamarckii Montr.	Bakauan (hybrid)
	Rhizophora mucronata Lam.	Bakauan-babae
	Rhizophora stylosa Griff.	Bakauan-tigkihon / bato
Rubiaceae	*Scyphiphora hydrophyllacea* Gaertn	Nilad
Sonneratiaceae	*Sonneratia alba* J. Smith	Pagatpat
	Sonneratia caseolaris (L.) Engl.	Pedada
	Sonneratia ovata Backer	Pagatpat baye
Sterculiaceae	*Heritiera littoralis* Dryand. ex W. Ait.	Dungon/Dungon-late

Figure no. 2 Mangrove distribution map of the Philippines as of 1994 (NAMRIA 2007)

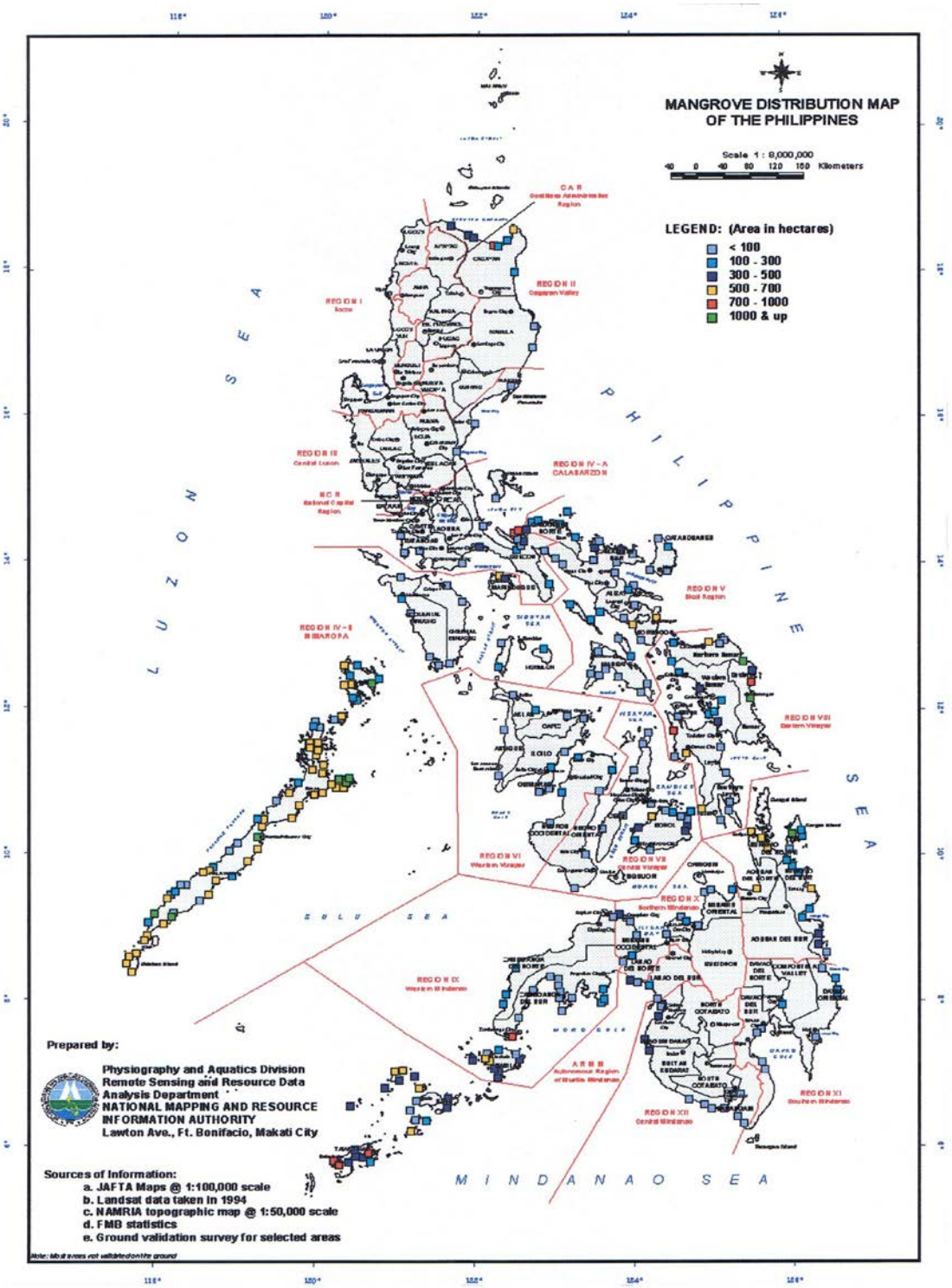

Table no. 2 Uses of Philippine mangroves (mainly from Primavera et al. 2004 unless specified)

Species	Uses
Acanthus spp.	dried flowers boiled and water drank to relieve cough
Avicennia alba	bark as astringent, resinous secretion for birth control; ointment from seeds for smallfox ulceration
Avicennia marina	smoke of dried branches as mosquito repellent, fodder for goats
Avicennia officinalis	fruits as astringent; seeds and roots as poultice to treat ulcers
Bruguiera sexangula	roots and leaves for burns; leaves have tumor-inhibiting alkaloids; fruits chewed as substitute for betel nut; lotion made from fruits to treat sore eyes
Ceriops tagal	dye; bark infusion for obstetric and haemorrhagic conditions, e.g. ulcers; dried bark chewed by old folks
Excoecaria agallocha	leaves for epilepsy; sap for ulcers and toothache; twigs as pest repellent
Heritiera littoralis	seed extract for diarrhea and dysentery
Lumnitzera littorea	leaf decoction for thrush in infants
Rhizophora spp.	pounded bark placed on skin to relieve jellyfish sting; bark decoction used to wash jellyfish before eating, and for scabies and skin infection; branches for chopsticks
Rhizophora apiculata	dye from bark extract for silk (Punrattanasin et al. 2013)
Rhizophora mucronata	dye from bark and leaf extract for batik (Pringgenies et al. 2017)
Scyphiphora hydrophyllacea	decoction of leaves used in folk medicine
Sonneratia caseolaris	sap as skin cosmetic
Xylocarpus granatum	seed oil used for lamps and grooming hair; fruits and seeds for diarrhea; bark decoction for cholera
Xylocarpus moluccensis	seeds for insect bites and diarrhea; seeds and bark as astringent

Table no. 3 Some cities, towns, villages and other places in the Philippines named after mangrove species and their associates (Primavera et al. 2004)

Genus/species (local name)	Place
Avicennia marina, A. alba (piapi)	Piapi Beach, Dumaguete City
Barringtonia spp. (bulubituon)	Bitoon, Jaro, Iloilo City
Calophylum inophyllum (dangcal)	Dangcalan, Tangalan, Aklan
Excoecaria agallocha (lipata)	Lipata, Culasi, Antique
	Lipata, Bacacay, Albay
	Lipata, Surigao City
Heritiera littoralis (dungon)	Dungon, Jaro, Iloilo City
Hibiscus tiliaceus & Thespesia populnea (balabago)	Balabago, Jaro, Iloilo City
Lumnitzera racemosa (culasi, tabao)	Culasi, Antique
	Culasi, Ajuy, Iloilo
	Tabao, Buenavista, Guimaras
	Taba-ao, Sagay, Negros Occidental
	Matabao, Buenavista, Agusan del Norte
	Matabao, Siquijor
Nypa fruticans (nipa, sapsap, sasa)	Casapsapan, Aurora
	Canipaan River, Palawan
Rhizophora spp. (bakhaw)	Bakhaw, Jaro, Iloilo City
	Bakhaw, San Joaquin, Iloilo
	Bacjauan (old name for Conception), Iloilo
Scyphiphora hydrophyllacea (nilad)	Maynilad (now Manila)
Sonneratia spp. (pagatpat/pedada)	Pagatpatan, Jasaan, Misamis Oriental
	Pedada Bay, Ajuy, Iloilo