Application of PRA integrated GIS: Tools to Develop Management Arrangement for the Devolution of Mangrove Management in the Municipality of Panay, Capiz, Philippines

Lerio A. Agdalipe+ and Somsak Boromthanarat
Integrated Tropical Coastal Zone Management, Asian Institute of Technology
P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand.
Presenting Author. Email: leriota@yahoo.com , panay@ns.roxas-online.net.ph,
Tel: +63 036 6212 - 021, 6212-022, Fax: +63 036 6214-792

Keywords: Mangrove, participatory rural appraisal, GIS, planning, management, devolution

Abstract

The mangrove ecosystem is a very valuable resource for a tropical and archipelagic country like the Philippines. Its economic and ecological importance however is seldom acknowledged with government policies usually relegating the mangrove area as “forestlands suitable for fishpond development”. The plight of the people living within the resource is rarely taken into consideration in planning mangrove conversion and their valuable knowledge about the uniqueness and makeup of the resource has not been given attention. This paper aimed to develop a strategy for the devolution of mangrove management functions through the use of public participation through Participatory Rural Appraisal (PRA) in integration with Geographic Information System (GIS).

1. Introduction

The mangrove resources have been widely used by man for centuries. Man’s activities in the coastal zone however have increasingly made mangrove growth difficult by converting the area into other uses. The Philippines’s mangrove resources have been decreased considerably over the years with aquaculture development acknowledged as the major cause of conversion. The coastal area of the Municipality of Panay is left with only a small fraction of the original forest, which is identified with the corresponding decrease in municipal fish catch.

The lack of information on the study area reflects the ineffectiveness of the local mangrove management. Updated and accurate data is crucial to the monitoring of the resource and the adjoining land use changes, in planning for its utilization and protection, and in managing for the sustainability of the resource. One of the basic problems in planning for the management of mangrove and other natural resources is to correctly evaluate the environmental, economic, legal and social issues existing on the resource. Integrating all these data is usually difficult; therefore there is a need for an approach to speedily identify the types of suitable use of the mangroves in aid of planning. To facilitate such evaluation, the Geographic Information System (GIS) tool was used to manipulate and analyze the different data which have a common geographical or locational base in the mangrove area. Remote Sensing (RS) data on the local mangrove resource however is often unavailable and existing maps usually outdated. Participatory Rural Appraisal (PRA) data is shown by this paper as an alternative to remote sensing data where integrated information from the local community and key government agencies are combined with GIS to aid in decision-making process in mangrove management in the Municipality of Panay.

2. Materials and Methods

2.1 Study Area

The Philippines is an archipelago in Southeast Asia, which ranks among the top fish producing countries in the world. 75% of its total annual fisheries production is produced by the three major coastal habitats: the mangrove forests, sea grass beds, and coral reefs (Alcala and Vande Vusse, 1994). The country's mangrove forest however has been reduced considerably from 500,000 hectares in 1918 to 74,268 hectares in 1994 (Overseas, 1998). The reduction of mangroves is traced to overexploitation by coastal dwellers, and conversion to settlements, agriculture, salt beds and industry. Aquaculture however was pointed out to be the major cause with about 140,000 has converted into fishponds from 1951 to 1988 (Primavera, 2000).

The study area, the Municipality of Panay, is situated at the center of the aquamarine industry of the country, the Povince of Capiz, which is also reputed as the Seafood Capital of the Philippines. It has one of the richest fishing grounds in the country, and accordingly, fishing is the main livelihood of the people. It is also one of the major rice-producing municipalities of the Province with 3,471.46 hectares cultivated for rice production. The 11 coastal barangays (villages) of the Municipality occupies 56% of the total land area and supports one-third of the total population. The topography is generally flat and contains a broad network of natural waterways that made the area rich and diverse in terms of aquatic resources. The fishery activities involve inland fishery, near shore and inshore or riverine fishery. The total land area devoted to aquaculture, about 6,508 hectares, is the biggest in the Province. It is mostly involved in milkfish and prawn/crab culture, with milkfish production estimated at 3,067.5 metric tons and other marine products at 1,800 metric tons. Prawn culture however has reached its peak in the early1990s and its production has declined due to disease problems. Fish farmers have switched to crab culture in the past few years while the majority have continued in milkfish culture with some intensification. Total supply of fish at 8,157.434 metric tons hugely surpassed total demand for fish by the local population. The Municipality's proximity to Roxas City, the provincial capital, is very strategic and expectedly would cause the economic activities to spillover to the area.

2.2 PRA data

In this study, Participatory Rural Appraisal (PRA) technique was used as an investigative and participatory method to generate local knowledge on the status of the resource. The perceptions of the local community and different institutions involved on local mangrove resource utilization and management were gathered.

Based on mangrove distribution and other criteria, the villages of the study area were clustered into four. PRA were conducted in four village-clusters with a central village serving as the host. The people themselves with the researcher acting as a facilitator conducted the investigation and analysis of data.

The PRA tools and techniques used in this study include:

(1) Semi-structured interviews with key informants,
(2) Time Line and Change Analysis,
(3) Village and Resource Mapping,
(4) Local Analysis of secondary source (use of topographic map and aerial photographs to corroborate the data),
(5) Brainstorming on Issues, problems and potentials of the mangrove resource, and
(6) SWOT analysis of lead government agencies.

The data generated using the PRA workshops include the

(1) local mangrove resource characteristics,

(2) government and community use and livelihood,
(3) issues, problems and potential of the mangrove resources,
(4) land cover and land use changes, and
(5) needs and objectives of the stakeholders, and
(6) lead actors, roles and rules on mangrove management.

2.3 Method

The research included two main steps (Fig. 1). The first stage was to create a table of attributes of the information and criteria, which would analyze the feasibility of proposed mangrove uses. The factors considered by this study include the physical mangrove forest attributes, site suitability and environmental factors, rules and regulations governing use of the mangroves, existing management issues and problems, and the potential use as identified by the local community taken through PRA workshops. This was done to accurately evaluate the environmental, economic, legal and social issues existing on the resource. The relevant geographical information were then stored in six GIS themes, namely: the Map of the Mangrove Forests, Map of the Community Identified Potential Uses of Mangroves, Map of the Management Issues in the Local Mangrove Forests, Maps of the Navigational Route, Map of the Mangrove Buffer Zone, and Map of the Aquasilviculture Regulation of the local government.

The second step focused on the integration of classified data to speedily identify the types of suitable use and management of the mangroves in aid of planning. Information and propositions collected from the local mangrove community was compared with identified criteria to find the conflict area, which resulted to the exclusion of an activity from the list of potential uses of the resource. The spatial processes and analysis was done through the use of the Geographic Information System (GIS) to match up the existing government rules, mangrove attributes, and other environmental considerations with the community-identified uses and activities.

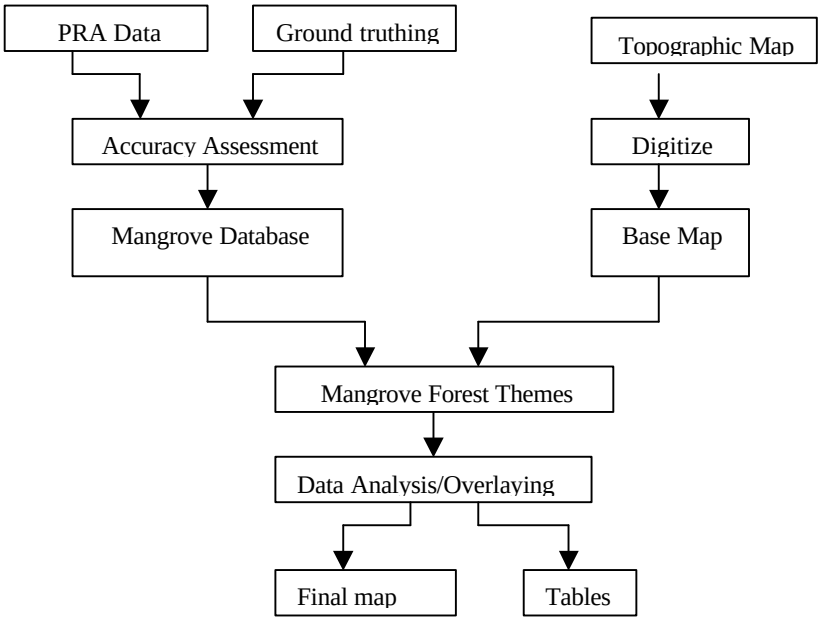

Figure 1: Methodology of the study

3. Results and Discussions

The relevant geographical information were stored in six GIS themes, namely :

1. the Map of the Mangrove Forests attribute,
2. Map of the Community Identified Potential Uses of Mangroves,
3. Map of the Management Issues in the Local Mangrove Forests,
4. Maps of the Navigational Route,
5. Map of the Mangrove Buffer Zone, and
6. Map of the Aqua silviculture Regulation of the local government.

3.1 Merged Themes

The different themes were overlaid with the map of community-identified potential use and management sites to identify conflict areas between the potential use and management and the government policy (the rules and regulation), and the physical attributes such as the mangrove forest through GIS merge theme technique. Using the criteria laid down for each rule, a new set of data was generated to reveal any conflict area between the two themes, e.g. community potential use and buffer zone (Table. 1).

Attributes of Buffer50_cmtyconflict.shp

Shape	BufferDis	Id	Village	conflict
Polygon	50.0000	8	Bantigue	no conflict
Polygon	50.0000	8	Bantigue	no conflict
Polygon	50.0000	8	Bantigue	no conflict
Polygon	50.0000	8	Bantigue	no conflict
Polygon	50.0000	8	Bantigue	no conflict
Polygon	50.0000	8	Bantigue	no conflict
Polygon	50.0000	11	Binantuan	
Polygon	50.0000	11	Binantuan	
Polygon	50.0000	11	Binantuan	
Polygon	50.0000	11	Binantuan	
Polygon	50.0000	11	Binantuan	

Table 1: Attribute of the merged community-identified potential sites and buffer zone regulation themes.

The results from overlaying the navigational route, mangrove forest attributes and the community identified potential uses showed many examples of conflict areas (Fig. 2). These are mostly identified potential use areas that conflict with the navigational route of the Municipality. Considering the priority of navigation over all other waterway uses, all potential use in conflict with it were disregarded and taken out of the final potential use list.

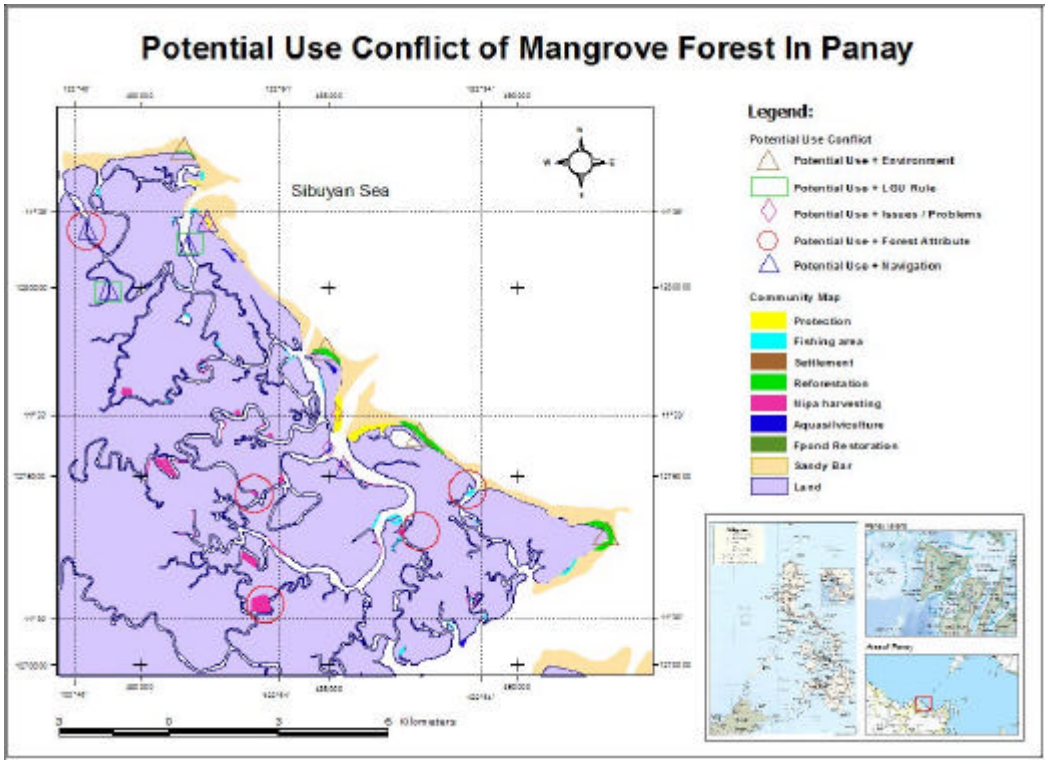

Fig. 2 Potential use conflicts map

In summary, some community identified potential use sites were disregarded due to the following main conflicts:

1. All firewood gathering sites were disregarded as it conflicts with the government rule of no cutting or harvesting of mangrove forest products;

2. Five of the proposed aquasilviculture sites were disregarded due to the following:
   a. The Tanza Norte aquasilviculture site in Tilaga River (South) was in conflict with the 50-meter aquasilviculture regulation while the Tilaga River (North), though not in conflict with the same rule, was disregarded due to conflicts with the navigational route. This shows that the Tilaga River is narrow and cannot accommodate the two uses simultaneously.
   b. The Napatasan River site in Brgy. Buntod was narrow and did not reach the 50-meter rule, hence its was disregarded;

   c. The two sites in Brgy. Jamulawon did not attain the criteria for freedom from strong wave action due to the potential effects of the Floodway Project;

   d. The harvesting of Nypa fronds often conflict with navigation as in the case of Binantuan (Cambiray) and Lanipga (south). These areas have overgrowth of Nypa due to natural characteristics of the specie (as in the case of Lanipga) or due to planting of Nypa in the river (the caseS of Binantuan (Cambiray) and Jamulawon). To prohibit harvesting of Nypa fronds from theses areas would however mean the continued proliferation of the stands, hence harvesting is recommended by this study coupled with enforcement of the local government's regulation prohibiting planting of Nypa along the water channels.

3. The proposed reforestation sites in Brgys. Agojo, Latasan, Butacal, and Navitas are priority sites for further technology research as its main conflict is with the strong waves prevalent in the area.

4. The identified Protection Forests encounter many problems at the moment such as continued threat of fishpond conversion or over-exploitation by firewood gatherers. However, these are the very same reasons why the sites should be established as protected areas where further utilization is prohibited to enable the forests to strengthen its protective capacities.

3.2 Final Results

By overlaying different themes with the community identified potential use and management as base map, the resulting map of the potential use sites (Fig.3) was generated and summarized in Table 2. It shows the feasibility of each proposed use which can regarded as potential use and management options for the local mangrove area.

Table 2. Potential Uses of the Local Mangrove Area

Number	Mangrove Use	Village	Area (has.)	Location/Landmark
1.	Protection Forest	Agojo	2.0	Mouth of Palpag river, facing Napatasan River
2.			2.0	Coastline of Sitio Liad
3.		Buntod	4.0	Fronting Buntod Proper
4.		Latasan	20.0	Reforestation Project
5.		Navitas	20.0	Facing Latasan and Sibuyan Sea
6.	Fishing area	All		Mangroves along the river banks
7.	Nypa frond site	Binantuan		Nypa stands along the river banks
8.		Lanipga		Nypa stands along the river banks
9.		Jamulawon		Nipa stands along the river banks
10.	Aquasilviculture	Buntod	6.0	Inland accretion
11.		Latasan	2.5	Accretion
12.		Bantigue	2.5	Facing Tinagong Dagat
13.	Reforestation	Agojo		Agojo shoreline
14.		Latasan		Shoreline near P. Ganzo
15.		Navitas		Facing Sibuyan Sea
16.		Butacal		Shoreline facing T. Dagat

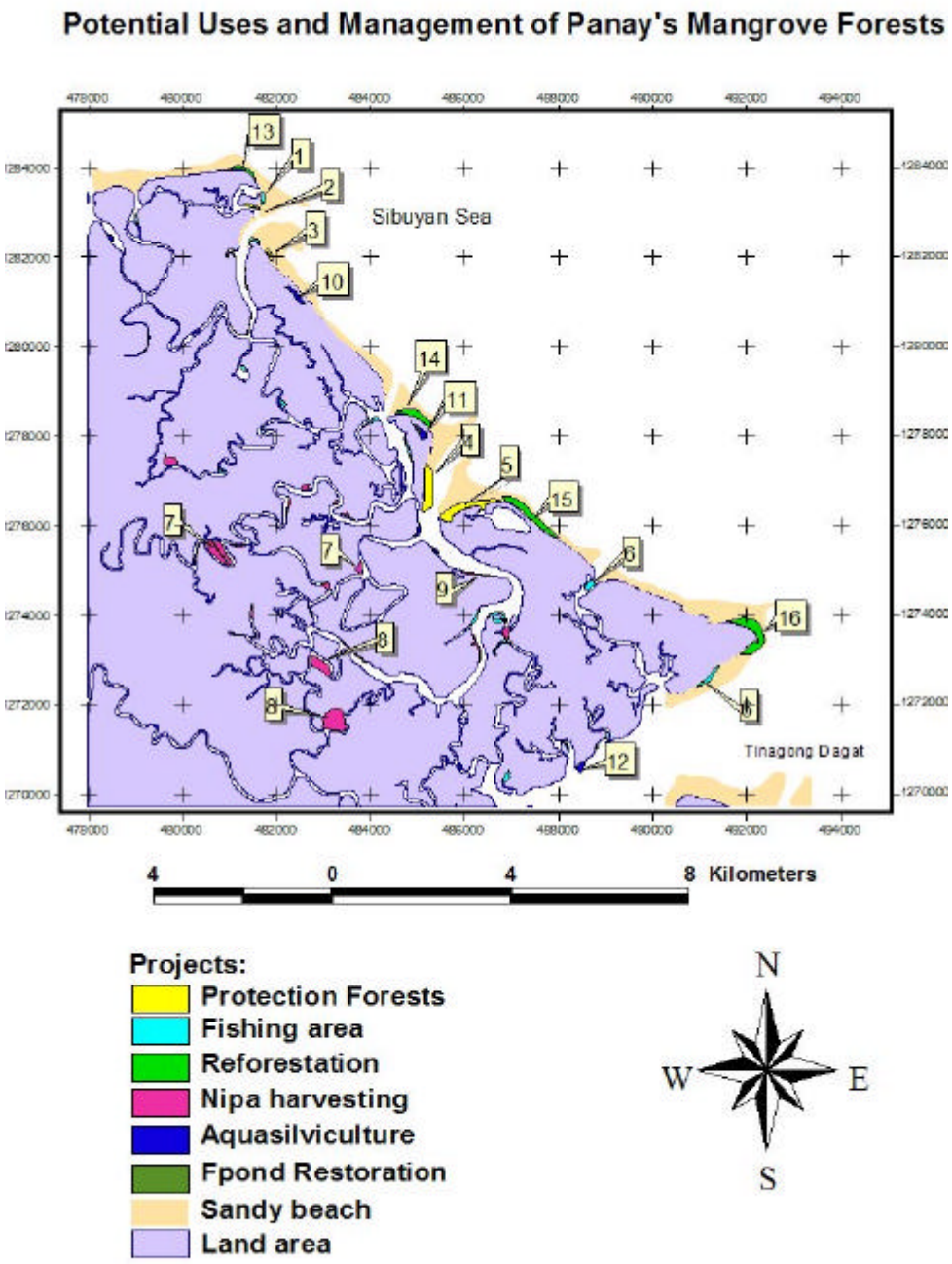

Fig. 3 Potential uses and management sites map

The final potential use sites identified in Table 2 and Fig 3 are when the government agencies develop a strategic plan for the future use and management of the existing mangrove resource. Ownership by the local community on the issues and plans stated therein is a powerful motivation for them to sustain the conservation and management efforts on the mangrove resource.

3.3 Use of PRA as GIS Input Data

Geographic Information System (GIS) as an approach to data processing and analysis usually uses Remote Sensing (RS) data such as satellite images, aerial photographs, and the like. But many local governments and natural resource planners face the problem of the lack of scientific data, which, if available, is usually outdated. This study discovered that the area identified by the lead national agency as mangroves all turned out to be existing fishponds. The reliability therefore of the existing scientific data is questionable to be used for planning purposes.

The PRA technique in data collection as described in this study produced the first ever report on local mangrove status. Krishnamoorthy and Gnanappazham (1998) concluded that the GIS database incorporating all thematic maps, field data on community, forest boundary details, etc. and offers added insights on various aspects on mangroves management leads to "provide entry points for community participation". This study maintains that community participation can start at the level of data collection and map generation, thereby giving more sense of ownership over the mangrove data. Once this relationship has been established, a stronger community commitment on future resource development can be expected.

3.4 Accuracy of the Results

It is important to take into account that results of the PRA were taken out of the recollection of the participants regarding the resource and the changes therein. This study found out that while information on the specie, density, and location of the mangrove forest is highly accurate, the extent of the mangrove forest in terms of area is not so consistent. It showed that PRA is not as accurate a tool for area determination as with the use of more precise tools like GPS or RS. Ground truthing therefore is an essential element in checking the reliability of very specific data such as spatial estimation. However, in the absence of such highly technical tools, community estimates on the forest area is highly acceptable. As with the drawback of cloud disturbances during collection of satellite images, recollection of past events in the community can also be a difficulty when participants do not include the older generation of residents. It is also important to have a good number of participants as consensus making enables more accurate information from the group.

An important contribution of PRA on the accuracy of the data relates to the variety of sources and date of the maps used during the study. For example, the map of the lead agency showed a coastal area covered with mangroves and the local government's base map showing the different rivers and fishponds areas of the Municipality. The PRA workshops worked to update the data given by both maps fishpond by pointing out areas where rivers no longer exist as they have been converted into fishponds, or to the coastline accretion building on the beach that has enlarged the land area and identifies expansion area for reforestation. The community was also able to put into the picture the causes of resource degradation by going over the history of the coastal area, and give a prognosis of the potential management issues and uses.

3.5 The Utility of PRA and GIS in Mangrove Management Planning

The results of the PRA and GIS integration is valuable in generating awareness on local mangrove management by involving both the community and the different horizontal and vertical levels of government. The data in GIS themes can be used very effectively for project design, planning and implementation. The data is also valuable during monitoring and evaluation, which are also planning and designing phases of the project cycle. Updating management plans will be simple and easy using the existing data as the GIS themes can be manipulated to produce other management themes.

4. Conclusions and Recommendation

This study has established that diverse resource, environmental, and legal data from various PRA and other sources can be organized through the use of the GIS and provide analysis to design a developmental scheme for mangrove management. While Mahfud and Weir (1999) stated that RS data was used in their study of the mangrove forest since "the task of collecting information by ground inventory is extremely difficult, time consuming and, therefore, expensive", this study found that data on mangrove forest could be gathered rapidly, inexpensively, and with convincing accuracy with the use of PRA.

Results of the study show that PRA integrated GIS is a useful tool to draw the local knowledge of the people about the resource by allowing the different stakeholders in the local community to contribute, evaluate and plan for the local mangrove resource. The study further showed that the local people are familiar with the mapping technique and they give integrated information, which may be used rapidly to provide summary information to integrate the plan for local mangrove management. The study also showed that analysis of the physical framework needs to be integrated with the social, legal and institutional structures in the local area to overcome the sectoral and juridical segregation prevalent in many any resource management programs.

Recognizing and assimilating the local community into the planning design may put their intimate understanding of the realities at the local level in good use and provide a sense of ownership which is an important foundation of resource sustainability.

Acknowledgement

This study is a product of the Masters Degree Course on Integrated Tropical Coastal Zone Management at the Asian Institute of Technology in Thailand. This was made possible through a scholarship from the Danish International Development Assistance (DANIDA) from January 2002 to August 2003. The authors wish to thank Dr. Harvey Demaine and Dr. Amararatne Yakupitiyage for their invaluable inputs to the study, to Mayor Felipe B. Barredo and the people of the Municipality of Panay, and to all others who have assisted in the course of this study.

References

Alcala, A. C. and F.J. Vande Vusse,1994. The role of government in coastal resources management, p12.-19. *In* R.S. Pomeroy (ed.) Community management and common property of coastal fisheries in Asia and the Pacific:concepts, methods, and experiences. ICLARM Conf.Proc.45,189 p.

Krishnamoorthy, R. And Gnanappazham, L., 1998. Remote Sensing And GIS Tools For Supporting Community-Based Management Of Mangrove Wetlands In East Coast Of India: Preliminary Experience. The World Bank/WBI's CBNRM Initiative. Available online: http://srdis.ciesin.columbia.edu. (Downloaded 07 Feb. 2003).

Mahfud, Y. and Weir, M., 1999. Monitoring Mangrove Forests using Remote Sensing and GIS. Available online: http://www.gisdevelopment.net/aars/acrs/1999. (Downloaded 07 Feb. 2003).

Overseas, November, 1998 Vol. 1 No. 11

Primavera,.J. H., 2000. Philippine Mangroves: Status, Threats and Sustainable Development. Proc. International Workshop Asia-Pacific.