

COMMUNITY-BASED MANGROVE-FRIENDLY AQUACULTURE: PHILIPPINE EXPERIENCE

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I. Introduction

Mangrove ecosystems throughout the Philippines are presently under threat by a variety of agents, a fact that is well known to all who have the occasion to consider the issue. In most cases, the basis of many activities which threaten the remaining mangrove stands is mainly for simple economic gain. Such exploitation may either be direct as in the case of fuel-wood gathering, charcoal production, and timber extraction or indirect as in the case of the release of the mangrove swamp areas for fishpond or real estate development.

The economic advantage associated with each type of exploitation has in the past been counted as a socially valuable contribution to the human community. In recent years however, a rising chorus of voices has been heard questioning the nature of such advantage and has indeed asserted that the various forms of exploitation represent the net cost to society.

Mangrove has various uses and values that have not been accounted for by traditional economics (Harger, 1982). Mangroves continue to provide the basic needs of man as well as intangible multiple benefits that influence man and his environment.

At the component level, mangroves are sources of food, firewood, poles, foundation piles, and raw materials for the manufacture of glue, dye, charcoal, tea, tannin, and resin. Mangroves also provide adhesive materials for plywood manufacture, honey, sugar, medicine, roofing and thatching materials, charcoal, vinegar, dissolving pulp, rayon, and livestock forage and feed supplement.

At the ecosystem level, mangroves provide essential spawning grounds that permit the reproduction of some species of fish and shellfish and at the same time serve as nursery for some offshore shrimps and fishes. Mangrove ecosystems are highly productive entities that contribute a major share of the energy requirements in the offshore ecosystems where a close dependence between mangroves and fishery productivity exists.

The contribution of mangroves to nearshore fisheries is supported by studies that show a positive relationship between a mangrove area ($r=89$), the total length of mangrove-lined rivers ($r=96$), and shrimp catches (Martosubroto and Naamin, 1977, Staples et al., 1985). A positive correlation between Philippine municipal fishery catches and existing mangroves ($r=72$) has also been documented by Camacho and Bagarinao (1987).

During the past decade and concurrent with the rise in population, was the increase demand for agriculture, aquaculture, and industrial development. Consequently, areas originally dominated by mangrove forests have been cleared for fishpond development. In 1967, mangrove forests totaled 418,990 ha, but after fifteen years this was reduced to 239,387 ha (BFD, 1984).

At present, the remaining total mangrove area in the Philippines is only 120,500 ha (EMB,1995). The reduction represents 73% of the mangrove area at the start of the century. The SPOT survey in 1988 revealed that 95% of the present fishpond areas were derived from mangroves between 1952 to 1987.

Unwise exploitation may eventually lead to loss of genetic biodiversity in the mangrove ecosystem (Serrano and Fortes, 1987). A point may be reached wherein future generations will be deprived of this unique environment. In order to redress this deteriorating scenario, planned changes must be implemented to arrive at coastal development within the concept of sustainability. This implies the need for development of strategies and/or alternative land uses for coastal areas that will provide for regeneration and at the same time satisfy the needs for human survival.

The government believes that by addressing the needs of the local communities, the people will join hands to protect and manage the very source of their livelihood. With this objective, the Community-Based Forest Management (CBFM) Program was created on July 19,1995 when the President of the Republic of the Philippines signed Executive Order No. 263 adopting the Program. The CBFM Program is a national strategy to ensure the sustainable development of the country's forestlands, resources and providing mechanisms for its implementation. The rules and regulations for the implementation of EO 263 is contained in the DENR Administrative Order No. 96-29.

II. Mangrove-Friendly Aquaculture

Mangrove-friendly aquaculture is a system whereby mangrove species with aquaculture and fisheries production harmoniously co-exist for the sustainable benefit of nearby communities without hampering the ecological functions of the mangrove ecosystem. Two community-based systems have been developed: aqua-silviculture and agri-nipa-aquaculture (ANA).

A. Aqua-silviculture

Aqua-silviculture (roughly translated as aquaculture or fish production under the forest trees) is a multiple-use system that promotes a harmonious co-existence between fishery species and mangrove tree species in a semi-enclosed system while providing coastal protection, maintenance to the ecosystem, and livelihood for the surrounding communities. The fish-mangrove inter-cropping system is also a compromise to solve conflicting interests between the forestry and fishery sectors, and the local communities. In this system, fish is cultured in the deeper part of the pond while mangrove species are planted in the shallow portion.

Thus, the aqua-silviculture technology promoted a peaceful co-existence between fish ponds and mangroves. It is a typical example of a multiple-use system of management which is now recommended and adopted as a community-based management of the mangrove forest ecosystem. The technology is expected to facilitate the reversion of the now abandoned and unproductive or denuded and open areas to their productive condition, since a portion of the areas will be utilized for brackishwater aquaculture development. This can also be tapped as an additional source of income for the mangrove-dependent population.

In the Philippines, the ratio of mangrove plantation to open pond area is 70:30 or 80:20, that is 70 to 80 percent is devoted to mangrove trees which is usually at the center of the pond, and 20 to 30 percent which comprises the deeper portion is devoted to fish production. Water is controlled in such a way that the whole pond including the plantation is covered with water during high tide. In addition to the growing trees, the system also increases the farmer's income from aquaculture production, and sale of mangrove propagules and other mangrove products.

1. Areas for aqua-silviculture development

Areas considered for aqua-silviculture development are those open and denuded mangrove areas with settlers; unproductive and abandoned fishponds; areas under Presidential Proclamation 2152 which have been fully or partially developed prior to the effectivity of such proclamation; and those A & D (titled or private lands) areas whose owners are willing to adopt the new technology. The planting of mangrove species in the aqua-silviculture system should consider the site requirements of the trees which include soil and sediment characteristics, water salinity, seedling development and tidal inundation; as well as silvi-cultural techniques and objectives regarding the management of the forests.

2. Forestry and mangrove development

Mangrove species suitable for aqua-silviculture which are economically important should be used. With respect to the mangrove soil utilization, some considerations in intensifying aqua-silviculture should include the following:

a. The first five years

During this period of pond utilization when the plants are still in the seedling or sapling stage, the pond can be utilized intensively from 3 to 5 years. This period can therefore be devoted to fish production and for repayment of investment. Starting on the third year, the plants may have already produced propagules that could be sold. The main activities therefore that can be carried out during this period are: maintenance of dikes, fertilization for algae production, protection of plants from pests and diseases, control of predators, and replanting.

- b. The next six to ten years

After 5 to 10 years, the mangrove seedlings shall have reached the sapling stage (2-10 cm diameter) or tree stage (> 10 cm in diameter) with 5 m or more in height. The trees in the pond should be pruned or thinned depending on the quality of the mangrove trees, to allow sunlight to penetrate the pond. This is necessary for the production of food for the species cultured in the ponds. The pruning and thinning may be utilized for firewood or for low cost housing materials while the leaves may be used as forage for livestock or organic fertilizer. The trees are considered mature from the 15th year onward.

3. Fisheries and fish production

The development of aqua-silviculture should be intensified to a maximum level of production by considering silvi-culture and mariculture requirements.

- a. Plantation establishment

The rows of mangrove species should be planted in the east-west direction. This is to allow full sunlight to penetrate the pond bottom for production of natural food for the cultured species.

- b. Pond engineering

This includes layout and pond construction, layout and canal system construction, and floodgate and control system.

- c. Pond Management

This includes preparation of pond bottom for algae production, water regulation (quantity, quality and regimen); pond fertilization (organic and inorganic); pest, disease, and predator control; fry and fingerling gathering and/or production; and stock management (fish, shrimps, crabs, etc.)

4. Aqua-silviculture establishment

In selecting sites for aqua-silviculture, the following conditions should be considered:

- a. Tidal inundation classes;
- b. Water quality assessment of pond water and surroundings (physical and chemical parameters);
- c. Soil analysis and nutrient status;
- d. Pollution (soil, water, air [acid rain]); and
- e. Availability of planting materials.

Planning is essential in the stage of implementation and the factors to be considered include the duration of implementation; availability of labor; and budget. Specific plans should also include the following:

- a. Pond compartmentalization;
- b. Pond bed drainage;
- c. Diking and/or use of nets and low dikes;
- d. Canal systems; and
- e. Location of guardhouse, watchtowers and floodgates.

As to the tidal classes in the aqua-silviculture site, the height of the dikes should be based on data of exceptional high tide or flood and astronomical high tide. Dikes should not be reached by both tides and floods, otherwise extra use of nets will have to be resorted to.

B. *Agri-nipa-aquaculture*

One of the technologies being tested and known to have a positive effect in the coastal areas is aqua-silviculture (Bacongus, 1991) which harmonizes the planting of mangrove trees with fish production. The technology however limits income generation to only fish production during the first seven years of operation, since harvest of planted mangrove trees can only be done on the eighth year.

An alternative which is considered a variation from aqua-silviculture is the agri-nipa-aquaculture(ANA). This is a sustainable land use system which combines the planting of nipa and agricultural crops with fish production in suitable areas.

C. *The impact of aqua-silviculture and agri-nipa-aquaculture*

The implementation of aqua-silviculture and agri-nipa-aquaculture in the coastal areas of the Philippines is in response to the environmental and socio-economic factors.

1. Environmental factors

a. Coastal degradation

The aqua-silviculture or agri-nipa-aquaculture technology will help rehabilitate the denuded mangrove, nipa and mudflat areas. Nipa and mangrove forests help stabilize coastal areas and protect rural coastal communities from strong winds, typhoons, and storm surges such as tsunamis.

b. Coastal pollution

In the implementation of aqua-silviculture or agri-nipa aquaculture, the coastal dwellers become aware of the effects of pollution on aquaculture, hence, communities will be vigilant in protecting their environment from pollutants.

c. Enhanced wetlands as wildlife habitat

The establishment of the nipa and/or mangrove forest harbors wildlife species that are also economically and ecologically beneficial.

d. Rehabilitation of degraded and/or abandoned fishponds.

All mangrove areas are potential acid sulfate soil sites. When fishpond location is inadequately designed or there is no freshwater source, acid sulfate soils will develop in two to three years. Consequently many fishponds become unproductive after three years. Milkfish for example, will not grow normally and shrimp will not survive under these conditions. With mangroves and nipa palms at the center of the pond, the farmer will still have some income even if fish production is minimal.

2. Socio-economic factors

a. Creation of job opportunities

The construction of ponds with its canal system and appurtenances, and planting of mangroves, nipa and agricultural crops create job opportunities. Inhabitants in and nearby areas will be hired as laborers, caretakers, and fry gatherers. Other income prospects will also come later either from fry gathering or supplying fingerlings or from selling fish and vegetables. Family members without regular jobs can therefore be involved in these productive endeavors.

b. Equity of natural resources

Many will benefit from the resources in areas where the management of aqua-silviculture or agri-nipa-aquaculture project is community-based undertaking or through cooperatives and/or associations. Equal distribution of the benefits will accrue to each member.

c. Increased income

Generally, income of coastal dependent communities will increase because fish with nipa and mangrove products will be harvested for additional income. If properly managed, producing agricultural crops, shellfish, molluscs, mud crab, small livestock, honey bees, etc. can also be integrated within the system. An example is the growing of passion fruit which has a good market potential and a good source of fruit juice and vitamins for the resource-poor coastal families.

d. Availability of low-priced animal protein

The culture of economic species in the ponds will also provide increased production of food for domestic consumption as well as for export.

e. Foreign exchange potential

Shrimp culture in the Philippines has gained popularity and the export potential of shrimp is still high. Nipa also yields industrial products with export potential such as high grade alcohol for industries, etc.

d. Availability of products

In the implementation of agri-nipa-aquaculture through community-based management, many products will be available for the poor coastal communities.

e. Community awareness

Technology dissemination and community awareness on the sustainable utilization of coastal areas, will be introduced to the communities.

III. The Community Based Forest Management (CBFM) Program

“People first and sustainability will follow” sums up the concept of the CBFM Program. The government believes that by addressing the needs of the local communities, they will be encouraged to protect and manage the very source of their livelihood. CBFM came into being on 19 July 1995 when the President of the Republic of the Philippines signed Executive Order (EO) No. 263 adopting community-based forest management as a national strategy to ensure the sustainable development of the country’s forestlands, resources and providing mechanisms for its implementation. The rules and regulations for the implementation of EO 263 is contained in the Department of Environment and Natural Resources Administrative Order (DAO) No. 96-29. The objectives of the CBFM Program include promoting sustainable management of forest resources; social justice and improved well-being of local communities; and strong partnership among local communities and the Department of Environment and Natural Resources (DENR).

A. *Scope of CBFM*

CBFM applies to all areas classified as forest lands, including allowable zones within protected areas not covered by prior vested rights. The Program integrates and unifies all people-oriented forestry activities of the Integrated Social Forestry Program (IFSP), Coastal Environment Program (CEP), and Recognition of Ancestral Domains.

B. *Features of CBFM*

1. Security of tenure

The Community-Based Forest Management Agreement (CBFMA) entitles forest communities to use and develop the forest land and resources for a duration of 25 years, renewable for an additional 25 years.

2. Social equity

Social justice is a basic principle underlying CBFM in granting forest communities tenure and comprehensive right to use and develop the forest resources.

3. Technical assistance

DENR and Local Government Units (LGUs) provide technical assistance to CBFM participants to help them attain sustainable forest management.

4. Investment capital and market linkage

CBFM helps participants access investment capital, identify markets, and build marketing capabilities.

C. *Who can participate in CBFM*

The main participants of the program are local communities including indigenous people represented by their People's Organization (POs) and Traditional Tribal Councils (TTC) whose members are actually tilling portions of the area to be awarded, or are traditionally using the resources for all or substantial portion of their livelihood, or are residing in or adjacent to the areas to be awarded.

1. Roles of DENR and Local Government Units (LGUs)

A strong DENR-LGU partnership is vital to the success of the CBFM Program. DENR and LGUs, in active collaboration with other sectors, work together to help strengthen local forest communities in managing the forest resources. The DENR and LGU partnership in CBFM has resulted in substantial LGU financial support for forest land use planning, community mapping, community organizing, technical training, and IEC. Thus, the DENR and LGU collaborate in order to identify potential CBFM sites, plan forest land uses with communities, and endorse and issue CBFMAs; organize and prepare CBFM communities for a CBFMA; provide technical assistance and skills training for CBFM communities; and monitor progress and environmental impact of CBFM activities.

2. Roles of the People's Organizations (POs)

The People's Organizations join DENR and the LGU in making a forest land use plan and prepare a Community Resources Management Framework (CRMF) including the POs Mission and Objectives. The POs also represent the interest of their forest communities, and help protect and maintain the forestlands entrusted to their stewardship.

IV. CBFM in Mangrove Areas (DAO No 98-10 March 4, 1998)

Pursuant to PD 705 as amended, otherwise known as the Revised Forestry Code of the Philippines, EO 263 entitled "Adopting CBFM as the National Strategy to Ensure the Sustainable Development of the Country's Forestland Resources and Providing Mechanisms for its Implementation and its Implementing Rules and Regulations" embodied in DAO 96-29, guidelines were issued for the establishment and management of CBFM within mangrove areas.

A. *Objectives*

Community-Based Forest Management Projects shall be established in mangrove areas in order to promote equitable access to natural resources, help in the socio-economic upliftment of local communities, and encourage their participation in the conservation, rehabilitation, afforestation and management of mangrove forests.

B. *Establishment and management of CBFM Projects*

The establishment and management of CBFM Projects in mangrove areas shall be in accordance with DAO 96-29 and other policies issued on CBFM. Provided, that in case the mangrove area is within a protected area, the management of the same shall be in accordance with the provisions of RA 7586 and its implementing rules and regulations. Provided further, that participants to CBFM Projects shall be organized and issued Community-Based Forest Management Agreement (CBFMA) consistent with relevant provisions of DAO 96-29.

C. *Cutting or harvesting and utilization within CBFM areas*

Cutting or harvesting of mangrove species shall not be allowed provided that these are planted by the CBFMA holders themselves and that the harvesting operations are included in the affirmed Community Resource Management Framework or Ancestral Domain Management Plan. Harvesting is also allowed provided further that replanting of the area harvested shall be undertaken within six months after harvesting operations, and provided, finally that the harvesting operations, shall be closely monitored by the CENRO/PASU concerned.

V. **Cooperative**

A cooperative is a business organization owned collectively by members who share its profits and benefits. Upland farmers and coastal communities are encouraged to form a cooperative citing the benefits that they can derive from it. These include motivation of the members to work and help each other; provision of cheap goods and services, and loans that can be availed of by the members; encouragement for members to save and invest their earnings for their own good; and provision of opportunities for members to own and manage the cooperative.

A. *Starting a cooperative*

1. Gather information to determine if there really is a need to start a cooperative
2. Suggest to community members that they will start a cooperative.
3. Form a committee who will organize the cooperative
4. Call a general meeting of prospective members of the cooperative. During the meeting the following issues will be discussed:
 - a. Will member's expenses be lessened with the establishment of the cooperative?
 - b. Will income in marketing of products be higher if there is a cooperative?
 - c. Will the community members gain experience and knowledge with the establishment of the cooperative?
5. If a decision is arrived at to form a cooperative, formulate the cooperative's constitution and by-laws.
6. Elect the cooperative's officers
7. Assign tasks to cooperative members for management of the cooperative
8. Prepare the following papers to register the cooperative
 - a. 4 copies of economic survey
 - b. 4 copies of Articles of Incorporation
 - c. 4 copies of By-Laws
 - d. Registration fee payable to the Cooperative Development Authority (CDA)
9. Register the cooperative with the Cooperative Development Authority

VI. Concluding Remarks

Mangrove is one of the critically significant ecosystems that characterize the Philippine environment. Although considered a minor contributor to the whole system because it occupies a very small portion of the total forest cover of the country, for economic reasons it is also of paramount importance to Filipinos in many ways, especially to those living in the coastal areas. The mangrove area in the country has been reduced by 73% from the 1918 figures, thus, impairing its economic and ecological role.

In order to remedy this deteriorating scenario, planned changes must be implemented to arrive at coastal development within the framework of sustainability. This necessitated the development of strategies and alternative land uses for coastal areas that will provide for regeneration and at the same time satisfy the needs for human survival.

This paper discussed two mangrove-friendly aquaculture technologies that will not only protect the coastal and mangrove ecosystem but could also increase the income of the coastal communities not only from the forest products but also from fish, shellfish, and crab production. Moreover, the technologies will not only serve as livelihood but also help in promoting the conservation of biodiversity.

The creation of Executive Order (EO) No. 263 adopting CBFM to ensure the sustainable development of the country's forestland resources could be one of the solutions. With the empowerment of the people, the communities will be encouraged to join hands to protect the very source of their livelihood. Thus, sustainable forestry development is expected to be attained.

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