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# Sustainable Management of Mangroves

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Abstract

Mangroves are unique and valuable ecosystems which occur throughout the tropics and subtropics, occupying around 180,000 km$^2$ around the world. Functionally, mangroves support a range of wildlife and fisheries resources, supply a range of commercial products and provide a number of ecological services. These include timber and honey production, fisheries nursery values, sewage wastewater treatment, and coastal protection.

Despite a greatly increased awareness of the environmental, and socio-economic importance of mangroves, they continue to be destroyed in many parts of the world. Urbanisation, pollution and aquaculture developments are three of the major agents of mangrove losses.

This paper explores links between the environment, the economy, and society which are intrinsic to the development of any sustainable management policy within the framework of integrated coastal zone management. To attain a balance between sustainable use, societal expectations and conservation, some guidelines will be discussed, including: (i) encouraging community regulation; (ii) zoning mangrove ecosystems; (iii) developing mangrove management plans; (iv) reassessing the value of mangroves; (v) improving community information; and (vi) rehabilitation of degraded mangroves.

## INTRODUCTION

Mangrove forests are unique and valuable coastal ecosystems which occur throughout the tropics and subtropics, occupying around 180,000 km$^2$ around the world (Spalding et al., 1997). Functionally, they support a range of wildlife and fisheries resources, supply a range of commercial products and provide a number of ecological services. These include timber and honey production, fisheries nursery values, sewage wastewater treatment, and coastal protection.

Despite a greatly increased awareness of the environmental and socio-economic importance of mangrove ecosystems, they continue to be destroyed in many parts of the world. Unless urgent action is taken to implement sustainable management of mangrove ecosystems, they are likely to be irreparably lost with long-term implications for coastal capture fisheries, coastal stability, and the socio-economic conditions of traditional coastal dwellers.

While draft guidelines for sustainable management of mangrove ecosystems have recently been promulgated (Clough, 1993), this paper explores links between the environment, the economy, and society which are intrinsic to the development of any sustainable management policy.

## PROBLEMS WITH CURRENT SYSTEMS OF MANAGEMENT

According to Valentine (1994), failures in existing systems of management can be attributed to:

1. **Information** failure - a failure to appreciate the full ecological functions of mangrove ecosystems as well as their biophysical basis. As a result of this type of failure, mangroves are viewed as wastelands on the one hand, while mutually conflicting uses or over-exploitation is allowed to occur on the other.

For example, in the Corinto area of the Pacific coast of Nicaragua, two Indian tribes were utilising the red mangrove *R. mangle.* One was selecting large trees to strip the bark off in sheets to use for tanning while the tree was left dead and standing. Another was felling trees, removing the bark by beating the trunks and using the timber for firewood.

To identify forms of over-exploitation or incompatible activities in and around mangrove ecosystems, Chansang (1984) has devised a compatibility matrix which summarises the interaction between fourteen resource use options for mangroves and estuarine areas. This matrix clearly illustrates the need to consider impacts of a variety of uses and outlines the effects of a combination of activities.

2. **Market** failure - a failure to incorrectly value the mangrove ecosystem or where the cost and benefits do not coincide.

Valentine (1994) suggested that natural resources are sacrificed due to their non-market valuation. Mangrove ecosystems are generally undervalued and often perceived as dispensable. This may be attributed in part to the flat terrain occupied by mangrove ecosystems and due to the prevailing attitude that mangrove forests harbour mosquitoes, smell and detract from real-estate value. Underpricing may often be made worse by open access to the resource.

In other instances, the loss of mangrove ecosystems is often justified if it results in capital formation elsewhere in the economy. More often, values are not known or quantifiable. For example, the fern *Acrostichum* is seen as a weed in much of south-east Asia but on Hainan Island, China, it is dried and by virtue of its very high calorific value, is used for domestic cooking.

The non-coincidence of costs and benefits is best illustrated by polluters who do not bear the costs of their polluting activities. Such costs are often borne by mangrove dependent communities and these external costs are not reflected in the market prices for mangroves or their products.

3. **Intervention** failure - these failures generally result from ineffective governmental intervention to correct market failures, generally in the form of subsidies, credit and intersectoral policy inconsistency.

For example, in Fiji, where mangrove conversions were justified for irrigated rice, subsidised costs of fertilizers, pesticides, irrigated water and seed costs were used in the economic analysis (Valentine, 1994).

Similarly in the Philippines, the low lease rate for fish pond operators encouraged the extension of aquaculture into mangrove wetlands. The clearance of mangrove forest for fish ponds in the Philippines is having detrimental effects on the livelihood of coastal dwellers. Coastal erosion, soil erosion, flood tides, and the exhaustion of mangrove forests for food and other services is taking its toll on the community (Ajiki, 1993).

## WHAT IS SUSTAINABLE MANAGEMENT?

The term sustainability is still one that is generally misunderstood, misused and without cross sectoral definition. Three quite different uses of the term sustainability are often confused in public discourse (Mercer 1991):

(i) As purely a physical concept for a single resource, e.g. the notion of maximum sustainable cut in the timber industry;

(ii) As a physical concept for a group of resources or an ecosystem; and

(iii) As a social-physical-economic concept.

The first two uses incorporate the sustainability of ecosystems, biodiversity etc. while the third use generally covers economic sustainability.

The continuing demand for conversion of mangrove lands cannot be met indefinitely without infringing on the demand and supply of mangrove products and services (Saenger, 1985; Saenger and Bilham, 1996). Sustainability of mangroves will therefore require that they are utilised at a rate less than or equal to the natural rate of regeneration. As an ecosystem, it also requires that wastes flowing into the system from external activities are generated at a rate less than or equal to the assimilative capacity of the ecosystem (Barbier, 1993).

It is becoming more widely accepted that conservation, economics and the needs for society are not issues that can be dealt with separately. Barbier (1987) outlines the human ascribed goals which need to be achieved in order to ensure sustainable management of ecosystems:

<u>Ecological Sustainability</u>

- Maintaining the genetic diversity of the area involved;
- Maintenance of the resilience of the ecological systems affected; and
- Maintaining the biological productivity of the area.

<u>Economic Sustainability</u>

- Satisfy basic needs of resident population and reduce poverty;
- Enhance equity through ownership, management responsibility and participation in decision making; and
- Increase the useful goods and services used in the area or region.

<u>Sustainability of the Social System</u>

- Maintenance of cultural diversity of the region;
- Sustaining local and national institutions and traditions;

- Ensuring social justice; and
- Ensuring full participation through decision making, employment and training.

Truly sustainable systems of management need to address each of the objectives.

## STRATEGIC ACTIONS FOR SUSTAINABLE MANAGEMENT

To attain a balance between sustainable use and conservation, the following guidelines are suggested:

**1. Encourage Community Regulation:** Remove open access to mangrove ecosystems by encouraging community regulation and management. All coastal areas and reserves need to be enmeshed in a pattern of community usage and acceptance, and development policies must be based on such an approach. Such policies must include community participation at all stages of development of any management policy.

Community ownership of a natural resources has in the past led to self-policing and regulation. For example, in parts of West Africa (e.g. Benin), the only healthy mangroves remaining are those that have been protected by local communities for religous reasons.

**2. Zone Mangrove Ecosystems:** The recent guidelines for sustainable management encourage the adoption of a four category zoning approach to mangrove ecosystems (Clough, 1993) i.e. conservation reserves, mangrove forest reserves, mangrove fisheries reserves and alienable mangrove land.

In many countries the opportunities to protect pristine mangrove areas are rapidly diminishing. Although the setting aside of reserves is important for genetic diversity it is important to realise that a diversity of structure is also crucial. Any reserve should be sufficiently large to accommodate representative systems of the mangroves.

The simple setting aside of mangrove ecosystems as reserves without a more comprehensive framework, does not necessarily offer a permanent solution. The setting aside of reserves must show obvious practical use in the eyes of the community (Saenger, 1985). For example, it is practical to have conservation (genetic) reserves set within areas of sustainable yield management as they are; (i) under constant surveillance by a dependent work force; (ii) of obvious and practical use (community appreciation); and (iii) unlikely to change in administrative or legal status.

**3. Develop Mangrove Management Plans:** Chan (1994) outlined eleven actions needed for developing a national mangrove management plan which include references to ecological, economic and social needs. However, recognition of the variable dynamics of each of the ecosystems is crucial. It would be dangerous to apply a single management option to all mangrove regions. Broad supplementary objectives may be initially set and these may subsequently be refined specifically for each country or region (Saenger, 1985).

For such national management plans, sustainable yield management must be the underlying approach. This practice, resulting in a continuous supply of a variety of products, cost little more than the non-sustainable extraction of products in the long-term. In order to combat a decline in diversity e.g. monoculture, it is highly recommended to set aside areas as reserves which, in turn, can act as a source of genetic diversity and seed stock (Saenger et al., 1983).

A number of such genetic reserves already exist as, for example, the Pichavaram Mangrove Forest in India (Lakshmi et al., 1997).

**4. Reassess the Value of Mangrove Ecosystems:** Studies similar to those of Lal (1991) in Fiji are needed to properly valuate mangrove ecosystems *in situ* and for off-site uses. Improved quantification of ecological services rendered by mangrove ecosystems also need to be obtained while systematic investigations for new mangrove products and services as well as for value-adding, can further increase their assessable value.

**5. Improve Community Information:** For informed community involvement in regulation of mangrove ecosystems, better public education and information networks need to be established. This process can be enhanced through hands-on type experiences via mangrove boardwalks and ecotourism initiatives.

In India, regulations pertaining to the Coastal Land Use Plan (CLUP) have extended full protection of mangrove regions to preserve biodiversity of the systems. These protective measures have led to an increased awareness of management at various levels. Four main Biosphere Reserves, several Sanctuaries, Parks and Protected Areas were established which have attracted researchers and nature lovers. Ecotourism is also being explored as a source of income and has had encouraging results (Untawale, 1993).

**6. Rehabilitate Degraded Mangrove Systems:** In many areas, degraded mangrove ecosystems can be easily restored to again provide the whole spectrum of ecological functions (Field, 1996). Rehabilitation is technically feasible but involves costs and human resources. In addition, newer technuiques such as air-layering (Kathiresan and Ranvikumar, 1995) and tissue culture (Satuwong et al., 1995) need to be established and evaluated in terms of the silvicultural improvement that may be attainable for improved mangrove growth.

## CONCLUSION

Although it would be preferred that detailed scientific and socio-economic studies were undertaken to maximise productivity and ensure sustainability of mangroves, in many instances insufficient resources are available to achieve this. The rapid rate of destruction of mangrove ecosystems needs to be controlled before we can afford the luxury of knowledge.

If mangrove exploitation and conservation and national interests are to beneficially co-exist on a long-term sustainable basis, Barbier's goals need to be incorporated into all activities involving mangroves and supported by appropriate policies and strategic actions by the respective national governments.

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