CHAPTER 2

REVIEW OF LITERATURE

Mangroves and seagrass beds are recognized as two of the most productive ecosystems on earth (McVey 1988). Mangroves are responsible for many vital ecological functions such as, aiding in soil formation by trapping debris, filtering land runoff and removing terrestrial organic matter, providing habitat for fish, invertebrates and birds, and producing detritus (Fortes 1988). Detritus is formed when mangroves recycle nutrients from leaf decomposition (Smith and Berkes 1993). Other benefits mangroves provide include shoreline protection, availability of a renewable resource to local residents (forestry), and provision of a location for permanent settlements (McVey 1988).

Mangroves are important because of the biodiversity such ecosystems possess. Biodiversity, in turn, is important for storing the information data base for ecosystem organization (Kay and Schneider 1994). All living systems go through constant cycles of birth, death, and regrowth. Most organisms living within an ecosystem are adapted specifically to a set of environmental conditions. A method for preserving information about what "works" and what "does not work" is crucial for the continuance of life. Biodiversity fulfills this role at an ecosystem level (Kay and Schneider 1994).

The Philippines is a country largely dependent on coastal resources. Viles and Spencer (1995) report that 65% of the country's 70 million people live in coastal areas and note that the ten largest cities in the Philippines are all coastal. Dense populations exert considerable stress on the natural coastal ecosystem. Mangroves and coral reefs are recognized as two particularly stressed areas of coastline (Viles and Spencer 1995).

Despite the importance of mangroves, globally as much as one million hectares of mangrove forest may be lost annually (Smith and Berkes 1993). Throughout the Philippines, large tracts of mangroves have been, and are being cut by commercial harvesters and fishpond developers. The Philippines has about 106,000 hectares of mangrove forest area remaining, but 176,000 hectares of mangrove have been converted to brackish aquaculture (Viles and Spencer 1995). Proportionately, the Philippines has converted a larger percentage (45%) of mangrove forests to aquaculture than any other Southeast Asian country (McVey 1988), and the long-term sustainable use of the region's resources is at risk (Thia-Eng and Kessler 1988). Large areas of environmentally important coral reefs and mangroves have already suffered irreparable changes as a result of overexploitation and population pressures (Thia-Eng and Kessler 1988).

2.1 Causes of Mangrove Depletion

Two main factors can be attributed to continuing mangrove destruction. The first is economics, the second is a combination of the physical nature of mangroves and the associated property rights.

2.1.1 Economics

An increase in population, along with the desire for economic growth and an improved standard of living, has resulted in severe stress on the region's marine ecosystem (Thia-Eng and Kessler 1988). Natural capital has been harvested or destroyed for profit. Under normal circumstances, clearing mangrove areas is environmentally unsustainable. In the Philippines, the problem is compounded since the pattern of land use that replaces the mangrove area further compromises environmental resilience and ecosystem health. Most of the lost mangrove areas have been converted to brackish aquaculture geared for shrimp production. Shrimp ponds, once developed, must still rely on the recruitment of larvae from the reproductive stock at sea for seasonal restocking and cease to be viable economic enterprises after a couple years when natural recruitment of larvae is no longer possible (Vannucci 1988). New mangrove areas must therefore be cleared to set up new shrimp ponds. The result is a positive feedback cycle - something resource managers want to avoid (Holling 1993). Short-term economic goals are thus a main cause of mangrove destruction in the Philippines.

2.1.2 Physical Nature and Property Rights Over Mangroves

The institutional aspects of how mangroves are managed in the Philippines is the second cause of mangrove depletion. Before engaging in a discussion on resource management, a distinct characteristic of mangroves must be recognized. Often, mangroves are common property resources. All common property resources share two important characteristics: 1) difficulty of excluding resource users and 2) subtractability. Subtractability means each user is capable of subtracting from the welfare of other users (Berkes and Favar 1989). For example, if one individual cuts down a tree, that tree is no longer available for use by other users. Nor can other users benefit from future trees that the felled tree may have produced. Understanding both requisite criteria for common property, the discussion can now return to management systems. Traditionally, when the community level institutional arrangements regulating the use for common property resources are undermined, the property rights regime that emerge are open-access regimes (Pomeroy 1994). Open-access regimes are characterized by free-for-all entry by resource users. There is an economic incentive for the user to extract as much of the resource as possible before other users do. The result of shifting management regimes from local level institutional arrangements to open-access is resource degradation. Thus, the institutional characteristics of mangrove management have contributed to mangrove depletion.

Tragedy of the Commons. Garret Hardin argued that all common property resources inevitably lead to resource degradation under a scenario called "Tragedy of the Commons." The underlying assumption was that whenever resources are limited and publicly owned, the rational action of each individual is to overexploit the resource to the point of degradation. As an illustration, Hardin hypothetically described how the process might work. Set in medieval England, Hardin's account centered on a pasture where many herders each had one cow grazing. The pasture represented the common property resource (albeit incorrectly as grazing fields in medieval England were in fact Crown lands and subject to central government authority). One herder of the group, recognizing the costs of maintaining an additional cow is simply the pasture's fodder home by the entire group, adds a second cow. The benefits of the second cow, however, accrue entirely and directly to the individual owner. Seeing the one herder benefiting at the group's expense, other herders also introduce more cattle until the pasture is depleted of fodder and no longer able to sustain the cows and the resource is degraded. So goes the tragedy of the commons as explained by Hardin (1968).

Hardin reported only two solutions to conserving common property resources. The first solution was to privatize the resource. The second was to keep the resource as public property, but have the rights of entry and use governed by a central authority. Since Hardin's landmark publication, social scientists have observed that not all common property resources are subject to the tragedy of the commons and have rejected the notion that the 'common' nature of the resource is singularly the problem (ICLARM and NSC 1996). More accurately, the property rights regime combined with the physical nature of the resource (e.g. common property) is more important. Feeny et. al. (1990) define four different property right regimes:

1. **Open Access.** Well-defined property rights do not exist and access to the resource is unregulated and free to anyone. Hardin assumed all common property resources are held in open access regimes.

2. **Private Property.** An individual or group possesses rights to exclude others from using the resource and to regulate the use of the resource. Private property rights are usually recognized and enforced by the state and are usually exclusive and transferable.

3. **Communal Property.** An identifiable community of interdependent users who exclude outsiders and regulate use among members hold the resource. Rights are unlikely to be exclusive or transferable, and are often rights of equal access and use. Group rights may be formally or informally recognized.

4. **State Property.** The rights to resource use are vested exclusively in the government which possesses decision making authority concerning access to the resource and rules of use. Identifying four property rights regimes proves Hardin's theory incorrect to the extent that an implicit assumption of the tragedy of the commons was that all common property resources are held under an open access regime. Common property resources vested in the other three regimes are not necessarily subjected to the tragedy of the commons as all three regimes possess components of Hardin's solution - the resource must be privatized, or controlled by a central authority. Further, even common property resources held in open access regimes are not necessarily bound to follow the tragedy of the commons because of social factors influencing individual actions and discouraging resource competition (Oakerson 1992). However, simply identifying the three other types of property rights regimes does not act as a panacea for all the problems associated with managing common property resources. Examples throughout the world identify that all four of the property rights regimes have led to overexploitation of resources (ICLARM and NSC 1996). Resource managers are now beginning to recognize that "what is needed is a more dynamic partnership using the capacities and interests of local communities, complemented by the ability of the state to provide assistance" (ICLARM and NSC 1996). Resource managers and resource management plans should, at a minimum, be concerned with equity, efficiency and sustainability.

2.2 Methods of Managing Resources

2.2.1 State-Level Management

There are different ways to manage natural resources. One style of management is state-level management. Pure state-level management is based on Western scientific data conducted by a centralized authority, such as a federal agency, and uses the authority of government laws and regulations for enforcement (Berkes 1994). State-level management is representative of the trend of resource management occurring in Southeast Asia and the Pacific. Using only Western scientific knowledge to manage resources, however, leads to problems, especially when the inherent management problems of common property resources are accounted for. One of the problems of Western scientific knowledge in dealing with common property resources is lack of experience. The western knowledge system is based on the scientific method, only developed in the 1800-1850s, as the basis of knowledge (Hoare 1993). The subsequent lack of practical application to natural systems has led to a mindset dominated by narrow assumptions such as unregulated access to the resource and lack of power for a single participant to prevent others from exploiting the resource. A further assumption of Western-based knowledge is that all common property resources are characterized by intense resource user competition and ultimately lead to the tragedy of the commons (Pomeroy 1994). However, regulated access, enforced at the local level through community institutions and social practices, are found so often in Asia and the Pacific where local authority still exists. Such forms of regulation appear to be the norm, not the exception (Pomeroy 1994). Therefore, due to a lack of practical application, the theoretical contextualization of Western scientific knowledge management systems often fails to recognize the actual situation and the benefits of existing management systems.

A second problem with using only Western scientific knowledge to manage resources is the fundamental weakness associated with this type of knowledge. Western scientific knowledge separates humans from the system and looks for simple cause and effect relationships -- relationships which are not common in complex natural systems. Modern scientific knowledge has been very successful in furthering human understanding and ability to manipulate simple systems based on the world view that humans are apart from, and above the natural world (Gadgil et al 1993). However, ecosystems are complex with no simple answers. Traditional Westem-based management approaches based on the scientific method need to be re-evaluated (Kay and Schneider 1994). When faced with complex ecological systems, neither the world view which separates humans from the environment, nor the scientific method has been particularly successful. Ecological systems vary on spatial and temporal scales, rendering generalizations of positivist science of little use in providing practical solutions to sustainable resource use (Gadgil et al 1993). The end result of state-level management actions is often a simplification of complex ecological systems leading to overuse and ultimately environmental degradation.

An example that indicates the difficulties that the scientific method has when applied at an ecosystem level is the paradox of the second law of thermodynamics. The second law of thermodynamics states "...when energy is transferred or transformed, part of the energy assumes a form that cannot be passed on any further" (Smith 1992:361). Translated to natural systems, the second law of thermodynamics states the world should be running down; but such is not the case. Left alone, ecosystems - and life - proliferate, not run down. Therefore, a fundamental law of the scientific method stands in direct opposition to a basic element of ecosystems -- regeneration.

In light of the paradox of the second law of thermodynamics, further arguments against using only the traditional scientific method in dealing with ecosystem management have been developed. For example, catastrophe theory focuses on necessary and unpredictable changes in ecosystems which are not accounted for in Western scientific knowledge. Catastrophe theory predicts systems will undergo dramatic, sudden and unpredictable changes in a discontinuous way. (Kay and Scnheider 1994). An example is a person's heartbeat, or emptying of his bladder. Both events are discontinuous, occur suddenly, and are necessary for that person's survival. At the point of change, however, (the catastrophe threshold) several potential changes are possible. The particular change that manifests itself cannot be known *a priori*. For example, an animal such as a dog establishes a territory around itself. Encroaching on the territory is a catastrophic event. The animal will either attack or retreat, but which one is not known. A complex system of environmental factors will influence the decision (Krebs 1989). When only two variables are involved, fairly accurate predictions can be made, but complex interrelationships within and between ecosystems make predictions more difficult as any one of a vast number of potential possibilities could manifest.

Kay and Schneider (1994) applied the catastrophe theory to a discussion at the ecosystem level. Natural systems rest in equilibrium with a constant exchange of energy. Systems reach catastrophe thresholds when excess energy is applied to the system and shift toward a new coherent behavioral state to achieve a new equilibrium. However, nature resists moving away from equilibrium (Holling 1993). The system's response is a spontaneous emergence of organized behaviour that spends the excess energy so equilibrium can be maintained (Kay and Schneider 1994). For example, tornadoes form when there is an excess of energy. After the tornado dissipates, the excess energy has been spent and the natural system is restored. The form of self-organization that is manifested is not predictable because the process of self-organization is catastrophic. Inversely, systems that do not receive enough energy cannot be supported and self-organization does not occur. Systems maintaining equilibrium, therefore, have a sustainable trade-off of all forces acting on the system. Energy which flows into the system is spent at the same rate.

When humans are viewed as part of the natural system, the community's methods of resource use are also included as factors which influence the environment (Gadgil et al 1993). With too much development of one type of structure, the system becomes overextended and brittle and unable to take full advantage of available resources and energy (Holling 1993). Left to nature's devices, a more optimal (better adapted) system or structure will displace the brittle one (Kay and Schneider 1994). Therefore, if local methods of managing and harvesting resources have existed for long periods of time, the argument can be made that such methods are optimal because no other system or structure has displaced the traditional practices.

State-level management that often focuses on maximizing one resource (such as aquaculture) and does not account for ecosystem functions is neither optimal nor sustainable. The top-down system of management analogous with a central administrative authority is often not well suited to developing countries with limited financial means and expertise to manage resources in widely diverse harvest areas (Pomeroy 1994). A reductionist cause and effect world view, unable to deal with the reality of self-organization in non-equilibrium systems, is incapable of supplying a sufficient explanation of how the world works (Kay and Schneider 1994).

2.2.2 Community-Based Resource Management (CBRM)

An alternative to centralized, top-down management of resources is local-level management. Pure local-level management systems are decentralized and, when necessary, use customary authority. Rule-making and enforcement are conducted at the local level relying on consensus, self-regulation and social sanctions to operate. Moreover, local-level management systems are based on traditional ecological knowledge (TEK) (Berkes 1994). TEK is a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings with one another and with their environment (Berkes and Folke 1994) and is increasingly being recognized as an effective management tool. Just as traditional knowledge of medicinal plants is no longer taken lightly, traditional practices in common property resource management are also being taken seriously as Western scientific knowledge recognizes the vast knowledge TEK possesses (Berkes and Favar 1989).

One system of local-level management that has been developed is called community-based resource management (CBRM). CBRM has been associated with a process by which the people themselves are given the opportunity and/or responsibility to manage their own resources, define their needs, goals and aspirations, and make decisions affecting their well-being (Fellizar 1994). It starts from the basic premise that people have the innate capacity to understand and act on their own problems. Essentially, CBRM builds on what the community thinks and allows each community to develop a management strategy that meets its particular needs and conditions (White et. al. 1994; Ferrer and Nozawa 1997). Its approach is people-centered and consensus-driven. At the core of CBRM is community organizing, where empowerment is a primary concern. CBRM has been responsible for activating social processes. Underlying many initiatives is a sense of ownership of management arrangements that tends to foster a high degree of commitment and rule compliance (Pomeroy et. al. 1996).

Improving the ability of local communities to raise their standard of living has several advantages. Despite high implementation costs in the initial phase, CBRM is less expensive over time due to lower administrative and enforcement costs when the local communities assume responsibility for monitoring and enforcement. Administrative costs of top-down management tend to be very high, especially where an external manager is distant and lacks on-the-ground expertise (Berkes, George and Preston 1991). Moreover, absentee management results in high transaction costs and induces rent-seeking behavior by resource users and yield uncertain benefits (Berkes, George and Preston 1991). CBRM strategies are site-specific and more aligned with the needs of the local community, often leading to more flexible management regimes. Instilling a sense of ownership over the resource, moreover, contributes to more sustainable resource uses. Over fifty well-documented cases of successful fisheries problem-solving by local bodies in pre-industrial and post-industrial settings exist (Dyer and McGoodwin 1994; Wilson et. al. 1994; Schlager and Ostrom 1993; Berkes 1989; Cordell 1989).

Thus, CBRM supports the goals of increased equity as local resource users develop management plans themselves. Efficiency is increased because of replacing the "red tape" associated with absentee management with site-specific decision making and at the same time generating greater compliance. However, CBRM is often not an effective management tool if used in isolation.

2.2.3 Co-management

Purely community-level management can be difficult in a complex world of multiple stakeholders (Berkes 1997). User communities, by themselves, will be unlikely to solve problems that originate outside their community (White et. al. 1994; Claridge and O'Callaghan 1997). Often, resource management cannot operate in a vacuum. It requires supportive policies, legislation, enforcement, conflict resolution, and other types of assistance (Pomeroy et. al. 1996). Policies and legislation need to spell out jurisdiction and control, provide legitimacy to decision-making arrangements, and clarify rights and rules on resource access and resource use. Arbitration and settlement of disputes, moreover, are imperative when conflicts arise between local resource users and between communities. Thus, co-management has emerged as an important concept. It makes two basic assumptions: 1) local people must have a stake in resource conservation and management, and 2) partnership of local communities and resource users with government agencies is essential (Berkes 1997).

Berkes (1994) notes that a common feature of many traditional local-level management systems was communal control of the resource, much like what is advocated in co-management. Berkes, George and Preston (1991) further state that co-management benefits extend beyond environmental sustainability. Social health, economic well-being and cultural sustainability are also fostered under co-management agreements.

Co-management may be viewed as a flexible management strategy where the level of community responsibility and authority in resource management varies. It does not claim that a single blueprint exists and does not assume equal power sharing. Partnerships are pursued, strengthened and redefined at different times in the co-management process, depending on the existing policy and legal environment, the political support of government for community-based initiatives, and the capacities of community organizations to become government partners (Rivera 1997).

How does CBRM differ from co-management? The difference essentially lies in the focus of each strategy, particularly on the level and scope of participation of government (Pomeroy 1998). CBRM is people-centered and community-focused. Co-management focuses not only on these issues but also on a partnership between the government and the local community and resource users. In co-management, government has a more prominent role. Government provides legitimacy and accountability to CBRM through co-management, having the power to legally establish and defend user rights and security of tenure at the community level. Co-management often addresses issues beyond the community level and of multiple stakeholders, and allows these issues to be brought more effectively into the domain of the community (Pomeroy (1998).

If seemingly much is known on mangroves, management systems, and the role of co-management, why are more studies needed? The need is prompted by the existence of unresolved questions on managing common property resources (ICLARM and NSC 1996). For example, why are some co-management arrangements successful and others not? How can the success rate of co-management arrangements be improved? What components of co-management are essential? Further research is needed to analyze co-management agreements and the factors leading to successful performance (ICLARM and NSC 1996). Studying co-management from an institutional analysis perspective will hopefully provide some answers.