FLORIDA INTERNATIONAL UNIVERSITY

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Proposal for Thesis

Master of Science in Environmental Studies

College of Arts and Sciences

Department of Environmental Studies

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I propose to the Major Professor and the the Committee Members a study of the following topic to be conducted in partial fulfillment of the requirements for the degree of Master of Science in Environmental Studies: **SOCIOECONOMIC AND ECOLOGICAL CONSIDERATIONS FOR MNAGROVE RESTORATION IN KARNATAKA INDIA**

Socioeconomic and Ecological Considerations for Mangrove Restoration in Karnataka India.

Research Problem

Small scale shrimp farming has been practiced sustainably in Karnataka, India for generations, but, in more recent years, wide scale conversion to large commercial shrimp farms has been taking place at a rapid pace. Beginning in the 1990's demand for shrimp for export grew substantially. This led to intensification of shrimp farming techniques. As a result, shrimp ponds increased in size and shrimp were raised in greater densities. Bhatta and Bhat (1998) state that since the 1990's over 65% of the available estuaries in Karnataka have been turned into modern shrimp aquaculture ponds, which necessitated chemical use for disease control and the flushing of water out of the ponds to get rid of dead biomaterials, shrimp feces, and uneaten food. Unforeseen problems began to arise from the industrialized shrimp aquaculture projects in Karnataka. It was found that salt water intrusion and chemical pollution led to un-arable lands and contaminated fresh water systems. Subsistence fishing areas have been polluted and access to waterways blocked by shrimp farms. Bhatta and Bhat (1998), also found that the salinity in the soils has decreased the ability of these ponds to alternately grow rice during the rainy season, and that in the 1990's a number of large shrimp farms were closed because of the spread of a shrimp viral disease.

One of the downfalls of shrimp commercialization is the loss of mangrove forests in the region. Although globally commercial shrimp farming has been a major cause of mangrove loss, in Karnataka there are other industries, which are also significant contributors to mangrove deforestation. Since 1990 over 17,000 hectares of mangroves have been developed and 50,000 people displaced in coastal Karnataka due to industrial development such as harbors, refineries, naval bases and hydroelectric projects (Bhatta and Bhat 1998). Because the state of Karnataka is currently considering reforesting areas in Karnataka, this research will focus on the social and economic interchange between shrimp farmers, other community stakeholders and the mangrove forest ecology.

In recent years, public agencies in Karnataka have been involved in mangrove reforestation projects in the Kali River estuary and have been seriously considering mangrove reforestation in the Gangavali and Aganashani River estuaries. This research will assess ecological, social and economic barriers to mangrove reforestation in the Gangavali and Aganashani River estuaries by addressing questions such as: 1). What is the current state of the mangrove forests in this region? 2). What knowledge do stakeholder's have of mangrove ecology? 3). How could this knowledge best be put to use to increase the likelihood of a successful restoration project? 4). What economic values do stakeholders place on mangrove forests in the region? 5). What concerns do stakeholders have about how mangrove restoration could potentially affect them? 6). What costs are stakeholders willing to bear in order to return the ecological diversity of the region closer to its original state?

Justification for This Research

Propagation of mangrove species around and between existing shrimp farms could potentially benefit the environment as well as community stakeholders in Karnataka including; shrimp farmers, fishermen, fisherwomen and rice farmers.

Mangrove forests provide habitat for many marine species that reproduce within them. Nutrient enrichment from decomposing leaves in mangrove forests attract prawns, crabs and fish (Rajendran and Kathiresan 1998). Mangrove wetlands also help to filter out pollutants from being released into the sea, for instance, Gautier et al (2001) found that suspended solids from shrimp pond drainage were reduced by using a mangrove wetland as a biofilter. Basin mangroves may also be capable of filtering chemicals such as pesticides (Clough, Boto and Attiwill 1983 as noted in Ewel et al. 1998). Mangrove forests also offer protection from coastal erosion and natural disasters. Williams (2005) states that damage to personal property and lives were less where mangrove forests were intact during the cyclone that hit eastern India in 2000, and the tsunami of 2004 because the mangroves absorbed the wave's impact and thereby reduced their intensity. Mangroves also benefit rice farmers by providing wind protection for their young rice crops, attracting birds that prey upon pests in the rice fields, and reducing salinity in rice fields (Dharmaraj, 2005).

Costs of mangrove restoration can be prohibitively expensive. Spurgeon (1998) estimates that the costs range from $3,000 to $28,500 per hectare when planting mangroves from propagules, $5700 to $230,000 per hectare when planting seedlings, and $90,000 to $510,000 per hectare when planting three-year-old saplings. Such efforts are often not successful in the long term if the original reason behind mangrove loss has not been simultaneously addressed.

When proposing mangrove reforestation around shrimp farms it is also important to consider the potential impacts of the reforestation projects on shrimp farming operations. Reforestation projects lead to an increase in ecological diversity of marine life within the mangroves. Such increase in marine life includes crabs, which may burrow through the earthen sides of shrimp ponds and feed on juvenile shrimp. Mangrove roots can also extend into shrimp ponds and increase the costs of maintaining structural stability (Personal Communication with Ramachandra Bhatta, 2005).

Species selection for reforestation efforts must also be addressed. Research has been conducted on optimal species types for mangrove reforestation. Basak and Das, (1997), found that in Orissa India, where mixed stands were planted, species survival and growth rates were higher than in mono stands. *A. officinalis*, and *H. fomes*, had the best survival rate while *S. apetala* had the largest canopy with the most branches. They propose that the presence of *S. apetala* could have increased the organic matter decomposition in the mixed stands. If *S. apetala* is not present surrounding the shrimp farms in Karnataka, its introduction could potentially increase the organic matter and viability of the other species present.

Although it is evident that mangrove restoration could be beneficial to the citizens of Karnataka state in India, social and economic conditions should be considered before implementing a reforestation project. Botero and Slazwedel (1998) conducted a study of mangrove reforestation in Columbia; they found that earlier attempts to improve the ecology of this area had failed due to a lack of institutional and community commitment to the project. Franks and Falconer (1999) note that although there are mechanisms for creating mangrove development plans there are no forums set up for stakeholder negotiation. They further state that governments are often biased towards the interests of land owners without considering impacts on other sectors. A study by Steyer and Llewellyn (2000) emphasizes that the complexity of natural and social systems must be

acknowledged when attempting reforestation. This study, conducted in Louisiana, USA, states that if agencies create restoration plans without community participation and their subsequent commitment to the project, failure of the project is virtually guaranteed. It is therefore critical to come to an understanding of how reforestation affects local residents and the role the residents could play in the reforestation. Ownership rights and financial viability of a project will need to be considered. Costs of mangrove restoration may be too high for Karnataka's landowners, fishermen or community members. Natural regeneration of mangroves would be less expensive but the impacts on community members from redirecting fresh water flow and the economic impact of crab predation in shrimp farms would need to be considered. If government or outside grants could be obtained for restoration purposes, community members could still be impacted by the loss of subsistence gathering areas while the mangroves are becoming established. Therefore economic viability of such a project would be dependent upon funding and community investment in the process with the understanding that a successful project would potentially economically benefit community members at some point in the future. In order to conduct a successful reforestation project, stakeholders will need to be identified and interviewed to try to come to consensus of community support regarding these and other issues that could come to light during the interview process.

Objectives

The overall goals of this research are to assess the ecological, social and economic conditions in Karnataka that would impact mangrove reforestation. Specific objectives include: 1) Investigation of current conditions of mangrove forests, 2) Identification of factors leading to mangrove loss, including the possibility of shrimp farming, hydrologic changes, and high salinity levels, 3) Assessment of stakeholder knowledge about and attitudes towards mangrove reforestation, 5) Identification of stakeholders subsistence uses of mangrove products (wood, shellfish etc) 6) Identification of economic and social issues that might prevent successful mangrove restoration.

Methods

In order to evaluate the above research objectives, the following hypotheses have been postulated.

- Property rights and usufructuary rights are important influences on the ability to initiate a reforestation project as well as its likelihood of its success
- Shrimp farmers will extend limited support to mangrove reforestation projects due to crab predation on juvenile shrimp when they migrate from reforested mangroves into shrimp ponds
- Fishermen and fishermen's wives will have the highest level of support for mangrove reforestation among the stakeholders because they stand to benefit from the provision of marine nursery habitat.
- Rice farmers will have less support than fishermen but more support than shrimp farmers because they have lesser known benefits and no known costs.

The proposed research will take place in Karnataka India, a land area of great diversity. The dense forests of the Western Ghats run roughly north and south, parallel to Karnataka's 300 km. coastline. Rivers that flow from the Western Ghats to the Arabian

Sea create over 8,000 hectares of coastal estuaries. The narrow strip that runs between the Western Ghats and the coast of Karnataka is densely populated.

Two to three potential reforestation sites will be investigated and a series of interviews will be conducted with stakeholders who could potentially be affected by such a reforestation project. Stakeholders interviewed will include: commercial shrimp farmers, rice cum shrimp farmers, fishermen, fishermen's wives and rice farmers wives. The interviews will take place over a seven week period, and will consist of interviewing 400 households divided between the five stakeholder groups. This research will also examine ecological parameters of village sites where stakeholder interviews are conducted to determine the likelihood of successful reforestation of these sites.

Following Walters (1997) the community survey (see appendix 1), will include questions to assess social barriers and benefits to reforestation. It will also include economic assessment of willingness to pay for environmental improvement of lands that will benefit the community. Officials from NGO's such as PREPARE and the MS Swaminathan Foundation, as well as the Karnataka Department of Forests will also be interviewed, to determine the current ecological state of the proposed sites, management goals and policy toward monitoring of the sites. Two potential reforestation sites in Uttara Kannada along the Gongavali and Aghanashani rivers will also be explored as well as sites on private and public land surrounding shrimp farms. A comparison of the likelihood of success based on the current ecological state and community support between two types of sites will be explored by this research.

Survey interviews will include open ended questions so as not to restrict the responses of the stakeholders. This will allow potentially unexpected issues or results to be uncovered. Surveys will also include fixed answer questions that will allow for easier comparisons between stakeholder groups. Data will be analyzed question by question and a comparison made both between stakeholder groups and within stakeholder groups to assess their similarities and differences. Results from this ethnographic, economic and ecological study will include both qualitative and quantitative information.

This research has the potential for facilitating mangrove reforestation efforts in India and increasing the likelihood that they will be successful. Hopefully this will lead to other such studies where mangrove reforestation has the potential for providing economic gain by reestablishing marine habitat and filtering pollutants, thus increasing fishing yields and preventing economic costs due to coastal erosion and storm damage. Other potential economic benefits to local livelihoods include an increase in rice yields due to a reduction in salinity levels in the rice fields and the provision of wind protection.

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