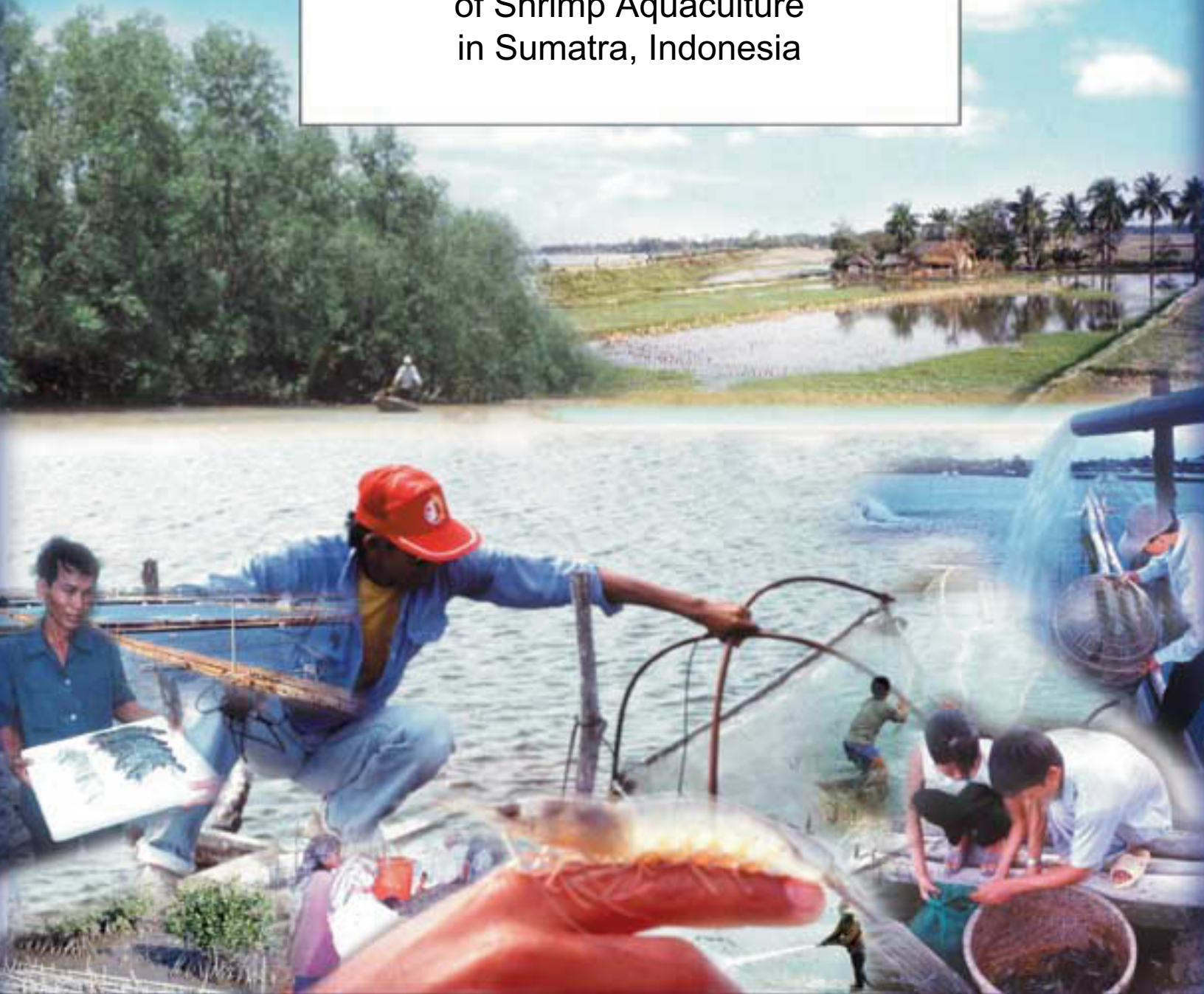


# Shrimp Farming and the Environment

Good Practices for Community-based  
Planning and Management  
of Shrimp Aquaculture  
in Sumatra, Indonesia



A Consortium Program of:



GOOD PRACTICES FOR COMMUNITY-BASED  
PLANNING AND MANAGEMENT  
OF SHRIMP AQUACULTURE  
IN SUMATRA, INDONESIA

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Consortium Program on Shrimp Farming and the Environment

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### Preparation of this document

The research reported in this paper was prepared under the World Bank/NACA/WWF/FAO Consortium Program on Shrimp Farming and the Environment. Due to the strong interest globally in shrimp farming and issues that have arisen from its development, the consortium program was initiated to analyze and share experiences on the better management of shrimp aquaculture in coastal areas. It is based on the recommendations of the FAO Bangkok Technical Consultation on Policies for Sustainable Shrimp Culture<sup>1</sup>, a World Bank review on Shrimp Farming and the Environment<sup>2</sup>, and an April 1999 meeting on shrimp management practices hosted by NACA and WWF in Bangkok, Thailand. The objectives of the consortium program are: (a) Generate a better understanding of key issues involved in sustainable shrimp aquaculture; (b) Encourage a debate and discussion around these issues that leads to consensus among stakeholders regarding key issues; (c) Identify better management strategies for sustainable shrimp aquaculture; (d) Evaluate the cost for adoption of such strategies as well as other potential barriers to their adoption; (e) Create a framework to review and evaluate successes and failures in sustainable shrimp aquaculture which can inform policy debate on management strategies for sustainable shrimp aquaculture; and (f) Identify future development activities and assistance required for the implementation of better management strategies that would support the development of a more sustainable shrimp culture industry. This paper represents one of the case studies from the Consortium Program.

The program was initiated in August 1999 and comprises complementary case studies on different aspects of shrimp aquaculture. The case studies provide wide geographical coverage of major shrimp producing countries in Asia and Latin America, as well as Africa, and studies and reviews of a global nature. The subject matter is broad, from farm level management practice, poverty issues, integration of shrimp aquaculture into coastal area management, shrimp health management and policy and legal issues. The case studies together provide a unique and important insight into the global status of shrimp aquaculture and management practices. The reports from the Consortium Program are available as web versions (<http://www.enaca.org/shrimp>) or in a limited number of hard copies.

The funding for the Consortium Program is provided by the World Bank-Netherlands Partnership Program, World Wildlife Fund (WWF), the Network of Aquaculture Centres in Asia-Pacific (NACA) and Food and Agriculture Organization of the United Nations (FAO). The financial assistance of the Netherlands Government, MacArthur and AVINA Foundations in supporting the work are also gratefully acknowledged.

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<sup>1</sup> FAO. 1998. Report of the Bangkok FAO Technical Consultation on Policies for Sustainable Shrimp Culture. Bangkok, Thailand, 8-11 December 1997. FAO Fisheries Report No. 572. Rome. 31 p.

<sup>2</sup> World Bank. 1998. Report on Shrimp Farming and the Environment – Can Shrimp Farming be Undertaken Sustainably? A Discussion Paper designed to assist in the development of Sustainable Shrimp Aquaculture. World Bank. Draft.

## **Abstract**

The case study for this report was conducted in the coastal village, Pematang Pasir in Lampung Province, Sumatra, Indonesia. Pematang Pasir hosts a pilot project promoting environmentally and responsible shrimp aquaculture implemented by the Indonesian Coastal Resources Management Project (Proyek Pesisir). Most of the shrimp farming techniques in Pematang Pasir are either semi-intensive or traditional extensive small-scale farms, with 10% of the production coming from the extensive systems. The hatcheries in the area are typically small 'backyard' hatcheries with a total production of around 190 million PL<sub>12</sub> per month.

This paper describes the lessons learned to date in Pematang Pasir and offers strategies and tools of community-based coastal resource management. The lessons learnt are based on findings from Pematang Pasir but can be used in a broader perspective as more general guidelines for community-based and participatory development of shrimp aquaculture in marginalized coastal areas.

The findings are not only based on natural and physical conditions but also on socio-economic aspects and impacts for the individual farmer and the whole community. The chances for sustainable development of shrimp aquaculture are connected to the communities' involvement in the planning. The more important shrimp culture is to the community, the more interested and committed it will likely be in adopting better practices. The management and the planning should involve stakeholders from NGO's as well as from the different governmental levels to ensure a good development. Also inputs from external sources are important since the technical knowledge can be limited in the more remote areas.

## Content

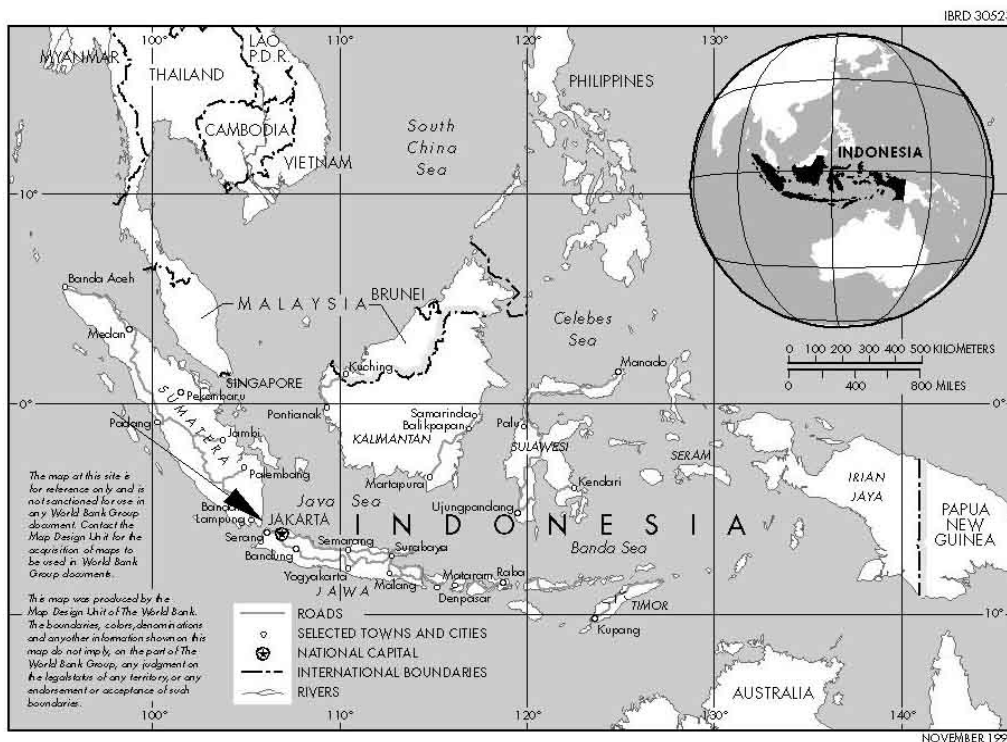
<b>ABSTRACT .....</b>	<b>IV</b>
<b>ABBREVIATIONS AND ACRONYMS .....</b>	<b>VI</b>
<b>INTRODUCTION.....</b>	<b>1</b>
<b>COASTAL RESOURCE ASSESSMENT OF LAMPUNG PROVINCE.....</b>	<b>2</b>
<b>GROWTH OF SHRIMP AQUACULTURE IN LAMPUNG PROVINCE, INDONESIA .....</b>	<b>2</b>
PRODUCTION .....	4
BACKYARD HATCHERIES.....	5
<b>INSTITUTIONAL AND LEGAL ARRANGEMENTS .....</b>	<b>6</b>
PRODUCER GROUPS.....	7
<b>CONSTRAINTS AND OPPORTUNITIES ANALYSIS .....</b>	<b>7</b>
OPPORTUNITY.....	9
COMPLEXITY .....	11
CAPACITY/COMPLEXITY TYPOLOGY .....	11
<b>SITE SELECTION .....</b>	<b>12</b>
<b>PROJECT ACTIVITIES.....</b>	<b>13</b>
PUBLIC EDUCATION AND PARTICIPATORY PLANNING .....	14
MANGROVE REPLANTING AND LAND USE.....	14
<b>LESSONS LEARNED .....</b>	<b>16</b>
<b>REFERENCES .....</b>	<b>18</b>

## **Abbreviations and Acronyms**

FAO	Food and Agriculture Organization of the United Nations
ICM	Integrated Coastal Management
NACA	Network of Aquaculture Centres in Asia-Pacific
NGO	Non-Governmental Organization
PL	Post Larvae
ppm	Parts per million
WB	World Bank
WWF	World Wildlife Fund

## Introduction

This paper presents a case study of a pilot project in Indonesia that is working to promote environmentally responsible and sustainable shrimp aquaculture. The project is located in Pematang Pasir, a coastal village located in Lampung Province on the island of Sumatra, in Indonesia (Figure 1 and 2).



**Figure 1.** Map of Indonesia The black arrow indicates the place of the pilot project. See figure 2 for a detailed map of the studie area.

Lampung Province is the second largest shrimp-producing province in Indonesia. It has achieved this status over a very short period of time. Like so many other places around the world, the rate of growth has overwhelmed government capacity to plan and guide shrimp aquaculture growth in a responsible manner.

The pilot project in Pematang Pasir is part of the Indonesian Coastal Resources Management Project (Proyek Pesisir) whose overall objective is to decentralize and strengthen coastal resource planning and management.<sup>3</sup> As a “pilot” project, it is intended to test and expand knowledge of effective methods and lessons learned that could be replicated in other locations on a wider scale.

This paper describes what has been learned to date, and offers strategies, methods and tools of community-based coastal resource management that can be used worldwide in efforts directed at analyzing constraints to adoption of good practices for shrimp farming and how to overcome them.

<sup>3</sup> Proyek Pesisir is funded by the United States Agency for International Development and executed by the University of Rhode Island’s Coastal Resources Center with Indonesian partner organizations.



## **Coastal Resource Assessment of Lampung Province**

Lampung is a province of approximately 7 million inhabitants, most of whom are relatively recent migrants from other regions. The capital city (Bandar Lampung) located on Lampung Bay in the south and the surrounding urbanized area has a population of about 2.7 million and is growing.<sup>4</sup> Very few people live on Lampung's rugged western seaboard, most of which is taken up by Bukit Barisan Selatan National Park. Lampung Province has 6 coastal administrative Regencies (Kabupaten), 21 coastal Districts (Kecamatan) and 184 coastal villages (Desa).

The Lampung project office of Proyek Pesisir and the Lampung Provincial Planning Board conducted an in-depth assessment of the condition and trends of coastal resources and coastal management issues in Lampung. The assessment was conducted in a participatory process involving the Center of Coastal and Marine Resources Studies at Bogor Agricultural Institute and approximately 270 local stakeholders, including more than 60 government and non-government organizations. The product that resulted from background studies, an extensive survey of existing information, workshops, meetings and consultations, is the Lampung Coastal Resources Atlas.<sup>5</sup> Until the coastal atlas, little was known about the extent or condition of coastal resources in the province. The major coastal issues identified by the atlas served as the focus of a strategic plan for the province's coastal management program.

The coastal assessment and atlas identified upland agricultural production, timber harvesting, and agro-industry as significant sources of environmental pollution and resource degradation. Habitat loss and effluent discharge from these production activities degrade water quality and reduce water quantity in the watersheds flowing to coastal ecosystems. But the most important issue in the coastal villages on the East Coast of Lampung Province is shrimp aquaculture. The major impacts are mangrove habitat destruction, coastal erosion, sedimentation and flooding.

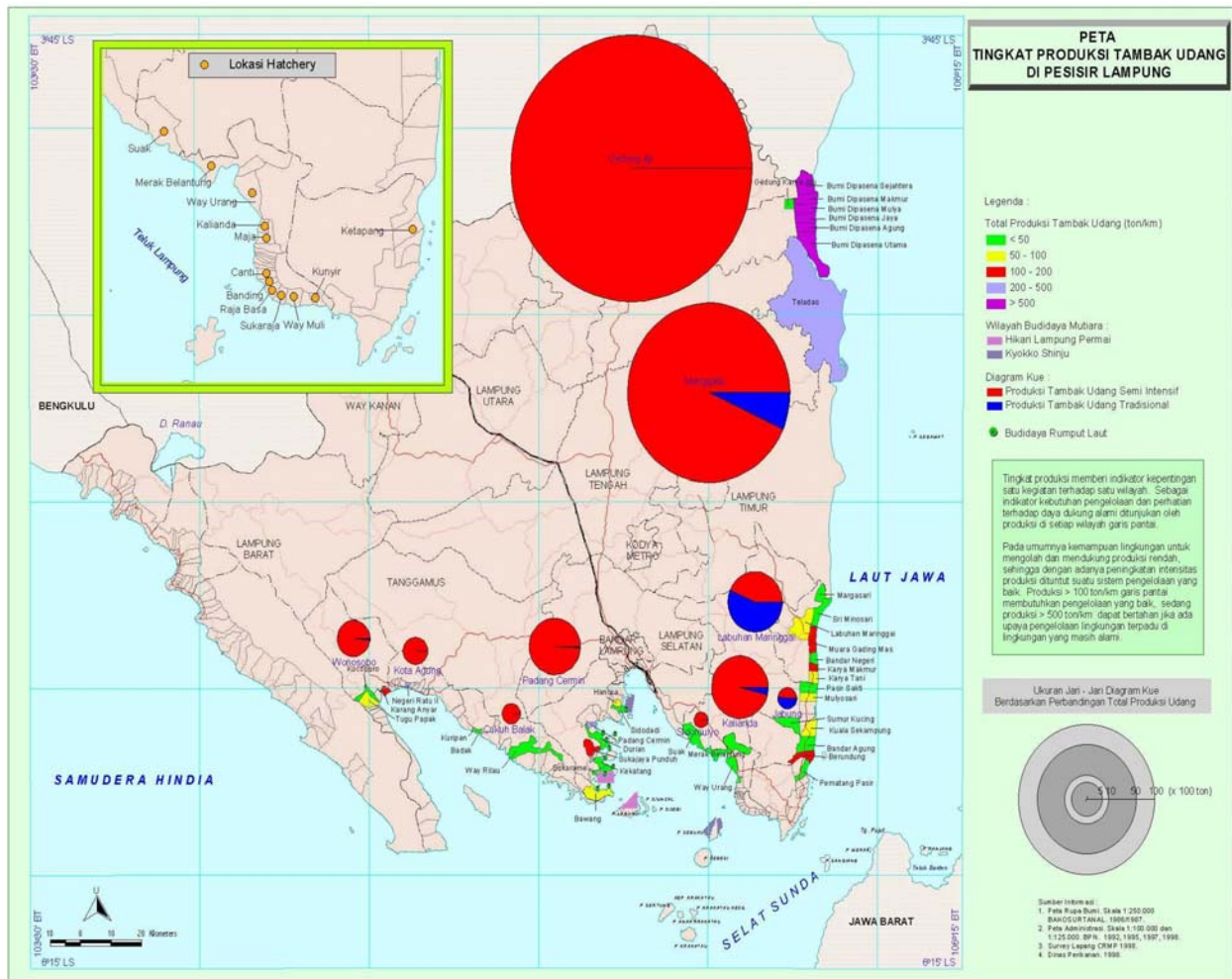
### **Growth of Shrimp Aquaculture in Lampung Province, Indonesia**

Government statistics indicate that the area of land dedicated to shrimp ponds in Lampung Province almost doubled between 1992 and 1996 (from 8,150 hectares to 14,960 hectares). This data may not be accurate since 1998 satellite imagery suggests that the area in shrimp ponds is closer to 50,000 hectares. The whole available East Coast of Lampung is now dedicated to small-scale, owner operator and small to medium size business operated shrimp farms and hatcheries (Figure 2). The harvested product is exported to Japan, Europe and the United States.

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<sup>4</sup> The Indonesian government has attempted to alleviate the pressure of expanding population by opening new areas for transmigration. The goals of this inter-island voluntary migration program were to alleviate poverty, to reduce the population pressure in Java and to stimulate regional development in the outer islands. Sumatra and especially Lampung Province were the destination for many of the migrants. Lampung Province is the most accessible area to Java. From 1979 through 1987, over half a million people were relocated to Sumatra.

<sup>5</sup> The atlas is a first for Indonesia and has influenced the development of national coastal policy. The Minister for Home Affairs sent a copy of the atlas to each of Indonesia's 26 provincial governors requesting that a similar product be produced in their province in the next year.



**Figure 2:** The distribution of shrimp farms and hatcheries in Lampung Province. The coloring of the areas indicates the pond production in ton/km<sup>2</sup>. The red color (light) in the circle diagrams indicates production from semi-intensive ponds and the blue (dark) indicates the production from traditional ponds.

Locally operated farms and hatcheries have had a major positive impact in terms of local employment and increase in standard of living in otherwise very poor communities. Lampung is relatively wealthy due to its rich agricultural resource base and proximity to West Java and Jakarta, but this prosperity has not trickled down to coastal villages.

The area was made suitable for inexpensive conversion to shrimp ponds due to government-supported clearing of forests to form rice fields in the 1970's and early 1980's. Many of these areas had drainage systems built by the Ministry of Public Works that facilitated the provision of fresh water and control of floodwater. Lack of government oversight and enforcement has led to the use of swamp drains to supply brackish water to shrimp ponds and to the use of land designated as rice paddy fields for shrimp aquaculture.

The economic benefit of shrimp farming compared with paddy field rice or other uses is sufficient to drive the transformation of all available land and eventually much land that is not suitable (in some places rice fields have been converted to shrimp ponds even though the availability of brackish water is limited to the dry season). In September 1998 it was estimated that the return from just one harvest of traditionally managed shrimp ponds made a gross income six times that of rice in one year of production (with two growing cycles). Because of the combined impacts of rice and shrimp farming, two coastal Regencies (Lampung Selatan and Lampung Tengah) have been completely deforested of mangrove trees. In areas of Forestry Service

supervised land, pond operators resist efforts to replant mangrove, as the status of the trees would revert to the Forestry Service—an outcome that shrimp farmers find unacceptable.

Once rice paddy fields are converted to shrimp ponds they cannot return to rice production unless the salinity in the soil and water on the site are removed. Thus, if the shrimp business fails there is an “opportunity cost” of foregone future rice production. Milkfish aquaculture would probably be the next best productive use of the land.

The first shrimp farm operations were semi-intensive and intensive and made use of the good quality water that makes the East coast so ideal for shrimp farming. Over time, extensive farms surrounded these farms and land lost to erosion eliminated many of the first farms. Government has invested in the construction of coastal defenses in Labuhan Maringgai District where loss of land from erosion is greatest. Following the loss of productive land, more farms began to locate further south down the East Coast. As the availability of land fell, and the intensity of shrimp farms increased, environmental stress increased. The first whitespot outbreaks occurred in 1997 in intensive ponds throughout the East Coast region of Lampung.

With failure resulting from disease, many of the new intensive shrimp farms went bankrupt due to the large investment needed to install and operate a business of this type. Farms that had successfully harvested one or more times had sufficient resources to sell and move to an area where the intensity of shrimp production was lower, driving up competition for land. As in other parts of Indonesia, when the production environment deteriorates below the level possible for shrimp production the result is relocation and capital flight.

These trends indicate that the cumulative impact of current production practices of small-scale operators is not sustainable. Mangrove habitat loss, erosion, sedimentation, eutrophication and flooding are major concerns of poor pond design and operation. A recent review of the industry concluded that the production environment, especially water quality in the ponds in two of the East coast Regencies has reached critical levels, and “unless immediate action is taken these two regions will soon face collapse” (Marsden 1999).

## **Production**

There are a wide range of production techniques and owner-management arrangements, but the primary production techniques are extensive and semi-intensive. They represent an area in pond production of 14,000 and 12,500 hectares respectively (Wiryanan et al. 1999). The productivity of traditional, extensive culture is only about ten percent that of semi-intensive culture.

Small-scale extensive or traditional farmers are typically less than 5 hectares and are the most likely to be owner-operated and living nearby. Under the traditional management system, 1-5 post larvae (PL) are stocked per square meter. At this stocking rate the natural pond environment provides all the nutrition needed by the shrimp until the third month of production. Land converted from rice paddy is prepared by scraping solid waste from the pond floor and walls, before filling with water, by diesel or petrol driven pumps. Where possible the farmers take water directly from the primary canal. After filling the pond there is a period of conditioning, usually with the addition of fertilizer and some form of lime. When there is an adequate population of plankton in the pond the water turns a green- brown and post-larvae are added. The plankton community or “bloom” is controlled by adding water, to dilute the plankton concentration and replace evaporated water. This farm technology is referred to as “traditional plus” if feed or aeration is added in the third or fourth month of culture.

Polyculture is typical in extensive farms in Lampung. Either wild caught or hatchery raised milkfish fry are stocked after the shrimp have been in the pond for a period of time. The milkfish are consumed and sold locally and nationally. Therefore, unlike shrimp, they directly contribute to local food security.

Small-scale, semi-intensive farms are typically less than 5 hectares in total pond area. Many are owned by absentee landowners and operated on a share basis. Medium scale businesses are defined as operations with one or more locations of 5-40 hectares in pond area and are typically owned by individuals living in the city of Lampung or Jakarta.

Semi-intensive farms stock between 5 and 25 PL per square meter. Feed is added beginning in the first month and aeration is used at night. Intensive culture is defined as stocking above 25 PL per square meter and requires careful management of water, plankton and feeding to keep the water environment optimal and minimize stress to the animals. The investment in PL, feed and equipment for semi-intensive and intensive shrimp farming usually excludes the small local farmer.

The majority of semi-intensive farmers have their own teams of technical staff who are paid a base salary and a production bonus. The use of technicians with experience from other parts of Indonesia, especially those with experience from Java or Sulawesi, limits employment opportunities for local labor to unskilled and low-paid jobs (e.g. watchmen or harvesters).

Two corporations own and manage large shrimp aquaculture concessions in the northern part of Lampung's East Coast. One of these (Dipasena Citra Darmaja Corporation), located in Tulang Bawang Regency is the world's largest shrimp farm operation. It is a 16,250-hectare concession encompassing 18,000 ponds and was producing about 50 tons of shrimp per day. The other encompasses over 3,000 ponds on a 23,000 hectares site. These industrial-scale operations control all aspects of production and marketing and operate their own hatcheries, feed mills, processing plants and storage facilities. On the largest facility, approximately 9,000 farmers and the majority of their families live on the premises. The corporation has built seven "villages" with schools, cooperatives, health facilities, administration buildings and meeting halls.

Dipasena Citra Darmaja Corporation is a joint venture between an Indonesian and Thailand holding company. Farm operators are required to obtain land and all inputs from the corporation and to sell the harvest to the corporation at the price that is offered. Farmers pay for the cost of land and operating costs with loans obtained from the corporation through an arrangement with a bank. In early 2001, the company operation was suspended due to financial problems. Until a new financial arrangement can be set up the shrimp farmers cannot obtain the capital to operate their ponds, make a living, and pay off their loans to the corporation.

Production under these corporations is semi-intensive and highly controlled. Technical staff, supervisors and trouble shooting advisors carefully monitor production. Senior management is recruited internationally. Marsden (1999) concluded that production from the industrial-scale facilities appeared to be environmentally sustainable. They conserve the "green belt" of trees to guarantee their intake water and through careful design and monitoring control the quality of disposed water.

### **Backyard Hatcheries**

The hatchery business also grew exponentially in the 1990's. There are about 100 "backyard" hatcheries producing up to 190 million PL<sub>12</sub> per month. They are predominantly located near the town of Kalianda on the East Coast of Lampung Bay where water quality is high enough for regular production of fry. The hatchery business is a major spontaneous and self-financed industry, important to the local economy. The major suppliers of shrimp broodstock come from Aceh, East Kalimantan and Central Java. Java broodstock is less preferred because of concern about disease.

Although there are no data on the sources of income of coastal residents in Lampung, shrimp aquaculture is clearly very important to the economy of East Coast villages. Shrimp aquaculture has created alternative livelihood opportunities not only in backyard hatchery business, but also in areas such as motorcycle rental to transport shrimp inputs to ponds; daily labor in pond preparation between culture cycles; ice production and

sales; and, shrimp collection. Rice paddy farmers usually work on a shrimp pond in the dry season or when the rice harvest fails.

## **Institutional and Legal Arrangements**

### **Land Tenure**

Security of tenure is an important issue in Lampung. Most shrimp ponds are located on public land either because they are within the coastal “no development zone” or are on land that is under the authority of the Forestry Service. The Forestry Service has authority for all land that is, or that was previously forested. This includes use of land within the coastal no development zone. Because of this arrangement, the Forestry Service is a key player in shrimp aquaculture development in Lampung. In the project pilot site described below all the shrimp ponds, as well as the entire village itself fall under the authority of the Forestry Service.

National policy prescribes that, at a minimum, the width of the strip is calculated (at the lowest tide) as a width of 130 meters times the difference between high tide and low tide. Within this minimum, Provinces set their own definition of the no development area. In Lampung it is defined as 100 meters from the lowest tide. Construction is, in principle, banned in this coastal strip.

It is virtually impossible to enforce the no development policy where populations are growing rapidly and people are using land and other resources in the coastal strip for subsistence. The result of public land tenure in the no development area and in forested areas is uncertainty of land tenure security. This makes it difficult to obtain credit and reduces private incentives to maintain and care for the land and make long term capital and infrastructure investments. It also creates jurisdiction disputes between agencies and confusion and cynicism in the community with respect to public agencies.

To address issues of coastal land use and land use planning, Proyek Pesisir established a formal Kabupaten Task Force in Lampung Selatan Regency comprised of the government, university, NGO, and private sector. The Task Force is led by the government head of the Regency (Bupati of Lampung Selatan) and provides an institutional forum for coordination, strategic planning, policy strengthening, problem solving and decision making. Meetings are bi-monthly, or more frequently depending on the urgency of the problems to be addressed. The issues that the Task Force is currently addressing are coastal spatial planning and resource monitoring. The Task Force is empowered by letter of decree from the office of the Lampung Selatan Regency. Groups represented in the Task Force as members and executive officers include: Regency Development Planning Board, Tourism Service, Public Works Service, Fishery Service, Agriculture Service, Villagers Development Office, Regency Law Division, Environmental Impact Assessment Division, Head of District, Regency Branch of Indonesian Fisherman Group and Heads of Villages.

### **Environmental Impact Assessment and Permitting**

Operations over 200 hectares require a permit issued from the national Directorate of Fisheries in Jakarta following approval at government offices of the Provincial Regency and City District, and completion of an Environmental Impact Assessment.

Operations over 50 hectares can be licensed with a letter of Permission following approval from the Office of the Governor and submission of a letter of request, plan of operation, tax documents, and environmental management statement. The Governor’s Economic Office reviews the technical and environmental feasibility of the proposed operation with a team composed of representatives of the Provincial Planning Board, relevant office of the Provincial Secretary of the area, Marine Security, Harbormaster, District Fisheries staff, and County government head. The Permission is valid for the lifetime of the company, provided reports are sent to the Provincial Fisheries Service every 6 months.

Operations between 2 and 50 hectares can be licensed at the District level after an assessment by government offices and environmental impact reports are completed. The agreement of the District Fisheries Service is in the form of an indication in writing and is valid for one year.

Aside from the largest operations, the permitting system is not regularly enforced. Government agencies lack resources to monitor and control the development of shrimp aquaculture. The proportion of medium-size businesses operating without letters of permission in Lampung is not known, but it is large and most small-scale farms operate without full government permission. The most common reason given by shrimp farm owners for failing to obtain permits is the worry of potential tax liability (Marsden 1999).

In the backyard hatchery business of Kalianda only about 30 percent of the hatcheries have been permitted. The most common reason stated by hatchery owners for not processing these permissions is the regulation banning construction within 100 meters from the coastline (Marsden 1999).

### **Extension**

With thousands of small-scale and family operated shrimp farms, extension and training is critical. The Fisheries Service has a limited number of field-based staff offering extension advice in all districts of Lampung, but the number of extension workers with education in shrimp aquaculture and the total resources available are inadequate to reach farmers in a meaningful way.

### **Producer Groups**

The shrimp aquaculture industry is not well organized in Lampung. There are two shrimp farm producer organizations. The first is GAPPINDO Lampung, the provincial affiliate to the national fish farming association. The board members are mostly shrimp farmers with small, semi-intensive businesses. This association is not very active in Lampung. The second is the Shrimp Club, an informal group that meets regularly on an informal basis. A more active organization is the Lampung affiliate of the National Association of Shrimp Fry producers, representing the backyard hatchery businesses.

There are no industry codes of conduct or efforts to promote voluntary good practices in Lampung or, to our knowledge, in Indonesia.

### **Constraints and Opportunities Analysis**

With the results of the Lampung coastal resource assessment and a separate study of aquaculture in Lampung, the Indonesian Coastal Resources Management Project decided to establish a pilot project in a coastal village to experiment with approaches to community development and promotion of good shrimp aquaculture practices. The purpose of pilot projects is to test methods and approaches and to determine their relevance, transferability and acceptability. They are often small-scale prototypes of larger-scale initiatives. Careful attention is given to choosing appropriate locations, structuring activities to fit local needs and conditions, and evaluating the project to determine conditions that influence success or failure and the preconditions for replication.

The selection process of the pilot site contributed to the development of generalized methods for how to diagnose situations, including constraints and opportunities, in coastal locations and match interventions to specific contexts. Such methods and diagnostic tools can help Provincial and District resource managers (e.g. local planning bodies like BAPPEDA) assess and compare coastal contexts and opportunities in sustainable coastal resource management, and help guide priorities for investment of scarce resources. Within a given coastal region many sites and/or resources may be candidates for management or restoration. However, funds are usually insufficient to address all possible sites and issues. Thus difficult choices must be made. Within this context, a method to highlight some of the most important factors relevant to the prioritization of coastal

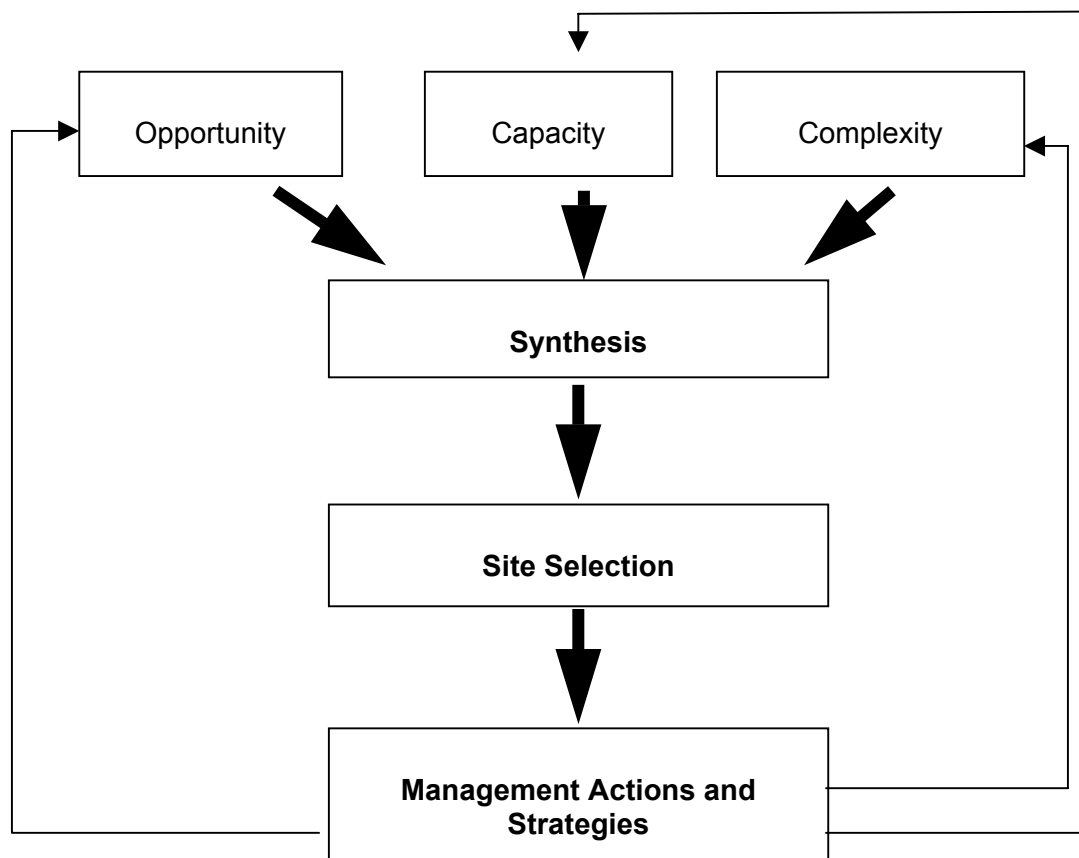
management pilot projects and strategies can offer needed help to policy makers and resource managers at all levels.

This is particularly relevant in Indonesia today. Structural changes in government related to decentralization provides coastal villages, Districts, and Provincial Regencies greater influence over how coastal resources are allocated, managed, and conserved. Understanding the type of coastal context is critical to the design and implementation of local efforts.

Below we describe a simplifying framework that is based on three categories of local considerations for formulating and implementing community development and small-scale aquaculture development activities. The three categories are:

- Opportunity in terms of the importance of the natural resources that coastal people are dependent on and that society values. This can be characterized by the resource “richness” (natural condition and trends) and the urgency of threats to coastal resources that people value.
- Willingness and capacity to take action on the part of beneficiaries, local institutions, and stakeholders.
- Complexity of the situation in terms of the kind and amount of change required, user conflicts present, and tractability of the problem.

In Figure 3 the interactions and connections in choosing the proper management actions and strategies are presented.



**Figure 3.** A Systems approach to constraints analysis and selection of management actions.

## Opportunity

In formulating and implementing pilot projects, the Lampung Province coastal management initiative gives consideration to the specific and unique ecological characteristics of areas into which new methods and innovations will be introduced, not only natural and physical conditions, but also their relationship in supporting human life. Resource condition and trends can be assessed using rapid assessment techniques or expert judgment combined with review of existing information. Key ecosystem components and dimensions of resource condition in coastal and marine environments include shoreline erosion, water quality, mangroves, coral reefs, marine fisheries and other marine living resources.

Urgency can be characterized by threats to coastal resource condition and quality of life. Urgent threats represent unequivocal and major threats to quality of life and sustainable development.

In a simplified typology of condition and threats we can identify four types as presented in Figure 4:

Condition of Coastal Resources	Good	Type 1 Resource rich, little threat	Type 3 <b>Urgent</b> Major future threats to good condition
	Poor	Type 2 Restoration opportunity	Type 4 <b>Urgent</b> Threats entrenched and cause major impacts Potential to avoid permanent loss.
		Low	High
		Severity of Threats	

**Figure 4.** The connection between the condition of the coastal resource and the severity of a potential problem (see text for further explanation).

All types represent an opportunity for coastal resource management. In Type 1, resource condition is good and threats are low. In terms of management, this represents an opportunity to put in place systems for conservation and sustainable use prior to threats and degradation. Under Type 2, condition is poor and threats are low. This represents a situation where ecosystem restoration efforts are needed. Under Type 3, condition is good but threats are high. Coastal management efforts are frequently targeted at Type 3 situations where an emerging activity threatens the condition of valued coastal resources. Type 3 management efforts attempt to proactively prevent degradation prior to significant loss. Under Type 4, condition is poor and threats are high. The management challenge is to avoid further degradation or permanent loss of coastal resources and their value for quality of life.

In the areas where shrimp farming occurs in Lampung the condition and trend over time in terms of shoreline erosion, water quality, and mangroves is poor and decreasing. The threat to resource condition and quality of life from unsustainable shrimp farm practice is high—the situation is characterized as Type 4.



## Willingness and Capacity to Act

The capacity that is present to address coastal management issues in a place is critical to site diagnosis, constraints analysis and tailoring management strategies. International experience and cross-country empirical evidence (World Bank 2000; Crawford et al. 2000; Pollnac and Crawford 2000) demonstrate that some of the most important dimensions of capacity include:

- Committed local leadership with the willingness to act on coastal management issues (courageous, charismatic leaders that others pay attention to).
- Community concern and awareness of coastal issues and support for the management effort. This includes the shared knowledge, information, and wisdom of people concerning their own living conditions, perception of problems, and identification of needs.
- Tradition of community organization, patterns of social interaction, cooperation, and trust.
- Structure and quality of local government (degree of honesty or corruption, stability of local leadership, extent of coordination across agencies).
- The availability of supporting structures and partners (e.g. Universities, government programs and services, NGO's, donor projects, etc.).

In Lampung coastal villages where shrimp farming is dominant the capacity to act is generally low when assessed in terms of these dimensions. Questionnaires and surveys conducted by the Indonesian Coastal Resources Management Project demonstrate that awareness and knowledge of coastal issues is low in coastal villages.

Villages have local organizations but community structure is fractured and there is little tradition in community planning and cooperation, or in proactively influencing resource use decisions at the local level. Also, there is a low level of cooperation and communication between shrimp farmers due to their individualist nature and diverse backgrounds. In addition, many shrimp farmers have had negative experiences in cooperative organization. Producer organizations are weak.

The ability of the government to mobilize sufficient resources to make a successful attempt at resolving the coastal management issues of shrimp farming is also low. Government technical expertise to support the industry is weak. Existing guidelines, regulations and legal frameworks for small-scale aquaculture development are not widely implemented. However, the need to do something is obvious to all government departments.

Finally, supporting structures are limited. The University of Lampung is just beginning to offer an aquaculture curriculum. The Fishery Service has field-based staff offering extension advice in all Districts of Lampung, but the total number of staff and the number with shrimp based education are both very limited. There are no local training and demonstration facilities. At the time of writing, there were no other government or donor projects working on sustainable small-scale shrimp aquaculture development in Lampung.

## Complexity

The complexity of the situation matters greatly to the constraints present and intervention strategy. We summarize the most important dimensions of complexity for coastal management in five categories (Berman 1980).

- *Use conflicts.* How contentious are the conflicts among stakeholders?
- *Scope of change.* The kind and amount of change required in the standard behavior of individuals to reduce or eliminate the coastal problem. It is far more difficult to change the destructive behavior of large numbers of people than it is to provide stakeholders with services or infrastructure that they perceive as beneficial. It is therefore far easier to build a seawall or a harbor than it is to eliminate an undesirable activity such as dynamite or cyanide fishing or the illegal construction of shrimp ponds in situations where such practices are well established and involve many people.
- *Tractability of the problem.* Some coastal threats are external (e.g. upland agriculture and inland watershed degradation) and beyond the control of the coastal site; others cannot be controlled at reasonable cost.
- *Stability of the policy environment* in terms of forces or conditions that affect the management system.
- *Number of institutions and stakeholder groups* that need to be involved. Complexity of interdependence and coordination increases as more institutions and stakeholder groups are actively involved in an ICM program—even when there is agreement on the basics of what to do and how to do it. Thus, enhancing the effectiveness of a single institution to manage shorefront development is likely to be easier than improving a shrimp pond permit process that involves agencies in three different ministries.
- *Certainty of solution.* Are the specific technologies and procedures for managing the problem well understood?

In general, the complexity of the situation in Lampung in shrimp farming communities is judged as moderate to high. Use conflicts are not high compared to other regions of the world where shrimp farming takes place. There are unresolved ownership issues in some places and jealousy between local communities and businesses, but there is little evidence of displacement of artisanal fishermen or of traditional communities since in most cases the land had already been converted to rice paddies. Also there are no “traditional communities” since the migration to the East coast is recent.

The problem is do-able in the sense that the changes that need to take place are located in the shrimp farms in the village and many may be low cost. The scope of behavioral changes required in terms of environmentally sustainable production practice is significant, but they are changes that are economically beneficial to the producer in the long run. The certainty of the solution is relatively high in terms of the technology of production. Global understanding of good production practices is relatively advanced and these practices could be adapted to the specific conditions found in the East Coast of Lampung Province.

The policy environment is not stable in the sense that national and local coastal resource management rules are evolving. Also, the number of stakeholder groups and coordination complexity is large because government institutional and legal arrangements need to be reformed to support community-based good practices in shrimp aquaculture.

## Capacity/Complexity Typology

As with condition and threats, there is also a straightforward but important relationship between the capacity and complexity of the situation (Olsen et al. 2000).

Complexity	High	Type 1 Capacity limited	Type 3 High complexity and high capacity
	Low	Type 2 Low complexity and low capacity	Type 4 Not limited by capacity
		Low	High
		Capacity	

**Figure 4.** The connection between capacity and complexity (See text for further explanations).

In situations where capacity is low and complexity is high (Type 1), it is important that a management effort avoids the most difficult (and complex) issues and invests in capacity building. The most visible failures in coastal resource management worldwide are initiatives with limited capacity that address complex issues over large geographic areas with the expectation that significant outcomes will be achieved in the intermediate time frame.

Our assessment of capacity and complexity with respect to promoting sustainable shrimp aquaculture in Lampung is that the situation is Type 1—medium to high complexity and low capacity.

### Site Selection

To improve likelihood of a successful pilot project, criteria for selecting the specific pilot site were focused especially on minimizing capacity constraints. Key criteria included:

- Community willingness to try new ideas.
- Local government support systems.
- Links with ongoing funding and projects from the Public Works Department.
- Shrimp ponds at least 50 percent locally owned.

A short list of ten sites was identified through a provincial level group consultative process. The list was reduced to two following visits and surveys of those ten villages. The final selection was made by the ICM Provincial Steering Team. The Steering Team is comprised of local leaders and individuals representing government agencies, NGOs, universities, fisheries business associations, and other stakeholder groups. The site selected is Pematang Pasir, a village of 4,500 inhabitants in Lampung Selatan Regency.

Pematang Pasir was originally mangrove forest and was part of a protected area under the authority of the Forestry Service. After 1974, legislation allowed the area to be opened for agriculture and settlement, with the land still public and under Forestry Service authority. Rice is the main agricultural crop. Since this area is a swamp, management of excess water is a problem especially during the rainy season. In 1980 the provincial government constructed a drainage system and dike to prevent seawater intrusion. Even with the dike, the area close to the tidal area is still unsuitable for the cultivation of rice because of water salinity. In 1984-1985

migrants from Kronjo (West Java) began cutting mangrove in the tidal area inside the dike for milkfish aquaculture. In the early 1990's the first shrimp ponds were established. As shrimp culture increased, it was extended to the mangrove area outside the dike.

The immediate profitability of shrimp culture has attracted very rapid growth and resulted in mangrove destruction. Most shrimp farmers are not aware of the ecological importance of mangroves or the coastline protection service it provides. Mangrove cutting has resulted in erosion and loss of land. People who have lost their land often attribute it to fate, predestined by God, and do not connect the loss of mangrove forest with subsequent erosion. The Forestry Service has attempted to replant mangrove trees but these efforts have generally failed because the community has not been involved and strategies have not included complementary efforts to increase awareness of the need to conserve mangrove areas.

Shrimp culture in Pematang Pasir is extensive and "traditional plus," usually with milkfish polyculture, and three harvests per year. There is no freshwater source, so the best time for shrimp culture is during the rainy season. In the dry season seawater salinity (that can reach above 45 ppm) reduces pond productivity. Farmers obtain water for their ponds by pumping seawater at high tide through the drainage dikes originally constructed for rice paddy cultivation. The same dike also serves for shrimp pond wastewater discharge. Most of the shrimp farms do not have settling or treatment ponds. The shrimp culture technology in this area is similar to that in northern Java where most operations have collapsed because of disease problems. The cycle of rapid industry growth, disease and failure is repeating itself in Pematang Pasir. Shrimp farmers here have little experience and manage their ponds by imitating their neighbors. There is little knowledge of good practices to maintain water and soil quality.

A "profile" of the community was conducted to understand the community context in detail with respect to coastal management and human development, to identify priority resource management issues, and to inform the community of the objectives of the project. Data were collected by questionnaire and informal interviews. The key issues identified in the profile process include:

- Coastal erosion caused by destroyed mangrove forest.
- Seawater intrusion and damage to freshwater quality and agricultural production caused by shrimp farm expansion.
- Decreasing quality of seawater and reduced shrimp farm production caused by shrimp farm effluents.
- Decreasing fish catch caused by mangrove loss and blast fishing.
- Unclear land tenure rights and unfair taxation.
- Lack of awareness and knowledge on the importance of the coastal ecosystem.
- Lack of understanding and enforcement of environmental law and policy.

## **Project Activities**

A core assumption of the project is that community self-management and voluntary approaches to resolve issues of shrimp farming are essential because government does not currently have the resources and capability to effectively develop implement and enforce shrimp aquaculture guidelines and regulations. In the community of Pematang Pasir, the major constraints to better local management of shrimp aquaculture are related to capacity—knowledge about good production practices, public understanding of the importance and functioning of the coastal ecosystem, and capacity of the private sector, government sector and local community to proactively address issues of shared resource use.

The field activity in Pematang Pasir began in 1999 and is planned to continue through 2003. Activities are designed to address capacity constraints by building environmental awareness, knowledge of good shrimp farm management practices, community self-reliance and empowerment for solving issues of shrimp farming and shared resource use on its own, and government institutional capacity. The table below summarises the project activities and desired impact

<b>Activities</b>	<b>Desired impact</b>
1. Inform and educate shrimp farmers, local government, and the community - Study tour - Environmental education	Increase shrimp farmer and community knowledge and understanding of the importance of coastal resource conservation to their own well being
2. Formation of community self-reliance group	Increase participation, awareness, and community empowerment to influence resource use decisions, and ability for self management
3. Formation of mangrove Committee	
4. Training on integrated coastal management for government staff, community members and shrimp farmers	Increase understanding of integrated coastal resource management processes and methods
5. Partner with and train local NGOs	Increase local capacity for coastal resource management and sustainable shrimp culture practice
6. Demonstration pond	Increase knowledge and adoption of good practices of traditional extensive culture suitable for the conditions at Pematang Pasir

### **Public Education and Participatory Planning**

Shrimp farmers and local government officers were taken to Java on a study tour to see first-hand the results of destroyed ecosystems and examples of restoration. This was intended to increase community understanding and awareness of coastal ecosystem cause and effect relationships and the importance of mangrove replanting for coastal and shrimp pond protection. Other actions to build environmental awareness include working with the Scout Movement for environment education and development of an environmental education program to reach students and teachers. The first step to introducing environmental education in school was to educate teachers themselves. Environmental education is not part of the national education curriculum and there are few government supported public education or extension programs for environment awareness raising.

The challenge of raising public awareness and community support has been greater than anticipated. One of the reasons for this is that a local leader with willingness to support and actively help guide the community pilot effort has not emerged. Instead, energy has been focused on competition for the role of village head. This unstable political situation was not anticipated and has slowed progress. A community self-reliance group was formed for communication and information exchange, to increase self-dependence, and to build community interest and trust in village-led, proactive resource management.

One of the strategies of the pilot project is to involve, work with, and train local NGOs. Through experiential learning it is hoped that NGO groups will have the confidence and capability needed to assist in community-based resource management efforts after the pilot project is completed. As in other coastal locations in Indonesia, NGOs are increasingly playing a catalytic and supportive role in coastal resource management in partnership with community groups and government agencies.

### **Mangrove Replanting and Land Use**

After visiting Java, some shrimp farmers in the village indicated interest in restoring mangroves and a Committee to address mangrove and conservation issues was formed. The Committee not only wanted to replant mangroves but also to establish a village ordinance concerning the use of areas of coastal accretion. Accretion is the result of both natural processes and sediment build-up from pond discharge. Where there is coastal accretion, these areas are typically converted very quickly to new shrimp ponds. The Committee felt that regulations should be established that direct the use of accretion areas for mangrove replanting and coastal protection. Both mangrove replanting and village land use regulations were viewed as part of a strategy to facilitate and establish links for cooperation between the community and local government.

The Committee developed guidelines concerning use of accretion areas and obtained the technical assistance of the Faculty of Law of Lampung University to convert the guidelines to legislative language. The draft regulation is in the process of adoption. First it must be approved at the Kabupaten level, then at the Provincial level.

For the work on mangrove replanting in the “green belt” of the coastal no development area, priority areas were identified and then the Committee talked to the shrimp pond owners in those areas to reach a replanting agreement. The Forestry Service planted the trees where requested, but because there was little interaction between the Forestry Service and shrimp farmers the rate of survival of the planted trees was low. Some 60,000 seeds were planted on about 30 hectares of land. A high percentage did not survive. The most important and immediate reason for failure is thought to be inappropriate planting—they were not planted in the rainy season.

The underlying reason for failure is related to land ownership. All the land falls under the authority and ownership of the Forestry Service and the seeds were planted by the Forestry Service without discussion or collaboration with the shrimp pond operators. The results of the replanting would probably have been different if the Forestry Service had promoted a sense of partnership and shared responsibility for land stewardship with the local residents and shrimp pond farmers (also known as “co-management”). Most people close to the land in coastal villages know how to successfully grow trees and crops where they are located. As in many coastal villages, participatory coastal management in Pematang Pasir is constrained by institutional barriers. Some institutions still maintain tight control of their program boundaries, and institutional structures and program policies do not readily allow for joint programs.

The current land stewardship situation is dysfunctional. Shrimp pond operators and village residents have little self-interest in replanting since the trees fall under public jurisdiction and ownership. Lack of tenure security produces an overvaluation of the present and under valuation of future generations. Without secure private property rights the potential energy and creativity of individuals in caring for the land in the long run and in their commitment to conservation ethics are restricted. Ensuring a socially desirable level of coastal conservation falls on public agencies that do not have the necessary resources and expertise. The result is the current situation in which most of the land that is under government authority and that was once forested, is now completely deforested.

In an effort to increase local government and community capacity for co-management and integrated coastal management, an intensive training course on ICM was delivered to individuals from the Forestry Service, Fisheries Service, a community leader and representative of a local NGO. The training was executed by the Center of Coastal and Marine Resources Studies at Bogor Agricultural Institute and was intended to enhance understanding and skills in planning and participatory processes. Additionally, the Lampung coastal management project assisted in establishing a Regency Task Force to build institutional capacity for local government coordination in coastal management.

### **Demonstration Pond**

The purpose of the demonstration pond is to develop, document, and increase farm-operator understanding of suitable shrimp culture techniques. It is a small-scale activity operated on two ponds each about 4 hectares in size that a shrimp farmer has volunteered to the project. It is a site that has been abandoned for almost six years, after intensive shrimp culture on the site failed.

The strategy of the demonstration pond is to establish a learning facility to experiment with and promote small and incremental changes to traditional practices that are more sustainable. By offering a successful example it is the expectation that this will build trust among shrimp farmers and willingness to adopt new practices. An incremental strategy recognizes reluctance on the part of many small producers to adopt new practices since

one poor harvest can mean bankruptcy. It also recognizes that the farmer sometimes has little or no control over the decision to adopt certain technology. For example, significant changes to pond design and construction may require involvement of the government agency responsible for providing infrastructure, such as drainage and water intake dikes, to public lands. Other changes may require credit and the approval of the creditor, such as the intermediary who purchases the shrimp for processing and marketing.

The technology of the demonstration pond is essentially the same as current practice in the village - i.e. extensive (“traditional plus”) with milkfish polyculture. Improved operational methods, such as soil preparation techniques, are being demonstrated and promoted.

Samples of water entering the pond and inside the pond are analyzed at the Lampung Center for Mariculture. The objective of this water quality monitoring is to understand seasonal water quality, especially content of organic matter, nutrients and plankton abundance. The results show significant eutrophication and relatively polluted waters. From plankton sampling, it was found that there is potential for red tide (Kurniastuty 2000). Salinity levels are high and fluctuate from 27 to 45 ppm. Considering the low quality of water, the pond bottom is layered with chalk and culture is delayed until after the summer months.

The demonstration pond was harvested for the first time in February 2001. Over 200 kilograms of shrimp were harvested. The pond was stocked at a density of about 6,000 post larvae per hectare. The relatively small shrimp size at harvest indicated that for traditional, extensive production methods, this stocking level is too high and impedes growth. In the next cycle, a lower density will be tested.

Being small-scale, incremental, and located on a pond in a shrimp farm operated by a local community member, the demonstration activity is designed as a “learning-by-doing” exercise for all those involved. During the first production cycle, shrimp farmers in the community visited the site and inquired about the activity. Some asked the demonstration pond technicians if they would be able to visit their ponds and discuss problems. The project plans to establish a discussion group to bring shrimp farmers together to share experience. If successful, this type of practical and inexpensive learning-by-doing activity could provide a model for community extension in shrimp aquaculture in other coastal villages in Indonesia.

## **Lessons Learned**

Pematang Pasir is just one of many coastal villages in Sumatra and Indonesia, but is representative of many other small-to-medium scale shrimp producing communities. This section highlights a number of findings that can be captured from the experience to date in Pematang Pasir and that may be relevant to the development of future community-based coastal resource management efforts addressing sustainable shrimp aquaculture. These are not scientifically tested findings; they are simply our expert interpretation of the experience and applicable lessons. The findings focus on the factors most likely to affect the success of site management and good practices for community-based management of shrimp aquaculture.

General findings with respect to contextual factors that are important for conservation and community development efforts include:

- 1) If the community perceives a crisis in the impacts of shrimp farming and in the health of the industry it will be more willing to take action to reverse such trends.
- 2) Natural resource stewardship is only likely to occur if the land-holder is aware of the problem, and is motivated to do something about it.
- 3) A community with experience working together or with a tendency for participatory processes and decision-making is more predisposed to developing broad-based consensus and proactively solving resource use issues.

- 4) The more important shrimp culture is to the community, the more interested and committed it will likely be in adopting better practices.
- 5) Farmers are motivated to adopt sustainable management practices where there are economic benefits associated with the practices.
- 6) The legal system relating to land tenure, use and management matters greatly to land-holders freedom of action.

Key findings with respect to good practices for community-based management of shrimp aquaculture include:

- 1) Awareness raising, education and training help build community understanding concerning environmentally sustainable aquaculture practice. Study tours and visits to other sites provide concrete evidence of the benefits of good practices and habitat restoration and can motivate people to take action.
- 2) A core community planning group that involves important formal and informal community leaders is critical in developing widespread community support for better shrimp farm practice and coastal resource management.
- 3) External advice to the community is important to help highlight and solve on-going problem areas. Small communities typically do not have adequate technical and planning capacity to resolve new issues.
- 4) NGOs can play an important catalytic and supportive role in promoting good practices in communities, especially where government capacity is low. Features that make NGOs especially appropriate partners for local-level coastal management activities are small size, internal flexibility, community and participatory orientation, local-level knowledge, autonomy and creativity, quick response and adaptability, and cost-effectiveness.
- 5) Many of the wider problems in coastal resource management and sustainable aquaculture at the community level must be addressed through complementary legal and institutional strengthening at the regional and national level. Unless there are effective mechanisms to connect local resource management with governance arrangements at higher levels, a coherent nested program of environmental and natural resource management cannot be achieved.



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Some of the above (and other related) references can be downloaded from the homepage of University of Rhode Island at: <http://www.crc.uri.edu/comm/publications.html>



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