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# COASTAL AQUACULTURE, RURAL LIVELIHOODS AND ENVIRONMENT
## Insight from Orissa, India

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**ABSTRACT**

*The paper examines the diverse impacts of coastal shrimp aquaculture on communities in Orissa (India). Shrimp farming has played an important role in generating employment opportunities and raising per capita income. This, in turn, has resulted in decreased dependency on agriculture and artisan fisheries for food and income. Unfortunately, the development of shrimp farming has also had a detrimental impact on coastal ecosystems. Environmental degradation and concerns over shrimp farming practices, now threaten the long-term viability of shrimp farming. Unless suitable measures are taken to overcome the problems faced by the local farmers, the potential that shrimp farming has to provide a basis for sustainable livelihoods will not be realised.*

### Introduction

Producing food in a sustainable and responsible way is perhaps one of the greatest environmental challenges facing nations throughout the world. Over the course of the past two decades, the processes of globalisation and increased trade liberalisation have facilitated the rapid growth of food exports from developing countries into the international market place. Although food exports are making significant contributions to national economies in the developing world, concern has also been raised about the role increased trade is playing in transforming rural economies and societies within the exporting nations. There is growing recognition of the need to improve our understanding of the impact that trade liberalisation is having on local ecosystems and the rural poor who depend on them. Although much of the attention has focused on agriculture, the concerns are also being expressed within the global fisheries sector. A key development has been the rapid growth of export oriented aquaculture, which has seen the replacement of traditional, low production forms of

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aquaculture by more resource intensive, monoculture production systems. This restructuring has generated widespread concern over the contribution of aquaculture to the degradation of coastal ecosystems, and the social and economic costs that are being passed on to the rural poor leading to growing inequity (Flaherty et al., 1999; Pradhan and Flaherty, 2008).

One of the most valuable species entering the international marketplace from tropical developing countries is shrimp. Rising international demand, high market prices and declining wild catches provided strong incentives for many developing countries and international aid agencies to promote shrimp farming in their coastal areas, both as a means of generating foreign exchange and supporting rural livelihoods. Around the globe, however, the development of shrimp farming has been highly controversial owing to the social, economic and environmental impacts that these have generated upon the local communities (see, for example, Primavera, 2006; Hein, 2002; Samal, 2002).

Shrimp farming in India has developed into a major foreign exchange earner, bringing in US $ 670 million in 2005 (FAO, 2007). The rapid growth of shrimp farming, however, has been controversial. Current decision-making on the role that shrimp farming might play in supporting sustainable rural livelihoods, however, is hampered by a lack of understanding about the nature and extent of the impact of shrimp farming on local stakeholders, economies, and environments.

## Methodology

*Objectives :* This study examines the diverse impacts of shrimp faming along Orissa's Coast (India) where shrimp culture is a leading economic activity. The specific objectives of the study are:

(i) to investigate the social and environmental linkages between shrimp farming development and the welfare of rural households; and

(ii) to examine the potential of shrimp farmin to help improve the social and economi conditions of the rural poor in a manne that does not degrade the environmer and increase social and gender inequity

Orissa has a coastline of 480 km that divided into seven districts. The areas covere by this study were Dhamara in Chandabali bloc of Bhadrak district, Ersama block in Jagatsinghpu district, and Satpada- Brahmagiri which is the sit of Chilika lagoon in Puri district. Fifty shrim farming households in five villages in Dhamar and fifty shrimp farming households in fiv villages in Ersama were randomly selected. I Satpada- Brahmagiri, ten Primary Fisherme Cooperative Societies (PFCSs) and one Primar Non-fishermen Cooperative Societies (PNFCS totaling eleven were selected randomly for ir depth interviews, as shrimp farming is mostl carried out by cooperative societies. Howeve the office-bearers of the PNFCS did nc cooperate with us, for which we have reporte the views of the PFCSs. It is to be mentione that there are more than 50 PFCSs in Chilika are and only five PNFCSs are registered recently. Ou study area covers only eastern part of the lagoo In order to ensure that women respondents fe free to express their opinions, they wer interviewed separately. For community surve two sets of structured questionnaires wer developed for the shrimp farmers, one for th individual shrimp farmers of Dhamara and Ersam areas, and another for the functionaries of PFCS PNFCS in Puri. A structured questionnaire for ric farmers was also designed in order to hav access to their opinions on shrimp farming i their communities. The other sources c information are: (i) village schedule (ii) ke informants interview, and (iii) group discussio The surveys were conducted during Januar October 2004.

## Coastal Aquaculture : An Overview

Aquaculture has been called the "Blu Revolution," similar to the "Green Revolution" i agriculture. Just as the Green Revolution wa promoted as a means to end world hunger, th

Blue Revolution is presented as a means of increasing incomes and the supply of affordable food in developing nations. In theory, the breeding of marine organisms in captivity is a good thing. Aquaculture can provide much needed food while relieving some of the pressure on dwindling fish populations in the wild. It can also improve income and employment opportunities for the poor in coastal communities, while the export products provide a means of generating significant foreign exchange. In practice, however, modern aquaculture is often profoundly wasteful and destructive. Unlike traditional, low intensity systems for farming fish and crustaceans, modern coastal aquaculture is often both technology and capital intensive. Although aggregate economic statistics suggest that production from marine aquaculture is providing handsome benefits to national economies, these figures provide little indication of the large-scale social, economic and environmental disruptions that this form of development has generated within coastal communities (Flaherty et al, 1999; Primavera, 2006).

Shrimp is the most important commodity traded in value terms, accounting for about 19 per cent of the total value of internationally traded fishery products (Vannuccini: 2003). The contribution of cultured shrimp to global shrimp production has increased from nine per cent in 1984 to 40 per cent in 2001 (Rosenberry, 2002). The global cultured shrimp production was valued at approximately US $6.8 billion in 2001 (Ibid). The world's production of farmed shrimp is dominated by developing counties in the tropical region. Regionally, Asia produced about four-fifths of the world's farmed shrimp output. All the countries in Asia and Latin America, however, have suffered severe production problems during the past few years due to viral disease outbreak. It is to be pointed out that Black Tiger shrimp (*P. Monodon)* dominates the global shrimp production with 56 per cent share of the total shrimp production.

India, by virtue of its strategic location in the Indian Ocean, has been described as the potential "fish basket" of Asia in terms of production from marine aquaculture (Alagarswami, 1995; Ganapathy, 1996). Among the coastal states, Andhra Pradesh occupies the top position by contributing 51 per cent of the total aquaculture production, followed by West Bengal, Kerala and Orissa. Coastal aquaculture in India, at present, mainly refers to brackish water shrimp culture. More intensive shrimp farming with selective stocking started in India in the later half of the 1980s. Shrimp culture developed into a major foreign exchange earner during the early 1990s, largely as a result of the national government's trade liberalisation policies. The government's export-import policy plan (1992-1997) brought major changes to the trade regime by sharply reducing the role of the import and export control system. Quantitative restrictions on imports were eliminated, tariff rates reduced, and the development of export-oriented industries encouraged (Chand and Jha, 2001). Tariffs were reduced and fish and fish products could be exported under the open general license (Salagrama, 2004). The government also became interested in the potential of aquaculture for increasing production and bolstering the economy in rural areas. Shrimp farming generated strong interest amongst farmers owing to its potential for high profitability (Rao and Ravichandran, 2001).

Shrimp has become the most important commodity in India's fisheries export basket, accounting for around two-thirds of the value of fishery exports. Shrimp production including both from capture and culture has increased from 0.25 million tonnes in 1990 to 0.31 million tonnes in 2002 (Flaherty et al, 2005). Production of shrimp from aquaculture has increased from 0.04 million tonnes in 1990 to 0.09 million tonnes in 2002, increasing its share from two to 28 per cent. This growth in production has largely come from area expansion rather than intensification of production. The average shrimp productivity in India is about 635 kg/ha, which is much lower than that reported by other major shrimp producing countries (for example, Thailand, 3,116 kg/ha). According to FAO estimates, the

total farmed shrimp production in 2005 was 130,805 metric tonnes with a value of US $ 670 million in 2005 (FAO, 2007). The east coast of India contributed about 88.8 per cent of the total shrimp production and the west coast contributed the remaining 11.2 per cent. Andhra Pradesh had the highest production (53 per cent), followed by West Bengal (23 per cent) and both Kerala and Orissa (8 per cent each). In terms of species, Black Tiger shrimp (Penaeus monodon) accounted for the largest share followed by the Indian white prawn (Penaeus Indicus). During the year 2000-01, India exported about 110,275 metric tonnes of shrimp, of which 60 per cent was contributed by the Indian shrimp farmers (MPEDA, 2001). The main market was Japan with 51 per cent share of the total shrimp export in terms of value, followed by USA (22 per cent) and United Kingdom (6 per cent) (MPEDA, 2001).

Orissa is an eastern coastal state of India that has unique hydro-topographic and climatic features that are very favourable for shrimp farming. Brackish water resources amenable for shrimp farming include Chilika lagoon, extensive brackish water plain lands, swampy wet lands in deltaic reaches of the Mahanadi river, and several estuaries located along the coast. According to the State Fisheries Department, a total of 32,587 ha was classified as being suitable for shrimp farming in the early 1990s (Flaherty et al, 2005). The Orissa coast ranks second in the country (West Bengal being the first) with regard to the availability of *Penaeus monodon* seed in the natural water. There are 13 shrimp hatcheries operating in Orissa, of which three are in government sector and the total production capacity of the hatcheries is 515 million post-larvae per year. As fish production from capture sources is declining, the State government has been encouraging the people of Orissa to go for aquaculture to compensate fish production from capture sources. The total marine fish production of Orissa in 2003-04 was about 116,880 metric tonnes out of which shrimp accounted for about 11,218 metric tonnes (GoO : 2005).

Currently four methods of brackish water shrimp farming are being practised in Orissa: extensive pond culture, modified extensive, semi-intensive and *gheri* culture (see Table 1 for details). While *gheri* culture is popular in Chilika lake area, extensive, modified extensive and semi-intensive methods are practised in other parts of the State. Intensive pond culture is not being practised in Orissa due to lack of required infrastructure including electricity to run aerators. So far as the area under different culture systems is concerned, the area under extensive pond culture is about 3848.49 hectares (64 per cent), modified extensive culture 385.74 hectares (6 per cent), semi-intensive pond culture 642.12 hectare (11 per cent) and extensive *gheri* culture 1161.94 hectare (19 per cent) (GoO: 2002). In terms of the size of the shrimp farms, out of the 7000 shrimp farms, about 80 per cent of the farms are less than one hectare, 18 per cent are 1-20 hectares and the remaining two per cent are more than 20 hectares of farm area (Mohanty : 2002).

**Institutional and Regulatory Framework**

The 1996 Supreme Court ruling identified the important areas of environmental concern regarding shrimp farming, particularly, the World Bank aided projects, viz, Narendrapur (Bhadrak district) within the National Park area, Beidipur area (Bhadrak district) as it is covered with wild sea seeds having direct relationship with the ecology of marine biota and, Jagatjore and Benapada (Kendrapada district) near Bhitar Kanika Wild Life Sanctuary. The Supreme Court gave orders of banning intensive and semi-intensive shrimp farming in the Coastal Regulation Zone (CRZ). It recommended that the agricultural lands, salt pans, mangroves, wet lands forest lands, and land for village common purposes shall not be used or converted for construction of shrimp ponds.

The Government of India and the state government have established rules and regulations to promote and regulate the development of shrimp farming. These are :

**Table 1 : Ownership and use of land of sample households in Dhamara and Ersama areas**

| S. No. | Characteristics | Unit | Dhamara | Ersama | Total |
|---|---|---|---|---|---|
| 1. | Shrimp farming in own land by households (HHs) | (No.) | 19 (47.5) | 32 (80) | 51 (63.75) |
| 2. | Shrimp farming in leased-in land by HHs | (No.) | 17 (42.5) | 6 (15) | 23 (28.75) |
| 3. | Shrimp farming in both own/leased-in land by HHs | (No.) | 4 (10) | 2 (5) | 6 (7.5) |
| 4. | Locals engaged in shrimp farming | (No.) | 36 (90) | 23 (57.5) | 59 (73.75) |
| 5. | Non-locals engaged in shrimp farming | (No.) | 4 (10) | 17 (42.5) | 21 (26.25) |
| 6. | Average area of own land occupancy per HH | (Acres) | 7.47 (85.3) | 6.30 (68.26) | 13.77 |
| 7. | Average area of leased-in land occupancy per HH | (Acres) | 1.29 (14.7) | 2.93 (31.74) | 4.22 |
| 8. | Average area of total land (both own/lease) per HH | (Acres) | 8.76 (100) | 9.23 (100) | 17.99 |
| 9. | Average area of land used for rice per HH | (Acres) | 6.0 (68.5) | 15.36 (58.84) | 11.37 |
| 10. | Average area of land used for shrimp farming per HH | (Acres) | 2.76 (31.5) | 3.33 (36.55) | 6.09 |
| 11. | Average area of land used for other per HH | (Acres) | - | 0.42 (4.61) | 0.42 |
| 12. | Average area of own land used for shrimp farming per HH | (Acres) | 1.55 | 1.55 | 3.10 |
| 13. | Average area of leased-in land used for shrimp farming per HH | (Acres) | 1.21 | 1.85 | 3.06 |
| 14. | No. of sample HHs who leased-in land | (No.) | 23 (57.5) | 8 (20) | 31 (38.75) |
| 15. | Average period of lease | (Years) | 1.85 | 1.04 | - |
| 16. | Average cost per acre per year of lease | (Rs.) | 5412.50 | 1004.17 | - |

Note : * Figures in the parentheses show percentage share to total.

**Box 1: Shrimp Farming Methods Practised in Orissa**

| Shrimp Farming Method | Characteristics |
|---|---|
| Extensive Pond Culture | Pond size varies from 1-2 ha and constructed in the tidal affected low-lying areas. Water supply is through pumping from the nearby creeks or canals. No water exchange during the culture period and stocking is done at a rate of 20 000 post-larvae per hectare. Pond-side prepared feed from clams and snails with fishmeal, soya, oilcake and cereal flour are provided. The yield varies from 300-700 kg per ha per crop. |
| Modified Extensive Culture | Laid out as extensive systems, but involve pond preparation with tilling, liming and fertilisation. Pellet feeds either locally made or imported are provided. Stocking density is about 50 000 post-larvae per hectare and the yields vary from 600-1100 kg per ha per crop. Maximum two crops are grown per year depending on the availability of saline water. |
| Semi-Intensive Pond Culture | Pond size varies from 0.25 to 1.0 ha. Water exchange is done periodically during the culture period. Stocking density varies from 100 000 to 300 000 per hectare. The application of drugs and chemicals to improve the resistance of shrimp to disease is common. Regular monitoring and higher levels of management skills are required. Average yield is about 2200 kg per ha per crop. One or two crops are practised per year depending on the availability of saline water. |
| Extensive *Gheri* Culture | Popular in Chilika Lake areas. *Gheries* are made by net enclosure with fixed bamboo or wooden poles inside the lake water. Shrimp seedlings are left in the *gheri* for natural growth. Tidally fed and no supplementary feed is provided in the cage. Average yield varies from 300-500 kg per ha per crop. |

(i) According to Coastal Regulation Zone (CRZ), as decided by the government of India, shrimp ponds should not be constructed within 500 metres of the high tide line or within 100 metres of a creek.

(ii) Shrimp farmers must register and obtain a license from the Aquaculture Authority of India (AAI) for practising shrimp culture. Upon registering, they are entitled to get subsidies once in a lifetime from AAI. The AAI was set up in 1997 and, functions under the administrative control of the Government of India through the Ministry of Agriculture and Cooperation . Each coastal state was also directed to formulate a state level and district level aquaculture committees. Accordingly, the government of Orissa has constituted the State Level and District Level Aquaculture Committees. These committees implement the precautionary principles and the "Polluter Pays" principle to deal with the situation created by shrimp farming in the coastal states and Union Territories. The AAI has issued guidelines for the adoption of improved technology for increasing production and productivity

of shrimp farming. The Coastal Aquaculture Authority Act 2005 provides for the establishment of a Coastal Aquaculture Authority in place of AAI for regulating activities connected with coastal aquaculture.

(iii) The Marine Product Export Development Authority (MPEDA) facilitates export standards, processing, marketing, extension and training in various aspects of the fishery sector. It functions under the Ministry of Commerce and Industry, Government of India. The MPEDA had taken the lead in promoting shrimp farming. The MPEDA, in its publication *Handbook on Shrimp Farming*, has brought out updated information and data relating to "how to start shrimp farming", promotional activities including training programmes, technical assistance, subsidy schemes to offer incentives to shrimp farming, etc., that would be of use to prospective shrimp farmers and entrepreneurs. The regional centre of MPEDA was established in Bhubaneswar (Orissa) in 1997 to assist shrimp farmers in the State.

The State Government of Orissa has implemented some regulations for shrimp farming. These include:

(i) A land conversion fee (*Kisam* charge) is imposed by the State Revenue Department, on the conversion of agricultural land to shrimp ponds. The rate assessed is five per cent of the market value of the land.

(ii) The State levies a water tax on shrimp farmers for the use of saline water (i.e. tidal water that intrudes into rivers and creeks) as well as directly from sea. The usual charge per farm is around Rs. 500 per annum.

The Government of Orissa also provides assistance to shrimp farmers through a variety of State agencies. As the brackish water fisheries resources of the State are confined to seven districts, seven Brackishwater Fish Farmers' Development Agencies (BFDAs) were established in Balasore, Bhadrak, Kendrapada, Jagatsingpur, Puri, Khurda and Ganjam districts. The BFDA was imparting short-term (15 days) and long-term (two months) training to shrimp farmers through their training centre at Paradeep. In 2004, the BFDAs were merged with the Fish Farmers' Development Agency (FFDA) by order of the Central Government under the scheme of Macro-management Aquaculture Development. All these agencies are under the Centrally sponsored scheme with equal funding by the Central and the State governments. However, these BFDAs are not accessible to most of the small shrimp farmers of our surveyed sites for which they culture shrimp in a trial and error method; since they lack knowledge and information about BFDA's activities.

The Government of Orissa rendered assistance for brackish water aquaculture to: (i) identify beneficiaries for brackish water shrimp farming, (ii) lease brackish water government land to the selected farmers in conformity with the State government's lease policy, (iii) arrange bank loans for the shrimp farmers, (iv) supervise the construction of ponds and provide technical guidance, (v) provide incentives to the farmers in the form of subsidies for the development of brackish water aquaculture against institutional finance as well as own source of finance, (vi) develop human resources by providing training to the farmers in shrimp culture, (vii) implement the guidelines developed by the AAI for sustainable aquaculture, and (viii) motivate shrimp farmers to register and obtain licenses.

In Dhamara, shrimp farmers are aware of most of the regulations relating to shrimp farming, however, none of the regulations are being enforced stringently. Most of the shrimp farmers in Ersama area are not aware of these policies, since these are not implemented. In case of Chilika, the largest brackish water lagoon in Asia, the situation is also similar. The 1991 lease policy for Chilika (modified in 1994) of the Government of Orissa, for the first time, allowed

shrimp culture for both fishers and non-fishers in Chilika. However, the Supreme Court of India in its 1996 judgment also issued directives relating to Chilika: (i) No aquaculture industry/ shrimp culture ponds shall be constructed/ set up within 1000 meters of Chilika, and (ii) any pond set up/ constructed beyond 1,000 meters of Chilika requires the prior approval of the Aquaculture Authority of India as constituted by the Supreme Court.

Consequent upon the agitation by the fishermen against the Chilika lease policy (1991 and 1994 for shrimp culture), the Government of Orissa, had suspended shrimp culture in Chilika in 1999, and then banned. The State Government brought a Bill called the Orissa Fishing in Chilika (Regulation) Bill 2002, in the State Legislative Assembly. However, due to opposition to the Bill in the Assembly, particularly by the non-fishermen legislators, it was sent to a Select Committee of the State Legislative Assembly which allowed shrimp culture in an indirect way and vested more power to Chilika Development Authority in its amendment to the Bill. Moreover, *State Reservoir Fishery Policy*, recently announced by the Government of Orissa, will allow companies and private individuals to enter the water bodies for fish/prawn culture, particularly in the coastal belt (Samal, 2007).

**Rural Livelihoods**

The 1999 Super Cyclone, which killed more than 10,000 people in Ersama, had a major impact on the coastal environment and rural communities that is still being felt today. Paddy fields and other areas were inundated by saline water, and betel vine and cashew nut plantations were destroyed. Shrimp farming was identified as one of the more promising ways for the rural poor to earn a living. Most of the farmers carry out shrimp farming using traditional practices, (locally called *banua chasa*). The introduction of shrimp farming has led to decrease in dependency on agriculture and artisanal fisheries for food and income. In Ersama, the rural poor carry out shrimp farming on their own land. Some politically powerful people, however, have developed shrimp farms by encroaching government land and common property resources. Shrimp farming has also provided employment to some local people through the collection of shrimp seeds (post-larvae) from river mouths that are sold to the shrimp farmers. The practice of traditional shrimp culture in the area has led to low yield resulting in less financial gain as compared to Dhamara. However, it has contributed in increasing the per capita income and purchasing power of the people.

Capture fishing is the main source of livelihood for the inhabitants of Brahmagiri-Satpada area on and around the eastern side of Chilika lagoon. Besides the fishermen community, the non-fishermen (from upper caste) have also taken up fishing as their occupation. Shrimp culture is carried out in an unauthorised manner in the area by the fishermen and the non-fishermen, the former in some portion of the leased land and the latter in the encroached area. Sometimes, it leads to conflict among various sections of the society. Cashew-nut and *polang* plantations are also a source of income of the local people. Shrimp farming which started in early 1990's is controlled through Primary Fishermen Cooperative Society (PFCS). In the initial years, shrimp culture was very profitable and people earned a handsome amount but the spread of shrimp disease gave a serious blow to the farmers thus adversely affecting their economic condition and trapping them in the debt net. The proportion of the non-fishers trapped in debtnet, including some Bengalis, is comparatively more than the fishers in shrimp farming as the former are financially well-off than the latter as shrimp culture requires huge investment.

In Dhamara, shrimp farming has provided additional income and employment opportunities for local people. Many outsiders have entered as export agent, feed and medicine traders. Shrimp farming requires a huge investment on both fixed and working capital. Therefore, the shrimp farmers depend on trade credit from merchants and traders or loan from bank on the pretext of credit for agriculture. Rural

labourers are able to be engaged in non-agricultural season in shrimp farms where their wages are comparatively higher than that in agriculture. The demand for labour in shrimp culture has increased the daily wage rate in the area. The people who have successfully adopted shrimp farming have experienced a significant improvement in their level of living. But lately, due to the White Spot Virus attacking shrimp, some of the farmers have incurred heavy loss which has deteriorated their economic condition.

*Socio-economic Profile* : The sample households in Dhamara area are split relatively evenly between scheduled tribe/scheduled caste (27.5 per cent), general caste (35 per cent) and other backward caste (OBC) (37.5 per cent). In Ersama, most of the respondents (52.5 per cent) belong to general caste.

In Dhamara area, the highest percentage of sample households (47.5 per cent) have shrimp ponds on their own land, followed by shrimp ponds exclusively on leased land (42.5 per cent) and then on both category of lands (10 per cent). Most of the shrimp farmers (80 per cent) in Ersama have shrimp ponds on their own land (see Table 1). About 85 per cent of the total farm land of the sample households in Dhamara is owned and the rest is leased; while the area of owned land (68 per cent) in the Ersama area is greater than the area of leased land (32 per cent). A majority of the sample households (57.5 per cent) in Dhamara prefer to lease land for shrimp cultivation. People prefer practising shrimp culture on leased land because of various reasons. First, the land used for shrimp culture becomes unproductive after five to six harvests. It can neither be used efficiently for shrimp culture nor for paddy cultivation or any other purpose. As a result, first, many farmers are unwilling to degrade their own land. Second, the respondents might not own land near a source of saline water, or they may be migrants from another area (see Table 1).

The locals as per cent of shrimp farmers, were 90 per cent and 58 per cent in Dhamara and Ersama, respectively. In Dhamara, land is usually used for cultivating paddy and practising shrimp farming, whereas in Ersama, apart from shrimp culture and paddy cultivation, land is also used for growing fruits, vegetables, nuts or betel vine.

Shrimp farming in Dhamara area is mainly done on an individual basis. Those shrimp farmers who do not have enough working capital to invest in shrimp farming, go for partnership. In Ersama, 90 per cent of the respondents operate their shrimp farms individually, and the rest have a partnership (see Table 2). The main sources of finance for shrimp farming in both areas are the farmer's own savings and feed companies. The main method for repaying loans is to sell the entire harvest of shrimp to the feed company (a case of forwarding trading). Around two-thirds of the respondents in Dhamara area did not receive their payments from merchants on time. About 80 per cent of respondents in Dhamara and 90 per cent in Ersama were unhappy with the price they received for their shrimp. The main reason for this was that price was too low and they had difficulty in recovering the cost of the inputs (see Table 2).

An average of three-fourths of the total income of the sample respondents in both Dhamara and Ersama comes from shrimp farming. There are also various other sources from which income is generated in Dhamara area. Most of the respondents in Dhamara and Ersama areas re-invested their income in shrimp farming.

The detailed socio-economic characteristics in Brahmagiri-Satapda (Chilika) area are presented in Table 3. The average leased area (from the State government) per PFCS is 1012 acres and the average length of lease is one year. The average period of culture per crop is 106 days and only one crop per year. The PFCSs are also engaged in capture fishing, which is their main traditional occupation. Most of the members of PFCS are literate and *dalits* (scheduled caste). Around one-third members have *pucca* houses. The average number of

**Table 2 : Economic profile of sample shrimp farmer households in Dhamara and Ersama areas**

| S.No. | Characteristics | Unit | Dhamara | Ersama |
|---|---|---|---|---|
| 1. | Type of operation of shrimp farms by the households (HHs) | (No.) | | |
| | a) Self | | 27 (67.5) | 36 (90) |
| | b) Partnership | | 13 (32.5) | 4 (10) |
| 2. | Arrangement of finance for shrimp farming by HHs | (No.) | | |
| | a) Own capital | | 4 (10) | 3 (7.5) |
| | b) Both feed company and own capital | | 23 (57.5) | 21 (52.5) |
| | c) Others | | 13 (32.5) | 16 (40) |
| 3. | Average volume of shrimp harvest per HH | (Quintals) | 19.55 | 7.06 |
| 4. | Average number of pieces per Kg | (No.) | 73.97 | 45.78 |
| 5. | HHs received typical harvest | (No.) | 5 (12.5) | 7 (17.5) |
| 6. | HHs having first crop | (No.) | 6 (15) | 6 (15) |
| 7. | Average selling price of shrimp | (Rs.) | 252.93 | 192.77 |
| 8. | Shrimp sold by HHs to | (No.) | | |
| | a) Feed agent | | 26 (65) | 18 (46.2) |
| | b) Export company | | 12 (30) | 5 (12.8) |
| | c) Both | | 2 (5) | 1 (2.6) |
| | d) Marketing agent | | - | 15 (38.5) |
| 9. | HHs did not receive money on time | (No.) | 27 (67.5) | 13 (33.33) |
| 10. | Average gap of receiving money by HHs | (Months) | 2.82 | 1.23 |
| 11. | HHs not happy with the obtained price | (No.) | 32 (80) | 35 (89.74) |

Note : Figures in the parentheses are percentage share of the total.

women members per PFCS is 18 and around three-fourths of them feel that shrimp farming is not good for their community (see Table 3). Three of the 11 PFCS/PNFCS interviewed are undertaking shrimp farming in encroached areas. The sources of shrimp seedlings for PFCS in Brahmagiri-Satpada (Chilika) area are both hatchery and wild. Tidal water from Chilika Lake is used for shrimp farming by all sample PFCS/ PNFCS. All these societies face problems with shrimp disease, and their members have credit problems. The lack of provision for formal credit by the government, lack of cold storage, absence of competent technicians and biologists are the major problems faced by PFCS.

*Social Impact :* The development of shrimp farming has not brought the anticipated improvements to the local communities. The education and health delivery systems continue to be unsatisfactory in all the surveyed villages. The illiteracy amongst the majority of the shrimp farmers restricts their ability to learn about the latest techniques and facilities associated with shrimp culture. Sanitation in the areas is poor.

**Table 3 : Socio-economic characteristics of shrimp culture by PFCSs in Brahmagiri-Satpada area**

| S.No. | Characteristics | Unit | Amount |
|---|---|---|---|
| 1. | Reporting cooperatives (PFCS+PNFCS) | (Nos.) | 10 +1=11 |
| 2. | Office-bearers who responded | Pres/Secy/Mem* | 6+4+1=11 |
| 3. | Average No. of households per PFCS | (No.) | 145 |
| 4. | Average No. of members per PFCS | (No.) | 280 |
| 5. | Average No. of women members per PFCS | (No.) | 18 |
| 6. | Literate members of PFCSs | (%) | 82 |
| 7. | Scheduled caste members of PFCSs | (%) | 91 |
| 8. | PFCSs'members having pucca house | (%) | 36 |
| 9. | Women feeling shrimp culture not good | (%) | 73 |
| 10. | Average annual income of household | (Rs) | 19,364 |
| 11. | Average distance covered by women for collecting drinking water | (Mtrs) | 130 |
| 12. | Average leased area per PFCS | (Acre) | 1,012 |
| 13. | Average length of lease | (Year) | 1 |
| 14. | Average encroached area per PFCS | (Acre) | 64 |
| 15. | PFCSs shrimp culture in encroached area | (No.) | 3 (33.33) |
| 16. | PFCSs shrimp culture in leased capture source | (No.) | 8 (72.72) |
| 17. | Average No. of crops per year | (No.) | 1.5 |
| 18. | Average period of culture per crop | (Days) | 106 |
| 19. | PFCSs culturing P Monodon | (No.) | 8 (72.72) |
| 20. | PFCSs culturing both P Monodon & P Indicus | (No.) | 3 (27.33) |
| 21. | Sources of shrimp seedlings: hatchery/wild/both | (No.) | 2+5+4 |
| 22. | Tide water from Chilika used for shrimp farming | (No.) | 11(100) |
| 23. | PFCSs that face shrimp diseases | (No.) | 11(100) |
| 24. | PFCSs members facing credit problem | (No.) | 11(100) |
| 25. | PFCSs problems relating to absence of competent technicians | (No.) | 8(72.72) |
| 26. | PFCSs problems relating to lack of cold storage | (No.) | 6(54.54) |
| 27. | PFCSs suggestion for provision of Govt. credit | (No.) | 11(100) |
| 28. | PFCSs suggestion for competent biologist | (No.) | 7(63.63) |
| 29. | PFCSs suggestion for cold storage facility | (No.) | 6(54.54) |
| 30. | Average quantity of harvest per PFCS | (Qntl.) | 11.6 |
| 31. | Average selling price of shrimp per kg | (Rs.) | 246 |
| 32. | Average quantity of captured fish per PFCS | (Kg) | 2850 |
| 33. | Average sale of captured fish per PFCS | (Rs) | 1,35,833 |

* Pres- President , Secy- Secretary , Mem- member

The figures in parentheses show percentage to total.

The majority of the sample households in all the three sites do not have an independent toilet at home.The only source of potable water in these areas is tubewells, including artisan tubewells (locally called *overflow*) in Brahmagiri-Satpada (Chilika) area. Around half of the sample households in Dhamara and Satpada areas are electrified while in the sample villages of Ersama, most of the people still live without electricity. Expansion of shrimp farming, however, has led to improvements in transport and communication facilities in the areas. As many outsiders frequently travel to the shrimp farming areas, the number of buses and other forms of transportation have increased substantially and the condition of the roads has improved in some areas.

Dwellings in Dhamara and Ersama districts largely consist of *pucca* and *kuccha* houses. In Brahmagiri-Satpada (Chilika) area, in the early 1990's, when shrimp culture was at its peak and the farmers were making reasonable earnings, they built *pucca* houses which we could see many in our sample villages. Almost every fishermen village in Chilika region has a community centre, locally called *Kotha Ghara*.

Shrimp culture in these areas has led to a rise in conflicts between the villages, between rice farmers and shrimp farmers, and between fishers and non-fishers. Such incidents occur frequently due to forcible encroachment of leased area of the fishermen by the non-fishermen particularly in Brahmagiri-Satpada area. Conflict between rice farmers and shrimp farmers also arises when saline water from neighbouring shrimp ponds seeps into the paddy fields, which adversely affects rice production. Social inequality has increased, as shrimp culture which requires a large initial investment has filled the pockets of the rich farmers.

The participation of women in shrimp culture in most of the surveyed villages is non-existent. Upper caste women do not involve themselves due to social stigma. Only some lower caste women are engaged by the export companies to de-shell the head of the shrimps. In Ersama and Brahmagiri-Satpada areas, a few lower caste women collect shrimp seedlings and sell them to shrimp farmers.

The employment opportunity of women belonging to lower caste who were working in the paddy fields earlier, has been reduced at present, after the conversion of paddy fields into shrimp ponds, because, in shrimp ponds, there is comparatively less work for them. Moreover, shrimp culture in coastal areas has led to encroachment of common property resources and thereby to reduction of grazing land for cattle.This adversely affects the standard of living of women-headed households who rear cattle, cow, and goat for their livelihood. Thus, the shift from paddy cultivation to shrimp farming fails to generate adequate employment opportunities for landless women workers mostly belonging to lower caste.

In Dhamara and Ersama areas, the primary reason given by women (mostly belonging to the non-fishers' households) for being in favour of shrimp farming is that due to shrimp farming by their households, their financial condition has improved and they are able to lead a comfortable life and avail of educational and health facilities. On the other hand, most of the women (mostly belonging to the fishers' households) held the opinion that shrimp farming does not provide any benefit to the women because, at present, it is no more profitable and it leads to indebtedness and causes conflict in the community due to frequent harvest failure of shrimp farming. It is to be pointed out that the fishers have alternative occupation of capture fishing inside the Chilika lagoon.

*Environmental Profile* : The average number of years of adopting shrimp farming in Dhamara area is 4.9 while in Ersama area it is 5.8 years. The sole motive for practising shrimp farming is to get a higher income. The shrimp farmers in the surveyed areas do not have any specialised training for shrimp farming. More than half of the sample households learnt it from the co-villagers. The other sources of learning about shrimp culture for the shrimp farmers were private companies, biologists, feed dealers, and farm managers. Very few shrimp farmers in

Dhamara and Ersama areas have received formal training or previously worked in a shrimp farm. Sources of formal training include the Fishery Department, NGOs, and BFDA.

The average number of shrimp ponds per farmer in Dhamara area is 2.5, whereas in Ersama it is around 2.1. The average period of culture per crop is 116 days in Dhamara area and the average number of crops grown per year per farmer in the area is 1.1. The shrimp farmers mostly use creek water for shrimp culture (see Table 4). Most of the sample households in both the surveyed areas mentioned that the area in which they are culturing shrimp at present were previously used as paddy fields. Most of the households culture *P.Monodon* species and only a negligible per cent of households culture both *P. Monodon* and *P. Indicus*. This is because *P. Monodon* is in great demand in foreign countries particularly in Japan, USA and the European countries. In Dhamara area, more than four-fifths of the sample households depend on hatchery for post-larvae shrimp seedlings. People in this area prefer superior quality and disease-free hatchery post-larvae seedlings. But in Ersama, the shrimp farmers mainly depend on local sources for their post-larvae shrimp seedlings (see Table 4).

**Table 4 : Shrimp farm site description of sample households in Dhamara and Ersama areas**

| S.No. | Characteristics | Unit | Dhamara | Ersama |
|---|---|---|---|---|
| 1. | Average number of shrimp ponds per household (HH) | (No.) | 2.45 | 2.10 |
| 2. | Average area of shrimp ponds per HH | (Acres) | 3.32 | 3.35 |
| 3. | Average period of culture per crop | (Days) | 116.24 | 128 |
| 4. | Average number of crops/year/HH | (No.) | 1.12 | 1.07 |
| 5. | Average distance of the shrimp ponds to the | | | |
| | a) Creek | (Km.) | - | 0.07 |
| | b) River | | 0.86 | - |
| 6. | Average years since adopting shrimp farming | (Years) | 4.87 | 6.43 |
| 7. | Average stocking (i.e post-larvae shrimp seedlings per square metre) | (No.) | 7.08 | 5.69 |
| 8. | Land use of HHs before adopting shrimp farming | | | |
| | a) Wet land | (No.) | 2 (5) | 4 (10) |
| | b) Rice farm | | 36 (90) | 28 (70) |
| | c) Other use | | 2 (5) | 5 (12.5) |
| | d) Wet land and other uses | | - | 2 (5) |
| | e) Wet land and rice farm | | - | 1 (2.5) |
| 9. | Shrimp species cultured in the area by HHs | | | |
| | a) P.Monodon | (No.) | 39 (97.5) | 34 (85) |
| | b) P.Indicus | | - | 6 (15) |
| | c) Both | | 1 (2.5) | - |
| 10. | Source of post-larvae shrimp seedlings of the HHs | | | |
| | a) Hatchery | (No.) | 34 (85) | 1 (2.5) |
| | b) Locally available | | 2 (5) | 34 (85) |
| | c) Both | | 4 (10) | 5 (12.5) |

Note: · Figures in the parentheses are percentage share of the total.

The brackish water used for shrimp culture is most commonly pumped from a river or creek in Dhamara and Ersama areas. All the sample households in Dhamara treat their intake water by applying bleaching powder. Bleaching or chlorinating helps to kill competitors, predators and disease causing agents. In Ersama, however, only 62.5 per cent of the households treat their intake water. The majority of households exchange pond water during the crop period (see Table 5). However, due to the lack of technical knowledge about shrimp culture, farmers are not aware of the time interval in which the water of shrimp pond should be exchanged. They just go by the advice of th biologists of the feed companies or othe villagers. In both areas surveyed, it was observe that the farmers do not treat the effluent that discharged from their ponds. This may b attributed to the following reasons: (i) The shrim farmers are not aware of the consequences c not treating the discharged water., and (ii) the are of the notion that the pond effluent will b diluted in the sea, and will not do any harn Shrimp had been attacked by some sort of diseas in both Dhamara and Ersama, the details of whic are given in Table 5.

**Table 5 : Water treatment and waste discharge of the shrimp ponds of the sample households in Dhamara and Ersama areas**

| S.No. | Characteristics | Unit | Dhamara | Ersama |
|---|---|---|---|---|
| 1. | Source-wise use of water for shrimp farms by households (HHs) | (No.) | | |
| | a) Tidal water pumped from river | | 7 (17.5)* | 21 (52.5) |
| | b) Tidal water pumped from creek | | 27 (67.5) | 2 (5) |
| | c) Both | | 6 (15) | 15 (37.5) |
| | d) Other | | - | 2 (5) |
| 2. | HHs treating intake water for shrimp farming | (No.) | 40 (100) | 25 (62.5) |
| 3. | HHs not treating intake water for shrimp farming | | - | 15 (37.5) |
| 4. | Distribution of HHs on the basis of exchanging shrimp pond water during crop period | | | |
| | a) Exchange | (No.) | 31 (77.5) | 36 (90) |
| | b) Do not exchange | (No.) | 9 (22.5) | 4 (10) |
| | c) Average time of exchange | (Months) | 2.42 | 0.56 |
| | d) Average number of exchanges | (No.) | 3.1 | 8.66 |
| 5. | HHs treating discharge water | (No.) | 11 (27.5) | 4 (10.26) |
| 6. | HHs not treating discharge water | (No.) | 29 (72.5) | 35 (89.74 |
| 7. | HHs facing shrimp disease | (No.) | 33 (82.5) | 33 (82.5) |
| 8. | Type of diseases occurring in shrimp | (No.) | | |
| | a) White Spot | | 31 (93.93) | 19 (57.57 |
| | b) Red Virus | | 1 ( 3.03) | 5 (15.15 |
| | c) Gill Chock | | 1 (3.03) | 1 (3.03) |
| | d) Other | | - | 8 (24.24 |
| 9. | Average years of last occurrence | (Years) | 1.39 | 2.04 |
| 10. | HHs facing total loss due to crop failure | (No.) | 3 (9.1) | 8 (24.25 |
| 11. | HHs facing partial loss due to crop failure | (No.) | 30 (90.9) | 25 (75.75 |
| 12. | Average reduction in price per Kg due to crop failure | (Rs) | 111.28 | 99.59 |
| 13. | HHs testing shrimp pond water | (No.) | 36 (90) | 26 (65) |

*.Figures in the parentheses are percentage share of the total.

*Environmental Impact :* The expansion of shrimp farming in Dhamara and Ersama areas is not free from environmental problems. Shrimp farmers assume no responsibility for the damage their activities cause to other groups.The adverse impact of shrimp farming on environment in these areas occurs in the following forms: (i) The use of large amounts of fertilisers and pesticides in shrimp ponds pollute the surface water; (ii) the discharge of these effluents into water bodies such as ponds, creeks, rivers etc. cause strong polluting effects leading to the mortality of fish and other marine species; (iii) saline water from shrimp ponds seeps into the neighbouring agricultural land and salinises it, decreasing the land's productivity; (iv) the use of water that is high in organic matter and the over-stocking of seedlings increase the risk of shrimp diseases; (v) fish mortality for pollution and the collection of shrimp seedlings from local water-bodies have depleted fish stocks and made it difficult for fishers to continue their traditional occupation of capture fishing; and (vi) many years of careless shrimp farming has resulted into the abandonment of shrimp ponds, the abandoned ponds are no longer useful for paddy cultivation.

In Brahmagiri-Satpada area, shrimp culture is carried on in shrimp ponds, embankment enclosure and net enclosure (*gheri*) which has also adverse environmental impact. In shrimp *gheri*, no other seedling grows, so there is rapid fall in the quantity of wild seedlings in Chilika lagoon. As a consequence, there is reduction in the stock of fish, shrimp and crab leading to a fall in the catch of fishermen in capture sources of Chilika.To meet the increased demand for shrimp seedlings in the area, collection of these seedlings takes place in the mouths of Chilika which results in the discard of all other seedlings, thus further depleting the stock of fish, shrimp and crab in the lagoon.The shrimp *gheris* inside Chilika hinder the free flow of water, and the movement and free migration of shrimp and fish juveniles (Samal, 2002). They also cause sedimentation of large denser particles in the vicinity and accelerate the process of siltation.

The agricultural farms adjoining the shrimp farms are reported to be affected. The farms are constructed on the banks of the creeks without leaving any space for draining of floodwater. Due to physical obstruction by the dykes, the natural drainage is blocked and floodwater accumulates in these areas leading to waterlogging.Therefore, protests have been voiced by the affected people. Indiscriminate conversion of fertile agricultural lands into aqua farms leads to many problems. This practice aggravates landlessness among the farmers. Absentee landlords sell their lands to aqua enterprises in order to receive high price. This adversely affects the landless agricultural labourers and tenant farmers.

**Suggested Measures for Sustainability**

Many people believe that shrimp farming has the potential to be a major source of livelihood for the people in India's coastal areas. The experience in Dhamara, Ersama and Brahmagiri-Satpada areas, however, indicates that there are many problems that must be addressed before this potential can be realised. Amongst farmers, a major barrier to the development of sustainable shrimp farming is the lack of technical knowledge, which results in poor pond management practises. As a consequence, farmers experience frequent crop losses due to outbreaks of disease.This reduces the economic viability of their farms, and has resulted in some farmers abandoning their shrimp ponds. As presently practised, shrimp farming is not sustainable in the study areas. There are, however, several measures that could be taken up by farmers and the government to help overcome the problems faced by the local farmers, and turn shrimp farming into a more sustainable source of livelihood.The measures suggested by the shrimp farmers are presented in Box 2.

To make it sustainable, emphasis should be laid on the following points: (i) diagnosis of the White Spot virus attacking the shrimp should be provided; (ii) the treatment of discharged water from shrimp ponds is essential to reduce

**Box 2: Common Problems Faced by Shrimp Farmers in the Surveyed Areas**

| Problems | Measures suggested |
|---|---|
| Absence of a **hatchery** with the capability to conduct the polymerised chain reaction (PCR) test to detect viral infections in post-larvae shrimp. | Establish a hatchery in the area. |
| Local stakeholders lack a scientific **knowledge base** for undertaking shrimp culture. Most of the farmers have no training and practise shrimp culture on a trial and error method. | The government should provide technica assistance to the shrimp farmers through local seminars and workshops. |
| **Cold storage** facility is not adequate. | For perishable goods like shrimp that are destined for international markets it is essential to develop adequate cold storage facilities in the area. This could be undertaken by the government or private sector or joint venture. |
| **No laboratory** is available to conduct water quality tests for the farmers. | Establish a laboratory in the area by the government or the private companies involved in shrimp culture. |
| **Farmers cannot obtain insurance for their crops** | The government should provide and/or encourage the private sector to offe insurance for shrimp crops. |
| **There is widespread exploitation of shrimp farmers** by feed and marketing agents. Shrimp markets in these regions are characterised by interlinked transactions associated with "dadan" credit. This arrangement takes the form of forward buying and involves cash advances by feed companies and other commercial agents to shrimp farmers on the condition that they sell their entire crop to the agents, often at a below market price (Rs.10-Rs.20 per kg). Thus small-scale shrimp farmers are doubly exploited both in the price of feed and shrimp. | Credit from government organisation/ financial institutions/scheduled commercial banks/cooperative societies i needed so that the farmers do not need t borrow from the agents and abide by thei unfavourable terms and conditions. |
| The dominance of private sectors restricts the resurgence of **small shrimp farmers**. | To safeguard the interests of the small scale holders, they should be provided witl seed facilities , bank finance and technica training. |
| Recently, restriction on export of shrimp under sanitary clause and **cartelisation of exporters** has resulted in continuous decrease in price of shrimp to which the shrimp farmers fall prey. They are unable to cover the cost of production during bad harvest. | The cartelisation of exporters should be checked by the interference of the government. |

| | |
|---|---|
| **The White Spot Virus** is affecting the shrimp and the shrimp farmers lack knowledge of preventive measures and water treatment methods that could help prevent the spread of the virus. | The shrimp farmers want accurate information and more effective medicines and diagnostic tests for the virus from a competent biologist/ technician appointed by the government. |
| Lack of **competent technicians** to guide the shrimp farmers. | The shrimp farmers would like to have access to experts who can give the accurate advice and information about shrimp farming. |
| Non-availability of **proper transport facilities**. | Efficient transport facilities are needed. |

**A specific problem in Ersama area :**

The free flow of water in the river is restricted due to the fixing of nets in the water by fishers. So the discharged water of the shrimp ponds is not able to flow freely, which leads to pollution thereby, increasing the possibility of virus.

**Typical problem in Dhamara area :** While bringing post-larvae shrimp seeds from the hatchery, the farmers are detained by the police near the toll gate with no reason but only to grease their palm. They pay a tax of 12 per cent on shrimps in the hatchery and have authentic receipt but still they are **harassed**. Without challenging, the farmers are forced to pay the bribe because of the fear of destruction of seeds. The establishment of a local hatchery would solve this problem.

**In Satpada/Chilika area, there are a few specific problems related to shrimp culture.**

| Problems | Measures suggested |
|---|---|
| **Construction of a new sea mouth** between the lake and the sea. Salinity of the lake is increasing which is unsuitable for shrimp in the adjoining area near the new mouth consisting of around seven villages. | Not surprisingly, the respondents of this area would like the channel to be closed as soon as possible. |
| Many respondents indicated that the land they have taken on lease is being **encroached** on by others, who refuse to leave. Also Common Property Resource (CPR) land, which is usually available for livestock grazing, is being used for shrimp farming in some places. Officials in the area are easily bribed and encroachers intimidate poor leaseholders. | Effective enforcement of laws relating to property rights is needed. The respondents would like their rights as leaseholders to be upheld by some official means that does not require them to spend their money on court cases. |
| **Annual Lease agreements** are not suitable to the farmers. | People prefer three year lease policy. |

the spread of diseases; (iii) the price of shrimp is falling while the cost of feed, medicines have been increasing; (iv) the government should intervene to prevent the exploitation of shrimp farmers by middlemen; (v) the overcrowding of shrimp ponds, discharge of effluent water to open water system and massive conversion of agricultural lands has degraded the natural ecosystem in many ways; (vi) shrimp farmers should be made aware of the hazardous

consequences of their culture process and should be made to avoid them; (vii) the existing knowledge, human resource capacity and supporting technologies are not sufficient for the sustainability of the industry; (viii) the government or NGOs may impart technical training and create awareness among the farmers for sustainable shrimp culture; (ix) research and development efforts should be directed towards integrated poly-culture and sustainable methods suitable for local farmers and fishing communities; and (x) absence of modern technology, non-availability of sufficient hatcheries and testing laboratories, higher price of inputs and unavailability of institutional credit affect the long-run viability of the sector.

The experts, in three Workshops organised as part of this study, have attributed various reasons for the lukewarm growth of shrimp culture in the State. These include: (i) lack of inter-departmental coordination, (ii) inadequate legal frameworks, (iii) no provision of crop insuranc (iv) an unjustified water tax, (v) inadequate supp of shrimp seedlings in the State, and (v undermining the fishery sector by th government compared to the agriculture sect

The establishment of hatchery is also n possible in all areas due to geographic characteristics, for which, there is no hatchery the surveyed sites. These experts suggest various measures to overcome these probler such as, (i) removal of land conversion fees, ( provision of electricity to shrimp farmers at concessional tariff as in case of agriculture, ( insurance coverage, (iv) similar status to shrim farming as that of agriculture, (v) registration all shrimp farmers, (vi) provision of infrastructu facilities and training facilities to shrimp farme (vii) simplification of the procedure of getti CRZ certificate, (viii) adequate and timely crec and (ix) formation of Aqua Club of shrim farmers.

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