



**CORAL TRIANGLE
INITIATIVE**

ON CORAL REEFS, FISHERIES AND FOOD SECURITY

AQUACULTURE IN TIMOR-LESTE



**This publication was prepared with funding from the United States Agency for International Development's Coral Triangle Support Partnership (CTSP)
January 2011**

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January 2011

USAID Project Number GCP LWA Award # LAG-A-00-99-00048-00

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This is a publication of the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF). Funding for the preparation of this document was provided by the USAID-funded Coral Triangle Support Partnership (CTSP). CTSP is a consortium led by the World Wildlife Fund, The Nature Conservancy, and Conservation International with funding support from the United States Agency for International Development's Regional Asia Program.

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I. Background

The WorldFish Center mission report on “Fisheries Dependence in Timor-Leste” prepared in March 2010 recommended development of a national aquaculture strategy for Timor-Leste to underpin various proposed investments in aquaculture for diversification and improvement of livelihoods and economy in the country. The present ‘Aquaculture in Timor-Leste’ project was included as an element within an umbrella agreement with WWF-US for ‘Planning the use of fish for food security in the Solomon Islands’ under Element R2: Ecosystem Approach to Fisheries Management Improved. In this connection, the WorldFish Center - at the request of the Government of Timor-Leste and with the support of the Coral Triangle Support Program (CTSP) - conducted a mission to explore the scope of an aquaculture development strategy in November 2010.

The key activities during the mission, which was also facilitated by FAO staff in the country, were:

- (a) Visits to freshwater aquaculture and seaweed farming sites;
- (b) Initial consultations with NGO and government stakeholders in Dili, the capital of Timor-Leste, and the field;
- (c) Meeting with government and FAO staff to outline issues and scope for aquaculture development.

The WorldFish mission was an initial step towards devising an Aquaculture Strategy for Timor-Leste. Although primary focus was on freshwater aquaculture, brackish water aquaculture and seaweed farming were also included.

Taking into account inputs received from the stakeholder consultations, meeting and field visits, this report analyses the potential role of aquaculture in addressing the problem of food and nutrition insecurity in Timor-Leste. Moreover, key issues to be considered while devising aquaculture strategy are drawn up to help develop a national strategy and a follow-up action plan.

2. The context

2.1 Widespread poverty and food insecurity

Rural livelihood systems in Timor-Leste, one of the poorest countries in Asia, are largely dependent on crop farming and livestock raising, essentially of subsistence or semi-subsistence nature. The country has been facing the problem of chronic food insecurity which is attributed to low crop yields, lack of income-generating activities, limited purchasing power, drought, and lack of infrastructure. Nearly half of its total population is living in extreme poverty and food insecurity. Around half of the children across the country are deprived of diet with balanced nutrition. According to the World Food Program (2010)^{1,2}, the proportion of underweight and stunted children under 5 in the country was estimated at 45% and 54%, respectively.

Around three quarters of the population in Timor-Leste is living in rural areas. Whilst the Government has set a US \$0.88 income per caput per day as national poverty line, progress towards meeting MDG targets has been rather slow. Despite continued efforts on the part of the government and its development partners in improving livelihoods, increased incidences of poverty have been reported in recent years. The proportion of the population living below the extreme poverty line in the country was estimated to have increased to 50% in 2007 from 36% in 2001 (UNDP, 2010)³. Regional variations in the incidence of poverty are also evident. In particular, Central and Western provinces are more prone to poverty.

Improving food and nutrition security of the population across the country is a primary concern. In order to address the widespread problem of poverty, the Government of Timor-Leste has in recent

1 In : <http://www.wfp.org/countries/timor-leste>

2 In: <http://www.oxfam.org.au/resources/filestore/originals/OAus-FoodSecuritySurveyTimor-I207.pdf>

3 In: <http://www.tl.undp.org/>

years put emphasis on diversification and intensification of agricultural production. Carbohydrate-based diet (maize, rice, cassava, taro, sweet potato and vegetables) is the major source of calories and animal source foods such as meat/fish is consumed only on special occasions, as these are not only expensive but also not easily available in rural areas. The need for increasing access to animal source foods (protein, micronutrients) is considered vital to improving the nutritional status of the resource-poor Timor-Leste population.

2.2 Aquaculture intervention as one of the likely options

There is increasing appreciation of the role of fish in a nutritionally balanced diet (particularly vitamins and micronutrients). Arguably, the food and nutritional security situation in Timor-Leste could be improved through harnessing its development potential for fisheries and aquaculture. The country, having over 700 km of coastline, possesses a tremendous potential for coastal fisheries and possibly aquaculture as well. Although coastal fisheries resources might be able to meet fish demand of the coastal communities to some extent, a large population in the hinterlands is presently deprived of access to these resources. Nevertheless, some inland areas are endowed with freshwater resources with potential for fish production for nutrition and income. In some cases, addition of small ponds to rural household farming systems may also improve resilience to seasonal droughts. Whilst there have been some attempts in the past to develop freshwater aquaculture, and currently several NGOs are making or considering investments in this sector, these initiatives to date have proved difficult to sustain, particularly during the previous period of political conflict.

Aquaculture development has been identified by the Government of Timor-Leste as a means of improving the food and nutrition security situation of inland communities. Coastal aquaculture is also considered as having the potential to provide opportunities to raise income among coastal communities.

The Government, in line with the recommendation made by the WorldFish mission to the country in 2009, has been considering devising a strategy and action plan for the development of sustainable aquaculture aimed at addressing the problem of poverty and hunger in the country.

3. Methodology

The methodology primarily included consultations with key stakeholders (GOs/NGOs) and visits to coastal and inland aquaculture sites, which are discussed below:

3.1 Consultation with key stakeholders

The WorldFish mission met with a number of I/NGOs and UN organization based in Dili. These meetings were aimed at getting acquainted with their livelihoods support programs (Appendix 1). Emphasis was given to understanding the experiences of these organizations in promoting aquaculture (if any). They were also requested to provide their views on the potential role of aquaculture in improving food and nutrition security situation in Timor-Leste and on the scope or plan to expand or include aquaculture component in their programs in the future. Attempts were made to outline the issues to be taken into account while promoting sustainable aquaculture.

The key organizations consulted were:

- i. Food and Agriculture Organization (FAO) of the United Nations, Timor-Leste (Mr Chana Ophaskornkul)
- ii. Oxfam International, Timor-Leste Country Office (Mr Herman Koopman)
- iii. CARE International, Timor-Leste (Mr Buddhi Kunwar)
- iv. The World Vision, Timor-Leste (Ms Fiona Hamilton)
- v. Rural Development Program – EU (Mr Philippe Becu)

Aquaculture was one of the smallest components of the livelihood support programs of all these organizations. Most of their activities were limited to provision of technical advice and some subsidies for pond construction, fish seed and feed. The numbers of farmers embraced by aquaculture promotional projects of these I/NGOs were very small. Some of the organizations (for example, World Vision) had even discontinued their fish culture project activities due to unavailability of fish seed and lack of aquaculture specialists to provide technical backstopping to the farmers, and questionable sustainability of the interventions tried.

Identification of agro-ecological ‘niches’ for aquaculture development by the Government and making provision of support services, including seed, feed and extension, are prerequisite for these I/NGOs to emphasize their focus on aquaculture. Nevertheless, integration of aquaculture in the crop-based farming system has been considered as one of the viable options for diversification of livelihoods of farming communities by Care International and Oxfam International. Whilst both organizations are promoting small on-farm reservoirs for irrigating vegetables, they are also considering integrating fish into the reservoirs to harness their fish production potential.

All the I/NGOs visited were well aware of the potential role of aquaculture in addressing food and nutrition insecurity in Timor-Leste and were quite positive about giving emphasis on aquaculture should the government develop a clear strategy and action plan for its development to benefit a large number of resource-poor households.

3.2 Stakeholders’ Consultation meeting in Dili

A one-day consultation meeting, involving key officials from the Timor-Leste National Directorate of Fisheries and Aquaculture (N DFA), was organized in Dili on 26 November 2010. The meeting was also attended by officials from the Food and Agriculture Organization of the United Nations/ Regional Office for Asia and the Pacific (FAO/RAP) and Coral Triangle Initiative (CTI)/ USAID Coral Triangle Support Program (CTSP) staff in Timor-Leste.

Opening the consultation meeting, the WorldFish team made two PowerPoint presentations – one on ‘Freshwater Aquaculture in Timor-Leste: Opportunities and Issues’ and the other on ‘Aquaculture Strategy for Timor-Leste’. The subsequent discussion centered around two complementary topics: (i) a framework for devising an aquaculture strategy and (ii) issues to be taken into account for sustainable aquaculture development. Three key questions were posed (Box I) to guide the discussion, but the participants were also requested to present their views/experiences.

Box I: Key questions posed during the stakeholder consultation meeting in Dili

1. ***Can Aquaculture contribute to addressing the problem of food and nutrition insecurity in Timor Leste?***
What are the key questions to be addressed?
What are the further studies needed?
2. ***What are the key issues on aquaculture development?***
How might these be addressed?
What are the further studies needed?
3. ***What are the next steps towards preparing national aquaculture development strategy?***
What is the process?
Who is responsible?

3.3 Visits to freshwater aquaculture and sea weed farming sites

3.3.1 Visit to freshwater aquaculture sites in Ermera District:

The WorldFish team, accompanied by Mr Julio da Cruz, Director of NDFA, and a senior official from the same organization, visited Gleno sub-district of Ermera District, one of the areas with recognized potential for fresh water aquaculture development in Timor-Leste. The team met with a number of stakeholders, namely officials from freshwater fish hatchery at Gleno and Ermera District Agriculture Office, and visited a few fish ponds in the area. The impression of the visit is outlined below:

- *Resource base context*

Gleno is endowed with favorable resource base by virtue of the availability of fresh water from the mountain springs and a gently sloped fertile landscape at the foothills. Rice-based farming system is prevalent in the sub-district. Use of crop fertilizers and chemicals is virtually nonexistent. Given the settlement clusters adjacent to the paddy plots, homestead pond aquaculture is likely to develop with minimal interventions.

- *Gleno freshwater fish hatchery*

The hatchery was established in 1984 with the construction of a few earthen ponds and introduction of carp (particularly common carp) broodstock from Indonesia. The system was upgraded with the construction of concrete ponds in 1989. Currently, there are 13 ponds being used for broodstock rearing. The hatchery produces seed of common carp, tilapia and a few local fish species (particularly *Ikan Mazalaya*). In 2004, all the broodfish were replaced with the new broodstock imported from Bali



Picture 1: Broodfish ponds at Gleno Fish hatchery

From the outset, the hatchery at Gleno has been operating at very low capacity. At present, it produces only 10,000 fry per year (a production that is barely sufficient to stock 1 acre [4000 m²] of pond). The hatchery has very limited human resources as there is only one technician and a watchman. Fish seed is distributed free of charge to the interested farmers in Ermera and sometimes to the farmers in other districts as well, depending on demand. The hatchery sells fish seed only occasionally, particularly when there is demand from NGOs promoting aquaculture.

There is considerable potential to increase production from the hatchery at Gleno. However, better hatchery facilities as well as human resource are vital to realizing improved performance.

- *Ermera District Agriculture Office*

A brief meeting was organized with the Ermera District Agriculture Office, which is mandated to provide agricultural extension services ranging from crops to livestock and aquaculture. However, the office lacks expertise in aquaculture extension. It generally solicits help from the hatchery at Gleno, should there be the need to provide technical advice to fish farmers. The District Agriculture Office also has a few fish ponds which are being used as demonstration ponds. Most of the ponds however seemed eutrophic in nature, reflecting poor management due to lack of technical expertise in fish pond management.



Picture 2: A weed-infested demonstration fish pond in the backyard of Ermera District Agriculture Office

- *Farm visits*

There were a few fish farming households adjacent to the Ermera District Agriculture Office. The farmers have been stocking common carp and tilapia in their ponds. These ponds were low input – low output systems and farmers were relying only on rice bran and kitchen waste as feed. Fish feed pellets were also applied, though in a very limited quantity (and only if provided under subsidy by the Government or the I/NGOs working in the area).

In general, fish is harvested 3-4 times a year. Fish produced is used for both household consumption and sale. Demand for fish in local area is very high as it fetches up to US\$ 10 per fish (weighing around one kg) – price that is not affordable for resource-poor households. However, the high fish price is due essentially to its very low production and supply at present, and can be expected to decrease with the increase in fish production in the future.

3.3.2 *Visit to Atauro Island - Mariculture site*

A visit was made to Atauro Island, which consisted of a meeting with local stakeholders (seaweed farmers, representatives from seaweed cooperatives, a priest, and district agriculture officials) and observation of seaweed farming and post-harvest handling activities. The meeting was organized to discuss the current status and issues relating to seaweed farming. Seaweed farming, drying and packaging systems were also observed. Officials from NDFA accompanied the WorldFish team during the trip.

The local stakeholders confirmed that seaweed farming has been one of the major income-generating activities since its introduction in the island. There are two local cooperatives that help farmers with technical advice on seaweed farming and post-harvest handling and facilitate its marketing. The seaweed is marketed through two Dili-based export companies, Global Timor and Reality, which connect local cooperatives with traders from Indonesia and elsewhere.



Picture 3: A local farmer showing seaweed at its culture site

It is believed that seaweed produced in Atauro is of high quality. The local members try to maintain its quality by following recommended practice from production to drying and storing. It is advised that farmers culture seaweed in a 45-day cycle; sun-dry for 3-4 days after harvesting; and store in a dry place (room) until buyers collect. The minimum farm gate price of seaweed (dried) has been set at \$0.75 by the local cooperatives. The buyers come to collect dried seaweed only in bulk, the minimum volume being at least 10 t. Total production of dried seaweed in the area would be up to 30 t per crop cycle if the harvest is good⁴. There is potential to increase production to 50 - 60t per cycle through the expansion of the culture area.

However, marketing has been an issue, and the farmers feel that they are not realizing adequate profits due essentially to the rather low price offered by the buyers. They wish to receive support from GOs/NGOs/INGOs to enable themselves to deal directly with international buyers rather than selling through local companies.

Another issue noted on seaweed farming was potential resource use conflict which is likely to affect its farming unless adequate measures are taken. There are no designated areas for seaweed farming, resulting in seaweed farming, recreational beach activities and movement of ferries and local transportation boats taking place in the same areas. The pressure on seaweed farmers is likely to increase once there is growth of tourism in the area, which is also a priority of the Government of Timor-Leste.

4. An overview of aquaculture development in Timor-Leste

Despite the decades of effort in developing aquaculture in Timor-Leste, the country has yet to realize its potential for improving livelihoods of its people. Like the other sectors, aquaculture grew very slowly (or even contracted) over the decades as a result of the political conflict that long affected the country. This section presents an overview of current situation of freshwater and brackishwater aquaculture and seaweed farming in Timor-Leste. The section, based on meetings with the key stakeholders, feedback from stakeholders' consultation meetings in Dili and Atauro, and secondary information available with NDFA and various I/NGOs, analyzes the status and recent growth trends in aquaculture development in the country.

4 Source: Discussion with local stakeholders at Atauro Island, Timor-Leste

4.1 Freshwater aquaculture

4.1.1 Number of fish farmers

There has been some effort on the part of GOs/INGOs to promote freshwater aquaculture in recent years. Whilst only 280 households were engaged in freshwater aquaculture in Timor-Leste in 2004, the number increased to 1280 in 2010 - over 4-fold in five years (Figure 1)⁵.

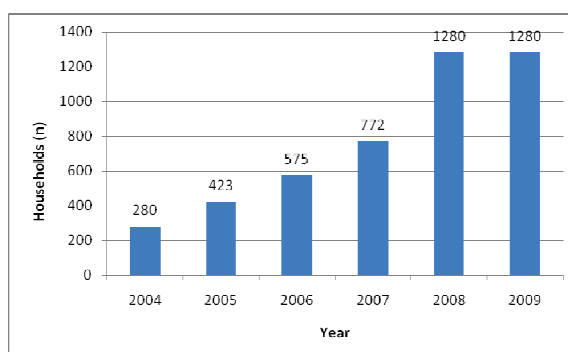


Figure 1: Number of freshwater fish farmers by year (2004 -2009) in Timor-Leste (Source: NDFA, 2010)

Freshwater fish farming households were distributed across the country and were recorded in all 13 districts. However, a large concentration was noted in Ermera (350 households), Baucau (210 households) and Bobonaro (150 households), accounting for over half of the country's total freshwater fish farmers. Access to fish hatcheries and a favorable resource base may be the reasons for the higher number of fish farmers in these districts.

4.1.2 Area (ha) under fish farming

Although there has been a steady increase in the number of freshwater fish farmers over time, only 41 ha of area is estimated to be under freshwater fish farming at this point in time (Figure 2)⁶. The districtwise distribution of area under freshwater fish culture follows a slightly different pattern from that noted in the number of farmers by district. Ermera and Lautem districts alone (7 and 8 ha, respectively) accounted for around one-third of the total area. The same was estimated at 4 ha in Aileu, Ainaro, Bobonaro and Manufahi districts each.

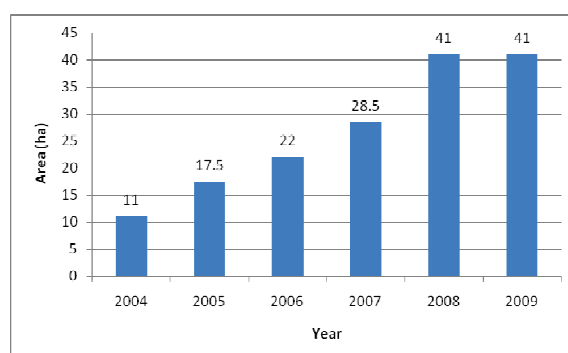


Figure 2: Area (ha) under freshwater aquaculture by year (2004-2009) in Timor-Leste

Data on fish productivity were not available. However, given the artisanal aquaculture in practice small volume of freshwater fish is produced across Timor-Leste is rather small. Increasing total fish production is essential to realizing the potential role of fish in improving food and nutrition security of resource poor communities. However, the rather small estimated area under aquaculture suggests the need for not only increasing the productivity of existing fish culture area, but also for expanding the total area.

5 Source: NDFA, 2010

6 Source: NDFA, 2010

4.2 Brackishwater aquaculture

A small number of farmers, particularly in Ambeno, Covalima, and Liquica districts, are engaged in brackish water aquaculture in Timor-Leste. In 2010, around 60 households from these districts were engaged in culturing shrimp and/or milkfish. All brackishwater ponds are operated in an extensive manner, resulting in low productivity. The Government's emphasis is on improving the performance of existing brackishwater farming systems rather than expanding the total production area.⁷ The area under brackishwater fish culture in Timor-Leste was estimated at a mere 6 ha in 2010, which has remained unchanged since 2007.

4.3 Marine aquaculture

Mariculture in Timor-Leste, essentially the farming of seaweed, was started in 2003-2004. In the beginning, a small number of farmers (20 farmers in 2004) participated in pilot trials. However, with the success of pilot testing, the number increased steadily and reached 1282 in 2010. The geographical focus of seaweed farming has mainly been on Atauro Island – a small island situated in the north of Dili with a population of 10,000. Unlike freshwater aquaculture, seaweed is produced mainly for export and only a small proportion is used for domestic consumption. In 2009, the total revenue generated was estimated at US\$ 19,130⁸.

Global Timor and Reality companies based in Dili serve as brokers for seaweed marketing. They negotiate the price with producers' cooperatives and inform overseas companies to come and collect the seaweed, which occurs at 3-6 month intervals. It was noted that the role of producers in setting the price of their produce was minimal.

Nevertheless, seaweed culture has been one of the major income-generating activities in the area. Growing concerns over the marketing issue could be addressed through the involvement of farmers' groups and cooperatives in the marketing process by empowering them to explore markets themselves and negotiate with the importers directly.

5. Aquaculture issues

The reconnaissance visit to a few inland and coastal aquaculture sites discussed in the preceding section and stakeholders (GOs and NGOs) consultations in Dili, Atauro and Gleno during November 2010 further suggested that aquaculture development in Timor-Leste is likely to be a viable option for improving livelihoods of both coastal and inland people and confirmed the need for devising an aquaculture development strategy and implementation plan with the participation of all the stakeholders. However, in-depth understanding of the key issues on aquaculture is essential for drawing up a national strategy and action plan that can create lasting impacts. This section highlights such issues.

5.1 Freshwater aquaculture

5.1.1 Seed

There are three freshwater fish hatcheries currently in operation⁹ in Timor-Leste. In response to growing fish seed demand, the NDFA is establishing a new hatchery in the near future. The current production of fingerlings from all the hatcheries was roughly estimated at 60,000 – 80,000, which is barely enough for stocking 3 ha of ponds. Given the 41 ha total estimated freshwater fish production area across the country (Figure 2), current demand is more than 1.2 million fingerlings per year, which clearly indicates the need for a several-fold increase in fish seed production, just to meet the present demand let alone that in the future.

7 Andrew, N., S. P. Kam, and M. Phillips. 2010. Fisheries dependence in Timor-Leste. The WorldFish Center, Penang Malaysia

8 Source: NDFA, 2010

9 Andrew, N., S. P. Kam, and M. Phillips. 2010. Fisheries dependence in Timor-Leste. The WorldFish Center, Penang Malaysia

Considering inadequate physical facilities and seed production capacities of the existing fish hatcheries, there is a strong need for not only improving the capacity of the existing hatcheries, but also for establishing new hatcheries to improve access of farmers to fish seed. Besides, acquiring and managing quality broodstock of fish species, particularly Nile tilapia and common carp, is essential for ensuring high quality seed production from these hatcheries.

5.1.2 Feed

Imported fish feed pellets are often subsidized – though in rather inadequate quantity - to the fishfarmers by the Government as well as NGOs promoting aquaculture. Therefore, farmers feed their fish with pellets only occasionally. There is very low productivity from fish culture due to inadequate feed supplies. Besides, there is growing concern about sustainability of fish production system with fully subsidized inputs. Although there is scope for preparing fish feed based on on-farm resources such as crop and animal byproducts (for example, coconut, corn, cassava, sweet potato, rice bran, and animal manure and urine), many farmers are unaware of utilizing such resources (which often are wasted) as fish feed.

5.1.3 Technology

The low input–low output aquaculture systems currently in practice in Timor-Leste are not likely to become viable options to improve livelihoods of resource-poor farming households. Improving performance of current ‘extensive’ fish culture systems to ‘semi-intensive’ level is a balanced approach to ensure optimal returns from aquaculture. Devising low-cost feeding technologies with effective utilization of locally available resources is vital to increasing the efficiency of homestead aquaculture systems aimed at improving food and nutrition security and augmenting household income.

5.1.4 Market

Markets for agricultural products, including fish, are poorly developed in Timor-Leste. Farmers often sell fish to their neighbors due to its very high demand locally. However, it is vital to link fish farmers with markets, along with increasing fish production. Developing clusters of fish farmers concentrated in a given geographical location and organizing them in groups or cooperatives, which is already proven to be successful in promoting aquaculture in small-scale farming systems elsewhere, is likely to become effective in Timor-Leste as well. This would not only make it easier to acquire seed and other inputs, but also help in marketing fish to local and distant markets through cooperatives.

5.1.5 Aquaculture development model

Small-scale homestead pond aquaculture is going to be a dominant freshwater aquaculture system in Timor-Leste at least for the next few years. However, the need to improve the performance of homestead aquaculture is vital to increasing its viability. Aquaculture interventions should be made in such a way that fish farmers are successful in selling fish and augmenting their household incomes, at least to some extent, on top of household consumption. Besides, ensuring economic viability is vital to the sustainability of fish culture systems. Testing and devising a promising technological package for wider recommendation domains could be done through on-farm trials managed by small-scale fish farmers themselves. Agro-ecological focus of aquaculture intervention should be in those areas with scope for scaling up and scaling out of the technology in wider recommendation domains. Once proved viable, many smallholder farmers gradually start expanding their fish production systems towards SME level, provided they are not constrained by the resource base and market access.

5.1.6 Extension and support services

Provision of promising technological packages and extension services are prerequisites for the development of sustainable aquaculture in Timor-Leste. Strengthening of institutional capacity of NDFA is crucial to prioritizing, developing and delivering aquaculture technologies that fit well with the given resource base and socio-economic context.

The emphasis should be on human resource development of NDFA through practical training (short-/long-term) on various aspects of aquaculture research and development. Besides, improvement of the infrastructures in hatchery facilities is also essential. Nevertheless, assessment of the need for human resource development also forms a part of national aquaculture strategy development.

5.2 Seaweed farming

Given the rather simple production technology, issues on seaweed farming are mostly related to social and economic aspects. As discussed in the foregoing section, strengthening and empowering seaweed farmers' organizations could enable farmers to explore markets by themselves and increase their bargaining power to secure better price for their products. The need to address the issue of resource use conflict between seaweed farming and ecotourism development, which is likely to emerge in the near future, was noted. Designating areas for mariculture and recreational beaches through the involvement of all the stakeholders would help in resolving this issue. Some technical backstopping on post-harvest handling of seaweed, especially related to value addition by improving drying and packaging systems, would fetch higher price.

6. Framework for aquaculture development strategy in Timor-Leste

Upon discussion of the present status and issues pertaining to aquaculture development in Timor-Leste, the following key issues drawn from the consultations and meetings with various stakeholders serve as framework for devising national aquaculture development strategy:

- i. Adequate analysis of the potential role of aquaculture in addressing malnutrition and poverty;
- ii. Identification of agro-ecological, social and economic 'niches' for aquaculture development;
- iii. Ensuring a conducive policy environment through harmonizing policies of different ministries related to water resource use;
- iv. Strengthening institutional capacity of NDFA;
- v. Devising viable production technologies for given agro-ecological and socio-economic contexts;
- vi. Development of input supply (seed, feed) systems;
- vii. Establishing and strengthening linkages with input and output markets; and
- viii. Development and empowerment of aquaculture farmers' groups/institutions.

7. The way forward

This study, which highlighted various issues related to aquaculture development, confirmed the need for a holistic approach to devising a national strategy and action plan for aquaculture development in Timor-Leste. The strategy should follow a balanced approach with due consideration for agro-ecological, social, and economic aspects and aim to produce lasting impacts on the livelihoods of a large number of resource-poor communities. In view of this, the following key activities are highlighted:

- i. Carrying out a more detailed analysis of the current situation of and potential for aquaculture development in Timor-Leste, focusing on:
 - i. Inland aquaculture
 - ii. Brackish water ponds
 - iii. Mariculture (principally seaweed farming)
- ii. Identifying agro-ecological 'niches' for aquaculture development;
- iii. Assessing aquaculture options and production technologies;
- iv. Assessing and helping to build capacity of the Department of Aquaculture and other relevant stakeholders;

- v. Identifying improvements needed in input supply (seed, feed) situation; aquaculture extension strategy; establishing market linkages; and developing and strengthening farmers' institutions;
- vi. Recommendations on policies, regulations and institutions required for responsible development of aquaculture; and
- vii. Preparing an implementation plan for the aquaculture strategy.

Activities should also include:

- i. Visits to and consultations with selected national institutions, I/NGOs, farms and private sector stakeholders involved in extension, production, trading of aquaculture products;
- ii. Consultation with government departments involved in natural resource allocation, particularly freshwater and coastal land/water;
- iii. Visits to existing/potential aquaculture farming areas and farms and consultations with various stakeholders in production and along value chains;
- iv. Identification of agro-ecological 'niches' for aquaculture development using Geographical Information Systems (GIS)/Recommendation Domain tools;
- v. Analysis of institutional capacity development needs of the Department of Aquaculture and other stakeholders through review and consultations;
- vi. Analysis of present aquaculture systems and development of strategies for their improvement, with special focus on:
 - input supply (seed, feed)
 - production systems and management
 - impacts on farm incomes and nutrition
 - aquaculture extension strategy
 - finance
 - market access
 - farmer organization
 - environmental impacts/management
- vii. Preparation of an implementation plan which will include two "pilot" project investments – one in inland areas and the other in coastal areas for follow-up action; and
- viii. Presentation of aquaculture development strategy and implementation plan to key stakeholders and its finalization based upon their feedback.

In consultation with Mr Julio da Cruz, Director of NDFFA, it was agreed that the strategy outline as an output of the workshop, would be submitted to government for consideration and feedback, following which the necessary studies and consultations would be undertaken by a team from government, supported by the WorldFish Center. FAO and several NGO's had also expressed their interest to participate in the initiative.

Acknowledgements:

We are grateful to a number of organizations and individuals for their help in establishing contacts with key stakeholders, organizing stakeholders' consultation meetings and field visits, and arranging logistics. Many thanks to Mr Julio da Cruz, Director of NDFA and his team, and Mr Rui Miguel da Silva Pinto, Dr Niall Byrne, Dr Enrique Alonso Poblacion, and Dr Don Griffiths for their very useful inputs and advices. Our thanks are also due to Mr Chana Ophaskornkul, Mr Herman Koopman, Mr Buddhi Kunwar, Ms Fiona Hamilton, and Mr Philippe Becu for providing us with useful information and suggestions.

This study was funded by WWF under its USAID - Coral Triangle Support Partnership (CTSP).

Appendix I: List of stakeholders consulted

Appendix I.1: List of key stakeholders consulted:

1. Mr Julio Da Cruz (Director, NDFA, Timor-Leste)
2. Mr Chana Ophaskornkul (FAO, Timor-Leste)
3. Mr Herman Koopman (Oxfam International, Timor-Leste)
4. Mr Buddhi Kunwar (CARE International, Timor-Leste)
5. Ms Fiona Hamilton (The World Vision, Timor-Leste)
6. Mr Philippe Becu (Rural Development Program – EU, Timor-Leste)

Appendix I.2: List of participants in Consultation meeting in Dili on 26 November 2010

1. Mr Antoninho Da Costa (NDFA, Timor-Leste)
2. Mr Fidelino Sousa Margues, (NDFA, Timor-Leste)
3. Mr Sabino Let Adonia (NDFA, Timor-Leste)
4. Mr Adriano Dani F DC (NDFA, Timor-Leste)
5. Mr Bendito Trindade (NDFA, Timor-Leste)
6. Dr Niall Byrne (CTSP, Timor-Leste)
7. Mr Rui Pinto (CTSP, Timor-Leste)
8. Dr Don Griffiths, (FAO/RFLP)
9. Dr Enrique Alonso (FAO/RFLP)
10. Dr Michael Phillips (WorldFish)
11. Dr Jharendu Pant (WorldFish)
12. Mr Pedro Laurentino da Silva (Interpreter)

Appendix I.3: List of participants in Stakeholders meeting in Atauro Island on 27 November 2010

1. Mr Mariano da Cruz (CPMS)
2. Mr Jose Veegas Frelas (CPMS)
3. Mr Padre Fransisco (Local religious organization)
4. Mr Adao Marques (Cottoni Star Cooperative)
5. Mr Marcello Bello Soares (Roman Luan, local NGO)
6. Mr Salomao Cabral (President Cottoni star cooperative)
7. Mr Jose Pereira (Cottoni star Cooperative)
8. Mr Jose Gereiro (NDFA)
9. Elias Morato (District Fisheries officer, NDFA)
10. Mr Adriano Dani F DC (NDFA, Timor-Leste)
11. Dr Jharendu Pant (WorldFish)



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