



- Least suitable
- Moderately suitable
- Suitable
- Most suitable



Freshwater Aquaculture Suitability Map of Timor-Leste

TIMOR-LESTE NATIONAL AQUACULTURE DEVELOPMENT STRATEGY 2012–2030



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FOREWORD

Chronic food insecurity, malnutrition and a high unemployment rate remain major impediments to the growth and development of Timor-Leste. The Government of Timor-Leste through the Ministry of Agriculture and Fisheries (MAF) is working side by side with relevant Government Ministries, national and international development agencies and NGOs to address these issues through diversification of livelihood options. Aside from development in the areas of food crops, livestock, forestry and industrial plantation, MAF considers fisheries and aquaculture to be one of the key sectors with high potential to contribute to improving food and nutrition security and creating employment opportunities in the country.

Aquaculture is a potential initiative that needs to be developed as it can contribute to improving food and nutrition security and provide job opportunities for inland as well as coastal communities. It is important for aquaculture farmers to understand and recognize this initiative as an integral part of the effort to improve their nutritional status and increase their household income. Developing aquaculture is in line with priorities of Timor-Leste Strategic Development Plan (2011–2030), which aims to diversify livelihood opportunities.

Both inland and coastal/marine aquaculture should be properly developed to address the needs of the people, especially to combat malnutrition, provide new livelihood opportunities and sources of income for many people, and thereby contribute to reducing poverty and malnutrition in Timor-Leste.

I, on behalf of MAF, endorse the National Aquaculture Development Strategy (2012 – 2030) as a reference for guiding aquaculture development endeavors of MAF as well as I/NGOs, development partners and private sectors in Timor-Leste.

Lastly, I wish to take this opportunity to thank WorldFish for providing assistance to National Directorate of Fisheries and Aquaculture to develop and produce this strategy. I also acknowledge that financial support provided by the Spanish Agency of International Cooperation for Development (AECID) through a Food and Agriculture Organization (FAO) of the United Nations trust-fund project, the Regional Fisheries Livelihoods Programme (RFLP) for South and Southeast Asia and the Coral Triangle Support Partnership (CTSP) of the World Wildlife Fund (WWF).

Dili, 7th March, 2013



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ACRONYMS

ALGIS	Agriculture and Land-use Geographic Information System
FAO	Food and Agriculture Organization
GIS	Geographical Information System
GoTL	Government of Timor-Leste
HRD	Human Resource Development
I/NGOs	International/National Non-Governmental Organizations
IAA	Integrated Agriculture-Aquaculture
MAF	Ministry of Agriculture and Fisheries
MoE	Ministry of Environment
MoED	Ministry of Economy and Development
MoH	Ministry of Health
MTCI	Ministry of Tourism, Commerce and Industry
NDFA	National Directorate of Fisheries and Aquaculture
RFLP	Regional Fisheries Livelihoods Programme
SDP	Strategic Development Plan
SME	Small and Medium Sized Enterprises



EXECUTIVE SUMMARY

The need to increase access to animal source foods – livestock and fish – is vital to improving the nutritional status of the people of Timor-Leste, and addressing the country's problem of chronic malnutrition. Aquaculture, or the farming of aquatic animals and plants, has been identified by Government as a means of improving the food and nutrition security situation of the country, and contributing to economic activity and household incomes in rural areas. This National Aquaculture Development Strategy is intended to guide future development of aquaculture in Timor-Leste. It was prepared through a process of consultation and analysis, and is anchored to the principles required for poverty reduction, combating malnutrition, economic development and effective ecosystem management. The strategy is harmonized with the country's Strategic Development Plan (2011–2030), with actions for implementation provided for the short (2012–2015), medium (2016–2020) and long term (2021–2030).

The National Aquaculture Development Strategy envisions a strong role for aquaculture in diversifying and improving livelihoods, and building resilience among rural households and agro-ecological systems. It is intended to contribute to increasing fish supply and consumption, with the objective of raising per capita fish consumption in Timor-Leste from 6.1 kg¹ to 15.0 kg by 2020 (closer to the global average annual per capita consumption of 17.8 kg²). The expectation is that aquaculture will by 2030 contribute up to 40% of domestic fish supplies, with the remainder coming from wild capture fisheries.

Both inland and coastal aquaculture are supported in the strategy. Freshwater aquaculture is identified as a means of improving food and nutrition security in inland communities in particular, while brackishwater aquaculture and mariculture provides more small business and income raising opportunities for coastal communities. A two-pronged approach to freshwater aquaculture development is proposed: (i) supporting the emergence of small and medium aquaculture business enterprises in suitable agro-ecologies, and (ii) advancing integrated agriculture-aquaculture (IAA) systems (principally for food and nutrition) around small-scale water storage systems among poor households in less favorable, resource-poor locations. Devising low-cost viable technologies through participatory processes; building necessary services; and empowering women and marginalized communities through their organizations are considered vital to the development

¹ FAO/RFLP (2011). Fish and animal protein consumption and availability in Timor-Leste

² FAO (2012). Recent Development in Fish Trade. In: <http://www.fao.org/cofi/29435-0d0f6e2deffce0e170131f15dcceff1d4.pdf>

of sustainable aquaculture. Emphasis has been laid on the development of aquaculture based on low-cost technologies that are environmentally benign, socially acceptable and economically viable.

The vision of the National Aquaculture Development Strategy is for aquaculture to contribute to improved food and nutrition security, diversification of livelihoods of inland and coastal communities, and economic growth in Timor-Leste. The goals of the strategy are that:

- i. There will be a significant and measurable increase in average per capita fish consumption by 2020 leading to a reduction in malnutrition rates and improved nutrition security;
- ii. Aquaculture will provide a range of new livelihood options in coastal and inland communities contributing to greater social resilience and reduced poverty; and
- iii. New infrastructure and technical capacity will be developed to support aquaculture enterprises leading to improved economic growth.

Implementation of the National Aquaculture Development Strategy involves coordinated actions of stakeholders from the central to local levels. Actions are necessary to deliver nine core outcomes within the 2012–2030 timeframe: (i) identification of suitable agro-ecological zones for aquaculture development completed; (ii) viable aquaculture technologies developed and disseminated; (iii) institutional capacity of the NDFA strengthened; (iv) sustainable input supply systems established; (v) aquaculture producers connected to markets; (vi) household food and nutrition security improved by aquaculture; (vii) effective partnerships between government agencies, NGOs, communities, the private sector and donors created; (viii) aquaculture farmer groups and representative institutions empowered; and (ix) favorable policies for environmentally responsible aquaculture development formulated.

The National Aquaculture Development Strategy calls for a coordinated effort and commitment from the public and private sectors, as well as from development partners. The National Directorate of Fisheries and Aquaculture (NDFA) is responsible for development and management of aquaculture in the country, and will take the lead role in implementation and formal monitoring of the National Aquaculture Strategy. NDFA will establish partnerships and a monitoring and evaluation system to enable progress to be regularly reviewed and adjustments made as appropriate. Implementation of the strategy will require mobilization of both public and private sector investment. The next steps will elaborate the budget required for implementation and actions to secure the resources needed from public sector, private sector, financing institutions and the donor community.

1

BACKGROUND



1. BACKGROUND

1.1 The Challenge: Combating widespread poverty and malnutrition

Around three quarters of the 1.2 million people in Timor-Leste, one of the poorest countries in Asia, live in rural areas. Livelihood systems are largely dependent on crop–livestock mixed farming, essentially of subsistence or semi-subsistence nature. The country is facing chronic food insecurity which is attributed to low crop yields, lack of income-generating activities, limited purchasing power, periodic droughts, and insufficient infrastructure.

Combating poverty and malnutrition has been the top priority of the government since the country acquired independence in 2002. It is apparent though that widespread poverty and malnutrition continue to remain major impediments to recovery and growth. To address this problem the Government of Timor-Leste (GoTL) has, in recent years, put emphasis on diversification and intensification of agricultural production. The Comoro Declaration against hunger and malnutrition was issued in 2010, reiterating the need for a nationwide coordinated action plan and international efforts to realize ‘food and nutrition security’ as a fundamental right of every person.

1.2 Timor-Leste Strategic Development Plan: Pathways towards prosperity

The Timor-Leste Strategic Development Plan (SDP) (2011–2030)³, launched in 2011, provides vision and guidance for the country’s development until 2030. Economic development will be built around growth in three critical industries: agriculture, petroleum and tourism. The SDP (2011–2030) emphasizes the importance of a thriving agricultural sector for food and nutritional security, reduction of poverty and economic growth for the nation as a whole. By 2030, subsistence agriculture will have been replaced by commercial, smallholder agriculture. The need for expansion and intensification of crop and livestock production systems as well as development of sustainable fisheries and aquaculture is emphasized in the plan. The SDP (2011–2030) is an integrated package of strategies and policies to be implemented in three stages, as follows:

- STAGE 1: Short term (2011–2015): Human resource development, strategic industries, and infrastructure;
- STAGE 2: Medium term (2016–2020): Infrastructure, strengthening human resources, and market formation; and,
- STAGE 3: Long term (2021–2030): Eradication of extreme poverty, strong private sector, and diversified non-oil economy.

³ <http://timor-leste.gov.tl/wp-content/uploads/2011/07/Timor-Leste-Strategic-Plan-2011-20303.pdf>

1.3 Aquaculture in the National Development Context

The need to increase access to animal-source foods—livestock and fish—is considered vital to the improvement of the nutritional status of a large proportion of the population that is presently deprived of a nutritionally balanced diet. Meat is expensive, and at the same time not readily available in rural areas, as cattle and/or pigs are slaughtered only on special occasions. Therefore, substantially increasing meat consumption in the daily diet of Timor-Leste households is a challenge.

Aquatic products represent an important opportunity for improving dietary diversity and nutritional status, and thus focus on fisheries and aquaculture deserves attention. Aquatic products make an important contribution to a nutritionally balanced diet, supplying vitamins, minerals, essential fatty acids and animal proteins. Aquaculture development has been identified by the government as a means of improving food and nutrition security as well as augmenting the income of inland and coastal households. The SDP (2011–2030) highlights the role of aquaculture in increasing energy and protein consumption as well generating revenues from the export of fish. The plan gives emphasis to the introduction of at least three types of marine or brackishwater aquaculture to coastal communities by 2020 and promotion of freshwater aquaculture in areas endowed with suitable water resources.



2

NATIONAL AQUACULTURE DEVELOPMENT STRATEGY



2. NATIONAL AQUACULTURE DEVELOPMENT STRATEGY

2.1 Development process and framework

The National Directorate of Fisheries and Aquaculture (NDFA), under the Ministry of Agriculture and Fisheries (MAF), is responsible for the development and management of aquaculture in the country. This National Aquaculture Development Strategy has been prepared to address the high priority placed on aquaculture development by the NDFA. It has been achieved through a process of consultation and analysis, and is anchored to the principles required for poverty reduction, combating malnutrition, economic development and effective ecosystem management.

A framework for the national aquaculture strategy was prepared based on reviews, consultations with stakeholders, and visits to selected aquaculture development sites in 2010. These activities highlighted a variety of issues related to aquaculture development in Timor-Leste and confirmed the need for a holistic approach to devising the national strategy and action plan. The key points drawn from these consultations and analyses emphasized the need to:

- i. Conduct adequate analysis of the potential role of aquaculture in addressing malnutrition and poverty;
- ii. Identify agro-ecological, social and economic ‘niches’ for aquaculture development;
- iii. Ensure a conducive environment by harmonizing the policies of different ministries related to water resource use;
- iv. Strengthen the institutional capacity of the NDFA;
- v. Devise viable production technologies for specific agro-ecological and socio-economic contexts;
- vi. Develop input supply (seed and feed) systems;
- vii. Establish and strengthen linkages with input and output markets;
- viii. Develop and empower aquaculture farmer groups/institutions; and,
- ix. Strengthen applied research.

NDFA conducted a further study in 2011 centered on these nine issues. This 2011 study involved a series of consultation meetings with stakeholders at national and local levels; review of relevant national policies and strategies, including the SDP (2010–2030); and analyses of agro-ecological, social, economic, and institutional aspects.

It was also stressed during consultations in 2011 that harmonization of the National Aquaculture Development Strategy with the SDP (2011–2030) was necessary in order to translate the aquaculture potential of the country into a practical reality—and thereby produce a lasting impact on both poverty and malnutrition, while improving the livelihoods of the large number of resource-poor households in the country.

This National Aquaculture Development Strategy has been prepared based on all these analyses and the participatory consultation process.

2.2 Overall Approach and Strategic Goals

The GoTL has recognized the role that fisheries and aquaculture can play in the country's development; evident from the inclusion of this sector in the SDP (2011–2030). The National Aquaculture Development Strategy provides the framework for harnessing the aquaculture potential of the country. The strategy envisions a strong role for aquaculture in diversifying and improving livelihoods, and building resilience among rural households and agro-ecological systems.

The strategy takes account of relevant regional and international experience including the Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries and guidelines on the ecosystem approach to aquaculture. It was developed within the framework of the SDP (2011–2030) by prioritizing actions and implementation in three stages—short, medium and long term. It will contribute to increasing per capita fish consumption in Timor-Leste from the current annual level of 6.1 kg⁴ to 15.0 kg in the medium term (closer to the global average annual per capita consumption of 17.8 kg⁵). In the long term, aquaculture is expected to contribute up to 40% of domestic fish supplies, with the remainder coming from capture fisheries. The strategy highlights the need for accelerated development of aquaculture to meet these targets.

Freshwater aquaculture has been identified as a means of improving food and nutrition security in inland communities in particular, while brackishwater aquaculture and mariculture provides more small business and income raising opportunities for coastal communities.

A two-pronged approach to freshwater aquaculture development is suggested: (i) supporting the emergence of small and medium aquaculture business enterprises in suitable agro-ecologies, and (ii) advancing integrated agriculture-aquaculture (IAA) systems (principally for food and nutrition) around small-scale water storage systems among poor households in less favorable, resource-poor locations. Devising low-cost viable technologies through participatory processes, providing necessary services, and empowering women and marginalized communities through their organizations are considered vital to the development of sustainable aquaculture.

⁴ FAO/RFLP (2011). Fish and animal protein consumption and availability in Timor-Leste

⁵ FAO (2012). Recent Development in Fish Trade. In: <http://www.fao.org/cofi/29435-0d0f6e2deffce0e170131f15dcceff1d4.pdf>

Environmental, social and institutional aspects of sustainable aquaculture development are given attention in the strategy. Emphasis has been laid on the development of aquaculture based on low-cost technologies that are environmentally benign, socially acceptable and economically viable. Given the current context, where rural livelihoods are becoming increasingly vulnerable to the effects of global climate change and sudden and profound changes in social and economic systems, the strategy emphasizes the need for diversification of livelihood options through IAA, an approach that is vital to maintaining ecosystem resilience and building social systems resilience.

The Timor-Leste aquaculture strategy is not solely an NDFA endeavor but is part of the national development strategy and calls for a coordinated effort and commitment from the public and private sectors, as well as from development partners, in order to achieve the country’s goal of food and nutrition security by 2020. The role of development partners in achieving this goal is highlighted in the action and implementation plans of this strategy.

VISION:

Aquaculture contributes to improved food and nutrition security, diversification of livelihoods of inland and coastal communities, and economic growth in Timor-Leste.

GOALS:

- i. There will be a significant and measurable increase in average per capita fish consumption by 2020 leading to a reduction in malnutrition rates and improved nutrition security.
- ii. Aquaculture will provide a range of new livelihood options in coastal and inland communities contributing to greater social resilience and reduced poverty.
- iii. New infrastructure and technical capacity will be developed to support aquaculture enterprises leading to improved economic growth.

OBJECTIVES AND INDICATORS OF IMPACT:	
Objectives	Indicators
Increased annual fish supply from aquaculture	12,000 t by 2030
Increased average per capita consumption of fish	15 kg per capita of fish consumption annually by 2020
Increased contribution of farmed aquatic products to consumption	Aquaculture contributes around 40 % of domestic fish consumption in Timor-Leste by 2030
Increased number of households deriving direct nutrition, food and income benefits from aquaculture	40,000 households by 2030, including small-scale IAA, and small and medium sized (SME) aquaculture enterprises

Objectives	Indicators
Improved nutrition for men, women and children in poor and vulnerable households	Household and national nutrition indicators
Improved capacity of public and private sector for management of aquaculture	Evidence of strengthened institutional capacity

2.3 Guiding Principles

The Timor-Leste National Aquaculture Development Strategy is based on the following principles:

- Aquaculture development in Timor-Leste is centered on the country's goal of addressing the problem of chronic food insecurity and malnutrition;
- The National Aquaculture Development Strategy is in harmony with the Timor-Leste Strategic Development Plan, and will be implemented in three phases;
- Development of sustainable aquaculture will be through an ecosystem approach, taking account technical, social, economic and environmental aspects:
 - o Aquaculture will be concentrated in agro-ecological pockets with potential for development and in harmony with other users;
 - o Aquaculture development, following the principles of an ecosystem approach, will be based on the judicious use of natural resources, and will be benign to the environment;
 - o Aquaculture development will contribute to the diversification of livelihood opportunities of inland as well as coastal communities;
 - o Gender equality and social inclusion will be addressed as cross-cutting themes; and,
 - o Viable aquaculture technologies will be developed through participatory applied field research, validated, disseminated, and promoted;
- The strategy envisions a coordinated approach with joint ventures between the government, local communities, International/National Non-governmental Organizations (I/NGOs), the private sector, and development partners⁶ being critical components to realize success.

⁶ This strategy includes reference to "development partners". A number of development partners are actively supporting or interested in aquaculture development in Timor-Leste including: ACIAR, CTSP, EU, FAO/RLF, NZAID, WorldFish, and others. The strategy does not specify particular activities for support by the different agencies, but recognizes that further dialogue between NDFA and various development partners will be needed to advance cooperative activities.

3

ACTION PLAN



3. ACTION PLAN

Implementation of the strategy calls for the coordinated efforts of stakeholders from the central level to the local level.

3.1 Overview of Roles and Responsibilities

The NDFA will play a vital role in carrying out activities that are directly related to overall aquaculture sector management, and with partners development and dissemination of viable aquaculture technologies. A number of other stakeholders including the government, non-governmental organizations and the private sector are expected to play important roles in devising and disseminating aquaculture technologies, and creating an environment conducive for aquaculture development through the expansion and improvement of infrastructure and provision of services. The strategy recognizes the pivotal role of primary stakeholders—the rural farm households—for the adoption, expansion and retention of aquaculture interventions.

3.2 Outcomes and Actions

The actions that need to be taken by the key stakeholders to implement the strategy within the 2012–2030 time frame are designed to lead to the following core outcomes:

1. Identification of suitable agro-ecological zones for aquaculture development completed;
2. Viable aquaculture technologies developed and disseminated;
3. Institutional capacity of the NDFA strengthened;
4. Sustainable input supply systems established;
5. Aquaculture producers connected to markets;
6. Household food and nutrition security improved by aquaculture;
7. Effective partnerships between government agencies, NGOs, communities, the private sector and donors created;
8. Aquaculture farmer groups and representative institutions empowered; and,
9. Favorable policies in place for environmentally responsible aquaculture development.

The following sections highlight the activities required for each of these outcomes to be realized.

1. Identification of suitable agro-ecological zones for aquaculture development completed

Aquaculture production in Timor-Leste will principally be located in areas classified as having a ‘high potential’ determined through GIS modeling, where scope for scaling up and replicating appropriate technologies

in wider recommendation domains is high. The GIS modeling will be based on bio-physical and socio-economic determinants that influence the potential of aquaculture systems to be promoted in the area. Whilst identification of agro-ecological zones and ‘niches’ has been based primarily on bio-physical and socio-economic data from secondary sources, its validation and the refinement of aquaculture development suitability maps will be done through visual observations, ground-truthing, and consultations with local stakeholders. By 2015, Timor-Leste will have up to date aquaculture suitability maps for freshwater aquaculture, brackishwater and mariculture areas, which will be updated every five years. These maps will be used by the government to zone suitable areas and prioritize investments in aquaculture from the public and private sector.

Actions	Time	Key partners
District level freshwater aquaculture suitability maps completed in priority districts (using updated statistics, observation and consultation with local stakeholders)	By end 2012	NDFA, Agriculture and Land-use Geographic Information System (ALGIS)
Brackishwater suitability maps prepared and validated through consultation with stakeholders at the local level	By end 2013	NDFA, ALGIS, Ministry of Environment (MoE)
Mariculture suitability maps prepared and validated through consultation with stakeholders at the local level	By end 2013	NDFA, ALGIS, MoE
All aquaculture suitability maps updated using most recent bio-physical, social, economic and statistical data	By end 2018	NDFA, ALGIS, MoE

2. Viable aquaculture technologies developed and disseminated

Low-cost but profitable technologies which effectively utilize locally available resources will be the focus of aquaculture interventions. Development and dissemination of technologies will be based on farmers’ participatory on-farm trials in agro-ecological locations with good aquaculture development potential.

Aquaculture technologies will be developed that are suitable for the two approaches: (i) emergence of competitive and economically viable SMEs scale aquaculture in suitable agro-ecologies, and (ii) advancing integrated agriculture-aquaculture (IAA) systems around small-scale water storage systems for poor households in less favorable resource-poor locations.

Priority districts will be:

- **Freshwater aquaculture:** Bobonaro, Ermera, Baucau and suitable agro-ecological areas within other districts. Bobonaro and Ermera have the highest proportion of population suffering from malnutrition and therefore offer greater potential for aquaculture to impact food and nutrition security.
- **Brackishwater aquaculture:** Existing brackishwater aquaculture sites in Dili, Liquiça, Manatuto, Covalima, and Oecussi districts.
- **Mariculture:** Dili, Liquiça, and Manatuto districts.

Proven technologies will be disseminated to other areas as recommended by the NDFA, I/NGOs, and development partners.

Investments in fish farming with rural households in resource-poor areas will be achieved by investments in small ponds. Digging a farm-pond with twin objectives – fish culture and irrigation, could be a ‘turning point’ for rural households in resource-poor areas. Experience elsewhere in Asia has shown that ponds provide scope to combine fish, vegetables and fruits into productive and diversified integrated systems, opening opportunities for improved household nutrition and income, as well as empowering women and marginalized communities, and strengthening resilience to climate change.

Actions	Time	Key partners
Accelerate uptake of viable freshwater aquaculture technologies for carp and tilapia production in existing and new ponds through participatory on-farm trials in suitable agro-ecological zones:		NDFA, development partners, I/NGOs, farmers, private sector
<ul style="list-style-type: none"> • 50 % of SMEs scale freshwater fish ponds with pond productivity over 4.0 t/ha/year 	By end 2014	NDFA, I/NGOs, micro-finance institutes, private sector
<ul style="list-style-type: none"> • Freshwater fish supply reaches over 9,000 t annually through wider expansion of the area devoted to aquaculture 	2020	NDFA, I/NGOs, private sector
<ul style="list-style-type: none"> • Freshwater aquaculture area and production increased to over 12,000 t through further expansion of both small-scale IAA systems and SMEs level aquaculture 	2030	NDFA, I/NGOs, micro-finance institutes, private sector
Implement a collaborative strategy for integration of fish into small scale irrigation/pond digging investments in ways that build food production capacity, better nutrition and resilience in resource-poor regions	Plan design by end of 2012; Implementation during 2013–2015	NDFA, I/NGOs

Actions	Time	Key partners
Rehabilitation of existing brackishwater aquaculture ponds and development of appropriate milkfish and possibly shrimp culture technologies through participatory on-farm trials	2015	N DFA, development partners, I/NGOs, farmers, private sector
Promotion of seaweed farming to become a more viable enterprise and benefits extended to a greater number of poor fishers:		N DFA, I/NGOs, seaweed cooperatives, development partners
<ul style="list-style-type: none"> • Zoning and carrying capacity studies define sustainable production limits within areas designated as suitable 	By end 2013	N DFA
<ul style="list-style-type: none"> • Management and technology improvements identified for seaweed farming areas are disseminated 	By end 2012	N DFA, I/NGOs, seaweed cooperatives
<ul style="list-style-type: none"> • Improvements made in post harvest handling of seaweed through participatory trials (drying, storing, packaging), and techniques disseminated 	By end 2013	N DFA, I/NGOs, seaweed cooperatives
Mariculture diversification opportunities identified, tested and implemented:		
<ul style="list-style-type: none"> • Participatory testing and validation of sea-cucumber farming technology in sites with suitable ecology 	By end 2015	N DFA, development partners
<ul style="list-style-type: none"> • Mariculture feasibility and investment studies completed on other potential mariculture species (such as mud crabs) 	By end 2015	N DFA, development partners

3. Institutional capacity of the N DFA strengthened

Aquaculture development in Timor-Leste is largely constrained by virtue of inadequate human resources, and limited extension systems. Government agencies and I/NGOs promoting aquaculture require strengthening through increasing the number of skilled aquaculture staff. The short term focus will be to build the capacity of existing human resources in N DFA through short term training courses, and to build capacity in partner organizations so that they also have the skilled personnel and resources to plan and support aquaculture development.

It is important to develop a strong team of staff in Timor-Leste that can conduct research and planning and then implement sustainable aquaculture development interventions producing lasting impact. In the medium term,

qualified staff members should be encouraged to pursue advanced degrees in NDFA priority subject areas. This activity should dovetail with the human resource development strategy that the NDFA is currently developing with support from the Spanish funded and FAO executed Regional Fisheries Livelihoods Programme (RFLP).

Other aspects of institutional development are also important. These include development of an effective extension services to support rural farmers and an improved statistical system. Regular monitoring of the adoption and retention of aquaculture technologies by farmers, and the changes realized in fish production and productivity over time, is essential. NDFA will develop national aquaculture statistical systems that will be updated on an annual basis. The targets and actions laid out in the National Aquaculture Strategy can then be adjusted accordingly.

Actions	Time	Key partners
NDFA aquaculture staff will increase their aquaculture and extension skills through short term training: <ul style="list-style-type: none"> • Provide training on fish hatchery and brood stock management to all NDFA hatchery managers and hatchery staff • Provide training to 80 % of NDFA aquaculture staff on development and dissemination of promising aquaculture technologies through participatory on-farm trials 	2013 2014	NDFA, development partners NDFA, development partners
NDFA builds a team of aquaculture experts through advanced academic degree training: <ul style="list-style-type: none"> • At least once third of aquaculture staff will complete advanced level (MSc, PhD) academic degrees in priority areas of aquaculture • NDFA prioritizes recruitment of new staff with advanced academic degrees in aquaculture 	2020 2020 2020	NDFA, development partners NDFA
Extension services developed for supporting rural households and enterprises in development of aquaculture	2015	NDFA, development partners

Actions	Time	Key partners
Aquaculture statistical system established and statistics collected on a regular basis:	By 2013	NDFA, ALGIS, development partners
<ul style="list-style-type: none"> District-level statistics National-level statistics 	By 2013	NDFA
	2014–2030	NDFA, ALGIS
NDFA coordinates the organization of vocational training on aquaculture to respond to Human Resource Development (HRD) needs at grass root level	By 2015	NDFA, development partners

4. Sustainable input supply systems established

Fish seed: Ensuring farmers have access to quality fish seed is crucial to the expansion of aquaculture. The NDFA presently has four freshwater fish hatcheries with modest facilities. The potential to increase their seed production capacity is high but requires rehabilitation of the existing facilities. If freshwater fish farming is expanded to 4,800 ha (i.e., 5.0 % of total potential area), the annual demand for seed will be over 150 million fry/fingerlings. Capacity improvement of existing NDFA hatcheries is likely to meet around half of the total demand; the remainder will have to come from new investment in hatcheries and nurseries.

Beyond an immediate rehabilitation phase, NDFA hatcheries should focus their activities beyond seed production and distribution, and diversify into serving as a reliable source of quality broodstock for private hatcheries. A clear business plan should be established for each hatchery to ensure sustainability.

Fish feed and fertilizers: In the short term, promoting small-scale aquaculture systems reliant on commercial pellet feeds is not likely to be viable because of high production costs which would be unsustainable when subsidized. Freshwater fish farming in the country will initially target small enterprises, with a view to improving household food and nutritional security. The initial target will be to produce sufficient volumes of lower priced aquatic products that are affordable to a wide range of households, and can still generate income for farmers.

Initially technologies that are efficient and profitable but based on low-cost farming systems will be promoted. This approach will require low-cost fertilization and feeding strategies, most appropriately through the utilization of locally available resources. Enhancement of normal pond productivity using natural organic fertilizers and

composts, or ‘green water technology’ for tilapia culture, and the use of on-farm supplementary feeds will be promoted. Formulation of feeds utilizing crop by-products (rice bran, cassava leaves and roots, grasses, corn, coconut by-products, etc.) can be researched and promoted as low-cost feeding systems. The variety of ingredients and their proportions in on-farm feed preparation will vary according to the resources available at the local level. Production of feed pellets in-country may be an option for intensification of fish production systems over the longer term.

Actions	Time	Key partners
<p>Fish seed widely available to fish farmers through a self-sustaining network of hatcheries, nurseries and trading:</p> <ul style="list-style-type: none"> • Rehabilitation of existing four NDFA hatcheries to full capacity, and operational on a sustainable basis (infrastructure investment, capacity building, strain improvement, business model development, investment, implementation) • NDFA hatcheries serve as source of quality broodstock for private hatcheries • New fish hatcheries and nurseries established through private or public–private partnerships in suitable agro-ecological areas; fish seed demand increasingly sourced from the private sector • Networks of nurseries and fish seed trading micro-enterprises reach all fish farmers in the country 	<p>Full capacity by end 2015</p> <p>By end 2015</p> <p>By end 2020</p> <p>By end of 2020</p>	<p>NDFA, development partners</p> <p>NDFA, development partners, WorldFish</p> <p>NDFA, development partners</p> <p>NDFA, private sector, I/NGOs, development partners</p> <p>NDFA, private sector, I/NGOs, development partners</p>
<p>Fish feeds based on locally available resources widely available to fish farmers:</p> <ul style="list-style-type: none"> • On-farm trials of feed and fertilization systems accomplished; widespread sharing of suitable technologies; majority of fish farming households formulate and feed with fish feed based on locally available resources • Majority of tilapia farmers take up green water pond fertilization technology • SME scale fish feed processing plants, based on locally available feed ingredients, are established at the community level and supply 50 % of the total fish feed demand 	<p>By 2013</p> <p>By 2013</p> <p>By 2020</p>	<p>NDFA, I/NGOs, development partners</p> <p>NDFA, I/NGOs, development partners</p> <p>NDFA, private sector</p>

5. Aquaculture producers connected to markets

Fish products need to be affordable and to reach consumers, especially the poor and malnourished, if aquaculture is to create impact. Markets within Timor-Leste for farmed fish are currently rudimentary, and fish marketing systems will need to be developed in parallel with production systems.

The proposed strategy is therefore to concentrate investment into carefully selected regions. Developing “clusters” of farmers in the specific geographical locations with the greatest potential for development, together with the necessary services such as a hatchery and feeds, is an approach that has already proven successful in supporting the emergence of small and medium scale aquaculture elsewhere. Value chains need to be understood, and investment made to address market access constraints and gaps.

Local (district and sub district) markets for fish sales and production inputs will be developed through joint collaboration between MAF and Ministry of Economy and Development (MoED). The NDFA, I/NGOs and the private sector will play important roles in establishing linkages between fish producers and local markets.

Likewise, improvement to seaweed quality, opportunities for value addition, new marketing initiatives, scale-up to a more business oriented approach, and strengthening of seaweed cooperatives will be jointly conducted by MoED, Ministry of Tourism, Commerce and Industry (MTCI), the NDFA, seaweed producers and exporters.

Actions	Time	Key partners
Fish marketing facilities are developed in all districts/sub districts and fish farming production groups are linked to these markets	By end 2015	MAF, MoED, private sector and I/NGOs
Fish campaigns implemented to raise awareness of the nutritional value of fish consumption	By end 2015	MAF, MoED, private sector and I/NGOs
Over 50 % of households producing fish sell surplus fish beyond household consumption in district/sub district markets	By end 2015	Farmers, NDFA, I/NGOs
MTCI in collaboration with MAF and seaweed cooperatives help in the formation of a Timor-Leste seaweed board to facilitate expansion of seaweed exports	By end 2015	MTCI, MAF, MoED, seaweed cooperatives
MTCI explores seaweed marketing opportunities and sets minimum quality standards for selling seaweed at premium prices	By end 2015	MTCI, NDFA

6. Household food and nutrition security improved by aquaculture

The potential role of fish in addressing nutrition and food security challenges in Timor-Leste deserves special attention. Fish are a rich source of high quality animal protein, as well as essential micro-nutrients such as zinc and bioavailable iron; fish also enhances mineral absorption from other foods. Small fish, which are eaten whole, are an excellent source of bioavailable calcium. Some fish are a valuable source of essential fatty acids, and there is growing appreciation of the role of fish in supplying essential fats for brain development and cognitive ability in the fetus and young child. Food and nutritional aspects of aquaculture are therefore given special attention in the strategy from two perspectives: total fish supply and household nutrition, particularly for women and children.

Achieving an average annual per capita consumption of 15 kg of fish by 2020, for the projected population of 1.6 million⁷, will require a fish supply of 24,000 t. The country has the potential to produce over 14,000 t of freshwater fish even if aquaculture is developed with modest inputs using only around 5.0 % of the area classified as ‘most suitable’ (around 4,800 ha). In the medium term, annual fish production from aquaculture is expected to reach over 9,000 t. Supply from capture fisheries is uncertain, but if we assume an increase from current levels of 3,200 t to 15,000 t through increasing coastal fisheries activities, as prioritized in the SDP (2011–2030), the demand-supply gap should be eliminated in the medium term (by 2020).

In the long run, the annual supply from capture fisheries is assumed to be limited to 18,000 t, but the supply from aquaculture could be increased from the medium term 9,000 t target to at least 12,000 t through improvement in production systems to semi-intensive level and the expansion of area at SME level. This would maintain per capita annual fish consumption of 15 kg through to 2030. The SDP (2011–2030) envisions significant improvement in the livelihoods of a large number of resource-poor communities in the years to come. Consumption of fish and meat will increase with rising income. Moreover, there is strong potential to promote fish consumption in the diet of pregnant and lactating mothers, and school children - needy sub-sectors of communities - under the on-going supplementary feeding program through the fortification of the Timor Vita (supplementary food currently being promoted) by adding fish.

⁷ <http://data.un.org/Data.aspx?d=GenderStat&f=inID%3a7>

Actions	Time	Key partners
Testing the feasibility of fortification of Timor Vita through the incorporation of fish	By end 2013	NDFA, Ministry of Health (MoH), development partners, private sector
Research and testing of new approaches to inclusion of fish in supplementary feeding programs at household and school levels	By end 2013	NDFA, MoH, research/development partners, private sector
Development of systems for inclusion of suitable fish species within small-scale irrigation farm pond programs	By end 2013	NDFA, MoH, I/NGOs, research/development partners
Fish consumption and nutrition survey of households with and without fish farming	By end 2015	NDFA, MoH
Replication of successful pilot test results across all poverty prone districts	By 2020	NDFA, MoH, private sector
Nutrition education campaign to raise awareness of nutritionally balanced diets held at community level	By 2015	NDFA, MoH, research/development partners

7. Effective partnerships between government agencies, NGOs, communities, the private sector and donors created

Whilst the NDFA plays a critical role in carrying out activities that are directly related to the development and dissemination of viable aquaculture technologies, a number of other stakeholders from governmental, non-governmental and private sectors will also be catalysts to aquaculture development conducting activities related to infrastructure and service provision that will stimulate aquaculture expansion and intensification.

A strong partnership between MAF, other line ministries and departments, I/NGOs, international aquaculture research organizations, the private sector and communities is crucial to the development of aquaculture in Timor-Leste in order for the sector to be able to contribute effectively towards addressing the nationwide problem of poverty and malnutrition.

Actions	Time	Key partners
Strengthen relationships among public and private sector stakeholders through the promotion of collaborative aquaculture research and development programs/ projects	2012 onwards	NDFA, I/NGOs, private sector
Foster partnerships with district and local governments to ensure that aquaculture development receives adequate attention in their development agenda	2012 onwards	NDFA, local government, community organizations

8. Aquaculture farmer groups and representative institutions empowered

Development of fish farmer institutions for production, marketing or service provisions among groups or clusters has scope to improve the viability of aquaculture among small holders. Formal (such as cooperatives) or informal groups of farmers can respond and react collectively when buying inputs and services and selling their produce. This approach can reduce production costs on one hand, and on the other, increase their bargaining power. Informal groups/clusters can be explored initially, and building on lessons may then move to more formal structures, such as farmer cooperatives over time.

Aquaculture development in Timor-Leste can also serve as an effective tool for empowering women and other vulnerable groups. Its promotion with the active involvement of women members of the community increases their access to and control over resources. Moreover, organizing within groups or cooperatives enables their empowerment and increases their decision-making capability.



Actions	Time	Key partners
Test organizational arrangements among fish farmers into production, marketing and service provision groups/clusters, starting in two pilot project areas	2013 onwards	NDFA, I/NGOs
Develop fish farmer groupings/cooperatives managed and owned by the members based on lessons	2015 onwards	NDFA, MoED, I/NGOs
Explore and support development of a federation of fish farmer groups/cooperatives at the national level, or other representative arrangements for farmers	By 2020	NDFA, MoED, I/NGOs
Strengthen existing seaweed cooperatives through the provision of training for improved organizational, management and marketing skills	By end 2015	NDFA, I/NGOs
Development of Timor-Leste Seaweed Board	2020	NDFA, MTCI

9. Favorable policies in place for environmentally responsible aquaculture development

A clear national policy specific to the aquaculture sector is required to support aquaculture development in Timor-Leste. Whilst the country's general policy is supportive of aquaculture, there are some particular issues that need to be considered in a more precise manner. Land and water use policies for aquaculture development need to be clearly laid out. There is need for legislation to ensure that aquaculture development in Timor-Leste is socially equitable, economically viable and environmentally benign.

The aquaculture development policy of Timor-Leste will be based on the wise and efficient use of land, water and energy resources in order to derive a full range of benefits from them, in harmony with other competing uses. As far as possible, aquaculture will be integrated with existing water and land uses, and fish and other aquatic products will be produced in such a way that it is environmentally benign. Overall, aquaculture development should complement the existing resource use policy of the government. The sector will be developed in compliance with environmental policies that are already in place or being developed within the country. Aquaculture will be expanded where its development has a comparative advantage over other enterprises.

Aquaculture needs its own place in policies, but NDFA should ensure coordination with other line ministries/ departments with regards to the use of land and water resources for aquaculture purposes and develop synergistic relationships between aquaculture and other water, land and natural resource management and conservation policies.

Aquaculture development should also be focused on increasing the adaptive capacity of rural livelihoods to cope with the effects of global climate change. Climate models predict that both total rainfall and seasonal variability in Timor-Leste will increase in the coming decades. In the future, water storage will play an indisputably more important role in enhancing resilience of household food production systems by shortening the ‘lean season’. Introduction of suitable fish varieties into these ponds through an integrated farming systems approach provides important opportunity for nutritional and income benefits to poor rural households that should be fully explored.

Actions	Time	Key partners
Guidelines established on land, water and habitat use for aquaculture	By end 2014	MAF, MoE
Government policy established for land and water use in aquaculture development	2015	MAF, MoE
Timor-Leste aquaculture legislation developed and implemented	2015	MAF, MoE
Update aquaculture development strategy based on recently developed national environmental policy	2015	MAF, MoE

4

IMPLEMENTATION



4. IMPLEMENTATION

The NDFA will take the lead role in the implementation and formal monitoring of the National Aquaculture Strategy. An informal partnership of government/donors/I/NGOs will be established by the NDFA which will meet regularly to promote coordination and planning. The NDFA and partners will develop a monitoring and evaluation system, with indicators, which will enable progress to be regularly reviewed and adjustments made as appropriate.

Implementation of the strategy will require mobilization of both public and private sector investment. A further exercise is needed to elaborate the budget required for implementation and to take action to secure the resources needed from identified sources that might include public sector, private sector, financing institutions and the donor community.





The Timor-Leste National Aquaculture Development Strategy (2012–2030) provides a framework for future responsible development of the aquaculture sector in the country. The strategy is anchored to the underlying principles of combating widespread poverty and malnutrition and for effective ecosystem management in the country. The development of the National Aquaculture Strategy involved consultation meetings with agro-ecological, social, economic, and institutional aspects.

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The content of the strategy does not necessarily reflect the opinion of FAO, AECID, RFLP, WorldFish, CTSP or WWF.

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