MAPPING FISHERIES DEPENDENCE AND AQUACULTURE DEVELOPMENT IN TIMOR-LESTE: A SCOPING STUDY

September 2011

This publication was produced for review by the United States Agency for International Development. It was prepared by Neil Andrew, Kam Suan Pheng, and Michael Phillips of WorldFish Center with funding from the Coral Triangle Support Partnership (CTSP).

Cover photo: A fisherman transports a small catch to market in Dili. Timor-Leste's people are highly dependent on natural resources for food security, exacerbating vulnerability to the effects of over-exploitation, as well as impacts such as civil unrest, internal migration of people, and global environmental processes. © Liz Roder / CTSP

MAPPING FISHERIES DEPENDENCE AND AQUACULTURE DEVELOPENT IN TIMOR-LESTE: A SCOPING STUDY

Neil Andrew
Kam Suan Pheng
Michael Philips

Coral Triangle Support Partnership

Mapping Fisheries Dependence and Aquaculture Development in Timor-Leste: A Scoping Study

Neil Andrew

Kam Suan Pheng

Michael Phillips

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

Citation: Andrew, N., K.S. Pheng, M. Philips (2011). Fisheries Dependence in Timor-Leste: A Scoping Study. Coral Triangle Support Partnership. 27 pp.

Edited by: Maurice Knight, Andrew Harvey

Printed in: Jakarta, Indonesia, September 2011

More information on the six-nation Coral Triangle Initiative and support by USAID can be found at:

www.cti-secretariat.net
www.uscti.org
www.usctsp.org

Funding for the preparation of this document was provided by the USAID-funded Coral Triangle Support Partnership (CTSP) to the WorldFish Center. CTSP is a consortium led by the World Wildlife Fund, The Nature Conservancy and Conservation International.

© 2011 Coral Triangle Support Partnership. All rights reserved. Reproduction and dissemination of material in this report for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders. Applications for such permission should be addressed to:

Maurice Knight
Chief of Party, US Coral Triangle Support Partnership (CTSP)
One Wolter Place - Mezzanine Fl.
Jl. Wolter Monginsidi No.63B
Kebayoran Baru, Jakarta 12180, Indonesia
Indonesia Phone: +62-81-116-0837/Fax: +62-21-576-1080
US Phone: 202-468-4502/Fax: 202-293-9211
maurice.knight@wwfus.org

Disclaimer: This document is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of Coral Triangle Support Partnership (CTSP) and WorldFish Center, and do not necessarily reflect the views of USAID or the United States Government.

CONTENTS

Acknowledgments iii

Executive Summary iv

Acronyms and Abbreviations v

1. Introduction 1
   1.1. Scoping Mission 1

2. Mapping of Fisheries-Dependent Areas 2
   2.1. Background 2
   2.2. Scoping Assessment 3
   2.3. Gaps and Opportunities 3
   2.4. Recommendations for Implementation 5

3. Aquaculture as an Alternative Livelihood Option in NKS 7
   3.1. Background 7
   3.2. Scoping Assessment 7
   3.3. Gaps and Opportunities 11
   3.4. Recommendations for Implementation 12

4. Development of a National Aquaculture Strategy 14
   4.1. Background 14
   4.2. Scoping Assessment 14
   4.3. Gaps and Opportunities 14
   4.4. Recommendations for Implementation 15

5. Implementation Framework 18
   5.1. Work Plan 18
   5.2. Timeframe 19
   5.3. Budget 19

6. References 20

Appendix A USCTI Results Framework 21

ACKNOWLEDGMENTS

This project was funded under the USAID-supported Coral Triangle Support Partnership (CTSP). As part of the US Coral Triangle Initiative Support Program, CTSP is part of the United States Government's commitment to promote the sustainable management of the marine and coastal resources in the Coral Triangle. In cooperation with the national governments of the Coral Triangle and the international community, this five-year program provides technical assistance and builds capacity to address critical issues including food security, climate change, and marine biological diversity.

The authors are grateful to Mr. Rui Miguel da Silva Pinto; Mr. Julio da Cruz, Director of Aquaculture, NDFA; Mr. Osorio Xavier da Costa, National GIS consultant; Mr. Nilton Jorge, Agriculture and Land Use Geographical Information System (ALGIS) Unit; Mr. Paulino da Cruz, Chief of Cadastral Survey, National Directorate of Land and Property (DNTP); Mr. Toru Nagayama, JICA consultant to DNTP; and Mr. Alipio Cardoso Moniz, Census Mapping Unit of Directorate of Statistics for discussion and guidance during our time in Timor-Leste. Many thanks also to Maurice Knight and Scott Atkinson for needed support in setting the project up and advice and helpful comments on the report.

EXECUTIVE SUMMARY

Timor-Leste's people are chronically food insecure. High dependence on natural resources results in high vulnerability to the effects of resource over-exploitation, as well as larger forces including climate change, civil unrest, internal migration of people, and natural disasters. CTSP and WorldFish Center conducted a scoping mission to Timor-Leste as a first engagement with government departments in designing investments in planning and livelihood diversification for fishery-dependent communities through the use of aquaculture. The scoping mission addresses CTSP Indicator 3: *"Number of policies, laws, agreements, or regulations promoting sustainable natural resource management and conservation that are implemented as a result of USG assistance"*.[1]

The scoping mission aimed to support the government of Timor-Leste to address the issue of fisheries-dependence and food security. Through an assessment of current situations and conditions, as well as consultations with stakeholders, the scoping mission proposed a strategy consisting of 1) capacity development of government staff (training and GIS infrastructure); 2) design and deployment of field surveys to map fisheries dependence and identify potential aquaculture areas; and 3) incorporation of survey findings into national Geographic Information Systems (GIS).

The scoping mission also conducted a preliminary assessment of the potential for aquaculture development as an alternative livelihood in Nino Konis Santana National Park (NKS). Marine seaweed is the dominant aquaculture in Timor-Leste's coastal environments, while inland aquaculture production is dominated by common carp (80 percent) and tilapia (20 percent). Through consultation with government officials it became clear that marine and freshwater aquaculture opportunities must be considered to best serve the development aspirations of Timorese people. The scoping mission established a proposed plan of action for 1) establishing an aquaculture spatial plan for NKS; and 2) establishing a pilot seaweed aquaculture project.

There are currently no established procedures for aquaculture licensing, site selection, or zoning in Timor-Leste. There is an urgent need to establish a National Aquaculture Strategy—with related capacity building, infrastructure development, and outreach activities—that considers complex social issues in Timor-Leste. Through consultation with in-country stakeholders, the scoping mission proposes a plan of action for developing a National Aquaculture Strategy.

[1] See USCTI Results Framework in Appendix A

ACRONYMS AND ABBREVIATIONS

ADB Asian Development Bank

ALGIS Agriculture and Land Use Geographic Information System

DNTP National Directorate of Land and Property

GIG Geographical Information user Group

GIS Geographic Information System

IDRISI An integrated GIS and remote sensing software developed by Clark Labs, Clark University.

LSS Life and Social Sciences

MAFF Ministry of Agriculture Fisheries and Forestry

MoAF Ministry of Agriculture and Fisheries

NDFA National Directorate of Fisheries and Aquaculture

NDP National Development Plan

NGO Non-Government Organization

NKS Nino Konis Santana National Park

SIP Sector Investment Program

ToR Term of Reference

1. INTRODUCTION

Timor-Leste's people are chronically food insecure. Floods, strong winds, drought and pest infestations occur annually, and result in loss of food production. Meanwhile the country imports almost half its cereal-equivalent consumption requirements (FAO/WFP 2007). Over 70 percent of the population depends on subsistence agriculture or fisheries for their livelihoods and food requirements, and poor nutrition is a serious issue with over 50 percent of children under five years old undernourished (NSD, 2010).

As a young nation with new government institutions, rapid population growth, and a history of conflict, Timor-Leste faces many challenges in addressing food security and economic growth. Rich marine and coastal resources have an important role to play. Ecosystem services provided by Timor-Leste's estuaries and oceans range from the provision of fish for consumption and sale, to tourism focused on highly diverse coral reefs and associated ecosystems. Balancing the multifarious requirements and uses of marine resources will require coherent government policies.

High dependence on natural resources makes the people of Timor-Leste vulnerable to the effects of resource over-exploitation, as well as larger forces including climate change, civil unrest, internal migration of people, and natural disasters. Diversifying livelihoods and reducing reliance on marine resources is a key prerequisite for the long-term development of coastal communities in Timor-Leste. With opportunities ranging from non-extractive use of natural resources, to aquaculture, to the development of land-based activities such as freshwater fish production, sustainable management of Timor-Leste's marine resources will require long-term strategies, sufficient capacity for implementation, and support from both government and communities.

1.1. Scoping Mission

CTSP and WorldFish Center conducted a scoping mission to Timor-Leste as an initial step towards engaging with government departments to design investments in planning and livelihood diversification for fisheries-dependent communities. The scoping mission addresses CTSP Indicator 3: *"Number of policies, laws, agreements, or regulations promoting sustainable natural resource management and conservation that are implemented as a result of USG assistance"*.[2]

The mission aimed to:

1. Provide technical guidance on the mapping of fisheries-dependent areas by in-country agencies such as the Agriculture and Land Use Geographic Information System unit (ALGIS) and the Department of Statistics.

2. Make a preliminary assessment of the potential for marine-related alternative livelihood programs, such as brackish water aquaculture, in appropriate areas of Nino Konis Santana National Park (NKS).

3. Make a preliminary assessment and recommendations to support the development of a National Aquaculture Strategy.

[2] See USCTI Results Framework in Appendix A

2. MAPPING OF FISHERIES-DEPENDENT AREAS

The scoping mission aimed to assess Timor-Leste's in-country capacity for spatial mapping, as well as the broader needs for applying geospatial technology to support national efforts to improve the management of fisheries resources and the livelihoods of low-income, fisheries-dependent communities. Assessments focused on two aspects: the needs of the fisheries and aquaculture development sector in Timor-Leste that can potentially be serviced by geospatial technology; and the existing in-country Geographic Information System (GIS) infrastructure and capacity of the various government agencies, with a particular focus on ALGIS as the unit that provides geospatial support for the Ministry of Agriculture and Fisheries (MoAF).

2.1. Background

The young nation of Timor-Leste, with a population of just over 1 million, is in the process of recovering from political instability, rehabilitating livelihoods, and strengthening the national economy. Development of the primary sectors (agriculture, fisheries, and forestry)—which provide employment to 78 percent of its population—is a top priority for the government. Timor-Leste's 2007 National Development Plan (NDP) focuses on reduction of poverty in all sectors, and identifies food security as a key issue and agriculture as a priority sector. The NDP also outlines strategies for a fuller use of rural labor, and confirms that agriculture and informal employment will remain important social safety nets for the foreseeable future. In 2009, six national priorities were identified, of which agriculture and food security were again identified as the most critical.

In this context, the fisheries sector is considered an important pillar of the rural economy, together with agriculture (crops and livestock). With a coastline of over 700 km and claim on an Exclusive Economic Zone of 200 nautical miles, Timor-Leste is well endowed with marine fisheries resources. However, weaknesses in policy and limited capacity to manage, monitor, and protect these resources exposes the country to illegal, unregulated and unreported fishing by foreign fleets that threaten to deplete fish stocks. While these issues are being addressed, local fisheries-dependent communities operating at the subsistence level are likely to be the most severely affected. Forward-looking strategies must consider diversification of income opportunities for such communities. Meanwhile, inland communities have limited access to coastal and marine fish catches to fulfill their nutritional requirements. Underdeveloped infrastructure, transportation and supply chains result in high fish prices that are beyond the means of subsistence farmers. Aquaculture offers considerable potential for diversifying livelihoods and enhancing protein food security for both coastal and inland communities.

MoAF is responsible for coordinating and supervising the agriculture, livestock, fisheries, and forestry sub-sectors in Timor-Leste. In 2004, MoAF prepared the Sector Investment Program (SIP) for these sub-sectors, which highlighted the need to evaluate the potential of aquaculture—including marine aquaculture—within the fisheries sub-sector. More recently the MoAF's National Directorate of Policy and Planning prepared a priority plan for proposed interventions, which included the formulation of an aquaculture policy, law, regulation, and development framework. However, with limited capacity for policy formulation, planning, monitoring, and implementation, as well as a lack of accessible information and reliable data on the sub-sector, development of aquaculture and fisheries remains a challenge for the government of Timor-Leste.

2.2. Scoping Assessment

To address the lack of accessible information and reliable data on fisheries, this scoping mission examined opportunities to enhance the capacity of MoAF to use information-gathering techniques, knowledge-generation, and decision-support tools to support rational planning and sound management of the sub-sectors under their jurisdiction. GIS are particularly useful in spatial planning and geographical targeting of development strategies and programs. The Australian government assisted MoAF to establish ALGIS in 2001, to meet mapping and spatial analysis needs for irrigation, forestry, agriculture, and aquaculture.

Various mapping projects, supported by external funding, have helped establish GIS systems in a number of government agencies and produced an impressive array of geospatial products, including the Atlas of the 2004 Population Census. However, the longer-term maintenance of GIS infrastructure (including the hardware, software, and technical capacity of the government staff) beyond the lifetime of these projects is lacking. The long-term impact of these investments will be undermined without continued commitment to maintain and upgrade local capacity in geospatial technology to support the nation-building process and implementation of a National Plan of Action.

It is therefore imperative for ALGIS to maintain its capability to provide geospatial support for fisheries planning and management. This scoping mission conducted an appraisal of existing GIS infrastructure within ALGIS, and identified weaknesses in database management and technical capacity to maintain equipment in a functional condition. These weaknesses inhibit the ability of staff who are keen to enhance their knowledge and skills in geospatial techniques and deliver quality products in their service to MoAF and other ministries and projects.

2.3. Gaps and Opportunities

In consultation with MoAF, and particularly the National Directorate of Fisheries and Aquaculture (NDFA), the scoping mission identified the following priority needs:

1. Proper identification and mapping of fisheries-dependent communities to assist with geographical targeting of livelihood-improvement initiatives that avoid compromising the natural resource base, given the general lack of reliable baseline data and information on the fisheries sector in Timor-Leste.

2. Capacity development to ensure strategic application of geospatial tools for decision-support and provide a rational and science-driven basis for fisheries and aquaculture planning and management.

To address these priority needs within MoAF, the following proposed plan of action was developed:

2.3.1 CAPACITY DEVELOPMENT

To support the role of ALGIS as the geospatial support unit for MoAF, it is necessary to upgrade the existing GIS facility and staff skills to a minimal functional level, as well as foster a closer working relationship between ALGIS and NDFA. This includes providing training to ALGIS and NFDA staff

on GIS basics and application analysis, while building Timor-Leste's national capacity for deploying knowledge-based approaches in planning and managing primary resource-based sectors.

A key priority is to enhance the capacity of ALGIS to conduct suitability mapping for aquaculture to provide the spatial dimension for a national aquaculture strategy, and utilize GIS-based decision support tools for future aquaculture development and management. Of particular importance is the development of country-wide suitability maps for target aquaculture systems, accompanied by a GIS-based decision support toolkit that can be used on a continual basis for aquaculture as well as agriculture planning and management by MoAF.

2.3.2 MAPPING FISHERIES DEPENDENCE AND RESOURCES

To assist with geographical targeting of livelihood-improvement initiatives and coastal resource management strategies, it is necessary to establish and enhance available data on fisheries dependence and aqauculture suitability in Timor-Leste. Mapping could be carried out using the in-country resources of ALGIS, although external technical support will be required.

Mapping approaches should prioritize the following objectives:

1. National scale (1:100,000 proposed) mapping to support national aquaculture planning, and focusing on suitability mapping for both freshwater and marine aquaculture (see section 4).

2. Local-scale mapping (1:25,000 proposed) of fisheries dependence. This involves developing and mapping indicators relating to (a) the resource; (b) the communities; and (c) the use of the resources by the communities — where, when, and how often they use the resource, and what contributions are made by the harvested resources to their livelihoods and food security. Secondary data required include (a) base maps such as those depicting topography (for interpretation of coastline features), bathymetry, road network, district boundaries and hamlet locations; (b) results of coastal habitat mapping studies (e.g., Boggs *et al.*, 2009); and (c) data from socio-economic surveys such as the 2006-07 Living Standards Survey (DNS, 2007). However, many of the indicators need to be developed using primary data collected in the field, which will require conducting participatory mapping supported by base maps from secondary sources and satellite imagery.

3. Local-scale mapping (1:25,000 proposed) of suitable aquaculture areas. This involves (a) identifying the key determinant factors relating to biophysical, socio-economic, and accessibility (to information, infrastructure and markets) conditions; and (b) determining which locations have the characteristics that meet the enabling conditions. Implemented within a GIS, suitable locations would be identified by simple overlays of the maps depicting the location characteristics, with outputs verified in the field and with local experts (see section 3).

Nina Konis Santana National Park (NKS) offers an ideal pilot site for developing and implementing local-scale mapping approaches, and would complement existing alternative livelihood programs while generating a spatial aquaculture plan to support wider management plans for NKS.

2.4. Recommendations for Implementation

2.4.1 STAFFING

A key objective of the proposed plan of action is to engage and enhance national capacity in the use of geospatial technology to address aquaculture planning and management challenges in Timor-Leste. To reconcile the conflicting demands of capacity development and time-bound project implementation, the following staffing arrangements should be considered for future GIS capacity development projects:

1. Appropriate staff from ALGIS with basic GIS experience.

2. Appropriate staff from NFDA with field experience to be exposed to appropriate GIS applications.

3. A national consultant with sound GIS/remote sensing background tasked with overseeing the implementation of activities and, in the process, undergo accelerated training that the consultant will subsequently impart to ALGIS and NFDA staff.

2.4.2 ACTIVITY FRAMEWORK

The following activity framework was developed in consultation with MoAF staff to support the proposed plan of action.

1. Upgrade GIS infrastructure at ALGIS.

    a. Install the existing server, and ensure it is functioning with an uninterrupted power supply.

    b. Ensure key computer equipment items are functional (e.g., notebook computer, color printer, GPS receivers).

    c. Implement proper database management protocols and train database administrator.

2. Provide basic GIS training for fisheries management.

3. Conduct practical training on participatory mapping.

4. Conduct biophysical and socio-economic profiling using background information.

    a. Interpret and map coastal features using available satellite imagery and topographic data.

    b. Compile and analyze socio-economic data (using hamlet-level 2007 LSS data).

5. Design field survey.

    a. Prepare base maps.

b. Develop spatial sampling frame.

c. Develop survey instruments and guides.

6. Conduct field survey.

7. Capture and process data.

8. Map fisheries dependence.

2.4.3 TIMEFRAME

The estimated duration for the activities listed above is six months, depending on how promptly required GIS infrastructure can be put in place and human resources mobilized for training.

3. AQUACULTURE AS AN ALTERNATIVE LIVELIHOOD OPTION IN NKS

The scoping mission aimed to make a preliminary assessment and recommend activities, budgets, and staffing for the development of marine-related alternative livelihood programs, such as brackish water aquaculture, in appropriate areas of NKS.

Through discussion with government officials it became clear that restricting consideration of livelihood diversification options to solely marine-based opportunities in NKS would not best serve the development aspirations of the people of Timor-Leste. Aquaculture development is therefore presented in a broader national context.

3.1. Background

Aquaculture is the world's fastest growing food production sector, and farming, trading, and processing of aquaculture products is of major social and economic importance to millions of small-scale farmers and small- and medium-scale enterprises in many countries throughout Asia. Asia comprises over 80 percent of global aquaculture production—currently around 65 million tons—and is expected to grow to meet future demand for aquatic products. The growth of aquaculture offers opportunities for rural development, employment creation, poverty reduction, nutritional improvements, and overall progress towards achieving the Millennium Development Goals. While the "big picture" in Asia is one of substantial future aquaculture growth, the status of development varies among countries and localities across the region. At national levels, experience suggests that development of the aquaculture sector requires supporting institutions and government policies, with farmers needing access to markets, inputs, skills, and investment to be successful. The right mix of public and private sector support, tailored to national social, economic, and environmental conditions, is essential for successful development of the aquaculture sector.

3.2. Scoping Assessment

3.2.1 AQUACULTURE INSTITUTIONS AND POLICY

Timor-Leste is in the early stages aquaculture development, with some existing coastal and freshwater aquaculture activities. Presently there is no aquaculture policy in Timor-Leste. A draft *Policy and Strategy for Fisheries Development in Timor-Leste* (2007) defines the development of a viable aquaculture industry as a policy priority, but this document has not yet been approved by the national government and has an uncertain status. The draft *Policy and Strategy* lacks a practical implementation strategy. Current legislation accommodates aquaculture in a limited way, but is mainly concerned with subsidies and fish licensing. Any investment in aquaculture (including in NKS) requires a clear policy framework to guide socially and environmentally responsible development of the sector.

The NDFA, within MoAF, is responsible for management of the aquaculture sector. Fisheries legislation exists, but the emphasis is on marine capture fisheries, with limited attention to aquaculture, except for licensing and subsidies. Policy for aquaculture development is a priority for the NDFA. There are presently no established procedures for licensing, site selection, or zoning. A draft policy for aquaculture has been prepared by an external consultant, but there is a technical

emphasis and uncertainties about the relevance of the document to the country; there appeared limited "ownership", capacity for implementation, and a practical implementation strategy.

Currently, ownership of coastal resources and the role of communities in managing resources remain unclear. It appears from discussions with the Haburas Foundation, a local non-government organization (NGO), that local clans play a critically important role in some areas over access to inshore coastal resources. A participatory approach to elicit such information using tools such as "participatory mapping" should be applied, ideally supporting clearly-established user rights for communities to manage aquaculture areas. Timor-Leste is a post-conflict society, and therefore extreme care is needed when considering any "outside" interventions related to fisheries or aquaculture.

A range of community issues need to be considered in developing livelihood diversification options in NKS, as well as other coastal areas within Timor-Leste:

- Consultation processes need to involve clans and will take time to build consensus.
- The right to access and use coastal resources in NKS is largely governed by the clan traditional systems — clans must be consulted on site selection and setting up new aquaculture initiatives.
- Timor-Leste is a post-conflict society, and interventions should contribute to reduced conflict and the development of improved relations and conflict resolution, not the opposite.
- It is extremely important to have local people and organizations supporting communities in participatory design and implementation of an aquaculture project.
- People live in and out of the coastal area — therefore the seasonal and community patterns of coastal resource use need to be considered in aquaculture planning and should be included in the primary data collected to determine fisheries dependence.
- There are some coastal areas of religious significance, or mass communal use (e.g., harvesting sea worms – *metchi*), which should be considered during site selection.
- Working systems tailored to local norms, traditions and livelihood activities need to be considered in any aquaculture venture.

Several project documents from the Asian Development Bank (ADB) and the World Bank caution about weak capacity for implementation at community and government levels. Such concerns need to be considered in the design of any aquaculture or other livelihood interventions that, according to ADB (2007), should be "practical, likely thinking long-term, and contain a mix of capacity supplementation as well as capacity building".

3.2.2 COASTAL AQUACULTURE

The first brackish water aquaculture was established in Timor-Leste in 1987 with milkfish (*Chanos chanos*) and shrimp (*Penaeus monodon*). Milkfish was considered a success, with yields up to 7

tons/ha, but shrimps less so. An estimated maximum of 50 farmers were involved in brackish water farming in the country. Currently there is a mix of government and community ponds, some undergoing or in need of repair (Table 1).

Table 1: Brackish water aquaculure ponds in NKS.

Location	Size (ha)	Management	Status
Tibar	4	community	undergoing repair
Loes	10	government	operational
Manatutu	1	-	damaged
Suai	4	-	damaged
Sakato		community	operational

All operational ponds appear to be extensively used for farming milkfish using seed collected from the wild (or naturally entering ponds). Government policy recommends against the development of new ponds, preferring instead to rehabilitate and improve production from existing ponds. Judging from the site visited at Tibar, there is a considerable need for improved pond design and management. Policy also seems to be directed towards management of ponds by communities rather than government—a positive trend given lack of capacity in government, but one that needs to be backed up by proper technical and organizational support to communities. There are no functional marine hatcheries and no reports of seed importation. In the short- to medium- term such ponds would therefore need to be extensive, and reliant on wild fry or fingerlings (collected, or naturally entering ponds).

Seaweed farming (*Eucheuma* sp. and *Kappaphycus* sp.) began in 1989 and is the main marine aquaculture crop in Timor-Leste. Seaweed is the major crop farmed using long lines — government statistics indicate 257 household groups are involved throughout the country, providing a livelihood for an estimated 1,255 people. Each household group maintains on average 3 ha of seaweed farm. One 3 ha farm visited outside Dili produced around 2 tons per year during 2008 and 2009, equivalent to US$ 1,300 per year. Seaweed is exported (some very limited local consumption of some species occurs), with reported markets in Indonesia, Vietnam, and the Philippines. The end market for these exports is likely to be China, the US, or Europe. Three companies purchase directly from farmers in Timor-Leste, at least one of which provides some input assistance for farmers. Input assistance has reportedly improved the ability of farmers to market products. Prices of US$0.65 – US$0.75 per kg were quoted. This buyer-farmer "cooperation" should be investigated further; as it has potential to offer mutual benefits to both sides if implemented in an equitable way.

Seaweed is reported to provide a useful income supplement to fishers in coastal areas and, subject to environmental assessment (zoning, particularly to avoid coral reef impacts) and community consultation, may have opportunities for development in NKS as an alternative livelihood activity. Support for seaweed farming should also include assistance for organized marketing and improved post-harvest handling to ensure optimal price for the harvested product. Production should be organized to ensure sufficient critical mass of interest to buyers, and address such issues as remoteness and dispersed locations that are common in NKS. Development of seaweed farming may require investment in drying racks, and training of household members in proper handling. Potential links with existing buyers should be explored before investment.

Haburas Foundation has an aquaculture project in Ulmera village (Liquica district) where they provide support for seaweed farming. In return, community members are required to plant and maintain mangroves. NKS has a population of around 7,000 people, some of whom are involved in fishing as part of their livelihood activities. The exact number of fisheries-dependent people and households is uncertain. Of 1,300 people in the area of Tutuala sub-district, where Haburas Foundation is supporting an ecotourism project, 81 people were engaged in fishing as a livelihood activity but it is unclear whether this is full or part-time. Such incomplete data emphasizes the importance of reliable information gathering on fisheries dependant livelihoods, upon which realistic interventions can be considered.

There is reported to be no freshwater or coastal aquaculture in NKS at present. There may be sites suitable for seaweed farming, but not in the Tutuala sub-district where the coastal geography is not favorable. Surveys are needed in other locations in NKS to determine physical suitability, as well as community interest and need, marketing, and other practical aspects.

The government has plans to diversify aquaculture to marine fish and oysters, but there has been no investments to date, and no infrastructure to support this (e.g.,, hatcheries). Sea cucumbers are harvested from the wild and there is limited trading. Based on experience elsewhere in the Indo-Pacific region, these fisheries are unlikely to be sustainable. The technology for sea cucumber aquaculture is well developed and presents a potential diversification option. By law, no live reef fish trade is allowed in Timor-Leste, however Lloyd *et al*. (2008) report that the island of Com is used as a base for exports of live fish to Asian markets.

3.2.3 FRESHWATER AQUACULTURE

Inland freshwater aquaculture production is dominated by common carp (*Cyprinus carpio,* 80 percent) with the remainder being tilapia (undetermined *Tilapia* and/or *Oreochromis* spp., 20 percent). Total annual production is estimated to be about 27 tons. According to government statistics, around 1,200 people are involved in freshwater aquaculture in the country (out of 2,655 aquaculture farmers recorded by the government in 2006). No detailed data on the number and area of ponds or their status were collected, but discussions with NGOs and government officials indicate that there may be significant numbers of small ponds and ditches which may hold water, at least seasonally, many of which were created through road reconstruction and rehabilitation projects since independence.

Government policies support freshwater aquaculture, and subsidies are provided (perhaps also involving donors) for inputs such as imported feeds, 5-12 cm fish fingerlings, and pond construction. The government has limited extension staff, and adopts a demonstration approach. Historically, freshwater carp were introduced in the 1980s and red tilapia in 1990, although the latter is reported not to perform well. Tilapia culture would likely benefit from the introduction of new strains and/or improved breeding and broodstock management in hatcheries. Government staff expressed a clear need for training in broodstock management and hatchery operations. Timor-Leste has three freshwater hatcheries/ demonstration farms, at Same, Loi Huno, and Gleno. Same has water all year round, but Loi Huno and Gleno lack water towards the end of dry season (Sept-Dec). A government-run training center/ demonstration farm exists at Maliana.

There appears to be considerable scope for improving farming systems to better integrate fish production with agriculture. Integrated fish-rice systems are reported, as well as some integrated farming with pigs and chickens. The number of ponds, percentage in use, and level of potential, remains to be explored. Similarly, the potential for farm diversification through aquaculture, from coffee to other crops, remains poorly developed and should be investigated. The timing and availability of water is likely to remain a key concern in the development of inland aquaculture, as is the porosity of soils. Such constraints could be analyzed using the "pond water availability period (PWAP)" modeling of the WorldFish Recommendations Domain tool (Kam and Hoanh, 2007).

Freshwater fish markets appear to be mainly in interior regions. Prices of US$3 per kg were quoted, an exceptionally high price for inland fish, but one that perhaps makes the economics of small-scale aquaculture quite favorable. Demand for freshwater fish in Dili is limited, with marine species being more popular. More analysis is needed on fish consumption patterns; some groups do not eat fish, and some people think that fish (particularly eels) represent ancestors. Cultural aspects in the production, trade, and consumption patterns of fish need to be better understood and used to formulate appropriate aquaculture development strategies.

3.3. Gaps and Opportunities

Although it is reported that there is no aquaculture within NKS at present, the area appears to have several locations suitable for marine aquaculture (mariculture), offering a potential alternative livelihood opportunity. Seaweed farming is highly suitable as a pilot project, with low technological and economic barriers to implementation. Simple technology and markets are available, although remoteness adds a layer of difficulty. Techniques can be adopted by communities, and experience in Timor-Leste shows that seaweed farming is an acceptable and successful livelihood supplementation strategy for coastal fishing households. A more detailed assessment of sites and interested communities would be necessary.

The environment in and around NKS also appears to be suitable for farming of other mariculture species (e.g., sea cucumbers, groupers, lobsters, clams, ornamentals, and possibly sponges) but more detailed feasibility studies are required, including issues related to capacity, remoteness, and market access. Adopting any of these options will require additional investments in infrastructure and skills development. They are less likely to be suitable in the short-term though could have potential in the medium- to long-term (2-5+ years) and should be considered in any National Aquaculture Strategy.

Experiences from other Asia-Pacific nations can guide development of marine aquaculture in Timor-Leste, providing opportunities for on-the-job learning and capacity building for government staff and community members. The specific locations for marine aquaculture cannot yet be identified as this requires more detailed survey and mapping, with potential areas defined during preparation of the proposed zoning plan for NKS. The planning and development of marine aquaculture in NKS should be conducted according to "best practices" defined in a national strategy and implementation guidelines.

Brackish water pond aquaculture is not recommended within the area of NKS due to environmental risks, particularly impacts on existing coastal ecosystems such as mangroves. There may be potential for brackish water ponds in other areas of the country, but more detailed surveys should be conducted before further promotion of this type of aquaculture. The existing government policy to

rehabilitate existing abandoned ponds appears to be the right choice, before embarking on new pond development without the necessary policy, institutions, and supporting services to ensure success.

Based on the findings of the scoping assessment and consultations with MoAF and other stakeholders, the following plan of action is proposed to support aquaculture development in NKS:

1. Establish an aquaculture spatial plan for NKS. This would identify suitable zones for different forms of marine and brackish water aquaculture in NKS, and feed into the wider zoning and management plans. This aquaculture zoning would form part of the overall spatial analysis of fisheries-dependant livelihoods for the NKS area, and identify suitable locations for aquaculture-oriented alternative livelihood investments. Freshwater aquaculture should also be included, to explore opportunities for providing alternative fish sources to inland communities in NKS.

2. Establish a pilot seaweed farming project. Based on the aquaculture spatial plan developed above, this pilot project would provide experience and learning opportunities for local stakeholders in NKS. Lessons learned from the pilot project would inform the development of a national aquaculture strategy for Timor-Leste.

3.4. Recommendations for Implementation

3.4.1 STAFFING

A key objective of the proposed plan of action is to engage and enhance national capacity in the use of geospatial technology to address aquaculture planning and management challenges in Timor-Leste. To reconcile the conflicting demands of capacity development and time-bound project implementation, the following staffing arrangements should be considered for support of aquaculture development in NKS:

1. Appropriate staff from the ALGIS Unit with basic GIS experience.

2. Appropriate staff from NFDA with field experience, including district level staff.

3. An NGO with experience in community consultations.

4. A national consultant with experience in aquaculture and/or coastal resource or rural development to oversee the implementation the activities.

5. Expert assistance in coastal aquaculture planning and seaweed farming.

3.4.2 ACTIVITY FRAMEWORK

The following activity framework was developed in consultation with MoAF staff to support the proposed plan of action.

3.4.3 STAGE I: ESTABLISH AN AQUACULTURE SPATIAL PLAN FOR NKS

1. Form aquaculture spatial planning team (see section 2.4.1).

2. Collect relevant spatial data (technical, social, environmental) through review of existing data and field visits.

3. Develop criteria for site selection for priority marine and brackish water aquaculture systems.

4. Prepare draft maps.

5. Determine enabling conditions.

6. Conduct ground-truthing and workshops to finalize maps.

7. Integrate aquaculture plan into overall spatial plan for NKS.

3.4.4 STAGE 2: PILOT SEAWEED FARMING PROJECT

1. Form project team.

2. Assess markets, transport routes, labor force, potential conflict, risk, and other factors.

3. Survey sites and consult communities for site selection. As a minimum, 5 sites totaling 15-20 ha should be identified to produce sufficient seaweed product to be of interest to wholesale buyers.

4. Conduct community consultations and together select households to participate in pilot project.

5. Prepare seaweed pilot project implementation plan in a participatory way with selected households and community members.

6. Conduct training and organizational support for households in seaweed farming, post-harvest processing, and organized marketing.

3.4.5 TENTATIVE TIMELINE

The estimated duration for Stage 1 activities is about 6 months, depending on how promptly human resources can be mobilized. Stage 2 activities may commence within about 3 months of the start of Stage 1.

The project should be implemented over at least a three-year period to assess the success of seaweed farming as an alternative livelihood. Details of the implementation phase should be established during Stage 2, including provision for regular monitoring and evaluation to direct project development.

4. DEVELOPMENT OF A NATIONAL AQUACULTURE STRATEGY

The scoping mission aimed to make a preliminary assessment and recommendations to support the development of a National Aquaculture Strategy in Timor-Leste.

4.1. Background

Current fisheries legislation in Timor-Leste accommodates aquaculture in a limited way, but is mainly concerned with subsidies and fish licensing. Investments in aquaculture (including in NKS) require a clear policy framework to guide socially and environmentally responsible development of the sector.

4.2. Scoping Assessment

Timor-Leste is in the early stages of aquaculture development, with some experience in coastal and freshwater aquaculture and considerable potential for the future. Presently there is no aquaculture policy in Timor-Leste. The draft *Policy and Strategy for Fisheries Development in Timor-Leste* (2007) nominates the development of a viable aquaculture industry in Timor-Leste as a policy priority but this document has not yet been approved by the national government and has an uncertain status. The draft *Policy and Strategy* lacks a practical prioritized implementation strategy.

Aquaculture experiences in Timor-Leste demonstrate the potential for coastal and inland aquaculture to contribute towards alleviating chronic food insecurity and nutrition problems, and in coastal areas towards income generation. Expanding these initial activities will require strategies that base aquaculture development on community needs and opportunities, requiring further analysis, and a participatory approach to aquaculture planning that addresses the needs and skills of inland and coastal communities.

4.3. Gaps and Opportunities

Preparation of a practical implementation strategy for aquaculture is suggested as a priority, and would support strategic investments for alternative livelihood development at the local level

Environmental issues and management options should be identified in the National Aquaculture Strategy document, and guidelines prepared to guide future aquaculture development in Timor-Leste. The need for environmental guidelines is identified in the draft National Plan of Action under the goal of livelihoods and implementation of the ecosystem approach to management. The approach will provide a more solid legal and policy foundation that would benefit aquaculture development, while also supporting the development of socially and environmentally responsible aquaculture throughout the country.

There is limited capacity within NDFA to support the development of brackish water and marine aquaculture, therefore a national strategy should prioritize small-scale practical interventions in the most suitable areas, gradually expanding as experience and capacity develop. A carefully-phased approach to aquaculture development, building upon existing capacity, and focusing initially in the areas most likely to be successful, should be central to the preparation of a National Aquaculture

Strategy. There is very little donor or private sector investment in marine and brackish water aquaculture. The United Nations Food and Agriculture Organization (FAO) is planning assistance to small-scale coastal aquaculture under the Regional Fisheries Livelihoods Program from 2009-2012.

4.3.1 MAPPING TO SUPPORT THE NATIONAL AQUACULTURE STRATEGY

The development of a National Aquaculture Strategy will require mapping patterns of fisheries-dependence and aquaculture suitability throughout the country. This process would build on the skills and experiences acquired by the local GIS practitioners engaged in mapping fisheries-dependence in Timor-Leste (section 2.4.1), and undertakes a more formal approach and advanced use of geospatial tools to analyze and support decision making in aquaculture planning and management at the national level, as depicted in Figure 1.

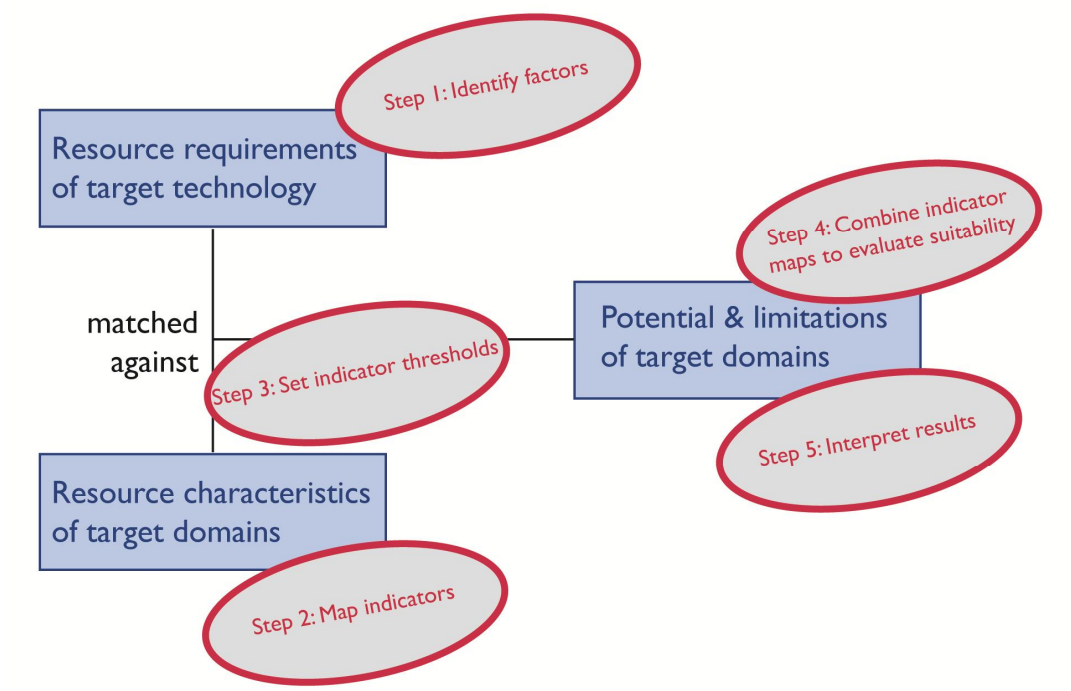


Figure 1: Framework for determining spatial recommendation domains for aquaculture.

This is a more involved and elaborate process that requires comprehensive national data sets and GIS-based modeling to develop a wide range of biophysical, socio-economic, and infrastructure indicators, and the use of multi-criteria evaluation techniques to analyze and map aquaculture suitability. The mapping process should develop suitability maps that can be electronically queried to assist decision-making about aquaculture development and interventions.

4.4. Recommendations for Implementation

4.4.1 STAFFING

A key objective of the proposed plan of action is to engage and enhance national capacity in the use of geospatial technology to address aquaculture planning and management challenges in Timor-Leste. To reconcile the conflicting demands of capacity development and time-bound project

implementation, the following staffing arrangements should be considered for support of a National Aquaculture Strategy:

1. The same team of NDFA/ALGIS staff proposed in section 2.4.1, some of whom will receive overseas training.

2. Domestic consultants.

3. External expert assistance in aquaculture.

4.4.2 ACTIVITY FRAMEWORK

The purpose of the National Aquaculture Strategy is to provide practical guidance for environmentally and socially responsible sector investment. The absence of such a framework to guide aquaculture development will likely result in a series of *ad hoc* initiatives that do not serve the broader development aspirations of Timor-Leste. Through consultation with stakeholders, including MoAF, the following plan of action is recommended:

1. Formation of a strategy development team in NDFA and ALGIS and preparation of a work plan.

2. Site visits, stakeholder consultations, and data collection via farm visits and meetings/local workshops at central and local levels.

3. Mapping analysis of inland and coastal aquaculture (see details below).

4. Preparation of investment plans covering improvement of existing government/community demonstrations and new investments, covering:

    a. Freshwater aquaculture, with an emphasis on opportunities for freshwater fish to contribute to food and income for inland communities.

    b. Coastal aquaculture and feasibility of the following mariculture species/ commodities: sea cucumbers, marine fish, lobsters, giant clams, oysters, ornamentals, and sponges.

5. Preparation of aquaculture implementation guidelines (environment and community approaches to implementation) to support freshwater and coastal aquaculture.

6. Training of key personnel on relevant aquaculture systems and planning.

7. Preparation of a draft national aquaculture strategy document for stakeholder review and finalization.

The following activities support the mapping component of the national aquaculture strategy (item 3 above):

1. Enhance in-house GIS capacity for spatial analysis and modeling.

a. Acquire IDRISI software; conduct IDRISI training.

b. Specialized/advanced GIS training for:

i. Spatial modeling and generation of indicator maps.

ii. GIS modeling using multi-criteria evaluation.

2. Conduct stakeholder consultation to develop GIS models.

3. Source, capture, and process secondary data.

4. Develop and map indicators – this is a time-consuming process that requires the use of a wide range of database and GIS analytical techniques to handle diverse data types and on different subject matter.

5. Conduct stakeholder/expert elicitation to parameterize models.

6. Run models, examine and verify results.

7. Provide training on use of decision support tools.

4.4.3 TIMEFRAME

The estimated duration for preparation of the national aquaculture strategy is 12 months.

5. IMPLEMENTATION FRAMEWORK

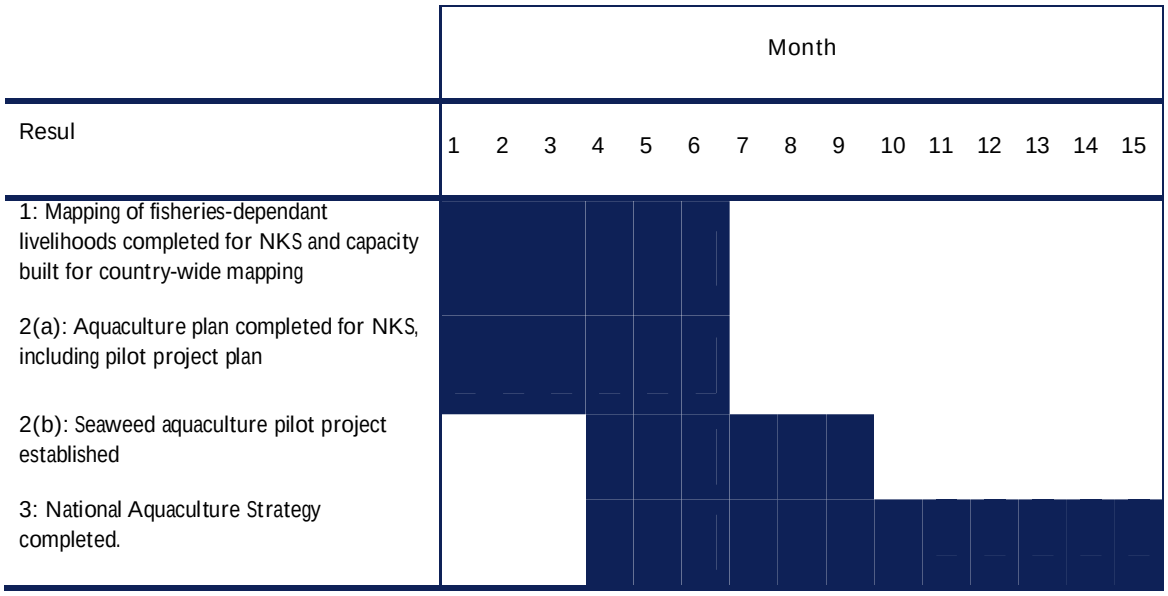
The following section provides a proposed framework for addressing recommendations of the scoping mission to: 1) map fisheries-dependent communities; 2) develop aquaculture as an alternative livelihood in NKS; 3) Develop a National Aquaculture Strategy.

5.1. Work Plan

Result	Activities	Inputs
1: Mapping of fisheries-dependant livelihoods completed for NKS and capacity built for country-wide mapping	▪ Upgrade GIS infrastructure at ALGIS ▪ Install the existing server and get functioning with uninterrupted power supply ▪ Ensure key computer equipment items are functional: notebook computer, color printer, GPS receivers ▪ Put in place proper database management protocol and train database administrator ▪ Provide basic GIS training for fisheries management ▪ Conduct practical training on participatory mapping ▪ Conduct biophysical and socio-economic profiling using background information ▪ Interpret and map coastal features using available satellite imagery and topographic data ▪ Compile and analyze socio-economic data (using hamlet-level 2007 LSS data) ▪ Design field survey ▪ Prepare base maps ▪ Develop spatial sampling frame ▪ Develop survey instruments and guides ▪ Conduct field survey ▪ Capture and process data ▪ Map fisheries dependence	ALGIS/NDFA staff Expert assistance Workshops/meetings GIS analysis equipment Domestic and international travel
2 (a): Aquaculture spatial plan for NKS completed.	▪ Formation of aquaculture spatial planning team. ▪ Collect relevant spatial data (technical, social, environmental data) through review of existing data and field visits. ▪ Develop criteria for site selection for priority marine and brackish water aquaculture systems ▪ Prepare draft maps ▪ Conduct ground-truthing and workshops to finalize maps	NDFA/ALGIS staff Expert assistance Workshops/meetings GIS analysis Domestic and international travel
2(b): Seaweed aquaculture pilot project established.	▪ Formation of project team ▪ Site surveys and community consultations for site selection. Objective should be to identify 5 sites covering 15-20 ha to produce sufficient seaweed product to be of interest to buyers. ▪ Conduct community consultations and together select households to participate in pilot project ▪ Prepare seaweed pilot project implementation plan in a participatory way with selected households and community members. ▪ Conduct training and organizational support for households in seaweed farming, post-harvest processing and organized marketing. ▪ Conduct monitoring and evaluation on regular basis and at end of year prepare up-scaling strategy over following 3 years.	NDFA and local government staff Community NGO or other local agency with community mobilization experience Expert assistance (seaweed farming and community mobilization) Domestic and international travel
3: National Aquaculture Strategy completed. The purpose is to provide practical guidance for environmentally and socially responsible sector investment. The absence of such a framework to guide aquaculture development will likely result in a series of *ad hoc* initiatives that do not serve the broader development aspirations of Timor-Leste.	▪ Formation of strategy development team in NDFA and preparation of workplan. ▪ Site visits and stakeholder consultations and data collection via farm visits and meetings/local workshops at central and local levels. ▪ Preparation of investment plans covering improvement of existing government/community demonstrations and new investments, covering ▪ Freshwater aquaculture, with an emphasis on opportunities for freshwater fish to contribute to food and income for inland communities ▪ Coastal aquaculture and feasibility assessments for the following mariculture species/ commodities: sea cucumbers, marine fish, lobsters, giant clams, oysters, ornamentals, sponges. ▪ Preparation of aquaculture implementation guidelines (environment and community approaches to implementation) to support freshwater and coastal aquaculture ▪ Training provided in Timor-Leste and Asian countries on relevant aquaculture systems and planning ▪ Preparation of draft aquaculture strategy document for stakeholder review and finalization ▪ GIS analysis of inland and coastal aquaculture (using modified WorldFish Recommendations Domain tool) ▪ Enhance in-house GIS capacity for spatial analysis and modeling ▪ Acquire IDRISI software; conduct IDRISI training ▪ Specialize/advanced GIS training for: ▪ Spatial modeling and generation of indicator maps ▪ GIS modeling using multi-criteria evaluation ▪ Conduct stakeholder consultation to develop GIS models ▪ Source, capture and process secondary data ▪ Develop and map indicators – this is a time-consuming process that requires the use of a wide range of database and GIS analytical techniques to handle diverse data types on different subject matter ▪ Conduct stakeholder/expert elicitation to parameterize models ▪ Run models, examine and verify results	NDFA staff Expert assistance Workshops/meetings GIS analysis Domestic and international travel In-country and overseas training

- Provide training on use of decision support tools.

5.2. Timeframe



5.3. Budget

Result	Budget (USD)
1: Mapping of fisheries-dependant livelihoods completed for NKS and capacity built for country-wide mapping	$35,000
2(a): Aquaculture plan completed for NKS completed including pilot project plan	$35,000
2(b): Seaweed aquaculture pilot project established	$100,000
3: National Aquaculture Strategy completed.	$120,000

6. REFERENCES

Boggs G, Edyvane K, de Carvalho N, Penny S, Rouwenhorst J, Brocklehurst P, Cowie I, Barreto C, Amaral A, Smit N, Monteiro J, Pinto P, Mau R, Amaral J, Fernandes L. (2009). *Marine & Coastal Habitat Mapping in Timor-Leste (North Coast) – Final Report.* Ministry of Agriculture & Fisheries, Government of Timor-Leste.

DNS [Directorate of National Statistics] (2007). *Interim Statistical Abstract: Timor-Leste Survey of Living Standards 2007.* Directorate of National Statistics. 160 pp.

Edyvane K, McWilliam A, Quitas J, Turner A., Penny S, Teixeira I, Pereira C, Tibirica Y, Birtles A. (2009). *Coastal and marine ecotourism values, issues and opportunities on the north coast of Timor-Leste – Final Report.* Ministry of Agriculture and Fisheries, National Directorate of Tourism, Government of Timor-Leste, 79 pp.

FAO/WFP [Food and Agriculture Organization/ World Food Programme] (2007). Crop and Food Supply Assessment Mission to Timor-Leste. Published by Food and Agriculture Organization of the United Nations, Rome and World Food Programme, Rome

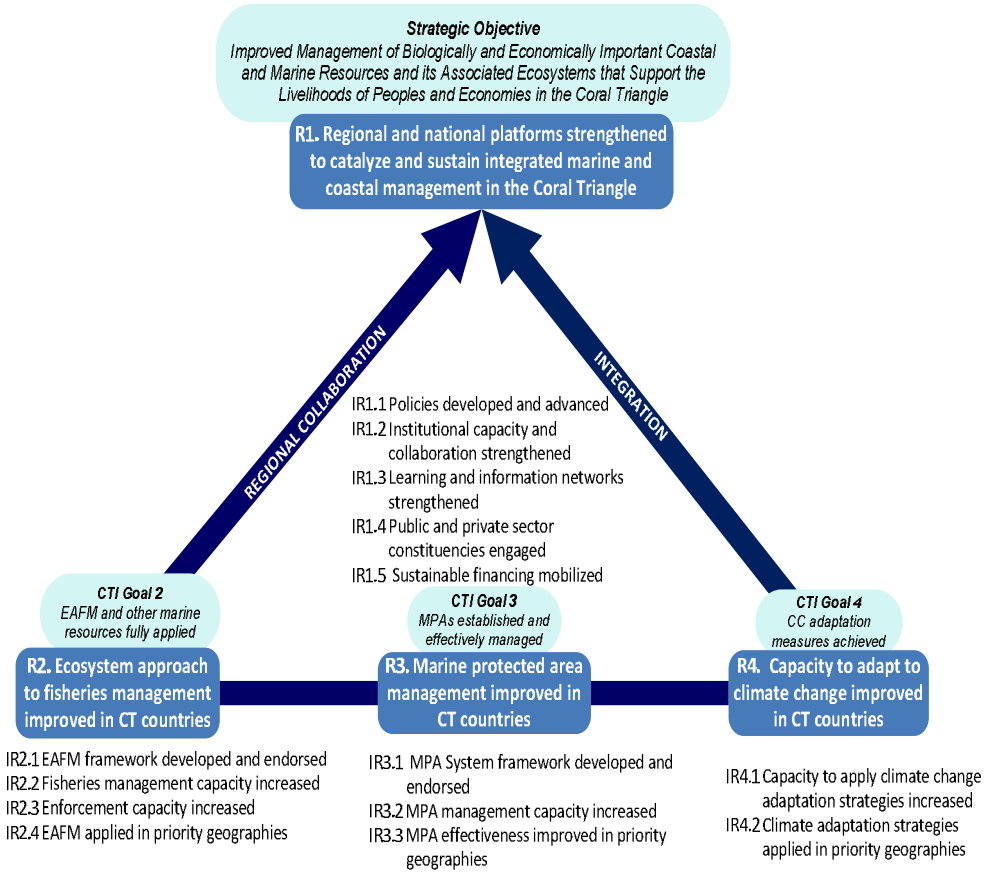
Kam SP, Barth H, Pemsl DE, Kriesemer SK, Teoh SJ and Bose ML (2008). *Recommendation Domains for Pond Aquaculture. WorldFish Center Studies and Reviews 1848.* The WorldFish Center, Penang, Malaysia, 40 pp., with accompanying DVD-ROM.

Lloyd J, Errity C, Howard K, Kane Dysart K, Damaso J, de Carvalho N, Jesus C, Monfeiro J, Da Cunha Barreto C, do Santos G, Pereira Gonçlaves R. (2008). *Fisheries development in the Com-Tutuala-Jaco Island area.* Northern Territory Government. 55 pp.

NSD [National Statistics Directorate] (2010). Timor-Leste Demographic and Health Survey 2009-10. National Statistics Directorate of Timor- Leste and ICF Macro.

APPENDIX A USCTI RESULTS FRAMEWORK

Progress for CTSP is measured against the USCTI Support Program Consolidated Results Framework illustrated below.



CTSP uses the USCTI set of common indicators to measure program progress:

Common USAID Indicators to Measure Program Progress

1. Number of hectares in areas of biological significance under improved management.
2. Number of hectares under improved natural resource management as a result of USG assistance.
3. Number of policies, laws, agreements or regulations promoting sustainable natural resource management and conservation that are implemented.
4. Number of people receiving USG-supported training in natural resources management and/or biodiversity conservation.
5. Number of laws, policies, agreements, or regulations addressing climate change proposed, adopted, or implemented as a result of USG assistance.
6. Number of public-private partnerships formed.

BLANK PAGE

CORAL TRIANGLE SUPPORT PARTNERSHIP

One Wolter Place, Jl. Wolter Monginsidi No.63B, Kebayoran Baru, Jakarta 12180, Indonesia