



NORWEGIAN EMBASSY

	Final report
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2 Executive summary

The Fisheries Sector Support Program, Timor-Leste (FSSP-TL) partners, WorldFish and the Directorate General for Fisheries, Ministry of Agriculture and Fisheries, Timor-Leste (DGP) have made substantial and lasting progress in the core areas in the four years since project inception. This progress has made substantial and lasting contributions to building the pre-conditions for sustainable management of coastal resources, and highlighted significant opportunities for the future development of the sector in a way that supports improved livelihoods and nutrition for the people of Timor-Leste.

Policy and legal basis for capture fisheries management in Timor-Leste

Prior to the FSSP-TL, there were no clearly defined objectives and aspirations for the sector, and the legal system was out of date (had not been updated for 15 years), inappropriate and in many cases inoperable. A highly participatory process for developing the National Fisheries Strategy (NFS) integrated input from stakeholder consultations in 27 fish landing sites across all 13 coastal municipalities of Timor-Leste engaging over 500 women and men fishers and community members, followed by 5 regional consultations and culminating in a very successful **Women Fishers' Forum** and the **National Fisheries Forum** where the final strategy was presented. The strategy outlines a vision for the sector that prioritises nutrition benefit to the people of Timor-Leste, sustainability of coastal and marine resources, and the development of fish-based livelihoods for coastal dwellers. It ensures integration with appropriate regional and international agreements. The strategy is now in final draft form, still requiring technical translation into Tetun and Portuguese, prior to being presented to the council of ministers for ratification.

The costed extension phase of the project supported a complete **revision of the fisheries law** for Timor-Leste. The project contracted a Portuguese consultant natural resources lawyer to work with WorldFish team members, a MAF working group and a diverse group of national and international stakeholders to revise and reduce the Fisheries Decree Law and associated Government Decree down from more than 400 (often repetitive or contradictory) articles to 148 articles. The law is simpler and contextually integrated due to extensive consultation processes involved, and therefore easier to implement. New directions are based on both the needs and aspirations of resource owners and stakeholders, and new opportunities for the sector. Due to the extensive participatory processes involved in its development, senior resource managers are intimately connected to the purpose and detail of the revisions. This document has been finalised and is ready to submit to the Parliament following translation.

Improved capacities for sustainable fisheries management in Timor-Leste

Project components relating to the actions of management included development of new tools for effective monitoring of small-scale tropical fishing activities, building new capabilities for assessment, and conducting preliminary assessments. A **digital fisheries monitoring data system** for Timor-Leste (*PeskaAS*) was developed and operationalized. This system likely represents one of the most advanced and contextualized systems for monitoring and management of small-scale tropical inshore fisheries globally. A number of discussions have ensued around implementing this system in other countries. The system uses a tablet-based data recording approach, downloading data through the mobile network directly to a centralised database. Fishery activity is monitored by solar powered GPS tracking systems that archive data and download it once the unit is in range of the mobile network (meaning expensive satellite subscriptions are not required). To improve the quality of data being entered into this system a new comprehensive **fish species ID guide for Timor-Leste** was developed, incorporating pictures, distribution maps, and ecological & biological information for ~200 fish species.

Not only has this data system been launched and become fully operational, it has now seen direct investment and uptake by the Ministry of Agriculture and Fisheries (MAF) as 11 new data recorders have been hired to collect fisheries data in each of the 11 coastal municipalities. This level of engagement ensures the sustainability of this project activity.

In addition, the **first quantitative assessment of fish biomass** on Timor-Leste's coastal reefs was conducted using underwater visual census methods, and associated training provided to DGP staff. These surveys showed that reef fish stocks are generally healthy, and as such while improved monitoring and management capacity is necessary for future sustainability, current levels of fishing pressure are not of great concern.

All recent research conducted under the FSSP-TL and associated projects, as well as available information from past efforts in the sector and in aquaculture projects, was summarised in an accessible form as a **State of Fisheries & Aquaculture Report for Timor-Leste**. This report represents the platform of knowledge on which the future of fisheries and aquaculture development in Timor-Leste can be based. It contains information on species composition of Timor-Leste's important fisheries, catch rates, new national production estimates, and recommendations for future directions in the fisheries and aquaculture sectors.

Increased production from fishing technology driving investment in fisheries sector

Participatory research on **fish aggregating devices** (FADs) conducted with communities has resulted in the refinement of FAD designs suitable for deployment in the challenging conditions in Timor-Leste and has shown FADs can be highly effective in boosting nearshore fish catch rates. FADs deployed in a number of sites in Timor-Leste have been effective at attracting small pelagic fish species. These not only represent a robust stock with a lifecycle conducive to sustainable management, but also as an oily fish, provide exceptional quality nutrition. Where FADs are effective this has also resulted in an increase in investment by fishers and traders in certain communities such as new boats, freezers and transportation. Further research is required to understand why FADs are more effective in some locations than others, enabling a sensible program of managed FAD deployment.

Working with a contracted master fisher also shone a light on a number of other options for technology development worth exploring in the context of increasing sustainable use of national fish resources by Timorese fishers.

Nutrition from fish: Improving understanding and raising awareness

A **tablet-based survey tool** incorporating local food groups has been developed for wider application in baseline studies for projects aimed at increasing fish consumption and dietary diversity. Detailed fish consumption survey was collected in 200 inland households, providing a baseline for households likely to be the focus of future value-chain development trails (although the value-chain component of the current project was discontinued). A locally produced **film raising awareness about nutrition from fish**, particularly for children and lactating mothers, will be a vital resource in future education campaigns conducted in association with value-chain development activities.

Indirect outcomes

The key indirect outcome from this project has been the catalysis of engagement and interest from other NGO, CSO and donors in supporting the fisheries sector in TL, but also external interest in the tools, technologies and methods developed. These include the further development of the data system as a prize-winning project of the CGIAR Big Data Platform's Inspire Challenge 2018; funding support for fisheries projects from ACIAR and USAID, and an ongoing and scaling relationship with private sector partner Pelagic Data Systems to other countries in the region. The project has built a strong platform for engagement with the new Fisheries program and the national University, while capacity built among key collaborating DGP staff will ensure strong and productive collaborations in the future.

3 Background

3.1 Fisheries and nutrition security in Timor-Leste

As a young, post-conflict nation Timor-Leste has strong ambitions for a future of self-sufficiency and economic growth. Yet with evolving institutions, a dynamic political environment and an as-yet restricted economic base, the nation faces many challenges in forging a prosperous future for its people. A looming challenge is to look beyond the current heavy reliance on oil (currently ca. 90% of national income) to a future with a diversified and sustainable national income making optimally use of renewable natural resources.

The government of Timor-Leste is acutely aware of these challenges. The Timor-Leste Strategic Development Plan (2011-2030) underscores the need for the development of a thriving rural economy to provide food security and promote economic growth. Yet the Food production indicators currently do not tell an encouraging story. Despite the agricultural sector employing 80% of the active population, and agricultural production accounting for 30% of non-oil GDP, in recent years the food sector component of agricultural GDP has declined on a per-capita basis, reflecting a failure to keep pace with a rate of population growth which is amongst the highest in the world (c.a. 3.2% per annum).

Nutrition security remains a significant challenge for Timor-Leste, today and into the future. Figures for 2013 (UNICEF 2013) placed Timor-Leste as having the highest rate globally of stunting among children under 5 years of age (58%), matched only by Burundi. Preliminary analysis of figures for 2014 (IRIN 2014) suggest that after several years of increasing stunting rates, there are at last signs of improvement (preliminary estimate 52%). However, there is clearly much to be done to continue this trajectory. The Timorese government recognised the need to address the nation's nutrition and food security challenges and in 2010 the Comoro Declaration against Hunger and Malnutrition reiterated the need for a co-ordinated action plan. Current efforts to improve food security are coordinated through 'The National Council of Food Security, Sovereignty and Nutrition of Timor-Leste' (KONSSANTIL). This inter-ministerial council seeks to co-ordinate policy and interventions and strengthen institutions to maximize benefit from interventions. Progressing towards the goals of KONSSANTIL, in January 2014, Prime Minister Xanana Gusmão launched Timor-Leste's involvement in the UN-coordinated 'Zero Hunger Challenge'. The program aims to defend the fundamental right to good nutrition for all.

The fisheries and aquaculture sectors have substantial and unrealised potential to contribute to improved food and nutrition security in Timor-Leste. In stark contrast to neighbouring nations and small island states globally, Timor-Leste currently makes very limited use of its living marine resources. Fish consumption is low, estimated at 6.1 kg/capita/yr¹ (AMSAT International, 2011) (c.f. Indonesia: 25.4; Solomon Islands: 33.0; Kiribati: 62.2). Moreover, consumption is heavily skewed towards coastal communities. Fish consumption on the coasts approaches global averages, while consumption in inland areas is exceptionally low; often below 4kg/capita/yr. Research suggests price and availability, not preference, are driving these low consumption figures. When asked why they did not consume fish, in urban, coastal and non-coastal areas the majority said it was due to high price (94%, 94% and 71%, respectively) (AMSAT International, 2011). In the non-coastal areas, 56% reported that limited availability was the reason for not consuming fish. Increased availability of affordable fish is likely to lead to substantial increases in consumption.

Fish has the potential to play a critical role in reversing the Nation's startling malnutrition statistics; particularly among children. Protein energy malnutrition and micronutrient deficiencies are the most common forms of malnutrition in the country (National Directorate of Statistics, 2010). Fish is both a rich source of quality animal protein and an excellent source of micronutrients and (dependent on species) essential fatty acids. Protein is important for growth, while essential fatty acids are important for neurological development, visual maturation, motor skill development and brain development (Michaelsen et al. 2009). Some fish species are a good source of bioavailable iron and zinc which are

¹ It should be noted that DGP dispute these low numbers, as they are based on a very limited sample across 5 districts only. A more comprehensive survey is needed.

important micronutrients for growth and immune function. In addition, fish enhances mineral absorption from other food items in the meal, and unlike some plant-source foods, fish does not contain inhibitors that block absorption (Andersen et al 2013). Small fish which are eaten whole are extremely rich in bioavailable calcium. Some small fish species also contain high amounts of vitamin A (Thilsted 2012). The high content and bioavailability of these essential nutrients make fish a valuable food in the diet, in all stages of life, especially in the first 1,000 days.

3.2 The fisheries sector in Timor-Leste

Currently, the consumption of fish in Timor-Leste is constrained by production, availability, price and customary consumption norms (AMSAT International 2011; Alonso 2013). Prior to this project's efforts, there was little available data on catch rates, and catch numbers reported to FAO annually were estimates based on out-of-date data. The most recent estimate prior to this study (Barbosa and Booth, 2009) of 5,600t is in line with estimates derived from consumption figures (c.a. 6,700t, which includes imports). Fishing is rarely a full-time occupation in Timor-Leste, but rather one component of a diverse rural livelihood system. Fishing techniques are simple and labour-intensive, and vessels small, resulting in relatively low catch rates. Recent estimates (Alonso et al. 2012) suggest there are currently some 3000 fishing vessels in Timor-Leste and some 4,700 fishers operating from vessels. The fleet is almost entirely comprised of small, dugout or fiberglass vessels, most of which are not motorized (62%). Fishing is normally by gill net or handline. In addition, spear fishing, gleaning for shellfish and cephalopods (primarily by women) and trap fishing are common, but often do not use vessels.

While the Timorese have a tradition of fishing that can be traced back at least 40,000 years, a more recent colonial history of some 430 years has seen local communities restricted largely to fishing near-shore and reef areas, with colonial powers claiming rights to oceanic fish resources and possessing the capital to exploit them (MAF, 2001). The inshore fishing grounds, due to the extreme topography of the country, are small in area and production capacity. With fishing currently largely restricted to these inshore areas, this limits production capacity and there are concerns that these areas are becoming overexploited. In addition, with exposed coasts and highly seasonal catches, coastal dwellers have been reluctant to invest in fishing, instead staying with simple production means and diversified livelihoods. This low production modality, combined with demand for fish from the middle-class, restaurant and expatriate communities in Dili has led to pricing that puts fish out of reach of the rural poor. This has been appropriately labelled a 'vicious cycle' of low productivity and high price (Hartmann 2010 cited in Alonso 2013). This contrasts strongly with neighbouring Indonesia, where fish clearly makes a strong contribution to food security and nutrition among the poor.

It is clear that the pathway to improving the contribution of fisheries to national food and nutrition security is neither simple nor linear. What is clear is that any move to promote greater use of marine resources must be accompanied by a parallel increase in capacity for resource management. The potential of the resource, appropriate approaches to sustainable management, pro-poor value chains and community education on the health benefits of fish consumption are all likely to be important in bringing about significant changes in fish consumption. The activities undertaken in this project began the processes of directly addressing these issues while, while working in close consort with other government and donor initiatives in the fisheries sector.

3.3 Timor-Leste – Norwegian cooperation

Cooperation within the fisheries sector between the Democratic Republic of Timor-Leste and the Kingdom of Norway was discussed on several occasions between the Norwegian Ambassador to Timor-Leste and the President of Timor-Leste and the Minister for Agriculture and Fisheries. In a letter dated 14 May 2013 to the Minister of Agriculture and Fisheries of Timor-Leste, the Norwegian Embassy suggested areas of cooperation within fisheries management.

The emphasis of this project built heavily on national priorities as articulated in the Timor-Leste Strategic Development Plan 2011 – 2030 and the MAF Strategic Plan 2014 – 2020. The project was founded on the notion of partnership and aimed to facilitate the development of the fisheries sector by engaging

appropriate local and international expertise in the processes of capacity building, research and targeted investment.

4 Objectives

Development Objective

This project was designed to be highly adaptive, with a scoping and piloting phase informing an intervention and investment phase. The follow on phase of intervention and investment was not supported, so this document reports the detailed results of only the *scoping and piloting* phase. As such, it is not possible at this time to answer the development objective of this project:

Improved food and nutrition security of rural households in Timor-Leste

This long-term goal contributes directly to the overall strategic and development goals of Timor-Leste as expressed in the *Timor-Leste Strategic Development Plan (2011-13)* and the clear intent of the '*Zero Hunger Challenge*'. The success in achieving this development objective is dependent on the success of other food-security related projects, and impacts from this project should be measured beyond the timeline of project activities (2025). Indicators of success are:

- Increased fish consumption by children and pregnant women
- Reduced incidence of stunted growth (malnutrition) in children under five

These outcomes can be quantified through the comparison of results from household surveys with project baseline surveys. Statistics from the ministry of health, and other NGOs focusing on food security will provide additional evidence.

In order for these ambitious objectives to be achieved over the longer term, substantial changes in fish production (through policy, technology and management), access (through the development of pro-poor value-chains) and in behaviour relating to diets (through education) are required.

Immediate objectives

The immediate objective or purpose of the FSSP-TL was to initiate the development of the essential preconditions to achieving the overall development objective, namely:

- 1) Improve information and capacity for resource management
- 2) Improve sustainable small-scale fishing technologies
- 3) Explore the participatory development of pro-poor fish value-chains
- 4) Build capacity through formal and informal training
- 5) Develop a strategy and policy for marine fisheries

This report highlights that through activities aimed to address these immediate objectives, many of the pre-conditions necessary to achieve the project development objective have been significantly advanced, and opportunities for future development of the sector highlighted.

5 Achievements against activities and outputs/milestones

Objective 1: Improved information and capacity for sustainable resource management

no.	activity	outputs/ milestones	completion date	comments
1.1	Support and further develop fishery data collection by NDFA	<i>PeskaAS</i> system of data capture, automated analytics and decision dashboard in place	Project end	Developing fishery data collection by MAF has incorporated a participatory design process and training in digital capture methods. This has culminated in MAF adopting the system and investing in hiring 11 dedicated SSF landings data recorders throughout the country.
1.2	Enhancing participatory IUU reporting and fisher tracking	Fisher tracking database of ~330 vessels since Feb 2018. IUU reporting undeveloped.	Project end	As part of this project 100 vessels were tracked at project sites, and the associated training was conducted with MAF. This has subsequently led to augmented support for nationwide tracking of 500 vessels leading to one of the most sophisticated SSF vessel data collection systems globally .
1.3	Building capacity for stock assessment	Training in underwater census and use of <i>PesKAAS</i> system provided Trainings reports available	April 2018	Biomass survey training with MAF staff by Dr. Tony Ayling; Stock assessment elements training by Prof. Jeppe Kolding; and data management and analysis training by Dr. Alex Tilley
1.4	Provide a preliminary assessment of pelagic and reef fish stocks	Reef biomass data from UVC and hydroacoustic methods	June 2018	Reef fish biomass shows comparatively healthy reef fisheries compared to Neighbouring and Pacific states. Complimentary hydroacoustic data has been collected but is yet to be analysed due largely to teething issues with the acoustic equipment.

Objective 2: To improve sustainable small-scale fishing technologies

no.	activity	outputs/ milestones	completion date	comments
2.1	Analysis of current fishing and resource use	Ongoing analysis using <i>PeskaAS</i> Participatory analysis of resource use with communities	Project end	An exhaustive review of the fisheries (and Aquaculture) sector has been completed and published and will form an indispensable reference and platform for future research and development in Timor-Leste. This report characterizes fishing and resource use in Timor-Leste

				using the latest analysis of landings and trip effort from peskAAS.
2.2	Test and refine new fishing techniques in focus sites	Fish aggregating devices deployed and monitored in 5 communities 2 gear trials conducted at focal sites on North coast by master fisher	August 2018	FAD construction and deployment was tested at project sites with a total of 8 deployments over the course of 3 years. The initial findings from analysis of catch data have been written up in a peer reviewed publication. Vertical longlines and other fishing methods were tested at project sites, but conclusions around optimal fishing techniques are yet to be made.
2.3	Conduct training in fishing techniques	2 trainings conducted by Master Fisher Mr. Robert Lee		2 MAF officers attended a total of 4 weeks practical training under tutorship of the Master fisher. Fishers at project sites were introduced and trained in new gears and fishing techniques through practical demonstrations and fisheries experience.
2.4	Collect data and monitor fishing activities	PeskAAS	Project end - and ongoing	The peskAAS database now contains ~13639 fishing trips since August 2016 and >22,000 km of tracked boat movements. We have utilised these data in various publications and reports, and MAF are now actively budgeting for the continuation of the system from next year.

Objective 3: To scope and develop participatory pro-poor market chains

no.	activity	outputs/ milestones	completion date	comments
3.1	Baseline assessments of nutrition status and fish consumption	Nutrition survey results, 200 households in 2 inland communities	December 2018	Substantial effort in the development of tablet-based survey system incorporating local food groups. Survey communities inland are a baseline for future trials in market chain development
3.2	Participatory market chain and economic assessment	Report on market chains supplying shops in Dili	July 2018	This component was scaled back due to change in emphasis of the project, however the Dili market chain assessment provides insights into approaches for fishers to access the high-value shop-based markets of Dili.
3.3	Community training	Community training in enterprise development and financial management	September 2017	Project partner social enterprise NGO Empreza Diak provided training in fish drying, book-keeping, and cooperative formation with communities in project focus region Atauro Island

3.4	Pilot-test social enterprise model for small-scale commercial fishing	project component discontinued	--	Due to increasing priority given to the National Fisheries Strategy (NFS) development, and indications that there would not be an implementation phase of this project, funds initially allocated for this component were, at the request of the Project Steering Committee, redirected to the NFS development (objective 5)
3.5	Processing and distribution	as above	--	Training provided (see objective 4) but no activities on the ground initiated due to priority change (see above)
3.6	Prepare and submit final assessment of market chains and social enterprise model and recommendations for scaling up in project investment phase	as above	End of project	While this component did not progress directly, FSSP-TL support has enabled further project development in this space - notably a new research project looking at value chain development, and the potential role of ICTs in the development of south coast snapper fishery value chains.
3.7	Nutrition awareness	Nutrition film	September 2018	Film provides a culturally contextual story of the importance of fish in the diets of children

Objective 4: formal and informal capacity development

no.	activity	outputs/ milestones	completion date	comments
4.1	Needs assessment	Program of training and engaging consultants	December 2017	While an initial assessment was completed, this has been an adaptive process by the project Steering Committee dependent on needs to implement project activities
4.2	Collaboration with UNTL	No direct outputs		During the implementation of the project, UNTL developed their undergraduate fisheries program. There is growing potential to build this interaction.
4.3	Stock assessment and management training	Training in: Acoustic stock assessment; underwater visual census; extensive training in use and application of the PeskAAS data system	project completion, some ongoing	Capacity building has come to the point where DGP are fully engaged with the ongoing processes of stock assessment, and capacities to run the system are improving. At this point, the system remains reliant on overall management by WorldFish. Given the commitment of WorldFish to remain in Timor-Leste for the foreseeable future, this is not currently an issue
4.4	Short term and informal courses	See above, also: data management training for DGP staff, fisher community training in business skills, numeracy, fish drying	July 2018	Formal and informal training sessions were carried out throughout the project timeline, by WorldFish national and international staff, and by local (Empreza Diak) and international

		technology and novel fishing methods.		consultants (e.g. Tony Ayling, Robert Lee)
4.5	Awareness of Nutrition and cooking	See 3.7 above		Further nutrition training would have occurred in focus communities for value chain scoping - see 3.4 above, and was not undertaken for reasons stated

Objective 5: To develop policy and marine fisheries strategy

no.	activity	outputs/ milestones	completion date	comments
5.1	Formation of a strategy and policy technical working group (TWG)	TWG convened by DG Fisheries in Feb 2017	April 2019	Strategy and policy working group were instrumental in all aspects of developing the NFS, consultation processes, and review of the fisheries law
5.2	Technical assistance of DGP to ID key issues and challenges	SWOT and PESTLE analysis completed by TWG	October 2017	Initial analysis completed by TWG was validated by a stakeholder meeting, and latter further updated following fisher inputs from the consultation process
5.3	Consultation with communities and stakeholders	Initial stakeholder meetings; community consultations, national forums	November 2018	This component was substantially expanded, involving some 35 stakeholder meetings from local to national scales, interacting with some 600 women and men fishers and stakeholders
5.4	Develop critical pathways and priorities	zero draft of NFS	October 2017	Developed initially with TWG
5.5	Whole of government consultation to refine and endorse pathways	Initial whole of government consultation; validation workshop	December 2017	Refined pathways validated with broader stakeholder workshop (60 attendees)
5.6	Draft NFS	Final draft document	November 2018	Still requiring final technical translation into Portuguese and Tetun
5.7	Draft Fisheries law revision	Revised Decree Law and Government Decree	March 2019	Following the costed extension of the project, this became a substantially larger and more participative process than anticipated when this results framework was constructed - see details in
5.8	Formal launch of NFS	Final translations of NFS	Ongoing	While the final draft was presented at the National Fisheries Forum, the NFS is set to be brought to the Council of Ministers in the 3rd quarter of 2019

6 Key results and discussion

6.1 Objective 1: Improved information and capacity for sustainable resource management

Summary

Prior to the FSSP-TL there was very little information available with which to inform marine resource management decision-making in Timor-Leste. Now, at the end of the first phase of FSSP-TL, Timor-Leste boasts one of the most advanced SSF monitoring systems in the world as a result of co-designed digital catch monitoring, high resolution effort tracking, and a near real-time decision dashboard displaying automatically analytics for fisheries managers. More importantly, over the past year, the sense of ownership by MAF partners has increased dramatically and they have invested in hiring data collectors to their staff for each of the 11 coastal municipalities, with associated budget applications for their continued employment and the maintenance of PDS boat trackers and services. WorldFish has trained these collectors and continues to provide supervision and technical support given our close relationship based within the ministry.

The compilation of current knowledge generated under the FSSP-TL was organised and published as the *Fisheries & Aquaculture in Timor-Leste 2019: Current Knowledge and Opportunities* report. This report represents the platform of knowledge on which the future of fisheries and aquaculture development in Timor-Leste will be based. It contains up-to-date assessments of reef fish biomass, species composition, fisheries target species, catch rates, new national production figures, and recommendations for future directions in the fisheries and aquaculture sectors.

Future priorities should be to work with MAF to formalise the registration system for small-scale fishers in Timor-Leste. Currently the only missing link in a clear picture of fisheries in the country is an accurate estimation of the number of people fishing for their livelihoods - either full time or part time. To ensure sustainability of *peskaAAS*, next steps should focus on enabling effective capacity within MAF and other agencies to use the system to inform decision-making.

Development of a monitoring system for small-scale fisheries

In the first months of the FSSP project, existing databases held by MAF were evaluated to see if further fisheries monitoring could incorporate these data and/or collection methods. However, a large amount of data had to be omitted from analysis due to various errors such as: misinterpretation of the methods; error by recorders during data entry; coding inconsistencies and incompatible data structure (e.g. ranges of values). Some elements of the database such as the list of registered boats in Timor-Leste proved more useful, and were incorporated into later calculations of estimated national production from small-scale fisheries in the absence of better information.

The objectives of a new fisheries monitoring data system for Timor-Leste was to minimise errors in data entry and reduce fatigue and frustration from fishers in contributing to detailed catch surveys by streamlining catch documentation down to the essential and useful information for resource management. The system is called *peskaAAS* - a pseudo-acronym for fisheries (*peskas*) in the national language of Timor-Leste, Tetum, combined with Automated Analytics System. Originally designed as a data sheet to be typed up by data collectors on a laptop, the *PeskaAAS* system soon evolved to be completely digital and cloud-based, from landing site to decision dashboard. This was achieved by designing a digital catch form on an ODK based platform called KoboToolbox, which data collectors filled in on a smartphone or tablet when they encountered a fisher returning from a trip. They record the catch of any fishers they encounter, as well as the ID code of their vessel tracking unit. The vessel tracking units are solar-powered, buttonless, archival GPS trackers developed by project partners, Pelagic Data

Systems². They also allow for the continuous recording of vessel position, whether moored or moving. Even if the solar panel is covered, it can continue to record for 1 month. These data are then sorted and added to an online database, run through various statistical analyses using R scripts, and presented on a dashboard using the Shiny web application framework³ (figure 1).

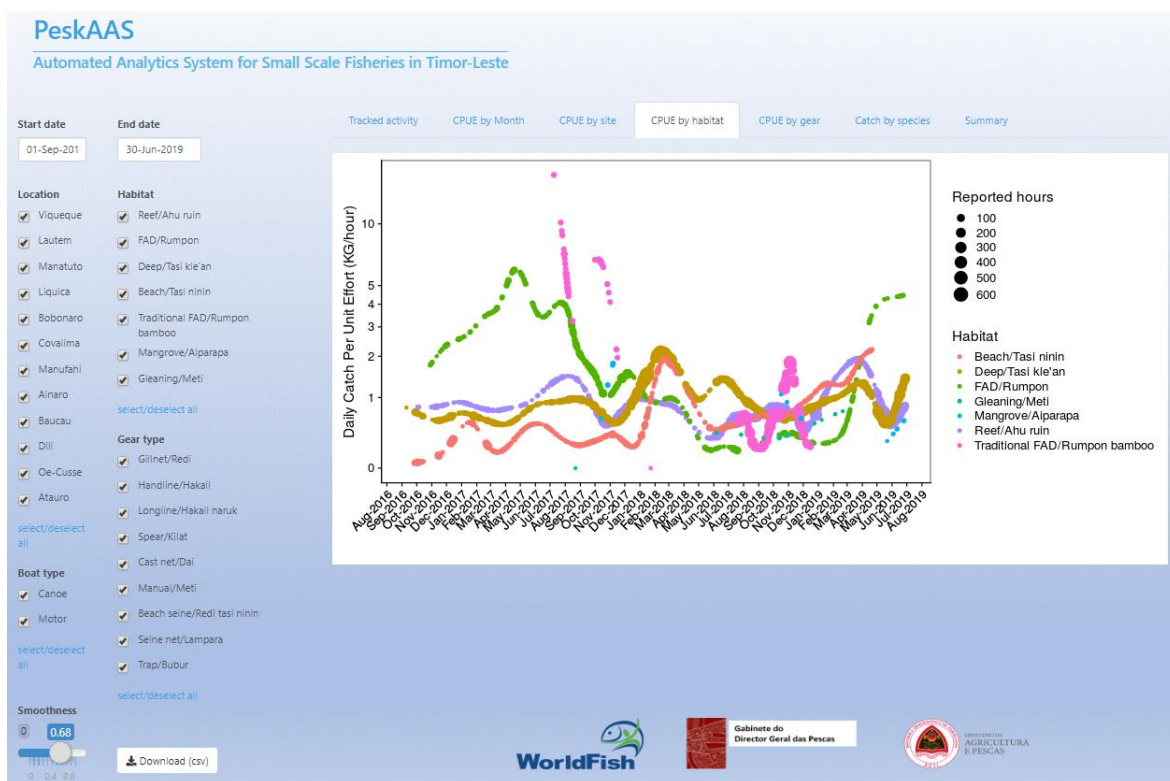


Figure 1. The peskaAS dashboard. A decision dashboard co-designed with Timor-Leste government partners to visualise and analyse small-scale fisheries data for science driven decision-making.

The PeskaAS catch survey and the technical infrastructure were modified and adapted numerous times over the past 3 years in consultations with the DGP and when confronted with obviously erroneous fishing data. Testing questions by deploying them and having collectors make mistakes allowed us insight into why the question was confusing or nonsensical in a local context. For months and months we had the same species being recorded under two or three different names due to local dialectal differences. While the tools available for things like translation are improving, it is crucial that initial and inevitable teething problems are accounted for in timing and project projections.

The argument for more detailed data at higher quality and frequency has always been driven by the assumption that they will lead to an improvement in management practices by facilitating informed decision making. Now with the capability to achieve real time or near real time data capture, proponents of big data approaches draw on the potential of responding to unanticipated shocks or observed stock declines. They are not wrong, but there is still a large distance between better data and changes to management and livelihoods. The reason why is not because the data do not adequately show the changes, or fast enough, but often merely due to a capacity gap. Fisheries managers in low income countries have often not had the necessary training or resources with which to do their job, so even if they had all cutting edge data tools available, they are not equipped to know how to apply that information to managing fisheries. This is certainly the case in Timor-Leste, where fisheries have received so little investment or attention, that managers do not know what their job is, let alone what data they need about fisheries trends.

² <http://www.pelagicdata.com/>

³ <https://worldfish.shinyapps.io/peskaAS/>

Incorporating gender into fisheries assessment and management is an ongoing challenge in Timor-Leste, where still fishers are perceived as “men in boats”, but where a large proportion of the nutritious food being provided at household level comes from women’s fisheries and fish trade. One area that *peskAAS* has thus far failed to adequately monitor and quantify is the contribution of “informal” fisheries such as gleaning. We integrated the relevant questions into the catch form, but these questions will only change with substantial behaviour change on the part of fishers, data collectors and managers. Meanwhile, independent analysis of women’s fishing activities is being undertaken by associated WorldFish projects to build the evidence base in support of women’s fishing activities.

A weakness of *peskAAS*, paradoxically, is contained within the attempt to integrate the existing national fisher registry into *peskAAS*. This fisher registry set up by the Regional Fisher Livelihoods Programme in 2012 (that also trialled initial fisher tracking technology presented in FAO’s *ICTs Benefit Fishing Communities* (2007)), had not been updated since the end of the project, yet the DGP were keen to maintain the registry of vessels. However, in deploying vessel tracking units on boats around the country, it became clear quickly that many of the registered vessels no longer existed, and many more fishers and boats were unregistered so there was no vessel code with which to link fish caught and the trip information. Had we developed a complimentary registry system from the outset, this would allow for much better tracking distributions, and easier estimation of national production figures. These problems are not insurmountable, but they present significant delays to providing useful information for management and development interventions.

Fish Biomass Assessments

Fish biomass is a measurement of the mass of living fish in a given area. It is often used as an indicator of reef health and on how heavily fished an area is. In December 2016 and June 2018, we used underwater visual surveys to assess reef fish biomass at five locations: Adara, Adarai, Beloi, Uaroana and Vemassee. In each location, consultant Drs Tony and Avril Ayling collected data on the number and length of all diurnally active, non-cryptic reef fish species. Surveys were performed in fore-reefs and reef flats between 5 and 10 m deep and in three sites per locations and four transects per site. Total biomass of fish on each transect was calculated using published length-weight relationship estimates available on FishBase (fishbase.org).

Results show an annual mean of 1624.4 kg/ha across all sites (Table 6). This figure fits in the range of reef fish biomass estimates from unfished reefs in the Indian Ocean (500–1800 kg/ha) (Graham and McClanahan 2013) and is an order of magnitude higher than biomass seen on heavily fished reefs (MacNeil et al. 2015). The fact that Timor-Leste fits in the range of unfished reefs may reflect a relatively low level of exploitation of the reefs, but also is likely the result of interacting factors such as oceanography and island geomorphology. Maintaining reef fish biomass at the current levels is beneficial for adjacent local communities, as high levels of biomass and sustainable exploitation rates ensure the provision of ecosystem services that these communities rely upon.

Table 1. Reef fish biomass estimates from underwater visual censuses at 5 sites around Timor-Leste in 2016 and 2018.

Location	Biomass (kg/ha)		
	2016	2018	Mean
Adara	2,444.0	1,971.6	2,207.8
Adarai	1,922.5	- *	1,922.5
Beloi	1,922.4	1,981.3	1,951.9
Uaroana	1,053.9	864.7	959.3
Vemassee	1,431.9	1,027.3	1,229.6
Mean	1,754.9	1,461.2	1,624.4

* Sampling not possible for logistical reasons.

6.2 Objective 2: To improve sustainable small-scale fishing technologies

Summary

Novel research undertaken as part of FSSP-TL on the potential for fish aggregating devices to boost production and improve livelihoods has shown that they can be highly effective. The catch rate at FADs compared to other fishing habitats varied according to site, but increased by up to 450%. The social cohesion and ownership of FADs was seen to be a driving factor in sites of large rate increases, along with targeted investments into FAD fishing equipment. This information will be critical to inform national strategic decision making around boosting fisheries production and related consumption for improved nutrition in Timor-Leste. However, anecdotal evidence from FSSP-TL community sites indicates that fishers and traders are investing in new fishing (boats) and value chain equipment (freezers, vehicles), as a result of long-term improvements to catch rates brought about by FAD fishing.

Future work will build on these findings and entrepreneurial endeavours to enhance value chain through targeted innovations in post-harvest management such as in fish handling, safety, preservation and value-added product processing. Combined with emerging infrastructural development to better connect Timor-Leste's south coast, there is enormous potential to target these approaches to south coast municipalities such as Covalima and Viqueque, which have thus far faced significant challenges in linking value chains to large urban markets. This potential has also been highlighted by JICA, who are currently providing seed money to private Japanese companies to invest in fisheries processing and value chain in Timor-Leste.



Image 1. Palm fronds used to attract fish on a fish aggregating device (FAD), Timor-Leste. ©WorldFish/A.Tilley

Construction and deployment process for Fish Aggregating Devices (FADs)

1: Anchor building and drying

Four holes are drilled through the sides of two halves of a metal '44 gallon' oil drum. 1m lengths of 20mm diameter rebar are inserted through the holes to form a cross within each of the half-drums. A chain is linked through the rebar cross of each drum, connecting them together. Each drum is then filled with cement and locally gathered rocks and left to set for 1 month. For the grapple, a 2m long square

tube wraps around 30mm rebar grapple, into which cement and small rocks are poured. This is also left to set and dry upright for 1 month prior to deployment.

2. Depth profiling

At each potential site, it was necessary to obtain detailed depth profiles of the sea bed in order to choose the optimal location for the FAD. A flat or gently sloping area not close to a steep drop off, was found to extend the longevity of the FAD and lessen the risk of premature loss. Depth profiles were achieved using a Furuno fish finder and augmented transducer, which was deployed on local boats undertaking traversing transects back and forth across the depth gradient within the desired area.

Tracks from the Furuno were then downloaded so that positional information could be plotted into ArcGIS. The depth data were then interpolated in ArcGIS using the geospatial tools and exported to a raster contour layer. This layer was then exported as a .kml file for overlaying google earth imagery to provide the image as below in Figure 2. Once the appropriate deployment location is chosen, the depth is used to measure the length of the FAD to be constructed.

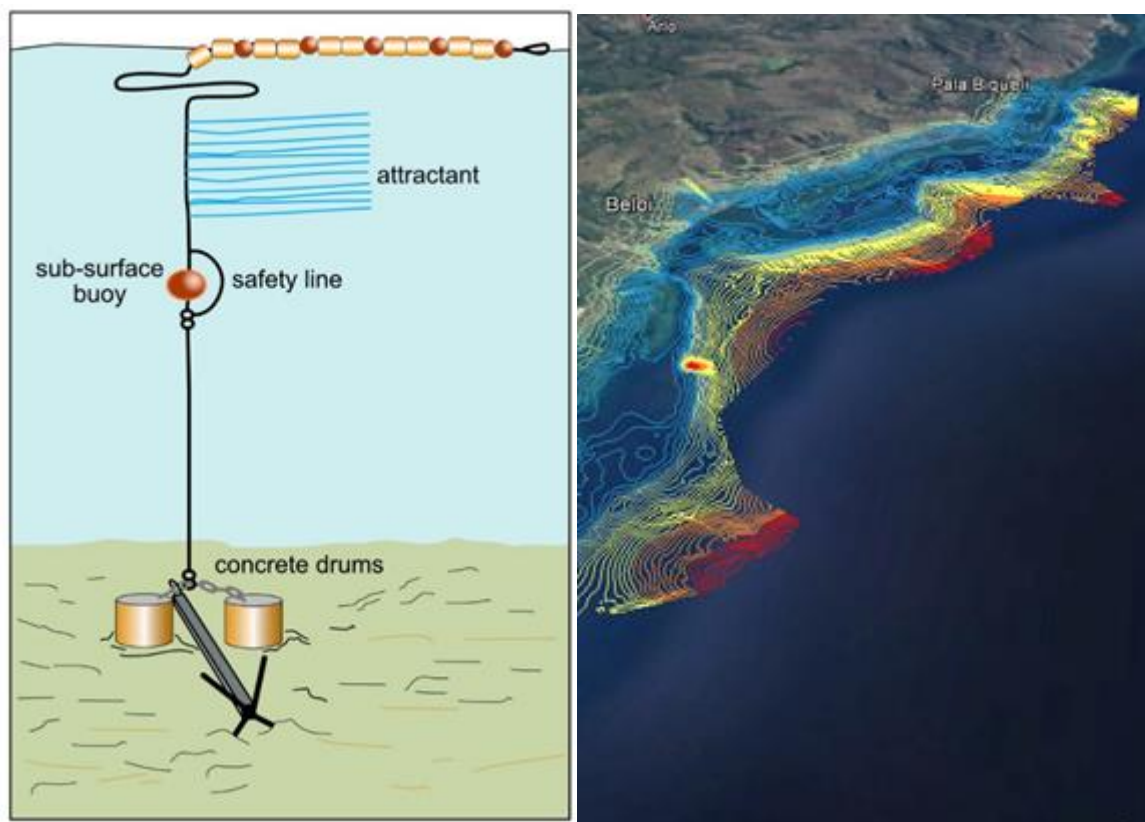


Figure 2. A) Diagram of final FAD construction design. B) Contour image created from depth profiling carried out prior to deciding FAD locations for deployment.

3. FAD building

Rope and buoys for the tested FAD systems were imported in bulk from Taiwan, as products of equivalent quality could not be found locally. All other equipment was obtained locally in Timor-Leste. WorldFish staff from the Pacific brought valuable techniques to share regarding FAD building such as the need for 32-38mm diameter clear plastic hose around the rope passing through the line of surface buoys, and for knots and joins to be wrapped in thin tyre rubber to prevent chafing. 18mm swivels at key points allow the FAD to spin without ropes twisting and tightening to minimise wear and tear. A subsurface buoy is integrated into the rope at 15 m below the surface. Small changes in deployment location and measurements can cause the SSB to sit further or nearer to the surface. A safety line connecting the main lines above and below the SSB was included at a late stage to prevent the loss of the entire FAD if only the SSB was lost. See FAD design evolution diagram and complete anatomy diagram (Figure 3).

4. Floating, towing and deployment

The anchors are moved by teams of fishers to the low tide mark prior to deployment and large floats are fixed tightly to the anchors so that the high tide will float them. (This rope will be cut to release the anchors in deep water). The grapple is loaded horizontally on top of the two float barrels. At high tide the upper unit of the FAD is connected to the anchor chain using a large galvanised 'D' lock shackle (19mm). The upper unit is then loaded into the boat and an additional line is tied to the floats and both lines are used to tow the anchor out into deeper water.

100m prior to reaching the drop location, the FAD upper unit is thrown out gradually to trail away behind the boat, so that it is full extended out in the water by the time the drop location is reached. Upon reaching the drop site, the rope of the FAD upper unit is released from the boat, and the grapple is toppled into the water to hang beneath the floats. When all boats and crew are safely out of the way of ropes and anchors, the anchors are cut away from the floats to drop into position. The FAD upper unit and floats may move across the surface of the water rapidly as the anchors pull downwards. After final settling of the FAD a GPS position is taken at the site to record the location.

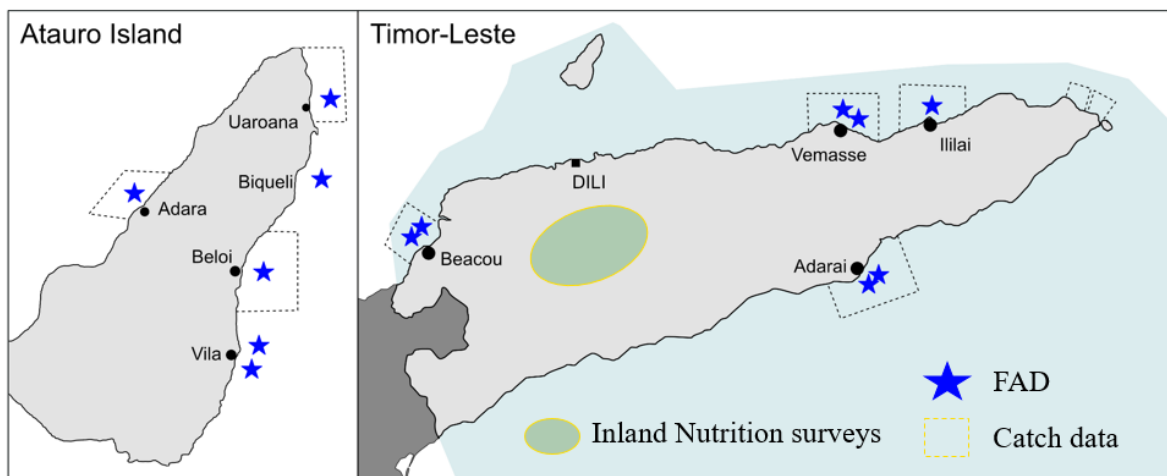


Figure 3. Locations for all FAD deployments since 2016

Effects of FADs on catch rates and effort

FADs resulted in higher catch rates per unit of effort (kg/(fisher*hour)) than other habitat types. Greater amounts of fish being landed that can be distributed, is the first step towards improving rural access to fish and the critical micronutrients they provide.

Our findings support the positive FAD effects seen in other studies, but also confirm the significant variability between sites. In a livelihood context, relevant considerations of 'effort' are energetic expenditure and time. Our results indicate a positive net effect of FADs on overall catch rates, with corresponding positive effects on rates of return on FAD investment at local and regional scales.

The highest catch rates for FADs compared to other habitats in Timor-Leste were seen from the site of Vemasse. This community has been deploying traditional FADs of their own for the past few years and have created FAD fishing groups of ~12 people who hold varying numbers of catch shares based on their investment in the equipment or labour. These FAD groups also utilise a specialised fishing technique documented in Mills et al. (2013) (figure X) where lights are deployed above the FAD before dawn, then a modified scoop-seine net is deployed around the schooling fish. Even incorporating the additional investment costs of specialised seine net fishing gear (~USD \$1,000, Vemasse fisher pers. comm.), the time to 100% return on investment would be ~33 days. At other sites, fishers predominantly use gill nets and hand lines on FADs, just as in reef and open water areas, with some infrequent use of scoop seine nets in Biacou, but without the organised FAD group structure.

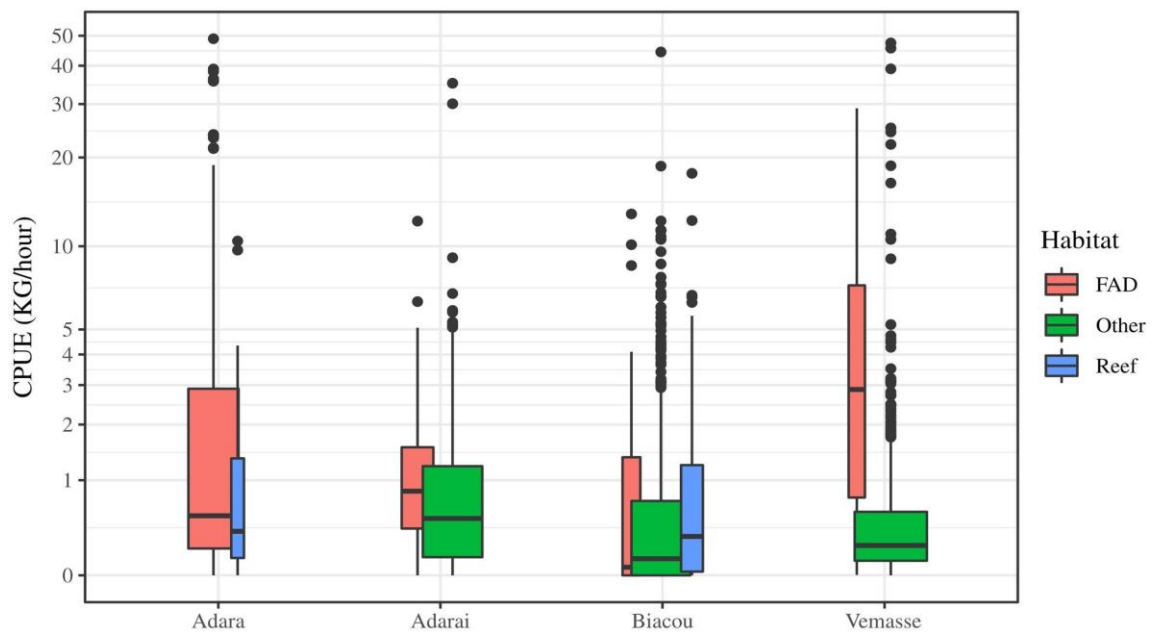


Figure 4. Catch rates (CPUE) at FADs, reef and other habitats from 4 sites around Timor-Leste

In Biacou, fishers traditionally focus on pelagic species. Analysis of vessel movements from GPS tracking show this pattern clearly, with the mean trip range (\pm SD) of vessels in Biacou reaching 7.5 km \pm 3.4), which is more than double that of all other sites (Adara: 1.4 km \pm 2.6; Adarai: 2.2 km \pm 1.3; and Vemassee: 3.5 km \pm 3.5) (Figure X). This existent capacity to fish further offshore may account for no differences seen between FAD fishing catch rates and other fishing, but the lack of year round data from Biacou make this inconclusive. The highly variable success of FADs seen in our results, suggests that the location of nearshore FAD deployments in Timor-Leste needs to be selected carefully based on gear types already in use and catch rates, and should incorporate the collection of some baseline catch monitoring from potential sites. These findings corroborate those of Albert et al. (2014) in the Solomon Islands, where villages presenting low catch rates, limited diversity of fishes, or degraded reef fisheries, were likely to benefit the most from access to a nearshore FAD. However, appropriate management steps should also be taken to ensure that this trend degradation does not merely transfer to pelagic fisheries, as improved catch rates can imply faster depletion of resources.

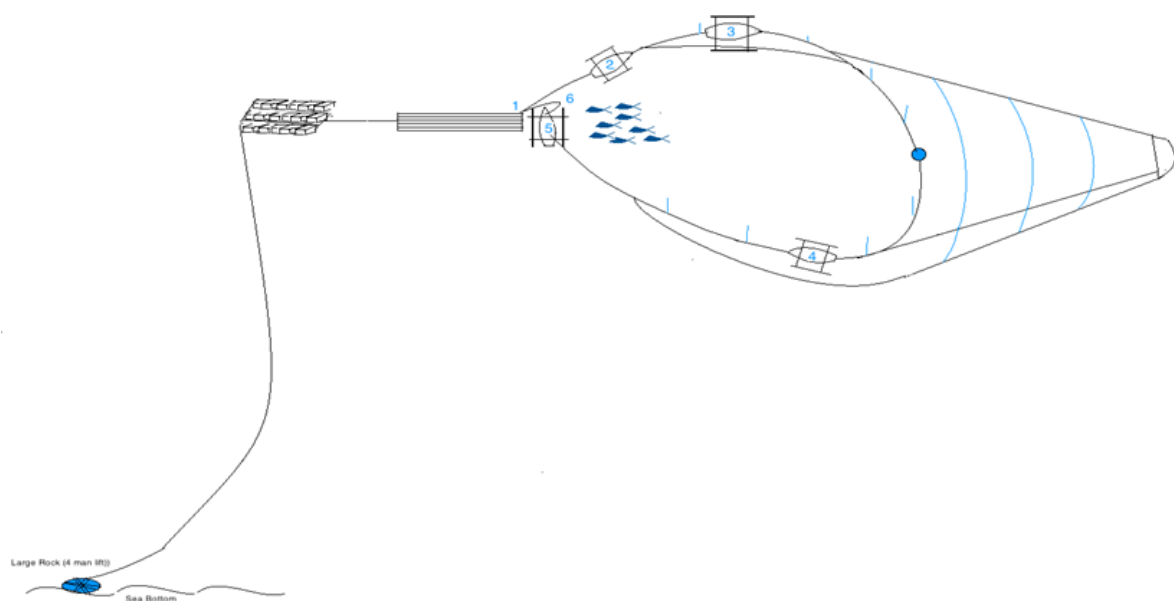


Figure 5. Diagram of seine net method used by Vemassee fishers on FADs. (Not to scale)

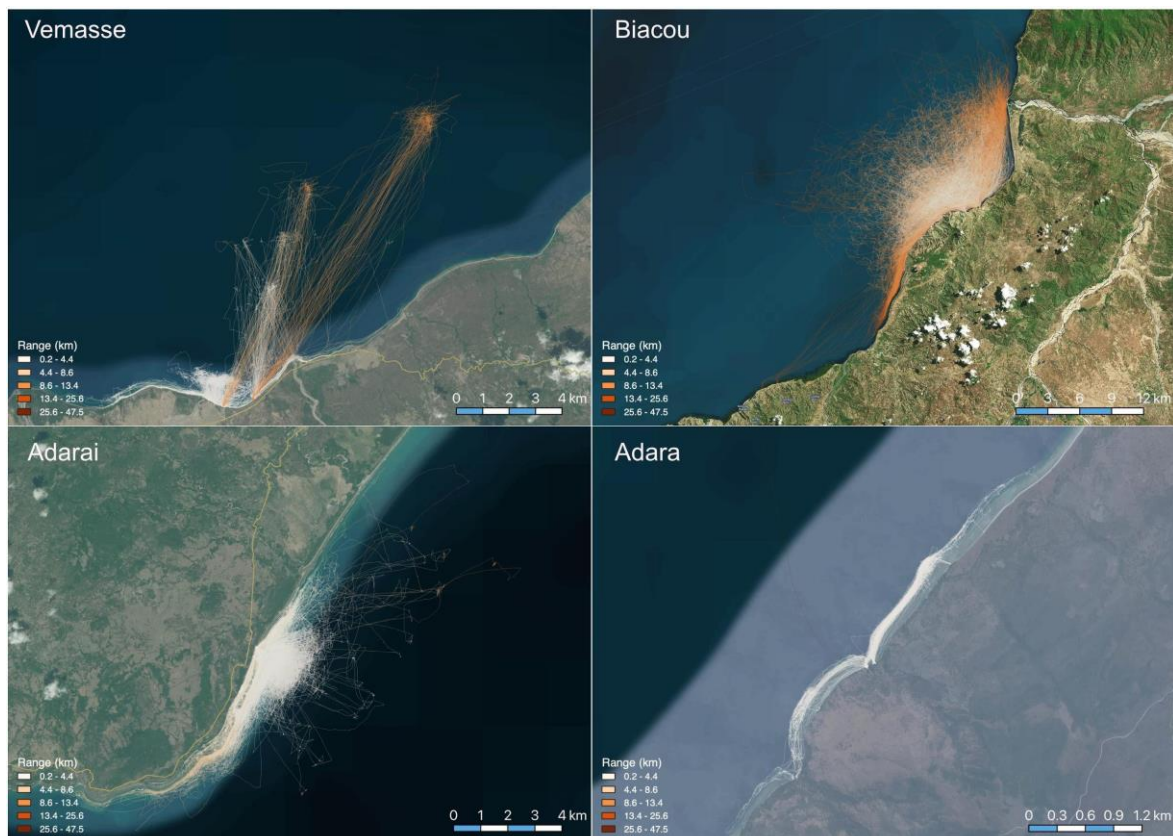


Figure 6. Fishing behaviour and range of fishing trips at 4 sites in Timor-Leste between February and October 2018.

Catch assemblages and biodiversity

Nearshore FADs in Timor-Leste aggregate small, highly mobile pelagic fishes such as mackerels and scads, which are highly productive and can sustain relatively high levels of fishing pressure. By providing access to an additional or more abundant source of fish, artisanal fishing effort may be reallocated from often heavily exploited coastal reef habitats, however, catch sampling was not sufficiently uniform to highlight changes in fishing effort on reefs, as the same fishers were not recorded every day. Fishing effort data before and after FAD deployments showed no significant increase or decrease on reef habitats specifically. However, redistribution of fishing effort in proportion to catch rates is a common phenomenon in SSF, suggesting that as fishers notice increasing catch rates at FADs, we are likely to see a geographical shift in effort.

A fisher focus group in Adara commented that the primary value of FADs for them was not larger catches, because there was a limit to what they could sell, but rather the reduced time taken to catch a sufficient quantity of fish, thereby allowing additional time to be dedicated to other livelihoods such as cultivating land and tending livestock. In a recent study from Timor-Leste, Mills et al. (2017) show that those households that fished year round had significantly better food security, and a lower number of livelihoods than seasonal fishers or farming households. FADs may have a very important role to play in this space, especially in the areas of acute seasonal food shortages, to reduce vulnerability to shocks. Data collection on SSF and FADs in Timor-Leste is still ongoing. In future, we hope that a longer time series allows the testing of seasonality on fishing effort and catch rates.

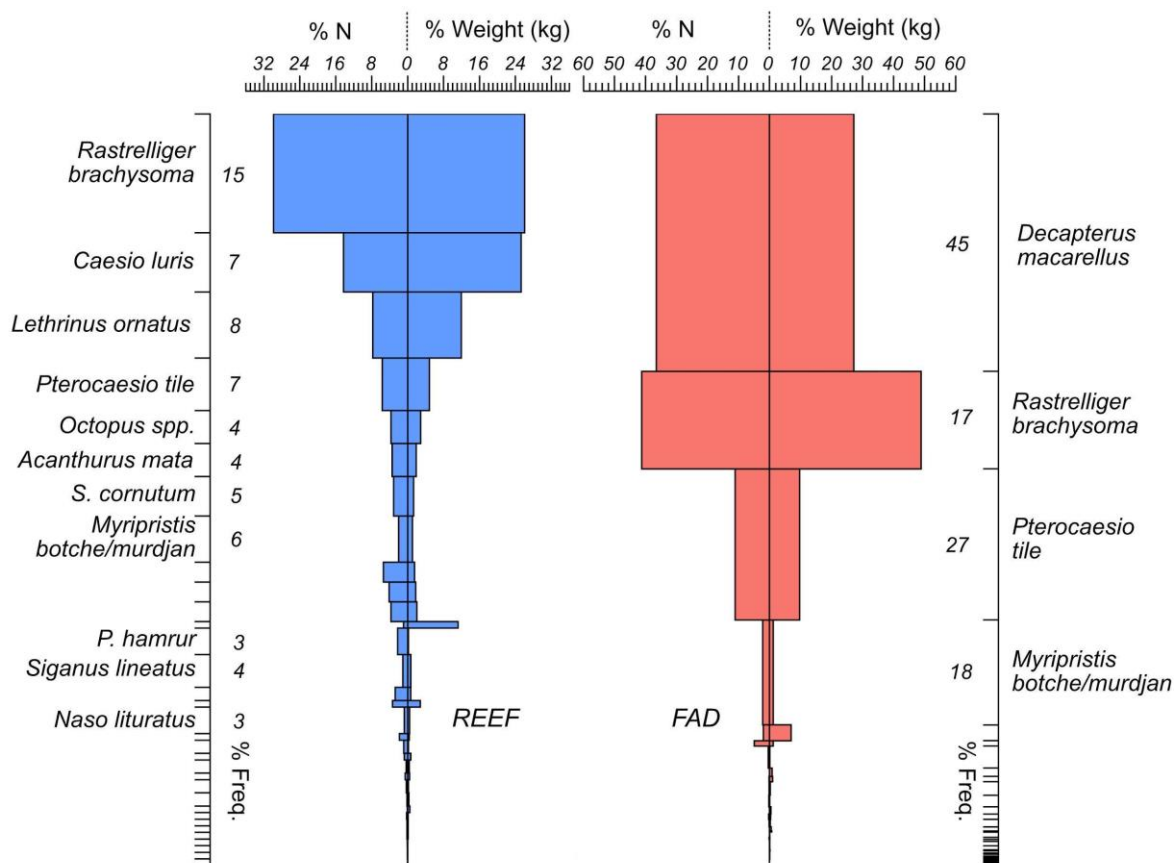


Figure 7. Catch composition for small-scale fisheries landings from reef and FAD fishing from Adara, Atauro Island, Timor-Leste. The size of the box represents the %IRI of each species in each location, where %N is the proportion of total individuals, %Freq is the proportion of total samples, and %Weight is the proportion of total weight landed.

On Atauro Island, FADs are notoriously difficult to deploy and maintain due to strong currents and steep slopes to depths exceeding 4000 m. The average duration of FADs in the water across all locations was 11 months, which is significantly shorter than the lifespan of FADs in the Pacific, with the minimum expectation being 2 years, with some extending to 8 years. However, this again is seemingly site and depth (Table 1) dependent, as the 2 FADs deployed on Timor-Leste's south coast have been in place for 26 months as of December 2018.

In experimenting with FAD designs, the materials from which FADs were constructed by WorldFish and MAF were more expensive than might be utilised in a larger scale deployment program. Assuming equal efficacy at aggregating fish of low and high-cost FADs, this indicates Return on investment would be achieved even faster by reducing the initial investment cost. The quality should not be compromised because of funding and that a few well-made FADs are better than many of low quality that may be quickly lost. This, of course, makes economic sense in exploiting returns, and environmental sense in reducing the contribution of marine debris with broken and dislodged FADs. However, there are instances when low-cost deployment may be preferable. If FADs are employed as a strategy by individual fishing groups in coastal communities (as opposed to a government program), they may lack the resources to purchase higher quality ropes and buoys. Furthermore, in Vemasse and Adarai, fishing on the FADs was only conducted seasonally when conditions were favourable, indicating a year-round FAD may be subject to wear and tear and be accumulating biofouling for a significant amount of time while it is not being fished. In this instance, low-cost FADs would be more appropriate.

At sites of increased FAD CPUE the average Return on investment was just 85 days, but intuitively, FAD longevity has a direct and significant effect on overall revenue generated. As with any financial investment, trade-offs of risks and gains scale with the number of shares, and in certain parts of Timor-Leste, the risks of losing FADs are significant. Hence, by encouraging and training fishers to act

cooperatively in FAD fishing endeavours, individual risks to already vulnerable fishers with limited capital can be minimised, and benefits can be maximised.

Fishing trials and training

A total of 65 men (58 from Akrema and Uaroana and 7 from Ililai and Vemasse) and 30 women participated in the fishing trainings, conducted by Master Fisher Robert Lee and assisted by WorldFish and MAF staff in September & October 2017 and August 2018. Of these 65 men, 24 took part in practical fishing exercises on fishing vessels.

Trial fishing was carried out around the FADs. However, there were no signs of small bait fish aggregating around the FADs. The reason could be that the FADs are too shallow and or the area is very low in primary productivity. However, FADs are still relevant to fishery livelihoods and the initiative should not be abandoned. It is recommended that at least 4 traditional FADs should be deployed offshore from Atauro in at least 1000 metres depth. These should be closely monitored and be part of any future training program.

Fishing for deep-water demersal fish was also carried out with experimental gears and there were indications that there are good prospects for catching these larger high value fish. However, these would require some modifications to the gear actually used.



Image 2. A FAD fishing group (left) and a traditional bamboo FAD raft attached to a WorldFish deployed FAD. Vemasse, Timor-Leste. ©WorldFish/A.Tilley

6.3 Objective 3: To scope and develop participatory pro-poor market chains

Summary

A tablet-based survey tool incorporating local food groups was developed for wider application in baseline studies for projects aimed at increasing fish consumption and dietary diversity. A detailed fish consumption survey was conducted in 200 inland households, and a mixed methods film using local actors from fishing communities was produced and distributed to raise awareness about the importance of fish in local diets for nutrition. With the decision from Norway to concentrate efforts on developing country fisheries elsewhere through the 'Fish For Development' program, the Project Steering Committee decided that pursuing the project plan under this objective was no longer appropriate. This component was planned as the first phase in a longer term investment in value-chain development. Instead, the Steering Committee took the decision that providing additional resources to Objective 5 (Strategy and Policy Development) was of higher priority.

Inland Nutrition Survey

Timor-Leste continues to struggle to reverse chronic under-nutrition problems, particularly among rural populations. A host of child malnutrition indicators such as a high incidence of stunted, wasted, vitamin A-deficient, and underweight children, reveal the extent of the country's dire condition (GOTL 2017, 2018;

Provo 2016; WHO & World Bank 2018). The cause is now largely accepted to be directly linked to poor prenatal and postnatal maternal healthcare and nutrition; the first 1000 days of life – the period between conception and age two – are principally considered a critical window of opportunity in influencing child health (Cusick & Georgieff 2014; USAID 2015). Ensuring proper maternal and child nutrition within this period secures a human’s long-term ability to enjoy an optimal path in their future cognitive and physical development (World Bank 2017). Conversely, a deficit in nutrition at this stage manifests as permanent impairment to human development (WFP 2017). Crucially then, in a country where the population suffers from chronic under-nutrition, high infant mortality rates, and low human capital, steps to improve a mother and child’s nutrition in the first 1000 days of life would bring about profound advancements in a child’s development, and reverberating social and economic benefits to the country (Results International 2015, Thousanddays.org 2018).

Under the FSSP-TL we set out to gather baseline data on inland nutrition, specifically targeting information on fish availability, purchase and consumption by various household members in the upland municipalities of Ermera and Aileu. This provides an important baseline in sites appropriate for future research into pro-poor value-chains. Given that malnutrition is high in the municipalities of Aileu and Ermera, there is the potential for fish consumption – a rich source of protein, lipids, calcium, vitamin A and micronutrients – to address the problem. However, Aileu and Ermera are the two landlocked districts of Timor-Leste, inhibiting availability of fish in these areas. Some inland areas in the districts are endowed with freshwater resources, yet only a small number of households in Aileu and Ermera report practicing fishing only occasionally and catches are virtually all used for household consumption GOTL (2012).

Brief results

The main outcomes of this project component were the development and field testing of tools that will be critical in advancing the long-term development objective of this project. Detailed results outlined here provide an indication of the application of these tools, as well as providing baseline data for the communities where the tools were tested.

Among the 171 survey respondents, 101 were from Aileu and 70 were from Ermera. 91% of the heads of households were male, where the average age of the male head was 48 years. However, there was a wide range of ages for male heads (as young as 24 and as old as 78). Of the 14 female heads of household the average age was 58 years.

Being landlocked areas, there were no households who reported owning any type of boat or fishing equipment. Surprisingly however, 86% of them also did not own a vehicle. The most common assets found in each household were mobile phones (90% of households), and livestock (94%). 58% (99 households) have a garden used to grow crops for commercial purposes. On average, these houses grow 2 types of crops. 95% (164 houses) have one garden used for subsistence crops (20% have more than 1). On average, they grow about 4 types of produce.

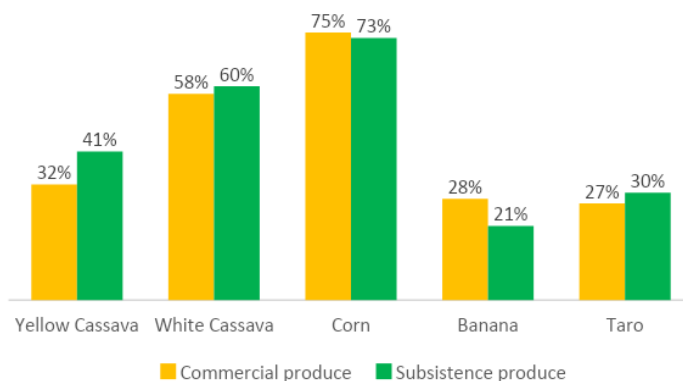


Figure 8: Top 5 crops grown by households for commercial and subsistence use

Despite being only a snapshot survey of maternal diets, our results suggest that breastfeeding mothers in these households may not be receiving the proper nutrition needed to ensure nutritious breast milk, since foods rich in vitamin A and iron were infrequently reported in the 24 hour food recall.

Results suggest a worryingly early transition to solid foods (even fish) in infants, from as early as 1 month, implying the need for both a more detailed understanding of the underlying drivers of exclusive breastfeeding practices in Aileu and Ermera. Infants appeared to have a somewhat balanced diet although quantities of food types were not recorded in the recall survey.

The rearing of livestock and the rate of meat consumption were not complementary, which supports findings from other research that suggests animals are a savings mechanism in Timor-Leste: any saved money is invested in animals, which they rarely consume, but rather use to satisfy socio-cultural obligations of contributing to ceremonial feasts. Also eggs were rarely reported as being eaten despite many households rearing chickens. This is likely to be because chickens are not consuming adequately nutritious diets themselves to produce eggs.

Only 41 households (24%) reported consuming fish in their diet. Of these 41 households, 70% of them only ate fish once in the previous week. The majority of households only consumed fish once a week. The distribution of how many units of fish eaten on a day ranged between 1 and 15, and was positively skewed (i.e. more households eat a smaller number of fish), with an average of 4 fish per day (Figure 3). Of the species of fish consumed, it was found that the majority of fish consumed are marine species (86%), with the rest being freshwater species. These fish came from a wide range of sources; the local market was the most common source (17 houses), with a few (7 houses) getting their fish from outside the village (e.g. Dili), and one house even reporting they caught the fish they consumed that week.

Only 39 houses (22%) answered yes to consuming tinned fish. When specifically asked about seafood, only 2 households reported eating fresh seafood. Comparing Aileu and Ermera, there were no discernible differences in the share of households eating fish, although there was markedly less tinned fish consumption in Aileu than Ermera (13% vs 37% resp.).

Fish Nutrition for the Family

The [Fish Nutrition for the family](#) film was produced by WorldFish Timor-Leste to highlight how crucial fish is to household nutrition, especially pregnant mothers and children under the age of 5. The film is narrated in Tetum and was produced in 2 versions, one with Tetum subtitles and one with English subtitles.

Timor-Leste is known as one of the poorest countries in Asia region, with about 46% of children under 5 years old were classified as malnourished based on 2016 national survey. However, at the local level, awareness and knowledge about the benefits of eating fish, and the risks from an unbalanced data is very limited. The film was made to raise public awareness about that consuming fish to boost intake of essential micronutrients, vitamin A, vitamin D, Zinc, Iron and Calcium that enhance childhood growth and development, and can improve household income and productivity in the long term.

The film content was guided by WorldFish, but was made with the help of local Timorese producers, filmmakers, editors, actors and spokespersons. WorldFish Timor-Leste produced the film concept and script, contributed additional footage and arranged logistics. The actors in the skit section of the film were the local coastal community members of Beto Tasi fishing village and students from Universidade Nacional Timor Lorosa'e (UNTL) who played the role as a WorldFish researchers. The documentary segment of the film includes Dr. Olinda dos Reis Albino, Head of Nutrition Department of Ministry of Health of Republic of Timor-Leste, who provided strong data evidence on malnutrition and message for mothers to encourage their family members to consume fish regularly.

Outreach and publication

The film has been shown to a wide variety of audiences throughout the country through *TV Edukasaun*, one of the most leading education TV channels in the country. This channel has enabled Timorese

communities to watch the nutrition film over 1 month period in 2018, including people in remote locations and the highland villages.

WorldFish has also displayed the film multiple times at regional consultations, the Women’s fisher forum, and National fisheries forum in 2018, as well as in various seminars and presentations at ministerial levels and universities. Now the film is openly available on Youtube, which is accessible to the public. A particularly successful aspect of the film was our use of local actors and locally appropriate humour. By lessening the academic and artistic expectations of the film, and focusing on contextualising the subject matter in a mock local scene, the message was much more readily taken up by viewers.

The film was well appreciated by government entities, development partners, academics, and especially local communities. With the rapid growth of multimedia, this video has been shared through multiple social media platforms, such as facebook, instagram and so on. WorldFish continues to utilise and show this film during visits to new communities and audiences to increase awareness about the benefits of fish-based nutrition.



Image 3. Scenes from the WorldFish produced film “Fish Nutrition for the Family” 2018. © WorldFish

6.4 Objective 4: To develop formal and informal capacity

Capacity building workshops and trainings

The location and integration of the WorldFish Timor-Leste within the MAF compound in Dili, enabled ongoing mentorship and day-to-day capacity development. Throughout the program there were attempts to formalise a *counterpart* style arrangement with MAF, where specific officers were assigned to accompany WorldFish field activities and research according to specific themes. However, this failed to materialise into any significant attendance, apparently due to reluctance and lack of confidence on the part of MAF staff to engage so closely with WorldFish activities. However, certain champions within MAF were responsible for driving change and maintaining active and important channels of communication and collaboration, and it was through these that the importance and urgency of engaging a fisheries legal consultant became a priority for extension funding provided by Norway.

Fisheries data collection trainings

Training data collectors to record catch data for submission to PeskaAS is an ongoing mentorship including formal training sessions, refresher workshops, on-site supervision, and continuous feedback and support.

Formal training undertaken with MAF included two catch data collection trainings - in August 2017 and June 2018. The first of these training took place in MAF and included a theoretical introduction to digital survey forms, the type of information collected by catch surveys, and data management, and a practical element where MAF staff and WorldFish data collectors practised recording hypothetical catches (of fish bought in the local market) on tablets provided by WorldFish. This training was conducted predominantly by WorldFish staff Joctan Lopes, with assistance from Mario Gomes, under the supervision of Alex Tilley.

The second training event was run to bring together the 11 new MAF collectors hired to contribute data to *PeskaAS* from each coastal district. Four of these collectors were existing WorldFish data collectors that had now transferred to a MAF staff contract, and their involvement also advanced the progress and uptake of the training to new collectors by their assistance and reflection on their experience.

In July 2018, a data management workshop was run by Dr. Alex Tilley (assisted by WorldFish research analyst Joctan Lopes) with the aim of introducing MAF staff to better techniques in collecting, storing, and manipulating data collected in various capacities. In spite of the basic computer literacy levels of MAF staff necessitating this being merely an introductory course to MS Excel spreadsheets, it was very well received by MAF and they requested follow up and refresher training, as well as investment in their hardware and software to adequately participate.

Community business training

In August and September 2017 FSSP-TL contracted local social enterprise NGO Empreza Diak to conduct a series of trainings in introductory business skills with the following objectives (see Appendix 4 for full report):

1. Group Formation and Numeracy-Literacy (“Haril Grupu/ Numerasia no Literasia”)
 - To develop participant understanding of the benefits of working as a collective.
 - To highlight the importance of developing an agreed set of goals.
 - To increase confidence in writing and understanding numbers.
2. Business Training (“Negósiu Di’ak”)
 - Increase the group’s ability to manage the money from their trading activities and generate more income.
 - Increased understanding of the market, record keeping and future business planning
3. Dried Fish (“Ikan Maran”)
 - Improve the quality and safety of dried fish to increase the value.
 - How to price the fish based on the cost of production

- To build a fish drying tent.

A total of 54 participants, the majority of whom were women, ages 22 to 56 attended the trainings from local women's groups. The delivery of the training modules was well received by participants, who were eager to learn and to put their skills into practice. They were the first step forward in equipping the recipient communities in Atauro to maximise the returns from their trading activities. The training provided an opportunity for the participants to identify, observe and practice new goals, business skills and improve the quality of their product, all of which can be applicable to their individual income generating activities. However, further enterprise mentoring and training follow up will be needed to embed their capacity in an effective and sustainable way. Furthermore, it would be optimal to be able to support the groups' access to new markets interested in producing dry fish, but also to support the communities in pursuing other livelihood activities that build on their existing strengths, to lower the level of dependence from fishing.



Image 4. Scenes from trainings conducted with fisher community women by Empreza Di'ak, 2017. ©WorldFish/A. Duarte

Reef fish biomass assessment training

In December 2016, a training in underwater visual census of fish biomass was offered to MAF, conducted by Dr. Tony Ayling. The training was comprised of a theoretical (illustrating the concepts and methods on a whiteboard) and a practical element (in-water training using SCUBA). Using translating assistance from Mario Pereira, the theory segment went well and was conducted with 5 MAF participants (Jose Monteiro, Constancio da Silva, Orlando Kalis, Enrique Bareto, Fernando da Silva, Lino de Jesus). They asked thoughtful questions and maintained their interest throughout the office-based part of the workshop. It was clear from the questions that one of the major problems any future UVC program will face is having a consistent and appropriate sampling design for any ongoing fish assessment program.



Image 5. Reef fish biomass training of DGP staff by Dr. Tony Ayling. © WorldFish/A.Tilley

Only one participant was able to attend the practical segment of the workshop. He experienced problems with fish IDs and also with the level of concentration required for accurate fish assessment. A major problem was also accurate fish length estimations which were often out by +/- 50%.

Any future attempts at UVC assessment will require lots of practice in fish identification, transect width estimations and fish length estimations by participants. Furthermore, DoF would do well to delegate specific officers to carry out these surveys consistently, to ensure any error is at least a constant error across time.

6.5 Objective 5: To develop policy and marine fisheries strategy

A National Fisheries Strategy for Timor-Leste

As the FSSP-TL progressed, the development of a new National Fishery Strategy (NFS) became an increasingly high priority for MAF. With the news that shifting priorities in Norway meant that there was unlikely to be a second phase of FSSP-TL, the Project Steering Committee requested that funds be diverted from participatory value-chain development work (Activity 3 - an activity designed to be scaled up in the second phase of the project) to ensuring a highly participatory approach was taken to develop a new National Fishery Strategy. While previous Fishery Strategy documents existed (see table 1) none of these had made a substantial impact on the development of the sector, and were often developed in a largely non-participatory way. The objectives of the new NFS were to ensure a broadly participatory process in the development of a strategy focused on sector growth, sustainability, equity and fisheries as an important contributor to nutrition security. While the initial plan was for a strategy on small-scale fisheries, the Project Steering Committee requested that this be expanded to cover all fishery sectors. This added significant complexity, as recent decisions on the allocation of licenses to foreign industrial fleets had been political in nature and controversial. For this reason, Mr Ulrich Schmidt, a consultant with decades of experience in fishery strategy and policy in a large diversity of countries, was engaged to assist with the strategy development process. His knowledge of international agreements and conventions particularly valuable to the NFS development.

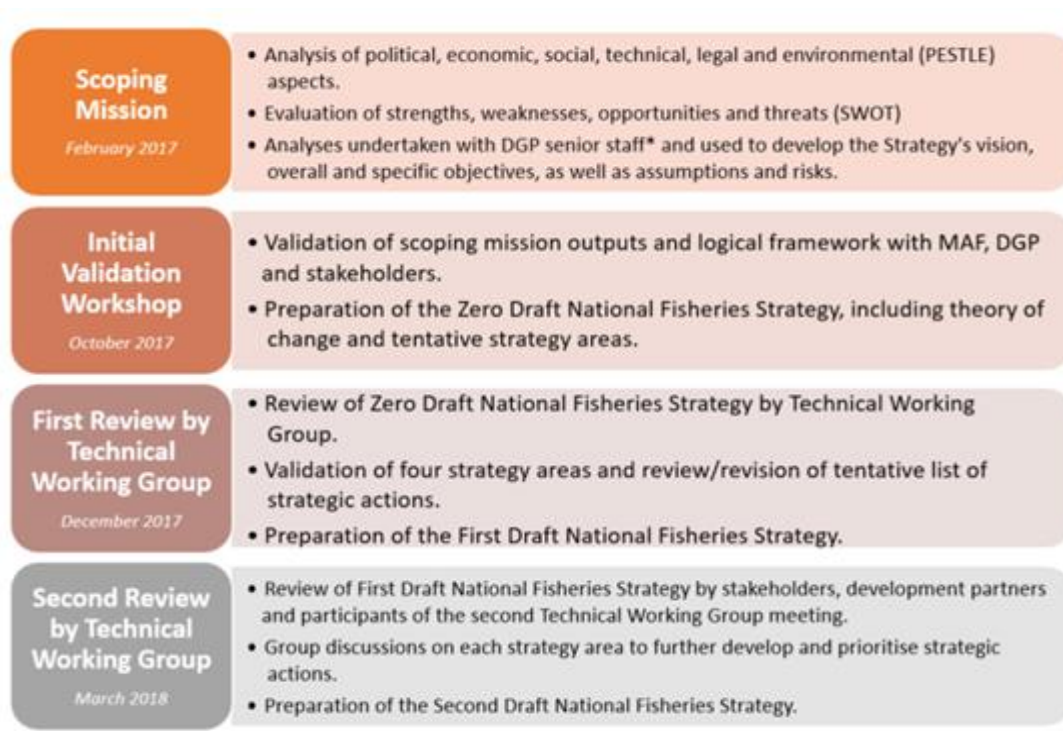
Table 2. The history of fisheries strategy documents for Timor-Leste

What	Year	Description and co-management development
'Fish for the Future' – first national fisheries policy	2001	Developed by MAF and Focused on nascent state priorities such as staff capacity building, assertion of jurisdiction, and development of legislation (Alonso et al., 2012).
Co-management or community-based, coastal resource management framework	2001	Developed by MAF with consultants under World Bank Agricultural Rehabilitation Project. A detailed proposed community-based, coastal resource management scheme (Stockwell, 2001, 2002) that was never implemented
'Fish for Sustainability: Our Strategic Plan for Fisheries, 2006 – 2011' – a new fisheries strategy	2005 (drafted), 2007 (released)	MAF document, developed with consultants designed to "...encourage and facilitate community-based, fisheries management initiatives and aims at establishing a network of local, community-supported marine protected areas and encourage involvement of NGOs" (MAFF, 2005). Was not formally adopted by the Council of Ministers

The early processes of strategy development are outlined in Table 2. A first draft Strategy was shaped around scoping with a Technical Working Group (TWG) appointed by the Director General for Fisheries. This group comprised heads of department from within the DGP selected WorldFish staff and representatives from key government agencies (although participation by these non-fisheries groups was sporadic). The early processes of drafting drew on a number of existing documents, including previous general and sectoral National Strategies, international conventions (including the Voluntary Guidelines for Securing Sustainable Small-scale Fisheries, the Code of Conduct for Responsible Fisheries), and manuals completed under the Regional Fisheries Livelihoods Program and the Coral Triangle Initiative. An extensive stakeholder consultations meeting was held in Dili attended by 60 representatives from NGOs, civil society organisations, academia and government.

The perceived strengths, weaknesses, opportunities and threats (SWOT) for the Timor-Leste marine and coastal fisheries sector are summarised below. The SWOT analysis has been developed with the TWG, reviewing and adjusting findings and conclusions of the assessment of political, economic, social, technical, legal and environmental (PESTLE) aspects of marine fisheries produced by the scoping mission (see Annex). The SWOT and PESTLE assessments were reviewed and adjusted based on the outcomes of the pre-consultation and Regional Consultation meetings, and National Fisher Forum in October 2018.

Table 3. Early process for developing the National Fishery Strategy



Following on from the Dili-based technical working group and stakeholder activities, honest reflection by the Steering Committee identified that the engagement processes used to-date had resulted in broad consultation, but hadn't engaged in any legitimate way with fishers, and particularly marginalised groups within fishing communities such as poorer fishers and women. To this end, the Director General for Fisheries appointed a 6-person team (3 from DGP, 3 from WorldFish) to assess how best to engage with these groups. An initial plan was to run 7 regional fisheries consultation meetings, culminating in the National Fisheries Forum. The communication strategy to involve stakeholders with these meetings would engage via regional fisheries officers. Again, once the organisation process had commenced, it was recognized that the communication plan was still deficient, primarily because:

- The quality of communication links between regional fisheries officers and diverse groups of fishers varied substantially from district to district – this would not lead to good representation at all meetings
- Engagement with women's groups was not generally seen as part of the remit of regional fisheries officers, so it was very likely that meeting organized by these officers would reinforce gender-based disadvantage, rather than redressing it.

Ultimately, this 6 person group concluded that a far more extensive communication strategy that involved meetings at the 'major landing site' level would be required. This would enable the team to directly link with marginalized groups, and gain a much more grounded experience of the situation of fishing communities and their resources. This was, however, outside of the funding scope of this activity under FSSP-TL. Fortunately, the group was able to attract supplemental funding from the Asian Development Bank, and activities from this point were co-funded by the FSSP-TL and ADB, and accordingly are components of project reports to both agencies.

Table 4. SWOT analysis for the fishery sector in Timor-Leste as developed by the TWG and refined through the extensive stakeholder consultation process

Strengths	Weaknesses
<ul style="list-style-type: none"> • National and sector policies prioritise sustainable resource use. • Potential to improve value chains (add value) and increase demand through consumer education. • Willingness to share resources – few conflicts among small-scale resource users. • Scope to increase production with diversified gear and access to more fishing grounds. • Sustainable resource use is the dominant goal in the legal framework. • Timor-Leste’s coastal and marine environment is relatively healthy. 	<ul style="list-style-type: none"> • Limited capacities at central and local levels to implement policy and strategy, in particular for enforcement and inspection. • Lack of public sector commitment – reluctance to invest in management. • Fishing communities are dispersed, limiting clustering to facilitate assistance. • Insufficient knowledge of diversified and sustainable fishing practices and gear. • Inadequacy of management instruments such as Total Allowable Catches and quotas for multispecies, multigear, tropical fisheries. • Knowledge of abundance and diversity of not resources available.
Opportunities	Threats
<ul style="list-style-type: none"> • Increased engagement with international laws, covenants, agreements and voluntary instruments. • Probable under-exploitation of pelagic fish resources, particularly small pelagics accessible to small-scale fishers – potential for increased effort. • A significant potential for co-management on the side of the community. • With better boats and gear, new fishing grounds can become accessible. • Legal provisions for co-management arrangements allowing full participation of communities and other stakeholders in resource management. • Possibilities to restore critical habitats e.g. mangroves. 	<ul style="list-style-type: none"> • Policy implementation is reliant on external assistance. • On-going GoRDTL donations of vessels and gear undermines self-propelled and responsible sector development. • New boats and gear may result in overfishing if not effectively regulated and enforced. • Legal provisions for obligatory Monitoring, Control and Surveillance are in place but enforcement capacities are virtually non-existent. • Lack of enforcement capability and political will may constrain efforts to prevent future environmental degradation and habitat loss.

These additional resources, and the remarkable commitment to this task shown by both MAF and local WorldFish staff, enabled a process that included the steps outlined in table 4 below. This new and extensive consultation process started with 27 meetings held in all 13 coastal municipalities (figure XX) - termed ‘pre-consultation meetings’ held over a period of 6 weeks. The team covered an impressive 2500km by road, sea and air to achieve this. Each meeting required district fisheries officers to organise a venue, and start communication processes with fishers and stakeholders. However after some ‘trial and error’ meetings where, for example, few women showed up, the team would arrive in communities early, and work to ensure representation of all important groups, including women, fish buyers and sellers. If necessary, meeting times were altered to allow for local activities, or to ensure women were not excluded due to household duties. This process ultimately engaged over 500 women and men fishers and community members in the process of developing the NFS and implementation priorities.

Table 5. Extended community consultation developed to ensure engagement and ownership of the strategy by fishers and stakeholders

<p>Pre-Consultation Meetings <i>July to Sept 2018</i></p>	<ul style="list-style-type: none"> • 37 meetings with fishers, their communities and other stakeholders in all 11 coastal municipalities • Group discussions/co-management exposure
<p>Regional Consultation Meetings <i>Sept to Oct 2018</i></p>	<ul style="list-style-type: none"> • 5 structured regional, participatory, inclusive dialogues with fishers, their communities and other stakeholders. • Outputs used to develop Final Draft National Fisheries Strategy.
<p>National Consultation Meetings <i>October 2018</i></p>	<ul style="list-style-type: none"> • Structured, participatory, inclusive dialogue at Women Fishers Forum and National Fisheries Forum in Dili • Outputs used to develop Final Draft National Fisheries Strategy.
<p>National Fisheries Strategy <i>Ongoing review</i></p>	<ul style="list-style-type: none"> • Preparation and launch of the Final National Fisheries Strategy as a "living document", updated through regular discussions with fishers (men and women), leaders of their community organizations and stakeholders.

The objectives of the pre-consultation meetings were:

- Provide a first point of engagement between fishers, DGP and WorldFish team members
- Provide basic information about the NFS, why it is important, and how it will help fishers
- Gain an understanding of:
 - Important species for food security
 - Important species for trade
 - Dominant fishing methods
 - Women's fishing activities
- Provide a basic understanding of what a shift to co-management would look like
- List the existing fishing related groups that exist in communities as important data for co-management planning
- Select a representative and engaged group of women and men fishers to participate in the regional consultation process

Results from open discussions and breakout groups were compiled in spreadsheet form, and presented graphically (see example below Figure XX). Graphic representation of data was used in order to simplify the process of reporting back findings to participants. This allowed the regional forums to be utilized as a process of endorsement of the findings from data collection at the pre-consultation meetings.

Information regarding important fish species and gears has been incorporated into the NFS, into a current effort funded by the Norwegian Embassy in Jakarta to revise the fisheries law, and will directly assist with priority setting for implementation of the NFS. Development of Fishery Plans as outlined in fisheries law, can be structured spatially around new information on the differences among regions, and can prioritize species that are shown to be important for food security and income.

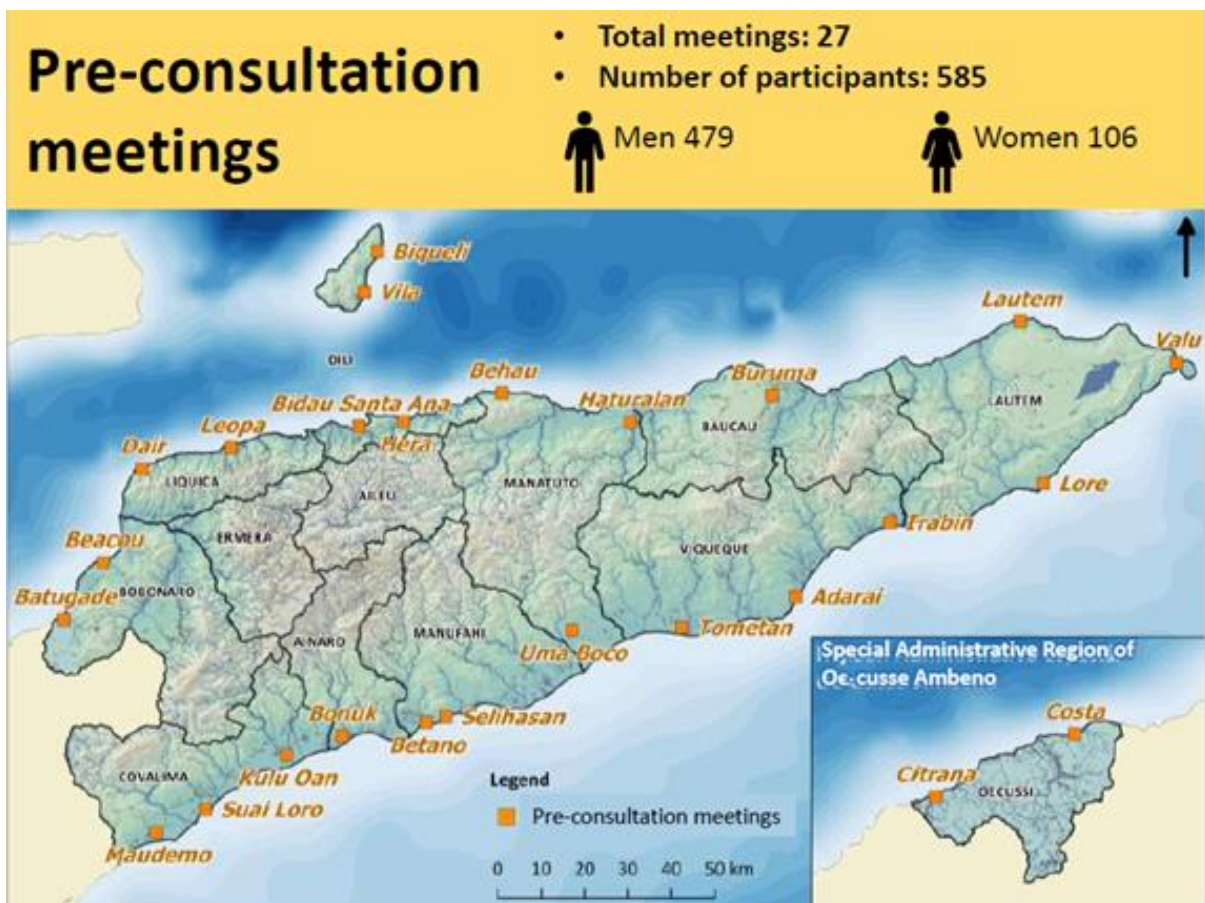


Figure 9. Locations of the 27 ‘pre-consultation meetings’ held across all 13 coastal districts

Women and men fishers selected as representatives during or soon after the pre-consultation meetings attended five regional consultation meetings. The objectives of these meetings were:

- To ensure that fishers, administrators and other stakeholders are aware of the review of the fisheries sector, including the new National Fisheries Strategy, and why it is being done
- To understand “what the changes might mean for me”?
- What is co-management?
- What does co-management look like on the ground??
- What might the involvement of communities, men and women fishers and other stakeholders be?
- What do the legal changes mean?
- To present back, and validate data on fishing livelihoods collected at the pre-consultation meetings, and get further comments/amendments
- To develop a **consensus statement** on fisheries in the region, to be presented to the National Forum by one or more members of the group
- To ensure good representation at the National Fisheries Forum by men and women

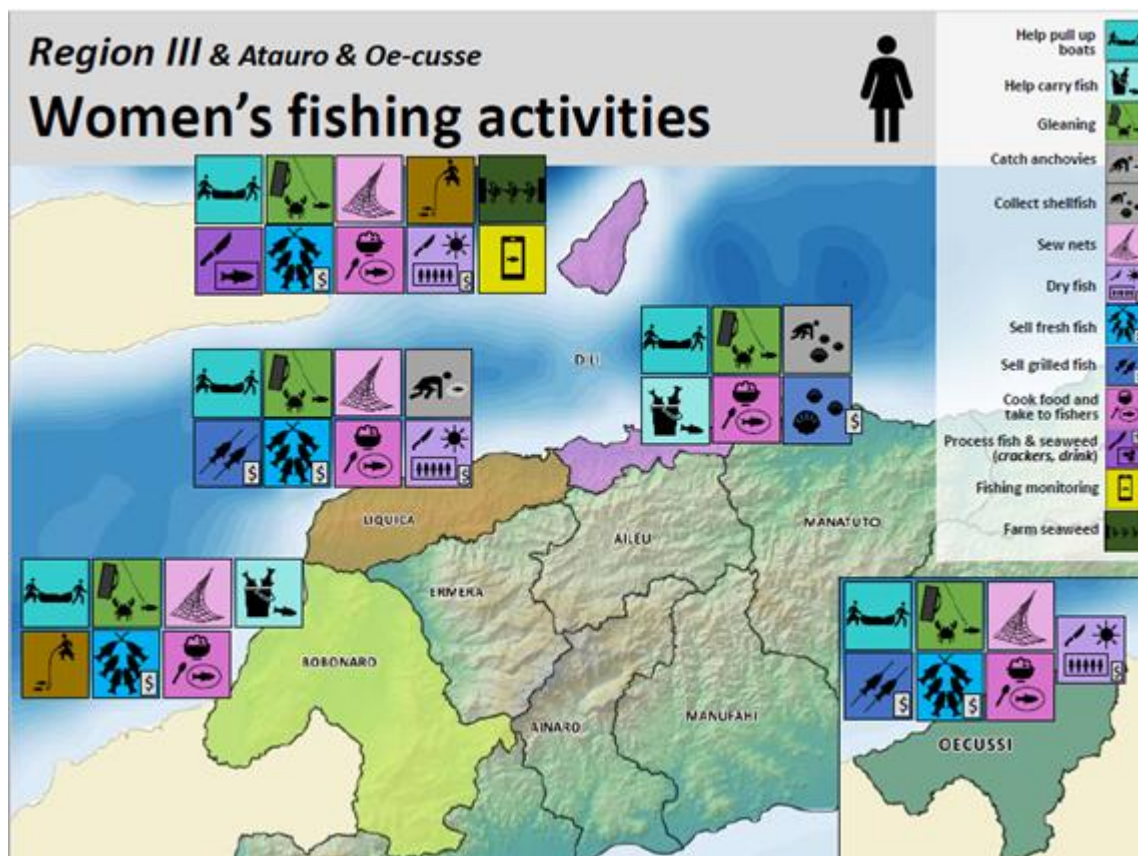


Figure 10. An example visualisation of data collected at pre-consultation meetings and validated at regional consultations. In this case, the graphic shows the main fishing activities undertaken by women in management region 3.

These meetings provided substantially more detail on the content and objectives of the NFS, provided a forum for discussion of this detail. Speakers provided a picture of what co-management might look like and what the benefit and engagement might look like for communities.

Breakout groups were used to validate data on fisheries from the pre-consultation meetings. In collating this data from pre-consultation meetings, we found that a number of groups, while having productive discussion, had not adequately ranked and recorded the information on important gears and fish species. We used the consultation meetings to validate or re-score these data and make sure we have a truly representative picture of the fishery in each region.

As most participants in the regional meetings had also attended pre-consultation meetings there was existing knowledge of the process, and this enabled more nuanced discussion of issues in the sector. Priority issues for each region were discussed and recorded.

Finally, the regional forums were used to designate a spokesperson or people for each region, and develop a consensus statement from the region to be presented at the National Fisheries Forum. The breakout groups were prompted to describe the character, strengths and issues with the fisheries in their region.

Women Fishers Forum and National Fisheries Forum

The Women Fishers Forum was held on October 16, 2019 (Images 6 and 7) while the National Fisheries Forum (Image 8) was held the following day, October 17. Approximately 100 women from 13 municipalities attended with Women's Forum, while 250 women and men were present at the National Fisheries Forum. Both meetings were considered exceptionally successful, providing a unique opportunity for fishers to celebrate culture, share experiences, have concerns heard, and contribute to

the future development of the sector. The project provided support to community members to travel to Dili for these meetings.

The Women Fishers Forum helped to encourage women, who have long had less engagement and voice in decision-making in small-scale fisheries governance and management than men. Women from communities where empowerment and livelihood activities were taking place were able to tell their stories, while gender specialists for NGOs and the public sector provided a bigger picture of progress with women’s issues, livelihoods and empowerment. After hearing one another’s stories, breakout groups were asked to develop a consensus statement for presentation at the National Fisheries Forum the following day. Three women were selected to present this statement.

The National Fisheries Forum was opened by the Minister for Agriculture and Fisheries, while the National Director of ADB and the Norwegian Ambassador to Jakarta provided statements of support. Presentations on the state of the fisheries sector in Timor-Leste, the National Fisheries Strategy and its development, approaches to co-management and the fisheries legal reform process were provided by project staff and consultants. Representatives from regional forums, and the women’s representatives, presented their consensus statements. The forum concluded with a panel session to allow those attending to air concerns or provide comments on the NFS.

The Women Fishers Forum and the National Fisheries Forum both served also as a celebration of fishing culture. Art and photography competitions were held in conjunction with the forums, and prizes were awarded at the National Fisheries Forum, while song and dance presentations were also a feature during the lunch break and following proceedings.



Image 6. Presentation of the Women’s consensus statement at the National Fisheries Forum. ©WorldFish



Image 7. Attendees at the Women Fishers' Forum, Timor-Leste, 2018. ©WorldFish



Image 8. Attendees and cultural activities at the National Fisheries Forum. ©WorldFish

The National Fisheries Strategy

The full final strategy draft is presented in Appendix 2. As illustrated in Figure 11, a diagram that is based on a traditional Timorese house, and structures the document, the strategy has been formulated around a vision statement, policy principles, an overall objective, and specific objectives is as follows:

The NFS proposes the following **vision** for Timor-Leste’s marine fisheries:

“Timor-Leste’s marine fisheries provide for sustainable livelihoods, incomes and employment, and contribute significantly to food and nutrition security while marine living aquatic resources and coastal environs are safeguarded for future generations”.

Its overall objective is:

“Responsible, sustainable and equitable management of fisheries and living aquatic resources based on a co-management arrangement and complying with regional and international laws, voluntary instruments, agreements and covenants”.

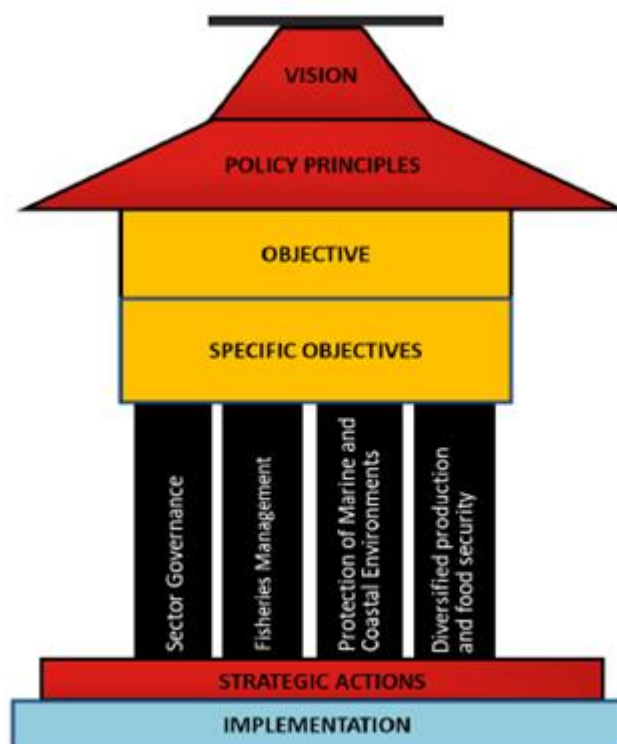


Figure 11. Structuring graphic from the National Fishery Strategy, based on the design of a traditional Timorese house.

The strategy has two **specific objectives**:

- “Co-management of marine resources by small scale and artisanal fishers, their families and communities represented socio-politically by legitimate basic democratic organizations, facilitating ownership and in compliance with legal and regulatory provisions, in concert with GOTL competent authorities”, and
- “GOTL competent authorities exercise their sovereign function of providing and enforcing a legal and regulatory framework conducive to co-management of marine resources in the EEZ for the benefit of the Timorese people, together with artisanal fishers, their families and communities”.

The **policy principles** underlying the vision and objectives are that:

- All Timorese fisheries resources which can be caught by small scale and artisanal fishers should be caught by small scale and artisanal fishers, and
- All Timorese fisheries resources which can be caught by Timorese fishers should be caught by Timorese fishers.

The policy principles are visualized in figure 12, which effectively becomes a decision tool for the development of, and access to, new fishery resources.

The greatest area of influence of the community and regional consultation processes was in the strategic actions and priority setting presented in the Strategy (Appendix 2). These data will further come into their own in the design of an Implementation Plan for the strategy, and in priority setting for co-management processes.

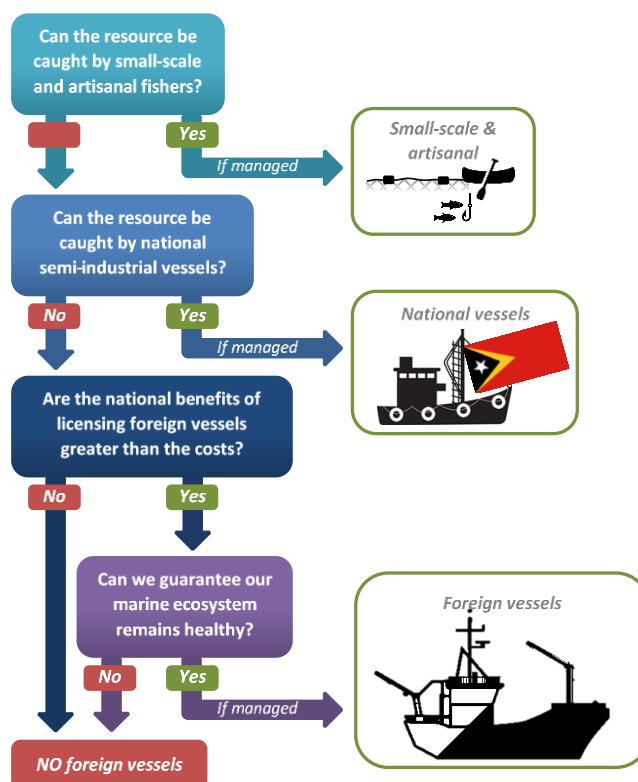


Figure 12 - Graphic of the policy principles embedded in the National Fisheries Strategy

A revised Fisheries Law for Timor-Leste

Additional support through the costed extension phase of the project enabled us to contract a Portuguese natural resources lawyer (Ms Teresa Amador - Ecosphere Consultants) to work with us, a MAF working group and a diverse group of national and international stakeholders to revise the legal framework for fisheries in Timor-Leste. The review focused on the General bases of the Legal Regime for the Management and Planning of Fisheries and Aquaculture approved by Decree Law n.º 6/2004, of 21 April and regulated by Government Decree n.º 5/2004, of 28 July.

Using a highly participatory approach, the review was initiated with a gap analysis of the fisheries legal regime bearing in mind the specific context and future aspirations for the fisheries sector in Timor-Leste. This analysis was based on:

- Timor-Leste policies and strategies relevant for the sector;
- International best practice;
- Regional and international commitments of Timor-Leste;
- Comparative analysis with other countries in the region.

The initial review and gap analysis concluded that the fisheries legislation:

- was outdated: 15 years had elapsed without any review to the main legislation, which had been in force since 2004.
- was fragmented, overly complex and unnecessarily long – besides the two main legal instruments there are numerous Government and Ministerial Decrees aimed at regulating the sector;
- was unclear and not consistent – the fisheries general regulation adopted by Gov Decree n.º 5/2004 repeated, and in some cases contradicted, the main provisions established under the general legal regime of Decree Law n.º 6/2004.

These factors make the understanding of the fisheries legislation by the managers and operators of the sector a difficult exercise, and its enforcement a daily challenge to the fisheries administration. Participatory work with communities as part of the development of the National Fisheries Strategy clearly showed that fishers had very limited understanding of the existing law, and in many cases the same applied to DGP employees. For example, fisheries managers in many cases had not recognised the contradictions within the existing law as highlighted by the gap analysis.

The participatory and drafting process of the review are outlined in table 6 below.

Table 6. Consultative processes in the revision of the fisheries law

Activity	Date	Outcomes
Mission 1– Teresa to Dili	2-9 March 2018	Establishing team, normalising expectations, planning process
Gap analysis	April/May 2018	Desk task by Teresa, producing a tabulated version of legal instruments with questions and requirements for the revision of each article
Mission 2 – Teresa to Dili	17-21 Sept 2018	Working through gap analysis with Technical Working Group including 60 stakeholders from diverse backgrounds. Breakout groups looked at different areas of the law
National Fisheries Forum	16 Oct 2018	Main elements of revision reported to 250 assembled stakeholders
Re-drafting	Oct – Dec 2018	Revisions and re-drafting by Teresa based on input from National Fisheries Forum and input from experts on requirements to conform with regional and global instruments
Mission 3 – Teresa to Dili	8-16 Feb 2019	Teresa with Technical Working Group to finalise draft including National Validation Workshop with diverse stakeholders (11 – 12 Feb) and Technical Working Group meeting (13 – 15 Feb) to incorporate comments
Final Submission	21 April 2019	Translation to Portuguese still required

The extensive documentation from the participatory gap analysis is available from the project leader on request, but has not been included here as an appendix.

Importantly the revisions introduce a level of ‘reality’ relating to the situation of fisheries in Timor-Leste, and due to parallel development, complement the National Fisheries Strategy. To highlight the most specific significant points of the revision, the revised legal regime has:

- 1) Reviewed the rules on fisheries management and co-management arrangements with stakeholders, local and regional experts, ensuring these reflect reality and incorporated these in legislation;
- 2) Updated the licensing and registration regime for commercial and non-commercial fishing to be practical and implementable;
- 3) Incorporated the obligations of Timor-Leste as a port and coastal state, including with regard to the use of ports, cooperation and exchange of information with relevant States, FAO, other international organizations and regional fisheries management organization, and the rules on Monitoring, Control and Surveillance;

- 4) Aligned the legal regime for marine protected areas with the National System of Protected Areas, adopted in March 2016;
- 5) Included new provisions that reflect the experience of the Timor-Leste fisheries administration, namely with regard to fisheries inspections and the adoption of conservation and management measures, as well as the best international practice regarding fisheries offences and sanctions scheme and rules on evidence and presumptions.
- 6) Considered the realities of the importance of fish for human nutrition in Timor-Leste, reducing wastage due to strict discard laws and allowing for home consumption (but not sale) of fish that would previously have been discarded.
- 7) Reduced the Fisheries Decree and Decree Law down from a total of 450 (often repetitive or contradictory) articles to 139 articles.

This revision has been finalised in English (Appendix 3) and will be ready to submit to the Parliament once technical Portuguese translation has been completed.

7 Sustainability

7.2 Improved data and information for fishery management

Prior to the FSSP-TL, the fisheries data collection system in Timor-Leste was largely non-functional, and the data collected was useful for neither estimating total catches nor managing fisheries. In close consultation with DGP staff, the new *PesKAAS* system is comprehensive, very usable, and possible one of the most advanced systems for monitoring and managing coastal small scale fisheries in any developing nation globally. Sustainability is clearly illustrated by the level of DGP buy-in to the system, having recently employed 11 officers who are tasked specifically with collecting data for this system. While the system would perhaps not be fully maintained currently without assistance from WorldFish, WorldFish is committed to partner with the DGP for the foreseeable future, providing ample opportunity to further build ownership of the system, and capacity to maintain it. The development of a comprehensive Fish Identification Guide for Timor Leste has greatly assisted in the training of data collectors, and will have a lasting impact on the accuracy of these data.

Stock assessment of reef areas has provided the first information on the health of reef fish stocks in Timor-Leste, and has demonstrated that these stocks are healthy or relatively healthy. While this 'snapshot' is very useful in shaping approaches to management approaches, and had a direct impact on the formulation of the NFS and the revision of the Fisheries Law, the activity itself currently relies on external assistance. While training was provided as a component of this work, this is a specialist task and those trained are not currently competent to repeat the underwater visual census process. Substantial further training would be required in order for DGP staff to continue this activity.

7.3 Improved fishing technologies

The research conducted under FSSP-TL leaves us confident that in many communities, FADs can have a very positive impact on fishing livelihoods and the availability of nutritious fish. FADs have been trialed in a number of communities, and where they work (for example Adara on Atauro Island, Adarai on the south coast), they work well. In communities where immediate gains have been seen have adopted FADs as a major strategy for fishing. However, at this point we do not fully understand where FADs are likely to be successful. Further research on factors determining success is required, and this can only be achieved through a larger, well-planned pilot with communities with diverse environmental and social settings. The engagement of a Master Fisher to train communities in fishing techniques has been useful in highlighting alternative approaches to FADs that are also worth exploring.

In summary, substantial progress has been made on this objective, but project impacts could only be described as sustainable in a small number of locations at this stage. Substantial further opportunities exist.

7.4 Pro-poor market chain development

While this project outcome area received lower priority due to changes in the project funding scenario, it remains a high priority. Initial scoping work, along with other companion projects, have shown that while there are no 'quick fixes' to market chain issues, a culturally integrated lens on value chain development will be critical, and requires close participatory work with fishers and traders. This remains an important area for future work in the sector.

7.5 Capacity building

Both formal and informal capacity building have had lasting impact. Training of management staff and field staff has been crucial to the implementation of the *PesKAAS* fisheries data system. Training directly through engagement of DGP staff in most project activities has resulted in a very definite and observable impacts in engagement in management activities and research. With current government reforms in place

to reform hiring systems to reward ability and performance in the appointment of senior staff within MAF, we see increasing opportunities in the future for impact of training activities. Staff engaged in the development of the NFS and the revision of the fisheries law have moved from having very little understanding of either fishing communities or the legal basis for management, to both understanding the legal system, and having a high degree of ownership of the revisions. This will undoubtedly have impacts in the implementation of key aspects of the law and the NFS.

7.6 Strategy and legal system reform

Both the development of the National Fisheries Strategy and the reform of the legal framework became the highest priority areas for the DGP during the project period. The engagement by senior staff in the extensive and often long (several consecutive days) workshops for these components was impressive and was noted particularly by the international consultants engaged for the process. The direct involvement of senior staff from DGP throughout the drafting and development stages of these components assures they are highly aware of their contents, and have ownership of the outcomes. This is in stark contrast to existing strategy documents and legal system where staff were largely unaware of details. This knowledge and ownership are very important pre-conditions for effective implementation of the NFS and the legal system. Both the Minister and the Director General have been very keen on following through with the outcomes. There is no doubt that this significant reform will have sustained impact and have a positive influence on the future of the fisheries sector in Timor-Leste.

The participatory processes utilized in the development of the NFS, including community consultations at two scales interacting with some 500 women and men fishers, and the national forums, provided unparalleled interaction and access between DGP staff and fishers. The increased understanding by DGP staff of the situation in fishing communities, and the new norms of communication established through this process are a key enabling condition for effective co-management. Moreover, the engagement of Women in this process has served as a key point of training in gender awareness for DGP staff, and has developed a new confidence among women and women's groups to assert their voices in management forums.

8 Conclusions and Recommendations

This section summarises the key successes of the FSSP-TL in achieving the project objectives and those of the Timorese people in the context of the National Strategic Plan 2011, and highlights the remaining challenges and priorities for future work, to harness the potential of fish and fisheries for development.

Harnessing the potential of fish and fisheries to combat malnutrition in Timor-Leste will rely on scaling up fish production, improved accessibility through functional and pro-poor value-chains, and improved nutrition education. Our results suggest there are key interventions and technologies that can be utilised to boost production in coastal fisheries. Already there is nascent entrepreneurship and mobilisation in the small-scale fisheries sector on a local scale, where fishers and traders are investing in FADs, gear and freezers to improve and regulate fish supply. However, to enhance fish production to the level necessary to combat malnutrition, a great deal of investment in coastal fisheries will be required. Furthermore, the challenges to fisheries are not limited to the fisheries sector, but are of course multi-sectoral (such as poor road and water infrastructure limiting distributional efficiency and food safety requirements respectively). Here, we will focus on sector specific recommendations as far as possible.

8.1 Information and capacity

Prior to FSSP-TL, there was a rudimentary fisheries data system in place, however review of the system showed data had not been entered for a number of years, data was of poor quality, and ultimately could not, and had not been used to improve the management of fisheries. The PeskAAS system has seen excellent buy-in by the DGP, and automatically generates fisheries statistics and data to inform government intervention priorities, for example in supply of new gear or FAD installations.

The project has provided the first quantitative assessment (although over a limited area) of reef fish stocks, with outcomes suggesting stocks are not under huge pressure and there are no immediate concerns about current exploitation levels. The PeskAAS system will enable similar monitoring and science-based management in other small-scale fishery sectors in Timor-Leste.

The project has consolidated current knowledge about the sector in the 'Fisheries and aquaculture of Timor-Leste in 2019: Current knowledge and opportunities' report, providing an excellent companion volume to the National Fisheries Strategy that will help shape future investments. The following next steps are required to ensure that this intervention is sustainable, and capacity built to ensure future sustainability of this intervention:

- The important next step will be for DGP staff to utilise these data to target their support and extension to fishers and coastal communities. This will require further mentoring/training, and WorldFish is committed to continue this task (under the existing Country Agreement between the MAF and WorldFish) where support through future funding can be identified.
- To ensure there is appropriate coverage of remote areas and fisheries, there is an urgent need for a new census and fisher registration of the SSF fleet in Timor-Leste. The RFLP started registering fishers, but the registration system has not been updated so the data on the number of boats and distribution of fishing effort is patchy. Without this, it is difficult to prioritize areas for intervention from government and NGOs.
- A dedicated national agricultural census planned for 2020 should include a section on fisheries and aquaculture, to quantify the importance of the sector. Household Income and Expenditure Surveys (HIES) have been used effectively in other countries to obtain a better estimation of production and consumption levels with little or no expense to fisheries agencies. Guidance on how to design HIES to provide reliable information on fisheries should be prioritized, to understand the drivers of fish availability and consumption.

8.2 Sustainable small-scale fishing technologies

FSSP-TL activities have reinforced that notion that there is unfished capacity in the small pelagic fisheries of the north coast. Approaches such as locally adapted FADs have shown improved catch rates for fishers at three out of four early trial sites, and the potential to return on investment within 5 months (with no new gear investment). DGP officers have been trained in constructing and deploying FADs and are now leading further deployments.

Equipment such as boats, engines and gear are prohibitively expensive for small-scale fishers in Timor-Leste, and 100% of fish centers identified inadequate boats and fishing gear as a main constraint to earning higher income. Also the need for training in areas of new fishing techniques and technology, as well as engine maintenance and fish processing, was highlighted by fishers at more than 80% of fish centers in all regions during NFS consultations. There are few sources of information available to them on novel fishing techniques, equipment, market information and sea conditions. As a result, SSF are currently limited in range and fishing capacity.

- Scaling up FAD deployments by the DGP across the country, combined with rolling out training on forming fishing groups and cooperatives, will strengthen fisher market competitiveness and boost organic growth and investment in the sector.
- Exploratory fishing should be continued in both the north and south coasts to provide for alternative fisheries of potentially higher value or diversified sources of fish-based income.
- Expand testing and development of diversification opportunities in small-scale fishing technology
- To ensure small-scale fishers can access information and training on sustainable methods to increase their catch rates, rather than resorting to exploitative technologies that may lead to environmental damage or overfishing, further capacity building of DGP municipal staff will be crucial, to establish fisheries extension officers in each municipality that are trained as trainers in sustainable fisheries technologies.

8.3 Pro-poor market chains

Currently, the primary obstacles to improving livelihoods through pro-poor market chain support on Timor-Leste's north coast is limited fish supply. On the south coast, potential fish production is much higher but distribution is inhibited by poor road and cold chain infrastructure. South coast fisheries for higher value species such as snapper, provide considerable potential for expanding local fleets and enterprises, providing new livelihoods as well as contributing substantially to availability of high-quality protein and micronutrients.

Fishers highlighted that when they need financial assistance, it is mainly for replacing fishing gear (81%) and to cover operational costs of fishing. While improved production and value chains will improve this situation, a level of investment is required. Fishers are constrained by poor access to credit. Few are aware of microfinance providers, so only a minority use existing savings and loan services; most borrow informally. These same challenges to accessing credit that fishers face, also constrains the development of entrepreneurship and microenterprise in fish value chains.

- Technological development and locally relevant innovations in fish processing and packaging would generate value-adding and employment opportunities.
- Fish traders must be supported to innovate and build on their ideas for stronger market chains to inland areas.
- Training for fisher communities in forming cooperatives to strengthen market competitiveness of fishers, and to maintain a viable value for fish if increased production leads to lower prices (when the system cannot commercialize the amount of fish produced).
- Key intermediaries must actively encourage and support distribution to markets in inland municipalities. If possible, during the time of high fish surplus, a market should be established in Aileu and Gleno, with consistent, good quality supply at affordable prices. Once a market has been established, existing supply routes should be leveraged from large supermarkets that

travel to and through Aileu and Gleno when purchasing vegetables for sale in Dili. This will provide cheap, cool and regular transport to these areas.

Nutrition

- Advocate fish consumption especially in lactating mothers as well as children under 5 years old through developing local recipe books and diversifying products containing fish products and crucial micronutrients. WorldFish recently produced a short film for distribution on this topic.
- Government institutions and NGOs should prioritize awareness-raising campaigns regarding the nutritional value of eating fish, paying particular attention to countering traditional beliefs that limit consumption of fish by certain groups or in particular areas.
- Through greater recognition of women's fishing activities (including gleaning) comes the opportunity to directly support household nutrition while empowering women according to their aspirations in the sector.
- Foreign vessels licensed to fish in Timor-Leste should be obliged to land and sell a proportion of the catch in Timor-Leste to boost the quantity of fish being sold on the market.

8.4 Formal and informal capacity

Community livelihoods trainings were successful in the short term but limited in their sustained impact due to challenges to maintaining and replacing equipment and financial trust issues within community groups. The most successful models of community training engagement are those that maintain a long term, mentoring relationship, as the involvement of an external agency is likely to minimise perceived risk and also heighten trust.

The participation and engagement of national MAF staff and other ministry staff in the technical working group to drive the revision of the national fisheries law and drafting of the national fisheries strategy was hugely encouraging. However, the challenge of implementing both of these important policies once confirmed, relies on the continuing momentum within DGP and MAF to adequately disseminate and roll out relevant capacity to municipal staff.

- Capacity development for fishers, managers and researchers in Timor-Leste will continue to be a priority for the next decade. Research in this area should focus on methods and tools for effective light touch scaling of support for fisher communities. This should be coupled with support for studentships, internships and collaborations with local university fisheries and resource management programs, as well as the continued training of trainers within DGP to serve as extension officers.
- Designated and specific funding support to continue momentum and implement the national fisheries strategy nationwide will be essential to move to a sustainable system of managing Timor-Leste's marine resources.

8.5 Policy and strategy

The FSSP-TL has achieved remarkable success in developing a drafting a truly representative and participatory fisheries strategy, and condensing the current 181 article fisheries law down to 148 articles. However, this is only the beginning of the journey. Timor-Leste has many fisheries and environmental laws in place, but with little or no enforcement action, most marine and coastal resources are effectively open-access, as there are no specific rules restricting physical access to fishing areas, except in locally managed marine areas.

The development of the fisheries sector is highly constrained by the limited human capacity (training and number) at the national and district level. The MAF has received limited benefits from the Human Capital Development Fund, and funds allocated for civil servants training have been steadily decreasing.

- Training to build capacity and awareness of the revised fisheries regulations with national and municipal level DGP staff and fish workers will be necessary to improve understanding and compliance in the sector.
- Prioritise development and implementation of contextualised co-management systems for priority fisheries and communities. Co-management is a new concept in Timor- Leste, so substantial capacity building among managers, resource owners and stakeholders will be required to implement this aspect of the NFS. The nascent expansion of tara bandu for marine and fisheries management should be further developed as a mechanism that people understand and one that is already mandated by law.
- Combining new fisheries technologies, such as FADs, with the development of co-management processes in communities can provide useful incentives for fishers to engage in co-management and conservation processes by providing alternative fishing grounds. However, further value chain incentives should be prioritised for research following promising progress made in the rapidly evolving field of ICT4SSF (Information and Communication Technologies for Small-scale Fisheries).

8.6 Cross-cutting themes

Gender and youth

A gender-disaggregated catch documentation system will quantify the contribution of women to fisheries, particularly in ordinarily informal fisheries like gleaning. Engaging and empowering women to make decisions about their marine resources will improve coastal stewardship and harness their potential to drive improvements to household nutrition and local economies.

Consultations associated with the development of the National Fisheries Strategy, and revision of the fisheries legal system were highly intentional and strategic about engaging women in these processes. For community consultations, the team were very proactive in ensuring women's participation, engaging approaches such as doorknocking if necessary to identify women leaders in communities, and holding consultation meetings at night after meal times so they did not clash with women's domestic commitments. The Women Fishers Forum proved instrumental in ensuring that women were strongly represented, and provided very well thought out input to the National Fisheries Forum. WorldFish will build on networks formed through these processes to ensure continued engagement by women in the higher levels of resource governance.

Information and communication technologies should contribute to transforming gender norms and driving equitable distribution of benefits in a fisheries context by actively disaggregating data collection and including marginalised groups and informal fisheries that are notoriously hard to monitor. The next phase of FSSP-TL in Timor-Leste would build on initial momentum generated by the women's fisher forum and incorporate gender transformative action to not only recognise women's contributions to fisheries, but to actively change gender norms to promote gender equality and empower women according to their aspirations in the sector.

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BLOG Improved fisheries in Timor-Leste: A path to greater well-being? Blog:

<http://blog.worldfishcenter.org/2017/06/improved-fisheries-in-timor-leste-a-path-to-greater-well-being/>

VIDEO Coastal fisheries help combat hunger and malnutrition in Timor-Leste:

https://www.youtube.com/watch?v=Ycl_Yk8k2Dk

VIDEO Fish nutrition for the family: <https://www.youtube.com/watch?v=ZRLnYjU4ZaM&t=38s>

9 Appendices

Appendix 1: Fisheries and aquaculture of Timor-Leste in 2019: Current knowledge and opportunities

Appendix 2: National Fisheries Strategy

Appendix 3: New Fisheries Decree Law

Appendix 4: Empreza Dí'ak Final Report (Market chain analysis, nutrition survey and community trainings)

Appendix 5: Nearshore fish aggregating devices show positive outcomes for sustainable fisheries development in Timor-Leste. *Frontiers in Marine Science*. (2019). Tilley, A., Wilkinson, S., Kolding, J., López-Angarita, J., Pereira, M., and Mills, D. J.