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Aquaculture Development Evaluation Report



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Evaluation Report: Aquaculture Development in Timor Leste

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Image details: The photo on the report shows harvesting of tilapia at the Gleno hatchery site, Ermera municipality, Timor-Leste.

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Abbreviations

ADD	Activity Design Document
ADS	Aquaculture Development Strategy
ADSIP	Aquaculture Development Strategy Implementation Plan
EDTL	Electricidade de Timor Leste
FFS	Farmer Field School
FIFO	Fly-In, Fly-Out
GDS	General Directorate of Statistics (Timor Leste)
GIFT	Genetically Improved Farmed Tilapia
GoTL	Government of Timor Leste
ha	Hectare
HH	Household
IADE	Instituto de Apoio ao Desenvolvimento Empresarial
IDR	Indonesian Rupiah
kg	Kilogramme
KOICA	Korea International Cooperation Agency
MAF	Ministry of Agriculture and Fisheries
MDF	Market Development Facility
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
NADS	National Aquaculture Development Strategy
NDA	National Directorate for Aquaculture
NDFA	National Directorate for Fisheries and Aquaculture
NGO	Non-Governmental Organisation
NIWA	National Institute of Water and Atmospheric Research
NZ	New Zealand
OECD-DAC	Organisation for Economic Cooperation and Development - Development Assistance Committee
PADTL	Partnership for Aquaculture Development in Timor Leste
SME	Small and Medium Enterprise
t	tonne
ToR	Terms of Reference
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USD	United States Dollar

Abstract

The purpose of the evaluation of Aquaculture Development in Timor Leste activities is to identify improvements that can be made to managing, implementing and achieving results of the programme and to contribute to the broader evidence base by informing future policy and implementation of aquaculture development activities within and outside the New Zealand Aid Programme.

The evaluation methodology included reviewing the Activity Design Document and subsequent Annual Activity Progress Reports, amongst other project documents. Interviews were held with key MFAT representatives, MAF-NDFA officers, PADTL staff, other donor project staff and PADTL fish farmer beneficiaries in Timor Leste.

Main findings and conclusions were that aquaculture is relevant as a provider of cheap protein in a country such as Timor Leste which continues to suffer from one of the highest rates of malnutrition in the world, however, its potential impact is limited considering the number of suitable sites and other more readily available sources of protein.

PADTL has supported NDFA to successfully produce GIFT fingerlings at the Gleno hatchery; however, several setbacks have prevented the production of milkfish fingerlings at the Vemase hatchery, which is yet to become operational. Concentrate feed at an appropriate price is still unavailable which has prevented the production of tilapia on a commercial basis. Nonetheless, first harvests at back-yard subsistence ponds have shown local consumers are willing to pay USD 4.00/kg for fresh tilapia and because of low production levels, finding a market is not a constraint.

Sustainability of the hatcheries is a concern once MFAT funding has concluded and most recommendations are concerned with addressing 'seed and feed' issues in the remaining twenty months before end of project.

Executive Summary

The purpose of the evaluation of Aquaculture Development in Timor Leste activities is to identify improvements that can be made to managing, implementing and achieving results of the programme and to contribute to the broader evidence base by informing future policy and implementation of aquaculture development activities within and outside the New Zealand Aid Programme.

Key findings were that aquaculture remains 'relevant' as a provider of cheap protein in a country such as Timor Leste which continues to suffer from one of the highest rates of malnutrition in the world. However, its potential impact is limited by the number of suitable aquaculture sites and other more readily available sources of protein.

PADTL has provided mentoring to NDFA staff to improve sector planning and coordination and the preparation of five-year ADSIPs but NDFA focus tends to be on the preparation and execution of annual work plans. Hatchery staff have received overseas training in hatchery management and on-the-job training from visiting specialists, significantly improving their knowledge and skills.

Improved technologies have been introduced and PADTL has supported NDFA to successfully produce GIFT fingerlings at the Gleno hatchery. Unfortunately several setbacks have prevented the production of milkfish fingerlings at the Vemase hatchery, which is yet to become operational.

PADTL has identified fish feed rations that can be produced cheaply using locally available inputs, however, this is not feasible on a commercial scale and concentrate feed at an appropriate price is still unavailable which has prevented the production of tilapia on a commercial basis.

Tilapia production remains at subsistence levels on a low-input, low-output basis. Nonetheless, first harvests at back-yard subsistence ponds have shown local consumers are willing to pay USD 4.00/kg for fresh tilapia and because of low production levels, finding markets is not a constraint.

Whilst the target number of PADTL direct farmer beneficiaries is only 250 households, the Gleno hatchery in 2016 distributed to not only PADTL farmers but 779363 households including MAF farmer groups, NGO projects and individuals across eleven municipalities. Nonetheless, to achieve significant impact, tilapia farming will need to be scaled up and introduced to thousands more farmers.

Implementation has been affected by the change of Government in 2015 and resignation of the international project manager in early 2016. Approximately NZD 1.7 million of funding remains, which is likely to be expended during the remaining twenty months of the project.

Some activities have been delayed and some are unlikely to be completed. These include the number of district and suco officers trained, number of commercial SME fish producers supported, number of farmers trained, number of commercial hatcheries and feed processors supported, the production of sea cucumber juveniles at the Vemase hatchery, the establishment of marketing groups and the creation of institutional and export market linkages. Most of the above is not a concern as either the (training) target was too ambitious, the (private) sector hasn't evolved as expected, the activity is not a priority (sea cucumber) or the activity is not yet required (marketing groups and linkages). However, it is recommended targets in the Results Management Table are revised accordingly.

Sustainability of the hatcheries is a concern once MFAT funding has concluded and most recommendations are concerned with addressing continuing 'seed and feed' issues in the remaining twenty months before end of project. These include over-coming the barriers of importing concentrate fish feed and supporting the establishment of private sector distributors in the municipalities; stopping the supply of free fingerlings at the Gleno hatchery to encourage the development of private sector hatcheries and nursery ponds in the municipalities; negotiating some system with MoF whereby payments received for fingerlings can contribute towards operating costs and an emergency fund for the hatchery; and operationalising the Vemase hatchery for the production of milkfish fingerlings along the same lines as the Gleno hatchery as soon as possible.

In short, the 'business case' for aquaculture, including hatcheries, has yet to be proven. Further sector development is reliant on the sustainable and commercial supply of 'seed and feed' and it is highly likely donor and government support will continue to be required after end of project. The support must focus on establishing the foundation for a viable aquaculture sector to attract private sector investment. If support is discontinued before the 'business case' level is reached, it is highly likely the previous investment and progress made at the hatcheries will be lost.

To mitigate the possibility of this negative outcome, it is recommended PADTL and NDFA prepare an Exit Strategy focusing on seed and feed supply that results in either: i) the business case level being reached before end of project with the private sector becoming the main suppliers of seed and feed; ii) MAF-NDFA addressing their own budgeting constraints to be able to operate the hatcheries as a public service in the interim period until the private sector business case level is reached; or iii) seeking continuing donor support to supplement MAF-NDFA funds to operate the hatcheries until the private sector business case level is reached.

Valuable lessons learnt are that five years is too short a time period to establish a well-managed and sustainable aquaculture sector when starting from such modest beginnings and in such a challenging environment. Also for a comparatively small project, activities should focus on fewer key priorities, such as seed and feed, rather than trying to address several constraints across the sector, for which collaboration with other projects would be necessary. In Timor Leste, the size of the private sector and financial capacity of government should not be over-estimated and if a project's sustainability is dependent on the private sector, a thorough feasibility study to identify partners should be undertaken and those private sector partners be involved from the start of the project.

1.0 Background

1.1 The Activity

The 'Partnership for Aquaculture Development in Timor-Leste' Activity (PADTL) will run over a five year timeframe (2014-2019) with a total budget of NZD5.1m. It will contribute to meeting government sustainable economic development and nutritional goals by increasing direct access to reasonably priced fish for the rural poor, link producers with domestic and export markets, and deliver economic benefits for aquaculture farmers.

The Activity is into its 3rd year of implementation. Implementing partners are NIWA (New Zealand-based contract managers and technical assistance), World Fish (Dili-based within the Ministry of Agriculture and Fisheries) and the Ministry of Agriculture and Fisheries (MAF).

1.2 Evaluation Purpose and Design

1.2.1 Purpose

This evaluation will be used by the New Zealand Ministry of Foreign Affairs and Trade (MFAT), NIWA and the Timor-Leste Government to:

- Identify improvements that can be made to managing, implementing and achieving results for the PADTL Activity.
- Contribute to the broader evidence base by informing future policy and implementation of aquaculture development activities within and outside the New Zealand Aid Programme.

1.2.2 Scope

The Terms of Reference for the evaluation are provided in Appendix A. The evaluation covers the time period from the beginning of activity implementation (July 2014) until present. It focuses on all aspects of implementation including project management arrangements as well as assessing progress towards achievement of outputs and outcomes.

The target groups are the implementing partners (NIWA and its subcontractors: World Fish and Tisbe), the National Directorate for Fisheries and Aquaculture (NDFA) c.f. Timor-Leste Ministry of Agriculture and Fisheries (MAF) and other key stakeholders. The scope of the evaluation excludes the technical expertise of the implementing partner.

1.2.3 Design

The evaluation focuses upon the key questions included in the Evaluation Matrix (See Appendix B) with a main emphasis on tilapia and milkfish but also covers seaweed and sea-cucumber production. Main areas of enquiry are NDFA capacity building, local fish-feed processing, fingerling hatcheries, increased fish production/fish-farmer income, and fish and seaweed marketing.

The project Results Measurement Table is a key source of information regarding major progress indicators. Annual Activity Reports, minutes of project management meetings and MFAT Activity Monitoring Assessments were studied and a full list of documents reviewed is provided in Appendix C. The evaluation fieldwork had a restricted timeframe of just over two weeks, therefore the number and geographical spread of field visits was limited. Nevertheless, interviews were held with implementing partners in Dili and field work carried out in Baucau, Bobonaro and Ermera municipalities to interview fish-farmer beneficiaries and MAF fisheries extension and hatchery staff.

2.0 Overarching Findings

The goal of PADTL is ‘*Aquaculture capability within Timor-Leste supports a self-sustaining aquaculture industry that addresses nutrition, food security and income generation targets*’. By the end of project in 2019, it is expected nutritional benefits will include an increased fish consumption of over 1kg/person/year, contributing to a 50% reduction in malnutrition and stunting. Economic benefits will include 200 aquaculture Small and Medium Enterprises (SME) established and include the creation of 600 jobs with annual sales worth USD1.6 million. There will be an increased access to fish and reduction in production costs to below USD2/kg.¹

The preparation of PADTL is based upon several key Government of Timor Leste (GoTL) policy documents. The **2010 Comoro Declaration against hunger and malnutrition** is a commitment to address nutrition through concerted and joint efforts of seven line ministries viz. the Ministry of Agriculture and Fisheries (MAF), Ministry of Finance (MoF), Ministry of Health (MoH), Ministry of Commerce, Industry, and Environment (MCIE), Ministry of Education (MoE), and Ministry of Social Solidarity (MSS).

The **Strategic Development Plan 2011-30** (SDP) articulates the Government’s over-arching economic development agenda and emphasizes the importance of a thriving agricultural sector for food and nutritional security, poverty reduction; and economic growth for the nation as a whole.

To achieve objectives stated in the SDP, the NDFA prepared a **National Aquaculture Development Strategy 2012-30** (NADS). The vision of NADS is for aquaculture to contribute towards improved food and nutrition security, diversification of livelihoods of inland and coastal communities, and economic growth in Timor-Leste. Both inland and coastal aquaculture are supported in the strategy. Freshwater aquaculture is identified as a means of improving food and nutrition security in inland communities; while brackish water aquaculture and mariculture provides small business and income raising opportunities for coastal communities. It is intended to increase per capita fish consumption from 6.1kg to 15.0kg by 2020 with the expectation that aquaculture will contribute up to 40% of domestic fish supplies by 2030.

The Theory of Change included in the PADTL Activity Design Document is logical, coherent and consistent with NADS. The aquaculture industry would be developed by improving NDFA planning and coordination, increasing NDFA staff technical capacity, introducing improved technologies including hatchery management, training fish farmers, supporting private sector development for feed and seed supply on a commercial basis, and establishing farm to market linkages. The ensuing improved production and productivity would lead to sustainable nutritional and economic benefits.

2.1 Relevance

Objective 1: To assess the extent to which strengthening the Aquaculture industry remains a priority for the partner country and the New Zealand Aid Programme.

Since the preparation of PADTL in 2014, the GoTL has reasserted its commitment to the Comoro Declaration by preparing the **Timor Leste National Nutrition Strategy (2014-19)** which sets key nutritional targets to be achieved by 2019 and describes the role of MAF to: i) increase availability of food from animal source at household level, ii) increase income amongst young mothers and adolescent girls from lowest wealth quintiles and iii) increase consumption of food from animal source by adolescent girls, young mother, and young children. The Nutrition Strategy targets are summarised in Table 1.

Table 1: Nutrition Indicators

Indicator	Baseline (%)	Nutrition Strategy Target 2019 (%)	PADTL Target 2019 (%)
% underweight under 5 year old children	38	<30	19
% stunting under 5 year old children	50	<40	25
% wasting under 5 year old children	11	<10	6

¹ NIWA (2014) *Activity Design Document; Aquaculture Timor Leste*

Table 1 also shows that PADTL targets are not consistent with and considerably more ambitious than the Nutrition Strategy targets.

The New Zealand Aid Programme has also reasserted its commitment to support the GoTL to achieve its development objectives. The **Joint Commitment for Development 2016-2020** between the Government of New Zealand and GoTL is to support Timor Leste achieve its goal and joining the ranks of upper-middle income countries, eradicating extreme poverty and establishing a sustainable and diversified non-oil economy by 2030. The Joint Commitment states the New Zealand development assistance programme will specifically invest in the development of aquaculture (production, skills development and infrastructure) focused on addressing the nutritional and economic needs of rural communities.

Since approval of the Partnership Agreement for PADTL between MFAT and MAF in 2014, the aquaculture sector landscape has somewhat changed, with commercial private sector investment in milkfish and prawn farming from both domestic and foreign companies. Whilst this was envisaged in the NADS, it does affect the relevance of projects such as PADTL and how implementation strategies may need to be adapted.

Foreign Direct Investment in prawn farming provides some local employment but does little to improve nutrition. Seed and feed are imported directly and any profits are assumed to return overseas, which does little to develop an indigenous aquaculture sector.

MAF has also recently embarked on a heavily subsidised programme to establish 1ha fish ponds in every district. Both of the above undermine PADTL efforts to establish an indigenous, commercially viable and sustainable aquaculture sector in Timor Leste.

2.1.1 To what extent does the Activity continue to be relevant to beneficiaries, the New Zealand Aid Programme and partner country/regional development priorities?

Timor Leste continues to be one of the most malnourished countries in the world. According to anthropometric indicators, 38% of children under five years old are under weight, 50% of children are stunted and 11% are wasted. These statistics indicate long-term deficiencies in nutrition and even starvation for severe cases.²

Average fish consumption in Timor-Leste is 6.1kg/capita/year, substantially lower than the regional Asian average of 17kg/capita/year. However, there are large variances depending on location. For example, coastal communities eat more fish (17.6kg/capita/year) than meat (12.1kg/capita/year) and non-coastal communities eat more meat (11.6kg/capita/year) than fish (4kg/capita/year). Chicken is the most common type of meat eaten.³

Whilst Timor Leste rates as a lower-middle income country with a comparatively high Gross Domestic Product for its size due to revenues from oil, the poverty head count remains high at 42% (GDS, 2014) and mean household income is estimated at USD 378/month, with urban households (USD 674/month) earning more than twice that of rural households (USD 292/month).⁴

Although more recent nutrition and income statistics are not yet available, it is assumed conditions have not significantly improved. Therefore, the key question for judging relevance is: *'Does aquaculture have the potential to significantly contribute to improved nutrition, food security and income generation, compared with other possible interventions'*.

National annual fish consumption is 7,120 tonnes.⁵ In 2016, the Gleno hatchery distributed a total of 403,700 fingerlings.⁶ Assuming a survival rate of 60% and an individual harvested fish weight of 0.15kg, total tilapia production would be 36,333kg, or just over 36 tonnes, only 0.5% of total fish consumption.

The PADTL goal is to increase fish consumption by over 1kg/person/year by 2019. With a population of 1,167,242 (GDS, 2015 census), this would require an increase in aquaculture production of 1,167 tonnes, a considerable increase on the 36 tonnes produced in 2016.

² GDS (2015) *Timor Leste Demographic and Health Survey*, MoF

³ NDFA (2011) *Fish and Animal Protein Consumption and Availability in Timor Leste*, MAF

⁴ GDS (2011) *Timor Leste Household Income and Expenditure Survey*, MoF

⁵ 1,167,242 persons x 6.1kg = 7,120 tonnes

⁶ Moss (2016), *Annual Activity Progress Report: Partnership for Aquaculture Development in Timor Leste 2015*, NIWA

It can therefore be assumed that aquaculture alone has limited potential to significantly improve nutrition, or even increase the supply of fish for consumption.

2.1.2 To what extent is the Activity providing benefits to different stakeholders?

PADTL itself has 259 direct fish farmer beneficiaries with a total of 266 ponds covering 39,602m², providing an average pond size of 149m². Although 250 farmers enrolled for FFS training, an extra nine have received fingerlings. PADTL monitoring records show 68 farmers/ponds have completed their first harvest. Total harvest was 1,197kg of fish, 36% of which was consumed and 766kg of fish were sold for a total of USD 3,170, or USD 4.14/kg. Therefore, each pond produced an average 6.33kg fish for consumption and USD46.64 of income from fish sales. Whilst production levels are modest, the additional access to protein and contribution to household income are considered worthwhile by subsistence farmer households.

2.1.3 To what extent do the market and commercialisation assumptions that underpin the activity still hold?

The Market Study carried out during the Inception Phase of PADTL in 2013 correctly concluded there was a demand for aquaculture products in Timor Leste, which was being met by imports.⁷ In 2016, the International Trade Centre estimated 1,055 tons of fish were imported but included fresh and salt water fish. Nonetheless, Kmanek Supermarket reportedly imports 10 tonnes of tilapia and 10 tonnes of milkfish a month.⁸

The Market Study also concluded there was considerable overseas demand for seaweed but did not foresee the collapse of the global seaweed market in 2015 due to over production in Indonesia and the Philippines. Indonesian buyers stopped buying from Timor Leste and production has since declined, even though prices have somewhat recovered.⁹

The design of PADTL included the clustering of producers into marketing groups to link with domestic and export markets. However, due to the low levels of production, finding buyers for harvested tilapia has not been a problem. Fish farmers inform the local community when they will be harvesting and fish not consumed by the producing households are sold at the pond. Based on production levels to date, finding markets will not present any challenges in the medium term.

Prices rural consumers are willing to pay for fresh tilapia have shown lower own-price elasticity than expected. USD 4.00/kg is commonly paid for fresh tilapia at the pond, even though imported frozen tilapia from China retails for USD 1.70/kg in Dili supermarkets. However, considering beef retails for USD 9.00/kg in local wet markets, fresh fish is comparatively cheap.

The design of PADTL assumed an emergence of private sector seed and feed suppliers and SME commercial fish farmers, which has not taken place. Indigenous private sector development is a considerable constraint in Timor across the whole economy. Philanthropic aquaculture enthusiasts do not exist and business persons are reluctant to invest in seed and feed supply businesses that require specialist technical knowledge when financial viability is unknown.

As such, the hatcheries continue to be operated by MAF and fingerlings provided for free, which itself prevents any private sector interest. Some fish farmers occasionally produce their own feeds from local materials and small amounts of expensive concentrated fish feeds are imported from Indonesia as demand remains low.

⁷ Heath et al (2013) *Market and Economic Potential for Aquaculture Development in Timor Leste*, NIWA

⁸ Baticados (2014) *Market Study of Farmer Milkfish and Tilapia in Timor Leste*, ACDI/VOCA

⁹ Sendall et al (2016) *Aquaculture Feasibility Study in Timor Leste*, USAID

2.2 Effectiveness

Objective 2: To examine the progress being made in achieving the Aquaculture Development in Timor-Leste Activity outputs and short and medium term outcomes.

2.2.1 What progress has been made in achieving intended outcomes and outputs, as outlined in the annexed Results Measurement Table?

2.2.1.1 Outputs and Short-Term Outcomes

a) NDFA Aquaculture Sector Planning & Coordination Improved

The 18-year National Aquaculture Development Strategy (2012-30) was officially launched by MAF in 2013 and provides a clear vision and plan upon which the NDFA and donors can cooperate and contribute to achieve long-term sector objectives. There also appears to be a genuine sense of NDFA ownership of the strategy.

For implementation purposes, the NADS is split into five-year 'Aquaculture Development Strategy Implementation Plans' (ADSIP), the first of which runs from 2014-2018. An Aquaculture Working Group (AWG) was established to prepare the ADSIP, with support provided by PADTL. The ADSIP was expected to be the main tool by which the AWG coordinates the implementation of projects between aquaculture development partners and the PADTL output target was for ADSIP to be adopted as the formal NDFA planning tool by 2015. Although the ADSIP 2014-18 was never 'approved' by MAF, the plan has been more or less followed.

Preparation of the next five-year ADSIP for 2019-2023 has yet to start and there is an impression that the ADSIP is not regarded as the main tool by which the NDFA plans and coordinates the sector. The implementation of activities focuses on annual work plans for which the staff involved will be held directly responsible.

The first Aquaculture Forum was held in September 2017, opened by the Minister for MAF and attracted 118 stakeholders from a diverse range backgrounds including MAF, trade and investment, commercial banks, academics, NGO's, private sector, embassies, bilateral agencies, farmers and fishermen. The forum consisted of three main sessions: i) the current status of aquaculture in Timor Leste, ii) fish value chain and marketing, and iii) the private sector in aquaculture development.

The PADTL output target was for the Forum to meet annually from 2015. Nonetheless, the National Aquaculture Forum provided a valuable platform for Government and industry to share their plans and visions for aquaculture development and it was agreed to repeat the exercise next year.

The PADTL output target was to establish and coordinate 18 suco level producer groups in three districts by 2016. To date, four groups were established in 2016 and five groups established in 2017. As the target number of beneficiary fish farmers (250) has already been met in eight sucos, it does not appear necessary to continue this activity.

b) NDFA Aquaculture Technical Capacities Enhanced

The PADTL output target was for five NDFA staff to be trained as aquaculture specialists to prepare support and supervise the implementation of ADSIP; to recruit and train five specialist aquaculture extension officers by December 2015; and train five district officers and 200 MAF suco officers by 2017. Expected outcomes would be NDFA senior specialists providing training for 20 private sector individuals per year from June 2016.

PADTL has provided mentoring for NDFA staff in ADSIP preparation, the effectiveness of which is questionable if NDFA do not appreciate the relevance of preparing an ADSIP. The National Director of Aquaculture, NDFA Chief of Hatcheries and five hatchery managers/staff were provided with two weeks of training in GIFT hatchery management at the Asian Institute of Technology in Thailand. Additional on-the-job technical training has also been provided at the Gleno hatchery by visiting specialists. Local feed formulation training was provided for Municipal MAF staff and NGO partners.

Three Municipal Chief of Fisheries and eight Suco Extension Workers have attended Farmer Field School (FFS) training provided by PADTL to farmer groups. Considering PADTL works in three, not five municipalities it is unclear why PADTL would want to train 200 suco extension officers.

NDFA technical capacity building appears to have been an ad-hoc mixture of technical hatchery management and production skills for extensionists. Although much of the hatchery training has yet to

be completed for the marine hatchery at Vemase, PADTL has provided a good standard of training at the Gleno hatchery and there has been a considerable increase in management skills. Production skills training for extensionists has been limited to attending FFS along with PADTL fish farmers and although less suco extension workers have been trained than planned, the level of training is probably adequate for their needs.

c) Improved Aquaculture Technology Introduced

- Gleno GIFT Hatchery

The GIFT tilapia hatchery at Gleno has been upgraded, brood stock imported from World Fish Penang and 403,700 single-sex fingerlings distributed across twelve municipalities to PADTL farmers, MAF farmer groups, NGO projects and individuals in 2016. Whilst this target was achieved a year later than scheduled, the achievement should not be under estimated considering the constraints faced.

Only 50,000 GIFT fingerlings were provided to demo farms, compared to the PADTL output target of providing 500,000 fingerlings and only 1,197kg of fish have been harvested from 68 ponds, compared to the output target of 50 tonnes just for the demo farms. Both these outputs were achieved one year later than planned.

- Vemase Milkfish Hatchery

The marine hatchery at Vemase has failed to become operational for the production of milkfish fingerlings. Originally established by the United States Department for Agriculture, repairs first had to be made to the sea-water intake and electrical systems. Since then the milkfish brood fish tanks were incorrectly constructed and the imported brood fish died during transit. The PADTL output target was for the marine hatchery to be providing milkfish fingerlings for local farms by May 2015.

- Sea cucumber

PADTL originally planned to also trial sea-cucumber hatching at the Vemase facility by June 2018, which now appears unlikely, considering the hatchery is not yet operational and the higher priority given to produce milkfish fingerlings.

- Fish Feed

The PADTL output target was to produce a tilapia feed at a cost of less than USD 0.50/kg. A local feed formulation workshop was held in April 2016 and local feed formulation is included in FFS training. Various rations have been developed which include rice bran, corn bran, lucaena leaf meal, taro/coco yam leaves, fresh cassava and blood meal. The feed contains between 13 and 18% crude protein and costs between USD 0.24 and USD 0.40/kg to produce. A ration of mixed local and imported inputs was also developed producing feeds of 26-27% crude protein at a cost of USD 0.55 to USD 0.69/kg.

The production of local feed is time consuming and some of the inputs are not available year round. Production on a commercial basis is not feasible and if SME production of tilapia is to take place, there will be a need for concentrate feeds. Such feeds retail for USD 40/bag in Dili, which makes tilapia production unviable. By comparison, a 30kg bag of the same basic 16-20% crude protein fish feed retails for IDR267,000 in Kupang, the equivalent of USD19.78/bag or USD0.66/kg.¹⁰

- Production Costs

The PADTL output target was to reduce tilapia production costs to less than USD 1.50/kg, increase fish production to 2 tonnes/ha and reduce production cycles to six months by 2019.

PADTL monitoring data suggests current production is 1.3 tonnes/ha. PADTL fish farmer beneficiaries interviewed during the evaluation estimated their fingerling survival rate was 60% and production cycle was over eight months. As fingerlings are provided for free, labour is provided at no charge by family members and farmers don't buy concentrate feeds but use local feeds/waste; production costs are very likely to be less than USD 1.50/kg.

PADTL monitoring does not provide reliable data upon which financial analysis can be carried out. Table 2 below provides financial analysis for tilapia production carried out as part of a feasibility study in 2016.¹¹

¹⁰ Personal correspondence, October 2017

¹¹ Sendall et al (2016) *Aquaculture Feasibility Study in Timor Leste*, USAID

Table 2: Gross Margins for Tilapia Production

1. Timor-Leste Actual Productivity (1ha)	USD	2. Industry Standard Productivity (1ha)	USD
<u>Income</u> 12,000 fish x 0.15kg/fish = 1,800kg @ \$5/kg	9,000	<u>Income</u> 25,500 fish x 0.15kg/fish = 3,825kg @ \$5/kg	19,125
<u>Variable Costs</u> 30,000 fingerlings @ \$0.05/fingerling 6,480kg rice bran @ \$0.50/kg Kitchen waste Farm yard manure <i>Sub-total</i>	1,500 3,240 0 0 <u>4,740</u>	<u>Variable Costs</u> 30,000 fingerlings @ \$0.05/fingerling 13,770kg feed ¹ @ \$1.33/kg <i>Sub-total</i>	1,500 18,314 <u>19,814</u>
Gross Margin	4,260	Gross margin	(689)
<u>Technical assumptions</u> Stocking rate: 3 fish/m ² = 30,000 fish/ha Survival rate: 40% Production period: 6 months		<u>Technical assumptions</u> Stocking rate: 3 fish/m ² = 30,000 fish/ha Survival rate: 85% Production period: 4 months Feed Requirement: 3% of body weight/day	

¹ 3,825kg fish x 3% body weight daily feed rate x 120 days

The study concluded the underlying cause for the slow growth rate is that farmers are not feeding the recommended concentrate feed requirements but are substituting with rice bran and kitchen waste. However, although productivity is low, the enterprise is profitable with an average 100m² pond producing 120 fish to eat or a gross margin of USD42.60.

The second gross margin example uses an improved survival rate of 85% and a shorter production cycle of four months (due to the use of concentrate feeds), which are both average industry standards for small-scale tilapia production. However, due to the use of concentrate feeds the gross margin becomes negative at minus USD 689/ha.

Therefore, the only remaining means to improve financial performance is to decrease feed costs and just to break-even, feed costs would need to reduce from USD 1.33/kg to USD 1.28/kg.

d) Fish Farmers Trained in Aquaculture Production

A well thought-out extension strategy was developed based upon the creation of demonstration ponds around which clusters of producers were established. A Farmer Field School (FFS) approach was used to train members of the producer groups at the demo ponds and extension materials prepared. The six FFS modules included: pond construction, fish stocking, feeding, Integrated Aquaculture and Agriculture, pest and disease management, and marketing.

Individual farmers would then establish their own individual ponds and the producer group would later evolve into marketing groups to coordinate sales of tilapia to market. Due to the current low levels of production, marketing activities are not yet necessary.

To date, nine tilapia demo ponds / producer groups have been established in eight sucos, across three districts. Two hundred and fifty farmers have started FFS training, 20% of whom are women and 8% are youth (aged between 18-25 years old). Four clusters (64 farmers) established in 2015 have completed all six FFS modules and five clusters (186 farmers) established in 2017 have completed two of the six FFS modules. Overall 259 farmers have established 266 individual ponds.

Although only 68 PADTL farmers have completed their first harvest, all farmers trained are continuing tilapia production and farmers who completed their first cycle are now waiting for the next delivery of fingerlings to start a second production cycle.

The PADTL output target was over 2,000 farmers receive access to training and training materials by 2019, which assumes would be the result of training 200 suco extension workers. Using the FFS approach to train so many farmers would be time consuming and expensive and is unlikely to be adopted by MAF as an extension tool.

Training materials will need to be prepared for milkfish production, once fingerlings become available. A Tilapia Farm Business Planning Guide was prepared in 2015 for use by IADE, however requests for business support from potential tilapia farmers is minimal.¹²

¹² Heath (2015) *Tilapia Farm Business Planning Guide*, PADTL

e) Private Sector Seed and Feed Suppliers Supply Inputs to Fish Farmers on a Commercial Basis

The PADTL output target was to identify three private sector hatcheries by 2015 and for them to be producing and selling three million tilapia and one million milkfish fingerlings by 2016. Low cost feed formulations were also to be supplied to commercial feed processors by 2015. None of the above targets have been achieved, due to a lack of private sector interest.

The 'business case' for both seed and feed production has yet to be proven to attract private sector investment. Management of the Gleno hatchery requires specialist technical knowledge and the real demand for fingerlings is unknown. Although there is a keen interest in distributing fingerlings for free, the real demand of farmers willing to purchase fingerlings has yet to be tested. As long as Gleno continues to provide fingerlings for free, there will be no private sector interest in hatcheries.

Similarly for feed production, the real demand from farmers wishing to buy feed is unknown beyond what is already sold by the agricultural input stores in Dili. Unless a large single source of by-product is available to process in country, it is unlikely businesses would have any interest in sourcing local materials and then processing feed, when they can make the same profit from just importing ready-made concentrate feed.

f) Farmer to Market (domestic and export) Linkages Established.

The PADTL output target was to establish six fish and one seaweed producer/marketing groups and to establish linkages with ten institutional and two export buyers by 2016.

Production levels are still low and all tilapia produced to date are sold directly to local consumers at the pond. Globally, the seaweed market is over supplied and there is little interest in buying small amounts produced by Timor Leste. As such, there has been little need for establishing marketing groups as the volumes of produce would not be enough to satisfy institutional or export supply contracts.

2.2.2 What factors are enhancing or constraining progress towards intended outcomes (e.g. management of risk, project management arrangements)?

PADTL has three medium-term outcomes relating to technology adoption, increasing productivity and access to market:

2.2.2.1 Aquaculture technologies are widely adopted by rural households and SMEs.

The PADTL medium-term outcome target is for 200 rural and coastal aquaculture producers to have received training in, and implementing, new technologies by 2019 and for 200 rural SME's to have been supplied with improved quality stock by 2019.

To date 250 tilapia farmers have enrolled for FFS training and 64 have completed all six modules, with the remaining 186 farmers expected to complete their training in 2018. It is therefore expected this target will be exceeded ahead of schedule. The hatchery at Gleno is now producing single-sex GIFT tilapia for distribution amongst trained farmers.

The fish farmers trained in FFS are small-scale producers, producing primarily for home consumption. Although using GIFT tilapia, it is unlikely they will adopt improved feeding technologies to increase productivity to a commercial level for the main purpose of supplying markets. If improved tilapia production technologies are to be widely adopted, a GIFT fingerling distribution network will need to be established in the municipalities and a mass extension campaign carried out, rather than continuing with FFS.

Due to the absence of affordable concentrate feeds that make the commercial production of tilapia viable, no rural SMEs have been established and this is likely to continue until the feed issue has been addressed.

Due to delays in establishing the marine hatchery at Vemase, no progress has been made with milkfish technology and it is unlikely sea-cucumber activities will go ahead as they will not be completed before end of project.

2.2.2.2 Increased productivity of aquaculture sector

The PADTL medium-term outcome target is to increase productivity of fish ponds in excess of 2 tonnes/ha/year by 2019 and for productivity of SME pond production in excess of 4 tonnes/ha/year in 200 ponds by 2019.

Productivity of PADTL ponds already harvested is estimated at 1.3 tonnes/ha and could quite possibly be increased to 2 tonnes/ha in the second harvest. To achieve yields of 4 tonnes/ha is reliant on the use of concentrate feeds. Financial analysis has shown the commercial production of tilapia at current concentrate feed prices is not viable.

A further consideration is that commercial 1ha pond requires 30,000 fingerlings and 13,770kg of concentrate feed to achieve a yield of 4 tonnes/ha. Multiplied up by 200 SMEs with a 1ha pond each will require 6 million fingerlings and 2,754 tonnes of concentrate feed, neither of which are currently available in Timor Leste.

2.2.2.3 Producers are making greater use of domestic and export markets.

The PADTL medium-term outcome target is for producer group sales to account for 50% (400 tonnes) of aquaculture product sales and to sell over 100 tonnes/year of fish to institutional buyers by 2019.

Based on the number of GIFT fingerlings produced by the Gleno hatchery, tilapia production in 2016 is estimated at 36 tonnes. Based upon interviews with PADTL fish farmer beneficiaries, sales were made directly to local consumers at the pond, rather than institutional buyers. The current supply of tilapia is not of enough quantity or regularity to negotiate supply contracts with institutional buyers. Also to produce 400 tonnes of fish would require the supply of approximately 3 million fingerlings (including mortalities), which is beyond the capacity of Gleno hatchery.

The PADTL medium-term outcome target for seaweed is for the production and export of over 250t of seaweed each year by 2019. At its peak, seaweed production was estimated at 100 tonnes/year.¹³ Due to ice-ice disease and absence of overseas buyers, production has since decreased and mainly serves the domestic market.

2.3 Efficiency

Objective 3: To review the cost effectiveness of the long-term NIWA and World Fish approach employed to deliver results

Responsibility for the overall coordination of PADTL is with NIWA, which prepared the original Activity Design Document. NIWA agreed to form a strategic partnership with World Fish to deliver in-country outputs, as NIWA had no presence or experience in Timor Leste, whereas World Fish did. An experienced international project manager was employed full-time to work alongside local Timorese support staff in-country and form a Project Implementation Team. The Team are responsible for daily implementation of the project and coordination with NDFA and other implementing partners. The international project manager and local support staff were housed in the World Fish office located within the MAF compound in Dili.

Specific project outputs were delegated to specific implementing partners. NIWA lead the development of marine and brackish water technologies, with an emphasis on supporting the NDFA priorities on marine hatchery and diversification of mariculture. World Fish, working under a sub-contract, lead the freshwater technology development and NDFA capacity building activities. Tisbe, also working under a sub-contract, lead the economic development activities for both fresh, brackish and marine water activities with IADE.

NIWA was primarily responsible for project management and ensuring MFAT reporting and financial control measures were met, whilst World Fish were responsible for co-ordinating the appointment of in-country staff. Until the resignation of the international project manager in early 2016, this arrangement reportedly worked well.

A suitable replacement international project manager could not be recruited and it was agreed to appoint a local Team Leader and develop the management skills of two local staff. The local implementation team would be supported by short-term consultant inputs from World Fish, NIWA and Tisbe. Due to implementation problems, especially with the marine hatchery at Vemase, NDFA

¹³ Bassford (2011) *Timor Leste Seaweed Value Chain*, World Fish Centre

complains the 'fly-in, fly-out' (FIFO) management support provided by NIWA is not enough to provide the quality of support required by the local implementation team and poses a risk to completing expected outputs before end of project.

2.3.1 What could be done differently to improve implementation?

The PADTL project never achieved its own 'identity' and it is most often considered a World Fish project, even though NIWA is the lead implementing partner. Whilst the delegation of specific outputs to the various partners was understandable, the status of the PADTL implementation team is ambiguous. World Fish is responsible for coordinating in-country staff, freshwater activities and NDFA capacity building activities. However, NIWA is responsible for overall project management, marine and brackish water activities but has no permanent presence in Timor Leste, since the resignation of the international project manager.

The current localised project implementation arrangement appears to focus on freshwater activities, rather than the marine hatchery at Vemase and the subsequent FIFO support provided by NIWA has not been sufficient to address the teething problems at Vemase and get the hatchery operational.

With the benefit of hindsight, a PADTL implementation team, contracted and managed independently of NIWA, World Fish or Tisbe could have been a superior solution to manage and implement the project. The PADTL implementation team would then coordinate with NIWA, World Fish and Tisbe for the provision of specific short-term technical support.

2.3.2 Are resources being used in the best possible way in order to provide value for money?

Table 3 provides the budget for PADTL divided by outputs. Thirty-seven percent of the budget is allocated to NDFA planning and capacity building. Other major budget items are improved technology which includes upgrading the hatcheries and feed development (27%) and farmer training (16%).

Table 3: PADTL Budget (NZD)

Output	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1: NDFA planning & coordination	185,346	166,323	161,195	120,488	152,960	786,311
2: NDFA technical capacity building	333,786	299,130	218,022	91,890	171,155	1,113,983
3: Improved technology	478,337	459,372	137,464	180,878	124,652	1,380,703
4: Fish farmer training	217,906	314,456	157,080	75,415	51,507	816,364
5: Private sector feed & seed supply	-	63,727	78,908	53,511	-	196,146
6: Market linkages	76,233	67,219	94,228	66,101	98,327	402,108
M&E	102,218	55,462	118,844	55,071	127,798	459,393
Total	1,393,826	1,425,689	965,742	643,354	726,398	5,155,008

Source: NIWA (2014) *Activity Design Document: Aquaculture Timor Leste*

Table 4 shows PADTL expenditure to date. Unfortunately, this is presented in a different format to the budget and there is a small disparity in total budget.

Table 4: PADTL Expenditure

	Budget (NZD)	Expenditure (NZD)	Balance (NZD)
Fees	2,688,324	2,204,802	483,522
Expenses	2,090,593	1,540,344	550,249
Per diems	376,805	102,199	274,606
Total	5,155,722	3,397,345	1,758,377

Source: MFAT, October 2017

Approximately 66% of the budget has been spent, forty months into the sixty month project, which leaves slightly more budget than planned to spend in the remaining time available. However, due to additional costs and delays at the hatcheries and considerable farmer training to complete, there is a risk not enough budget is remaining to complete all outputs.

The project has suffered delays for several reasons, some due to externalities such as change of Government and NDFA staff and some due to internal project management issues after the resignation of the international project manager.

The overhead costs of employing international project staff and consultants usually consumes a high proportion of any development project budget. Considering the average annual budget for PADTL is just over NZD 1 million, there had to be some strategy in place to reduce international staff costs. The original strategy of one full-time international project manager supported by several short-term international technical consultants was a reasonable means of reducing international consultant overhead costs.

2.4 Future Design and Support

Objective 4: To identify the key changes needed (if any) to deliver sustainable outcomes from the Aquaculture Development in Timor-Leste

The original design of PADTL integrated means for achieving sustainability, mainly through supporting NDFA to provide an enabling environment for sector growth and increasing private sector involvement in support services such as the provision of seed and feed.

2.4.1 To what extent is local ownership of the Activity developing?

The main concerns regarding sustainability are the operation and maintenance of the hatcheries at Gleno and Vemase. Currently PADTL covers most of the operational costs at Gleno such as infrastructure repairs and maintenance, three staff salaries, fuel for the generator and some feed costs. MAF currently pays for four staff salaries, some feed costs and electricity is provided free of charge by EDTL.

A Hatchery Sustainability Workshop was held in September 2017, during which MAF confirmed its plan to cover all operational costs at the Gleno hatchery by the end of 2018, but no mention was made of the Vemase hatchery. NDFA did raise the need for continuing access to technical support for hatchery management.

2.4.2 To what extent are the activity interventions likely to be sustained after MFAT's funding has concluded?

Sustainability of the hatcheries are dependent on two main factors – availability of funds to operate the hatchery and demand for fingerlings.

It is estimated the cost of operating the Gleno hatchery is USD 25,000/year. Access to emergency funds are also required to quickly fix equipment failures, such as pumps, otherwise fish die. Although MAF has promised to budget for the regular Gleno hatchery operational costs, there is no provision for accessing emergency funds.

Currently all fingerlings are provided free of charge. Whilst NDFA recognises proceeds from the sale of fingerlings would significantly contribute towards the sustainability of the hatchery and estimates are that income could be as much as USD 3,000/month, no process exists for the hatchery to receive money, which requires approval from the Ministry of Finance. If MoF approves the sale of fingerlings, the proceeds may well be deposited into general treasury funds and not necessarily ear-marked for the hatchery.

The real demand for purchasing tilapia fingerlings is unknown. Current demand projections are based on planned numbers of project beneficiaries, who receive free fingerlings. As commercial SME ponds have not emerged as expected, the main customer base in the short-term will continue to be subsistence farmers, therefore, actual demand for purchasing fingerlings could be much lower than predicted.

The location of a single provider of GIFT fingerlings in Gleno is also a risk to sustainability, as it is unlikely farmers will be willing to travel from other districts to buy fingerlings in Gleno. Although brood

hatcheries are not necessary in every district, local nursery ponds are required where farmers can purchase fingerlings closer to home.

Tilapia production will have to be scaled up to a commercial basis, to create customers who are willing and able to pay for fingerlings. However, analysis has shown the commercial production of tilapia at current concentrate feed prices is not profitable. Therefore, one could say the future of the hatcheries is dependent on the cost of feeds.

The current strategy for addressing the feed issue is the production of local feeds. Although good work has been done on identifying low cost rations, the viability of scaling up local feed production to a commercial basis is questionable and is not being suitably addressed.

2.4.3 What could be done to mitigate the impact of changing in-country staff?

As a replacement for the international project manager was unable to be recruited, PADTL decided to mitigate the situation by restructuring the in-country team and creating new local staff roles to cover project coordination, M&E and training and finance and administration.

Whilst this has worked well, it has created an increased need for technical support and short-term inputs from World Fish, NIWA and Tisbe. A negative consequence is the marine hatchery at Vemase has fallen behind schedule due to the FIFO approach. To address this NIWA will provide an international hatchery specialist to provide two inputs of two months each to get the Vemase hatchery up and running before project closure.

2.4.4 Is an exit strategy in place?

No formal 'Exit Strategy' is in place. In the short-term, MAF-NDFA has committed to covering all operational costs of the Gleno hatchery starting at the end of 2018. There is also some hope the hatcheries will be taken over by the private sector, possibly under some form of public-private partnership agreement. However, this is very unlikely until the 'business case' for the hatcheries and aquaculture sector as a whole has been proven, including access to affordable concentrate feeds that makes commercial aquaculture financially viable.

3.0 Evaluation Conclusions

3.1 Relevance

Timor Leste continues to be one of the most malnourished countries in the world and MFAT has selected aquaculture as one means of improving nutrition, as well as increasing incomes. Currently aquaculture contributes less than 1% of total fish consumption and contributes even less for total protein consumption if meat is included. Although aquaculture provides a cheap source of protein which can be consumed in divisible proportions dependent on daily needs, the potential impact of aquaculture on improving nutrition at a higher national level is small. Firstly, the potential areas for aquaculture which have level ground, deep soils and perennial water supply for pond construction matched with land owners wishing to undertake aquaculture is limited. Secondly, the necessary support services and inputs to develop the sector, namely seed and feed, also present several challenges.

Financial analysis has shown tilapia production on a commercial basis using current imported concentrate fish feed prices is unviable, which explains the lack of private sector SME interest. On the other hand, the back-yard production of tilapia by subsistence farmers has proved viable. Small 150m² ponds are stocked with fingerlings and fed locally available feeds. Although productivity is low; PADTL harvest data to date shows the low-input, low-output system produces 17.6kg of fish over a period of at least eight months. Although modest the increased fish for consumption and income is welcomed by poor rural households.

Considering the above, targets set in the PADTL Results Measurement Table are over ambitious and aquaculture has limited potential to significantly improve nutrition alone. Nonetheless, considering the limited opportunities within the agriculture sector in Timor Leste, aquaculture does have a contributing role to play in improving nutrition and income at a small-scale household level.

3.2 Effectiveness towards achieving medium-term outcomes

It is not expected all PADTL outputs will be achieved, especially regarding suco extension worker and farmer training, private sector seed and feed suppliers and market linkages. Although there have been several challenges and delays, PADTL has upgraded the GIFT hatchery at Gleno to produce and distribute single-sex tilapia fingerlings. This is a major achievement and should not be underestimated, even though the number of fingerlings produced is less than targeted. However, upgrading the marine hatchery at Vemase is far behind schedule and no milkfish fingerlings have been produced to date. It is also unlikely the production of sea cucumber juveniles will take place at the Vemase hatchery, before end of project.

In 2016, the Gleno hatchery distributed 613,687 GIFT fingerlings to 779 households across eleven municipalities, not only to PADTL fish farmer beneficiaries but also MAF farmer groups, NGO projects and individuals. This indicates the key role PADTL's support to the hatchery will play in the future development of the aquaculture sector.

Although significant progress in the supply of GIFT fingerlings has been made, productivity of the aquaculture sector has not improved as expected. This is mainly due to the lack of access to appropriately priced concentrate fish feeds that make commercial aquaculture viable. Efforts to date have concentrated on developing feed rations based on locally available materials, which is not feasible for a commercial level of tilapia production.

As such, subsistence based low-input, low-output tilapia production is taking place on a back-yard scale and commercial SME producers have yet to emerge. With production levels remaining low, marketing and finding buyers has not been a problem and is unlikely to become one in the medium-term. Fish harvested to date are either consumed in the home, or sold directly to local consumers at the pond. Local consumers are willing to pay USD 4.00/kg for fresh tilapia, even though frozen tilapia imported from China is available in Dili supermarkets for USD 1.70/kg.

The effective implementation of PADTL has been affected by two main factors. The technical support provided by NIWA, World Fish and Tisbe has been of high quality, hence the success at the Gleno hatchery. However, day-to-day in-country project management was negatively affected by the resignation of the international project manager and the absence of a PADTL team identity. Project activities were delegated between implementing partners, hence the upgrading of Vemase was

exacerbated by NIWA only being able to carry out FIFO support. Secondly, the change of Government in 2015 delayed decision making by MAF-NDFA.

PADTL expenditure has been slightly less than planned and there is a remaining budget of approximately NZD 1.7 million to fund the remaining twenty months of project. Considering the remaining work to be done to get the Vemase hatchery operational, no residual budget is expected at end of project.

3.3 Sustainability

The main concern is sustainability of the hatcheries after MFAT funding has concluded. The current strategy is to try and attract a private sector partner to assume the management, operation and maintenance of the hatchery but there has been little interest to date. The main reason for lack of interest is the 'business case' for the hatchery has yet to be proven as a viable investment. The hatchery only started producing GIFT fingerlings in 2016 and the real demand for fingerlings from farmers willing to pay for them is unknown. The current supply of free fingerlings also discourages any private sector investment in new independent hatcheries.

NDFA is well aware of the sustainability issues and is trying to negotiate with the MoF a system whereby they can charge for fingerlings with proceeds being used to operate the hatchery. NDFA has also committed to allocating budget for the full operation of the Gleno hatchery by the end of 2018 but this still does not address the need for access to funds when emergency repairs are required.

Sustainability of the Vemase hatchery is affected by similar issues and when operational will need to be included in a similar exit strategy.

4.0 Lessons Learned

Lessons learned have been identified to contribute to the broader evidence base by informing future policy and implementation of Aquaculture development activities within and outside the New Zealand Aid Programme.

- Five years is too short a time to establish a well-managed and sustainable fish hatchery when starting from such modest beginnings and working in such a challenging environment.
- To support multiple activities such as NDFA capacity building, hatchery and feed development, fish farmer extension, private sector development, and marketing for multiple products – tilapia, milkfish, sea cucumber and seaweed; requires longer than five years, a larger project implementation team and more substantial budget. PADTL objectives were too ambitious considering the resources accorded it.
- If a sector requires multiple activities to develop, collaboration should be sought with other donors, based on respective experience and strengths.
- To implement a project such as PADTL, a permanent in-country project implementation team is required. Although more expensive, it may have been better to tender the implementation of PADTL to a management contractor with the proviso of contracting specialised technical support from NIWA and Tisbe, rather than project implementation being delegated between different implementing partners, some of whom do not have a permanent presence in Timor Leste.
- If a project's sustainability is dependent on the private sector, a thorough partner search and feasibility study is undertaken at the beginning to ensure private sector involvement from the start.

5.0 Recommendations

Recommendations focus upon priority activities for the remainder of the project to improve management, implementation and achievement of results for PADTL to achieve maximum sustainable impact and should form the main components of an Exit Strategy.

1. Facilitate access to affordable concentrate fish feed that will make commercial tilapia production viable.

The sustainable supply of affordable concentrate fish feed is dependent on the private sector being able to import and distribute the feeds throughout the municipalities at a price that provides financial rewards for all involved. Based upon retail fish feed prices in Kupang and allowing for additional customs charges this is possible and at least one agri-input supplier in Dili is interested in doing so, if two major hurdles can be overcome. These are transparency regarding import processes and distribution, which could both be addressed before end of project.

It is recommended PADTL and NDFA carry out negotiations with MAF Quarantine and Directorate of Customs (MoF) to overcome any constraints currently impeding the import of concentrate fish feed from Indonesia which is preventing the commercial production of tilapia in Timor Leste.

Also for PADTL to identify potential private sector wholesaler importers and facilitate linkages with retailers in the districts to establish a fish feed distribution network. The Loja Agrikultura previously supported by Mercy Corps would be a good starting point to establish a network of district-based retailers.

Initially, demand for concentrate fish feed is likely to be small. It will take several years for domestic supply chains to develop and will only be possible if fish feed is purchased from the private sector importers and distributors, rather than being imported directly by MAF and donors for free distribution to fish farmers.

2. Stop the supply of free or subsidised fingerlings from the Gleno hatchery.

PADTL and NDFA to find a solution to charging for fingerlings with income ideally returned to the hatchery to provide an emergency fund and cover operational costs. This will ensure sustainability of the existing hatcheries in the short-term, long enough to establish a business case for private sector investment in hatcheries. This may not necessarily be adoption of the MAF-NDFA hatchery at Gleno, which has long-term constraints regarding location and size.

3. Facilitate the establishment of SME GIFT nursery ponds in key districts to make fingerlings available for more farmers wishing to buy fingerlings.

PADTL to identify key districts / locations where there is a high potential to supply GIFT fingerlings. Current PADTL, previous COMPAC-TL, CRS and other tilapia project beneficiary areas should be considered.

PADTL to identify potential SME nursery pond operators, facilitate skills and business training as required and link to the Gleno hatchery for the supply of fingerlings. This will facilitate the wider adoption of GIFT aquaculture across the country.

4. Complete repairs to the Vemase hatchery and operationalise as soon as possible

NIWA has already proposed sending a hatchery management specialist for two, two-month inputs to get the hatchery operational. NIWA has also recommended importing milkfish eggs as well as brood stock to accelerate the first production of fingerlings. Other priority activities include the hatchery manager and other key staff attending overseas technical training in milkfish hatchery management, and visiting specialists to provide on-the-job training as required.

5. PADTL and NDFA prepare a joint Exit Strategy

To consolidate sustainability issues, it is recommended PADTL and NDFA immediately prepares and implements an Exit Strategy focusing on seed and feed supply that results in either: i) the business case level being reached before end of project with the private sector becoming main suppliers of seed and feed; or ii) MAF-NDFA addressing their own budgeting constraints to be able to operate the hatcheries as a public service at the end of project, until the private sector business case level is reached.

Other recommendations include:

- Review the Results Management Table and revise the targets, based on current circumstances, priorities and what is achievable within the remaining time before end of project. To accommodate for the increased focus upon seed and feed sustainability in the Exit Strategy described above, it is recommended low-priority activities such as the production of sea-cucumber juveniles and establishing seaweed and fish marketing groups are stopped. Nonetheless, FFS training for the remaining 186 fish farmer beneficiaries will need to be completed.
- Prepare strategies to scale up adoption of aquaculture amongst fish farmers with NDFA, other donor projects such as TOMAK and private sector and contribute towards implementing the strategy where possible. PADTL involvement should be limited to feed and seed issues, whilst other partners ensure farmers receive access to training and training materials, as stated in the Results Management Table.
- Based on the revised targets, cost planned activities to ensure enough budget is available for the remaining twenty months.
- Due to the relatively short time remaining before end of project, it is not recommended to radically change project management structure. NIWA has already committed to getting the Vemase hatchery operational through the provision of four months on-site technical assistance, which has worked well in the past. However, the World Fish project implementation team will need to provide day-to-day support and coordination to assist NIWA in getting the hatchery operational. It is recommended World Fish and NIWA agree clear roles and responsibilities to achieve this and are resourced accordingly, which may require some reallocation of budget.

Appendix A

Evaluation Terms of Reference

Appendix A Evaluation Terms of Reference

Background

The 'Aquaculture Development in Timor-Leste' Activity (PADTL) will run over a five year timeframe (2014-2019) with a total budget of NZ\$5.1m. It will contribute to meeting government sustainable economic development and nutritional goals by increasing direct access to reasonably priced fish for the rural poor, link producers with domestic and export markets, and deliver economic benefits for aquaculture farmers.

The Activity is into its 3rd year of implementation. Implementing partners are NIWA (New Zealand-based contract managers and technical assistance), World Fish (Dili-based within the Ministry of Agriculture and Fisheries) and the Ministry of Agriculture and Fisheries.

Evaluation purpose

This evaluation will be used by MFAT, NIWA and the Timor-Leste Government to:

- Identify improvements that can be made to managing, implementing and achieving results for the Aquaculture Development Programme in Timor-Leste (PADTL) Activity.
- Contribute to the broader evidence base by informing future policy and implementation of Aquaculture development activities within and outside the New Zealand Aid Programme.

Evaluation objectives, criteria and questions

Objectives

Objective 1: to assess the extent to which strengthening the Aquaculture industry remains a priority for the partner country and the New Zealand Aid Programme (Relevance)

- To what extent does the Activity continue to be relevant to beneficiaries, the New Zealand Aid Programme and partner country/regional development priorities?
- To what extent is the Activity providing benefits to different stakeholders?
- To what extent do the market and commercialisation assumptions that underpin the activity still hold?

Objective 2: to examine the progress being made in achieving the Aquaculture Development in Timor-Leste Activity outputs and short and medium term outcomes (Effectiveness)

- What progress has been made in achieving intended outcomes and outputs, as outlined in the annexed Results Measurement Table? To what extent are the results achievable? And if not what needs to change?
- What factors are enhancing or constraining progress towards intended outcomes (e.g. management of risk, project management arrangements)?

Objective 3: to review the cost effectiveness of the long-term NIWA and World Fish approach employed to deliver results (Efficiency)

- What could be done differently to improve implementation?
- Are resources being used in the best possible way in order to provide value for money?

Objective 4: Future design and support – to identify the key changes needed (if any) to deliver sustainable outcomes from the Aquaculture Development in Timor-Leste

- To what extent is local ownership of the Activity developing?
- To what extent are the activity interventions likely to be sustained after MFAT's funding has concluded? What actions could be taken to improve sustainability?
- What could be done to mitigate the impact of changing in-country staff?
- Is an exit strategy in place?
 - If yes, is the exit strategy appropriate?
 - If it is not appropriate, what should be amended?

Evaluation scope

The evaluation will cover the time period from the beginning of activity implementation (July 2014) until present. It should focus on all aspects of implementation including project management arrangements as well as assessing progress towards achievement of outputs and outcomes. A particular focus should be placed on examining progress in the milkfish component and ongoing feasibility of this component.

The target groups will be the implementing partners (NIWA and its subcontractors: World Fish and Tisbe), the National Directorate for Aquaculture (NDA) c.f. Timor-Leste Ministry of Agriculture and Fisheries (MAF) (Ministerio Da Agricultura E Pescas) and other key stakeholders. *The scope of the evaluation will exclude:*

- The technical expertise of the implementing partner.

Engagement with key stakeholders

In support of a consultative and participatory approach, the evaluation team will be expected to engage with a number of key stakeholders. These stakeholders could include:

- Respective country Programme and Activity managers and other relevant MFAT staff;
- Timor-Leste government (Minister and Ministry of Agriculture);
- Head of Mission and development staff at Dili Post;
- Development partners, including implementing partners;
- Other donors engaged in this sector;
- Key non-state actors including private sector and civil society organisations of the partner country;
- Key private sector actors involved in Activity delivery; and
- Target population.

The results of the evaluation will be reported and disseminated to MFAT, the implementing partner and relevant partner government institutions and other key stakeholders.

Appendix B

Evaluation Matrix

Appendix B Evaluation Matrix

Question	Information Required	Information Source	Method
Objective 1: Relevance - to assess the extent to which strengthening the Aquaculture industry remains a priority for the partner country and the New Zealand Aid Programme.			
1.1 To what extent does the Activity continue to be relevant to beneficiaries, the New Zealand Aid Programme and partner country/regional development priorities?	<ul style="list-style-type: none"> Current/planned MFAT, GoTL & MAF strategy & development priorities. Relevance of project objectives to problem addressed. Coherence and logic of project design – theory of change. Continuing fish farmer interest, adopter and drop-out rates. Alternative means of improving nutrition. 	<ul style="list-style-type: none"> MFAT, GoTL/MAF policy & strategy documents. MFAT & MAF staff Fish farmer beneficiaries. 	<ul style="list-style-type: none"> Document review. Interviews.
1.2 To what extent is the Activity providing benefits to different stakeholders?	<ul style="list-style-type: none"> Improved nutrition. Increased incomes and employment. 	<ul style="list-style-type: none"> Fish farmer beneficiaries. Project reports. 	<ul style="list-style-type: none"> Interviews. Document review.
1.3 To what extent do the market and commercialisation assumptions that underpin the activity still hold?	<ul style="list-style-type: none"> Market prices of aquaculture products. Demand for aquaculture products. Availability of cheap imports. Number of active marketing groups established. Number of aquaculture SMEs. 	<ul style="list-style-type: none"> Fish markets. Beneficiary interviews. 	<ul style="list-style-type: none"> Interviews.
Objective 2: Effectiveness - to examine the progress being made in achieving the Aquaculture Development in Timor-Leste Activity outputs and short and medium term outcomes.			
2.1 What progress has been made in achieving outputs, and intended short and medium term outcomes, as outlined in the annexed Results Measurement Table? <i>To what extent are long term outcomes achievable? And if not what needs to change?</i>	<u>NDFA capacity</u> <ul style="list-style-type: none"> Functioning NDFA aquaculture planning process. Functional aquaculture forum and producer associations. NDFA AWG proactive in industry outreach. Increase in NDFA staffing & training. NDFA training provided at demo farms. NDFA senior aquaculture officers provide specialist training for private sector. 	<ul style="list-style-type: none"> As listed in the Results Measurement Table. Fish farmer beneficiaries. NDFA staff. Project reports. 	<ul style="list-style-type: none"> Document review. Interviews.

Question	Information Required	Information Source	Method
	<p><u>Feed & seed</u></p> <ul style="list-style-type: none"> • Local fish feeds developed. • GIFT fingerlings available from NDFA hatchery. • 3 commercial hatcheries supplying over 1 million fingerlings/year. • Marine and milkfish hatchery operational and supporting new species development. • Number of private sector hatcheries. <p><u>Fish-farmers</u></p> <ul style="list-style-type: none"> • Number of HH and SMEs using new aquaculture technologies. • Increased productivity of fish ponds. <p><u>Aquaculture marketing</u></p> <ul style="list-style-type: none"> • Number of marketing groups and marketing plans. • Increased sale of aquaculture products. • Number of supply contracts with institutional buyers. • Number of overseas seaweed buyers. 		
2.2 What factors are enhancing or constraining progress towards intended outcomes (e.g. management of risk, project management arrangements)?	<ul style="list-style-type: none"> • Have assumptions proved true? • Project management arrangements. • Technical feasibility. • Financial viability. 	<ul style="list-style-type: none"> • Project documents. • MFAT, MAF-NDFA & World Fish. 	<ul style="list-style-type: none"> • Document review. • Interviews.
Objective 3: Efficiency - to review the cost effectiveness of the long-term NIWA and World Fish approach employed to deliver results			
3.1 What could be done differently to improve implementation?	<ul style="list-style-type: none"> • NIWA & World Fish management arrangement. 	<ul style="list-style-type: none"> • MFAT, MAF-NDFA & World Fish. 	<ul style="list-style-type: none"> • Document review. • Interviews.
3.2 Are resources being used in the best possible way in order to provide value for money?	<ul style="list-style-type: none"> • Budget execution. • Timeliness in achieving project targets. • Scale of achieved targets. • Quality of results achieved. 	<ul style="list-style-type: none"> • Project documents. • MFAT, MAF-NDFA & World Fish. • Beneficiaries. 	<ul style="list-style-type: none"> • Document review. • Interviews.
Objective 4: Future design and support – to identify the key changes needed (if any) to deliver sustainable outcomes from the Aquaculture Development in Timor-Leste, viz a viz the insights and recommendations in the draft Country Program Evaluation aquaculture section			

Question	Information Required	Information Source	Method
4.1 To what extent is local ownership of the Activity developing?	<ul style="list-style-type: none"> • Ponds are being maintained by fish-farmers. • Hatcheries are being maintained by NDFA. • NDFA training of fish-farmers is continuing. • Local fish feed is being produced. • SMEs are marketing aquaculture products. 	<ul style="list-style-type: none"> • Project documents. • Fish farmer beneficiaries. • Hatchery staff. • NDFA staff. • Fish feed processors. • Aquaculture SMEs 	<ul style="list-style-type: none"> • Document review. • Interviews.
4.2 To what extent are the activity interventions likely to be sustained after MFAT's funding has concluded? <i>What actions could be taken to improve sustainability?</i>	<ul style="list-style-type: none"> • Fish farmers are buying seed and feed and maintaining ponds. • Aquaculture is profitable. • Continuing market demand. • MAF-NDFA budget for aquaculture extension. • MAF-NDFA budget for hatcheries. 	<ul style="list-style-type: none"> • Fish farmers. • MAF-NDFA staff. • Fish market. 	<ul style="list-style-type: none"> • Document review. • Interviews. • Market visits.
4.3 What could be done to mitigate the impact of changing in-country staff?	<ul style="list-style-type: none"> • Staffing records. 	<ul style="list-style-type: none"> • Human resources staff at NIWA and World Fish. 	<ul style="list-style-type: none"> • Document review. • Interviews.
4.4 Is an exit strategy in place? <ul style="list-style-type: none"> • <i>If yes, is the exit strategy appropriate?</i> • <i>If it is not appropriate, what should be amended?</i> 	<ul style="list-style-type: none"> • Exit strategy. 	<ul style="list-style-type: none"> • Project Exit Strategy document. 	<ul style="list-style-type: none"> • Document review.

Appendix C

Documents Reviewed

Appendix C Documents Reviewed

Bassford (2011) <i>Timor-Leste Seaweed Value Chain</i> , World Fish Centre
Baticados (2014) <i>Market Study of Farmer Milkfish and Tilapia in Timor-Leste</i> , ACDI/VOCA
Bhujel (2016) <i>Technical Support to Gleno Tilapia Hatchery</i> , PADTL
FAO (2013) <i>Mainstreaming Gender in Fisheries and Aquaculture</i> , Rome
Heath et al (2013) <i>Market and Economic Potential for Aquaculture Development in Timor Leste</i> , NIWA
Heath (2015) <i>Tilapia Farm Business Planning Guide</i> , PADTL
MFAT (2015) <i>Activity Monitoring Assessment for Aquaculture Development in Timor Leste: May 2014 – Jun 2015</i>
MFAT (2017) <i>Activity Monitoring Assessment for Aquaculture Development in Timor Leste: Jan 2016- Jun 2017</i>
Moss (2016), <i>Annual Activity Progress Report: Partnership for Aquaculture Development in Timor Leste 2015</i> , NIWA
Moss (2017), <i>Annual Activity Progress Report: Partnership for Aquaculture Development in Timor Leste 2016</i> , NIWA
NDFA (2012) <i>Analysis of the Current Situation and Potential for Aquaculture Development in Timor Leste</i> , MAF
NDFA (2011) <i>Fish and Animal Protein Consumption and Availability in Timor-Leste</i> , MAF
NDFA (2014) <i>Timor-Leste National Aquaculture Development Strategy Implementation Plan 2014-2018</i>
NDFA (2013) <i>National Aquaculture Development Strategy 2012-2030</i> , MAF
NIWA(2014) <i>Activity Design Document: Aquaculture Timor Leste</i>
PADTL (2016) <i>Tilapia Aquaculture Feeds Development</i>
Sendall et al (2016) <i>Aquaculture Feasibility Study in Timor Leste</i> , USAID

