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The Fish in School Meals pilot report

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Partnership for Aquaculture Development in Timor-Leste Phase 2 (PADTL2)

The Fish in School Meals pilot report

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About Partnership for Aquaculture Development in Timor-Leste Phase 2 (PADTL2)

The Government of Timor-Leste is committed to developing aquaculture to improve the country's food and nutrition security while enhancing income opportunities for coastal and inland farming communities.

The Partnership for Aquaculture Development in Timor-Leste Phase 2 (PADTL2) (2020–2024) project aims to scale up production of Genetically Improved Farmed Tilapia (GIFT) to support progress toward the National Aquaculture Development Strategy (2012–2030). The strategy aims to increase fish supply to 30,000 t per year by 2030, with the goal of increasing per capita consumption to 15 kg, including 12,000 t from farmed fish. The project adopts a holistic approach to scaling up and out for impact, including by engaging and coordinating efforts with the private sector.

The project focuses on increasing the availability and accessibility of fish and encouraging greater fish consumption. Phase 2 builds on the efforts laid by Phase 1 (2014–2019), which developed high quality seed and feed, trained farmers in better management practices and worked with Ministry of Agriculture, Livestock, Fisheries and Fisheries (MALFF) staff and private sector partners to build their skills and knowledge.

The PADTL2 project is funded by the New Zealand Ministry of Foreign Affairs and Trade (MFAT) along with the United States Agency for International Development (USAID), which provided complementary funding in 2021–2023 to support the achievement of the project's goals.

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The design and implementation of this pilot has been possible through the collaboration of many parties—first and foremost, the PADTL2 and WorldFish teams, including field facilitators, who made the pilot concept a reality on the ground. We are thankful to the national and municipal authorities of the MALFF, the Ministry of Education, Youth and Sports (MOEYS) and the Ministry of Health (MOH), as well as to the local authorities in Ermera for their invaluable support, guidance and collaboration. We acknowledge Mercy Corps for its social behavior change contributions, the cookbook development and in-kind support during training for school cooks. Our appreciation extends to the GIFT producers in Poetete, Fatuquero, Laubono (Ermera) and Leohitu (Bobonaro) for growing the fish, as well as to the local service providers in Ermera Vila and Atsabe for delivering the fresh tilapia. Finally, we want to thank the 10 participating schools, their directors, Programa Merenda Eskolár coordinators and school cooks, and especially the students, who ate the meals with fish.

The PADTL2 project is funded by the MFAT (2020–2024), with complementary funding from USAID (2021–2023). The project is implemented by WorldFish in partnership with the MALFF. The program is supported by contributors to the CGIAR Trust Fund.

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Executive summary

This report documents the design, implementation and evaluation of the Fish in School Meals pilot and provides recommendations for scaling up fish supply to schools in Timor-Leste. The pilot fits within pillar 3 - increased consumption activities of the Partnership for Aquaculture Development in Timor-Leste Phase 2 (PADTL2) project in partnership with key government stakeholders. It aims to establish and test systems to supply fresh tilapia to schools and assess its future scalability while helping to boost fish consumption among school-aged children in rural areas. In collaboration with Mercy Corps, the project developed a cookbook with safe and nutritious fish recipes to promote including fish in meals at public institutions.

As part of the national school meal program, Programa Merenda Eskolár (PME), the pilot supplied locally produced and genetically improved farmed tilapia (GIFT) to 10 schools in Ermera municipality. Over 1000 students from five preschools and five primary schools in rural and remote areas received a nutritious fish dish once a week, between July and November 2023. Ermera has some of the highest child malnutrition rates in the country, and it is a land-locked municipality with limited opportunities to access fresh fish. During the pilot, close to 10,000 meals with fish were served and over 2 t of tilapia supplied.

The 4-month pilot established and tested an innovative system to supply schools with fresh tilapia, a protein-rich and nutrient-dense fish. PADTL2-supported local service providers (LSPs) collected fresh fish from three clusters of tilapia producers in Ermera and transported them in iceboxes with ice using motorcycles, ensuring fish quality was preserved. In addition, the project trained school cooks and provided appropriate utensils and cutlery, guaranteeing that the children received nutritious meals prepared hygienically. The fish were procured following a subsidized model to focus on testing the feasibility of the systems. The pilot also boosted the local economy and employment. Fish farmers in Ermera sold tilapia locally, creating business opportunities for producers as well as LSPs. In total, the project supplied over USD 11,500 worth of fish to schools during the pilot.

Designed in consultation and partnership with the agriculture and fisheries, education and health ministries at the national and municipal levels, the pilot is aligned with policies and strategies of the Timor-Leste government. The project selected 10 schools based on their proximity to producers and road conditions and calculated fish requirements following the recommended quantity for protein foods by age group established in the PME's guidelines.

Implementation started with a launch at each school. The main ceremony took place at a preschool in Gleno on July 17, 2023, attended by donors, partners, and national and municipal authorities. A key aspect of the pilot was to ensure that the supply of fish of adequate size was consistent throughout the implementation period, requiring detailed planning and careful consideration of stocking cycles and fish growth rates. Although the school cooks were trained to prepare various fish recipes, the preferred choice was serving a boneless fish fillets over rice and vegetables as well as fish broth, made by boiling fish heads and bones. The children were served fish fillets to address the concern of them choking on fish bones. Notably, 98% of students liked the meal, indicating that fish is a well-accepted food among school-aged children in Timor-Leste.

Evaluated through key informant interviews (KIIs) with school staff, as well as discussions with local leaders and relevant stakeholders at the national level, the pilot was highly rated among participating schools as well as municipal and national authorities that strongly recommended the pilot continuation. Cost per meal analyses showed that fish for one meal costs USD 70 cents per student, requiring a subsidy of USD 52 cents, as the PME's budget only allocates USD 18 cents for protein foods. Although this amount is insufficient to purchase fresh fish at market retail value, there are opportunities to lower the cost of fresh fish by developing contracts with producers. Importantly, the tilapia fillets served during the pilot made an outstanding contribution to the daily nutrient requirements for children. For preschool students 3–5 years old, 45 g of tilapia fillet in a meal accounted for 61% of their protein needs, 48% of vitamin B12, 35% of iron and 32% of calcium.

	Challenges	Lessons
Supply 	• It was difficult to ensure a consistent supply due to breaks in the PME's calendar. • Ensuring minimum fish size is important.	• Fish farmers may choose to sell their fishstock to alternative buyers, which could be addressed by implementing year-round contracts between producers and schools.
Delivery 	• Road access and poor weather can affect delivery. • Motorbikes can transport limited volumes of fish. • Ice availability is unreliable. • Punctual and early delivery is required.	• The proximity of the school to producers is key. • The innovative delivery approach was effective. • Developing contracts with LSPs or deliverers is recommended.
Preparation 	• Schools lack refrigeration. • Food preparation starts early. • Cleaning fresh fish takes time.	• Fish bones are a concern, but fillets overcome this worry. • Fillets generate waste and fish broth can maximize nutrition. • Starter kits should also include scales for schools.
Consumption 	• Children are not used to consuming fish broth.	• Most children like eating fish! • Continued exposure to new flavors and textures can widen children's palates.
Operational issues	• Administration of PME funds can be a challenge. • School attendance and closures impact the supply schedule.	• Coordination among all stakeholders to address issues is important.
Affordability	• The PME's budget does not cover the cost of fresh fish.	• Advocate to raise the PME's budget and include fish in meals.
Stakeholder input	• Serving fresh fish beyond the pilot is difficult due to the limited budget per meal.	• "Fish days" can incentivize school attendance. • Continue the pilot and expand its coverage.
Impact on nutrition	• It was not possible to conduct dietary or nutritional assessments among participants.	• Including fresh fish in student meals has a significant impact on their nutrient intakes.

Table 1. Challenges and lessons learned from the pilot.

Supplying fish to all schools in Timor-Leste is recommended because of the remarkable nutritional benefits, incentives for student attendance and the accumulative long-term health benefits of eating fish. However, most schools lack refrigeration facilities.

Our main recommendation from the pilot is that a "mosaic of approaches"—incorporating fresh fish and a variety of fish-based products tailored to production systems, seasonality, and agroecological and sociocultural contexts—is essential for ensuring a consistent supply of fish and fish-based products in the PME across Timor-Leste.

- For schools that are located close to the coast and to aquaculture producers, it is possible and recommended to scale up the supply of fresh fish.
- For all other schools, and likely the majority in the country, fish-based products that do not require refrigeration, such as dried fish or fish powder, are recommended.

Increasing the availability and affordability of fish is a prerequisite for scaling. The PADTL2 project has developed a successful model for scaling aquaculture, and it is essential to implement this model across the country to guarantee a consistent fish supply in the required volume. Fish-based products present further opportunities to scale up the supply of fish to the PME.

The nutritional gains generated from the supply of fish to schools cannot be overstated in the Timorese context. To improve nutrition, a coordinated effort is needed among all stakeholders (government, donors, development partners, private sector).

Fish has a big part to play in realizing a more nutritious PME in Timor-Leste.

1. Introduction

This report aims to document the design, implementation and evaluation of the Fish in School Meals pilot and provide recommendations for scaling up fish supply to schools in Timor-Leste.

The Fish in School Meals pilot is a pillar 3 - increased consumption activity of the PADTL2 project. PADTL2 is funded by the New Zealand Ministry of Foreign Affairs and Trade (MFAT), 2020–2024, with additional funding from the United States Agency for International Development (USAID) through the Accelerating Aquaculture Development in Timor-Leste (AADTL), 2021–2023, project.

PADTL2 aims to increase food and nutrition security and diversify livelihoods through sustainable aquaculture development. The project has three outcome areas regarding fish: increased availability, increased accessibility and increased consumption (Figure 1) (Pant et al. 2024). The Fish in School Meals pilot focuses on increasing the consumption of fish among school-aged children, and brings the three pillars into action by leveraging the availability of farmed fish, increasing accessibility through an innovative distribution system that enables fresh fish access to schools, and including fish in the diets of students. Although schools in Timor-Leste provide lunch to children, they often lack animal-source foods such as fish or meat (Pant et al. 2020). The pilot was designed to test the potential for including locally produced fish in school meals to contribute toward addressing malnutrition among children.

Partnership with Mercy Corps

PADTL2 partnered with Mercy Corps to develop safe and nutritious fish recipes and products as well as guidelines for preparing diverse, wholesome meals to consumers. The aim was to increase fish consumption and promote the inclusion of fish in meals at public institutions.

Mercy Corps developed a social and behavior change (SBC) strategy and a package of multiplatform communication materials that promote key nutrition and hygiene messages. The strategy aimed at increasing protein intake among women, children and families by creating an enabling environment that seeks to support increased fish consumption and creates a community demand for fish. The SBC package not only targeted fish farming families and communities but also public institutions where food is provided, such as schools and hospitals. The development of educational nutrition and fish resources was done in collaboration with the Ministry of Health (MOH).

A key SBC material for the Fish in School Meals pilot was the fish cookbook. A summary of the cookbook and additional SBC strategy components can be found in Annex I.

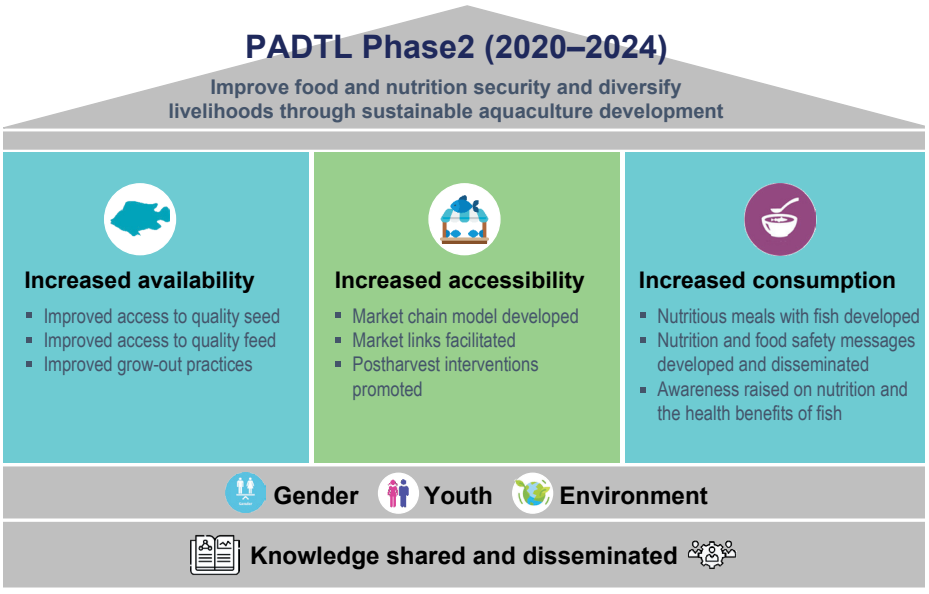


Figure 1. PADTL2's objective and three pillars.

2. Pilot overview

The Fish in School Meals pilot supplied locally produced GIFT to selected schools in Ermera municipality, a PADTL2 initiative in partnership with key government stakeholders. The pilot aimed to supply tilapia to 10 schools with an operational PME or school meal program and also document implementation opportunities and barriers. Over 1000 students from five preschools and five primary schools in Ermera and Atsabe received a nutritious fish dish once a week as part of the national PME. The 4-month pilot, which ran from July to November 2023, established and tested an innovative system to supply fresh tilapia, a protein-rich and nutrient-dense fish, to participating schools and evaluated its future scalability while helping to boost fish consumption in rural and remote areas among school-aged children.

Three PADTL2-supported clusters of tilapia producers in three villages in Ermera were engaged in the pilot: Poetete, Fatuquero and Laubono. To sustain a consistent tilapia supply to the 10 schools, PADTL2-supported LSPs collected fresh fish from tilapia farmers and transported them in iceboxes with ice using motorcycles. This innovative approach preserved fish quality during transportation. Additionally, the project trained school cooks and provided appropriate utensils and cutlery, guaranteeing that the children received nutritious meals prepared hygienically. The project procured the fish following a subsidized model to focus on testing the feasibility of the systems. The pilot not only added fresh fish to school meals but also boosted the local economy and employment. Fish farmers in Ermera sold tilapia locally, creating business opportunities for farmers as well as LSPs. In total, the pilot supplied USD 11,540 worth of fish to schools over its duration (Box 1).

Box 1. Highlights of the pilot.

Three clusters of fish producers supplied

±165 kg

of fresh tilapia each week.

Fourteen school cooks were trained in recipes and food hygiene.

One cookbook was developed titled, Fish for Improved Nutrition.

Implementation stretched across

16 weeks

Over that period, **2131 kg** of fresh fish were supplied and **9843 meals** were served to **1014 students** per week.

USD 11,540

was generated in revenue, of which **USD 8524** came from aquaculture producers and **USD 3016** from LSPs.

98%

of the students liked the meal with fish.

Tilapia fillets made an outstanding contribution to the daily recommended nutrient intake (RNI) for children.

For preschool students 3–5 years old, 45 g of a tilapia fillet accounted for

61% of protein requirements,

48% for vitamin B12, 35% for iron and 32% for calcium.

The first PADTL2 municipality to test the pilot program was Ermera. The landlocked municipality has some of the highest child malnutrition rates in the country (MOH 2022b), and limited opportunities to access fresh fish. Supplying fresh and locally produced tilapia to schools in rural and remote areas with poor road access is a feat in itself. Increasing annual fish consumption among school children in rural Timor-Leste can support improved nutritional outcomes.

The pilot was launched on Monday July 17, 2023, in a preschool in Gleno and finished on November 24, 2023. Prior to the pilot, 14 nutrition sessions with a total of 182 PADTL2 farmers and community members in Ermera (86 females and 96 males) were held in collaboration with Mercy Corps. The aim was to raise awareness of the benefits of fish for nutrition and to train 14 school cooks on how to prepare delicious and nutritious fish recipes while maintaining sanitation and hygiene. Participating schools were given an icebox, cooking equipment and utensils, as well as a cookbook of fish recipes developed by Mercy Corps as a part of PADTL2 activities. These activities were done in consultation and partnership with the agriculture and fisheries, education and health ministries at the national and municipal levels.

Including fish into the national school meal program helps address malnutrition by providing children with a healthy meal that includes fish and by empowering schools with valuable resources. This effort also benefits local fish producers, encourages fish production and raises awareness about the importance of consuming fish for better nutrition and health in schools and communities.

Preschool students enjoy a meal with tilapia fillet, rice and vegetables during the pilot's launch in Gleno.

Timor-Leste government's school meal program

School meal programs are a critical social safety net for vulnerable children and households. In Timor-Leste, the PME plays a key role in the government's strategy to increase children's academic and nutritional outcomes in the country. The PME was launched in 2005 with support from the World Food Programme. Since 2011, the government has led its implementation through the Ministry of Education and its National Directorate for Inclusive Education and School Social Action. The program has received bipartisan support for the past 18 years and was recently enshrined in Decree Law 61/2022, 24 August (Government of Timor-Leste, 2022).

The PME is framed as a government investment to support learning for preschool and primary school students through healthy and balanced meals. Links to the importance of food and nutritional status for brain development and optimal learning, as well as impacts on school attendance, are clearly acknowledged. Government funding for the PME has recently increased from USD 25 to 42 cents per student and meal (USD 35 cents for food costs, USD 7 cents for administrative costs), comprising a total annual investment of over USD 20 million. In 2022, the PME targeted 314,183 students aged 3–15 years old (3–5 years for preschool, 6–15 years for primary school) (Ministry of Education 2021), covering 23.4% of the country's total population (Timor-Leste National Institute of Statistics 2023).

In 2023, the government published policy guidelines for the PME's operation and menu composition (MEYS and MSA 2023). The budget for the PME has been decentralized and is now executed through each municipality and school council. Menus encourage the use of ingredients from the three food groups recommended by the MOH (Figure 2) and indicative quantities and costs are provided. Aquatic foods such as fish, dried fish and shellfish are promoted as a nutritious source of protein and micronutrients. However, resources allocated for school meals are limited, making it difficult to purchase aquatic foods and other animal-sourced foods. Imported tinned fish, however, is currently not permitted because of the emphasis on sourcing locally produced foods.

Note: This section has been adapted from a WorldFish brief on a related topic (Bonis-Profumo et al. 2023, 2).

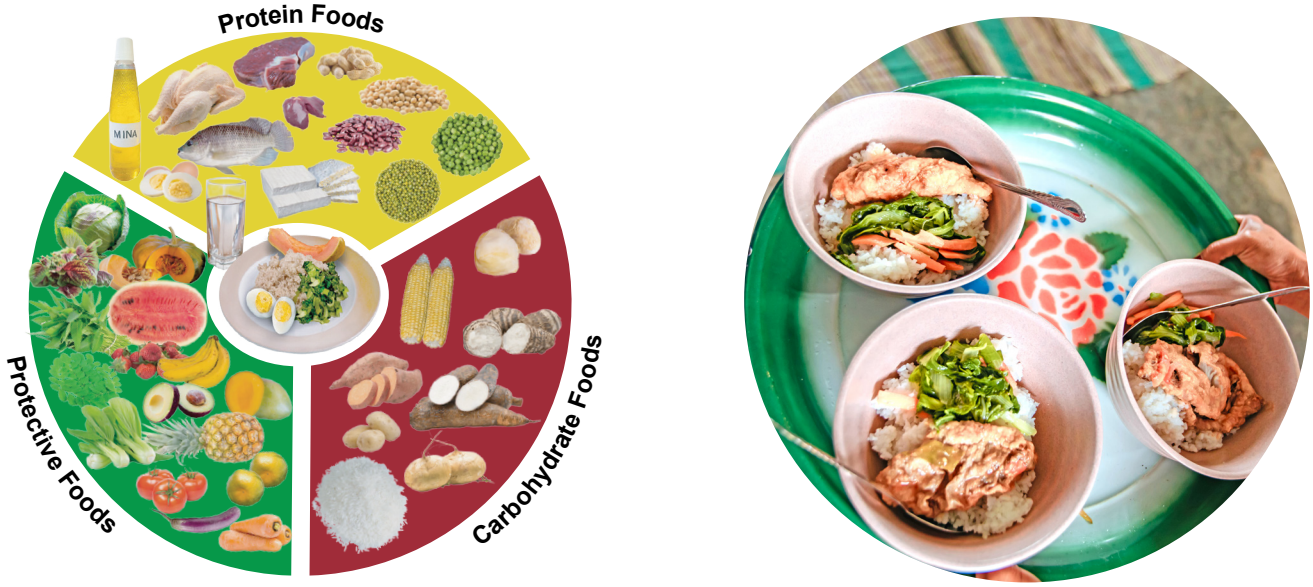


Figure 2. The three food groups recommended by the MOH (left) and an example of a balanced school meal containing fresh farmed fish (right).

Alignment with national policies

The Fish in School Meals pilot is aligned with two national strategies and two policy guidelines (Figure 3).

National Aquaculture Development Strategy 2012–2030

The National Aquaculture Development Strategy (NADS), by the Ministry of Agriculture, Livestock, Fisheries and Forestry (MALFF), sets the vision and action plan to develop the aquaculture sector in Timor-Leste (National Directorate of Fisheries and Aquaculture 2013). The NADS states that one of the actions to support food and nutrition security is by researching and testing new approaches to include fish in supplementary feeding programs for households and school meal programs. This specific action is precisely what the pilot has done by supporting the national school meals program, the PME.

> "There is strong potential to promote fish consumption in the diet of pregnant and lactating mothers, and school children." (NDFA 2013, 25)

National Health Sector Nutrition Strategic Plan 2022–2026

The National Health Sector Nutrition Strategic Plan articulates the strategic nutrition priorities of the MOH for 2022–2026 (MOH 2022a). The overarching outcome of this strategy is to improve the nutritional status of children under 5 years old school children, adolescents, and pregnant and lactating women by 2026. The pilot contributes to this goal by providing nutritious fish to children attending preschool and primary school and generating evidence on how the PME can streamline the supply of locally produced fresh fish through cross-sectoral coordination and collaboration.

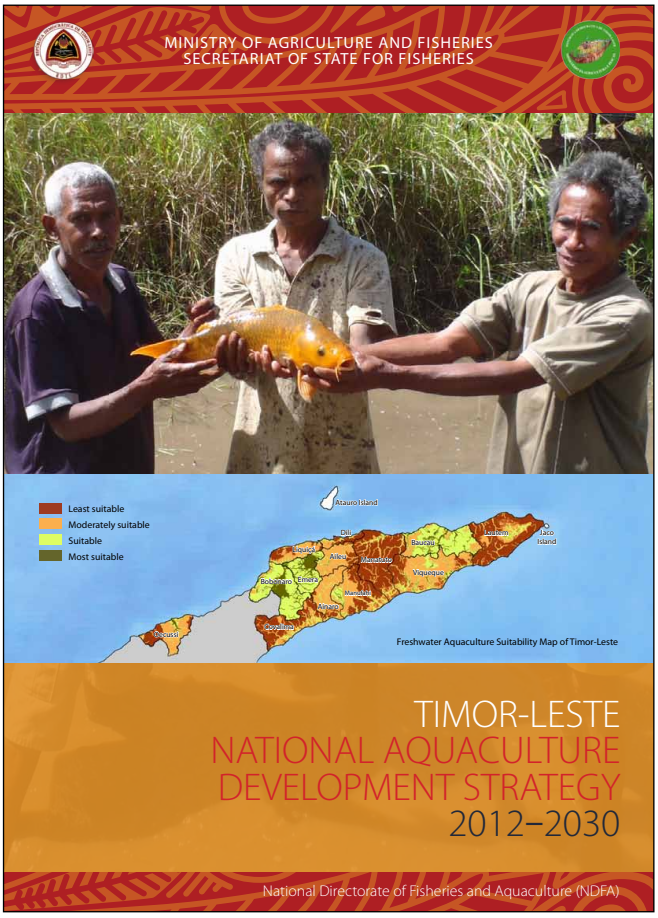
Food-Based Dietary Guidelines

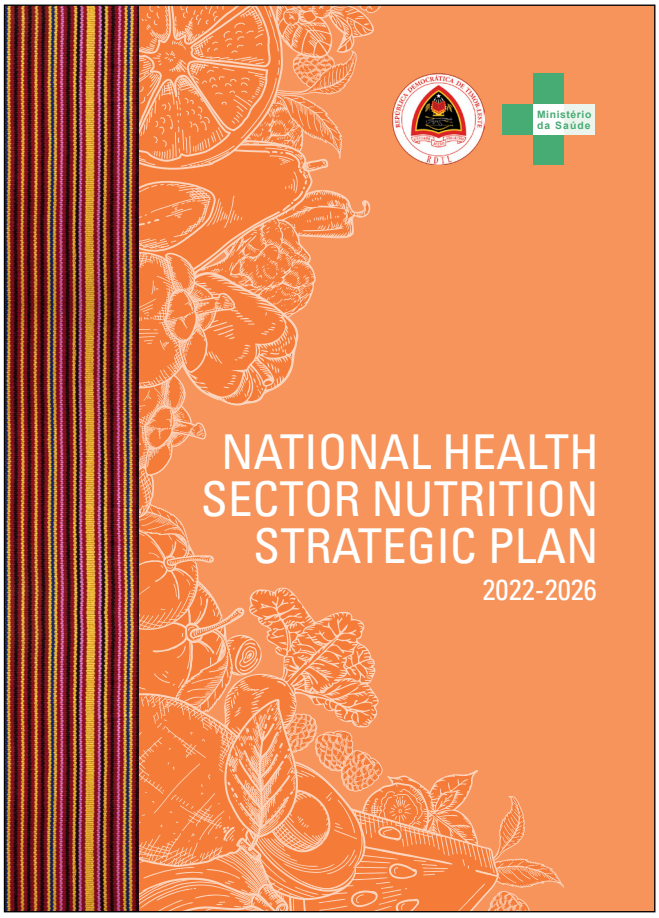
Timor-Leste's Food-Based Dietary Guidelines (FBDGs) provide recommendations for the whole population. Led by the MOH, the guidelines advise which foods should be eaten regularly for good health. The FBDGs recommend eating one serving (100 g) of cooked fish two or three times per week for adults and children, and daily for pregnant and breastfeeding women as well as young children (6–35 months old) (MOH 2017). The pilot supports one weekly meal of local and fresh fish to school-aged children.

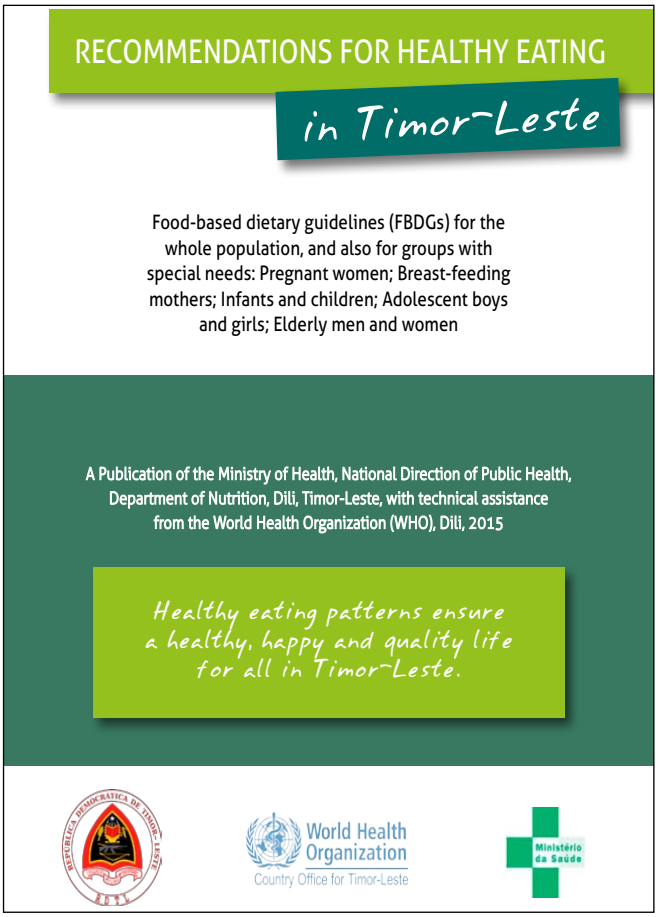
> "Fish contains a special nutrient, called an omega-3 fatty acid, which is very important for brain development in children. Therefore, feed your child fish at least three times a week. If you cannot get fresh fish, you can use tinned sardines or pilchards." (MOH 2017, 10)

Implementation guidelines of the school meals program

The implementation guidelines of the PME define its operation and menu composition. The guidelines were developed by the Ministry of Education, Youth and Sports (MEYS) and the Ministry of State Administration (MSA) in collaboration with the MOH (MEYS and MSA 2023). These guidelines operationalize the specific actions required by the stakeholders involved at the municipal level as well as PME implementers and schools in the context of a decentralized budget. They also define the food groups, provide 12 menu examples (four of which include fish or seafood), require that 75% of foods procured are nationally produced, and set budget and quantities according to food group and age group. For example, USD 18 cents or 51% of the meal budget per student is to be allocated to protein foods, such as fish. The pilot documents the lessons and challenges when supplying locally farmed fresh fish in school meals following the guidelines' specifications.







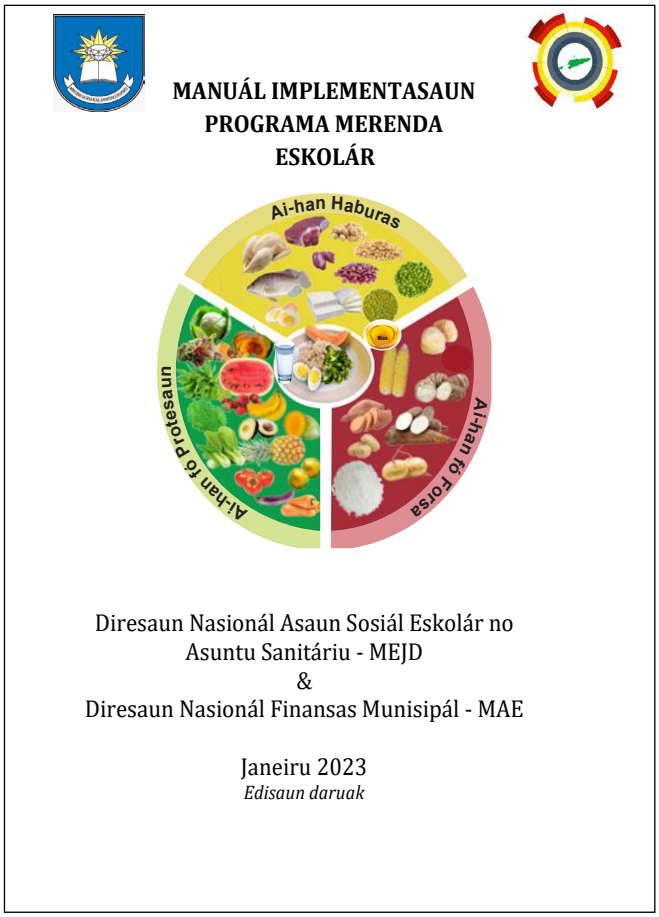


Figure 3. Government of Timor-Leste policy documents with which the Fish in School Meals pilot is aligned.

3. Pilot design

The pilot design started by engaging stakeholders and selecting targeted municipalities and schools, followed by calculating the fish requirements and designing the fish delivery model and the monitoring and evaluation (M&E) plan. Finally, support for schools was considered by training their cooks on how to clean fish and cook fish recipes and by providing the required equipment to prepare and serve fish-based meals.

Stakeholder engagement

Planning and activities for the pilot were done in close consultation and partnership with the agriculture and fisheries, education, and health ministries at the national and municipal levels.

The team engaged representatives from the Government of Timor-Leste in May and June 2023. These included the national director for aquaculture from the MALFF, the national director of school meals and social action from the MEYS, and other relevant stakeholders, including the national director of food security from the MALFF and the head of the nutrition department at the MOH.

At the municipal level, the team engaged with multiple authorities, including the president of the municipality, the director of education, the school meals cooridnator, the director of agriculture and fisheries, the director of food security, the director of nutrition and the nutrition officer. The pilot design was refined through valuable input from these key stakeholders.

Selecting municipalities and schools

At the time of the pilot's planning, PADTL2 was supporting fish producing clusters in six municipalities: Baucau, Bobonaro, Ermera, Lautem, Dili and Manufahi (Figure 4). The team selected Ermera because it is a landlocked municipality, with limited access to fish, and has very high malnutrition rates in which 63% of children under 5 years old are stunted (MOH 2022b). Ermera also allowed the project to test the pilot and supply systems in rural and remote areas, since one producer cluster, Laubono, is located in the remote Atsabe administrative post, with challenging road access. PADTL2 supports three producer clusters with ponds: Poetete, Fatuquero and Laubono.

The selection of schools to participate in the pilot was mainly based on their proximity to producers and the road conditions, with the aim of minimizing the time between fish harvest and delivery to the schools. As part of the selection process, the project also considered the number of students eligible for the PME, based on a list provided by the municipal director of educational services, and the carrying capabilities of the LSP motorbikes and iceboxes. As such, schools with very small and very large numbers of children were excluded. Finally, the pilot required that schools had an operational PME, as providing a basic meal, such as with rice, vegetables and oil, was necessary to supplement it with fresh fish.

Meeting with key government stakeholders to plan the Fish in School Meals pilot.

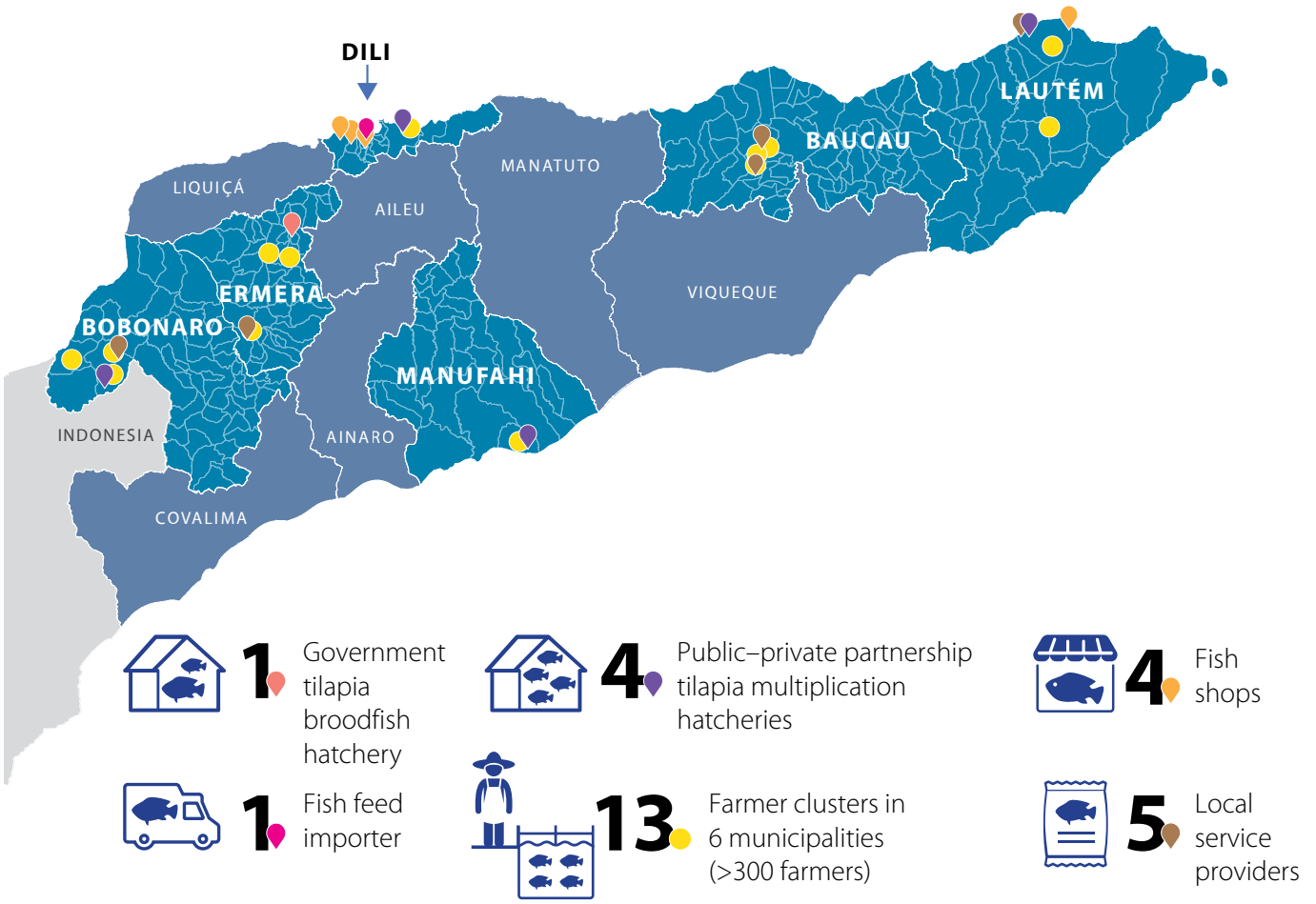


Figure 4. Map showing PADTL2 farmer clusters, hatcheries and fish value chain actors across the municipalities (adapted from Pant et al. 2024).

To keep delivery manageable and trackable, the project designed the pilot schedule to supply fish 1 day a week, Monday to Friday, to five schools close to the rural clusters of producers, in Poetete and Fatuquero, and the same schedule to five schools near the remote cluster of tilapia farmers, in Laubono. The team learned that school cooks start preparing lunches early in the morning, between 06:00 and 07:00, and many served lunch as early as 10:00. Some schools had two turns of students and served lunch twice. This limited the travel time between producers and schools to ensure the fish would arrive early enough for the cooks and volunteers to clean and prepare them in time.

Based on these criteria, the project identified a preliminary list of 10 eligible schools. After consultations with municipal authorities and school visits, the team selected the final five preschools in the administrative post of Ermera (rural), and five primary schools in the mountainous administrative post of Atsabe (remote) (Figure 5). The total number of students enrolled in the schools was 1271.

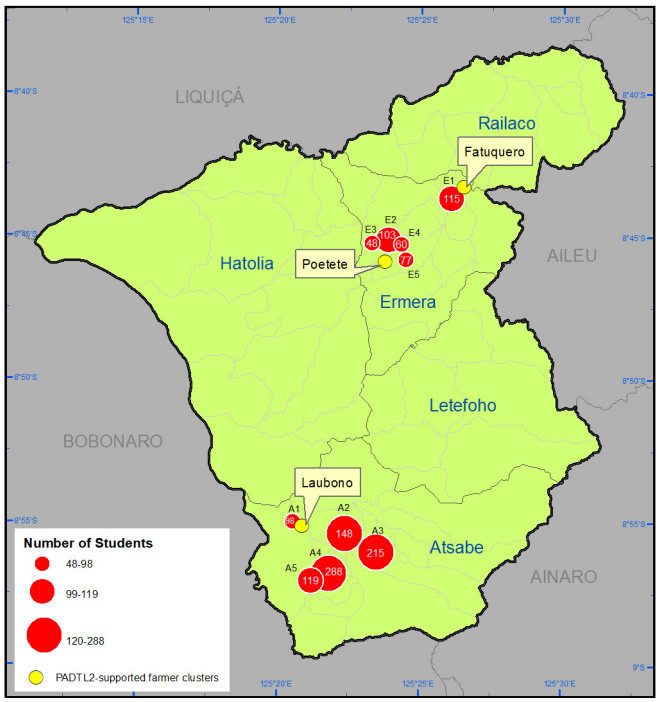


Figure 5. Map of PADTL2-supported producers and the 10 schools selected for the pilot in Ermera.

Fish requirements

The implementation guidelines of the PME (MEYS and MSA 2023), described on page 11, establish the recommended quantities and funds for each food group and other meal ingredients, such as oil and seasonings (Table 2).

To calculate the number of tilapia required to supply the school needs, we assumed that one fish of 200 g can feed approximately two students and that 1 kg can feed approximately 8–10 students. We added 20% as a buffer and to account for potential weight loss during transportation, and we later increased an additional 10% after receiving feedback from the schools on the quantities supplied. Considering the school types and number of students, we estimated that 165 kg of tilapia were needed per week for the Fish in School Meals pilot in Ermera (Table 3).

School type	Students age range	Number of students*	Protein foods group**	
			Grams/student	USD cents/student
Preschool *Pre-Eskolár (PE)*	3–5 years old	25,679	45	20
Primary school *Eskola Bázika (EB)*	6–15 years old	288,504	60	16

**Totaling 314,183 eligible PME students in 2021 (MOE 2021).*
***Grams are in raw weight. The budget allocated USD 35 cents for food per student, with an average of USD 18 cents for protein foods (51%).*

Table 2. School type and students eligible for the PME and recommended protein foods and funds.

ID	Admin. post	Village	School type and name	Number of students	Number of tilapia (+30%)	Weight (kg)	Delivery day
E1	Ermera	Rihey	PE Filial Nino Conis Santana Gleno	115	75	15.0	Monday
E2	Ermera	Poetete	PE Municipal Ermera Vila	103	67	13.4	Tuesday
E3	Ermera	Poetete	PE Filial Abeigo Nino Conis	48	31	6.2	Wednesday
E4	Ermera	Legimea	PE Filial Hatuleta	60	39	7.8	Thursday
E5	Ermera	Railori	PE Mirtutu	77	50	10.0	Friday
			Subtotal	403	262	**52.4**	
A1	Atsabe	Laubono	EBF 1.2 Sirui Lesumanu	98	64	12.7	Monday
A2	Atsabe	Tiarlelo	EBF Tiarlelo	148	96	19.2	Tuesday
A3	Atsabe	Malabe	EBF Malabe	215	140	28.0	Wednesday
A4	Atsabe	Batumanu	EBC 1.2.3 Batumanu	288	187	37.4	Thursday
A5	Atsabe	Laubono	EBF 1.2 Laubono Biabote	119	77	15.5	Friday
			Subtotal	868	564	**112.8**	
			WEEKLY TOTAL	1271	826	**165 kg**	

Note: PE = preschool; EBF = primary school subsidiary; EBC = primary school central.

Table 3. Calculations of fish requirements according to school type and student numbers.

For future reference, the team refined the calculations by weighting the fillets obtained from different fish sizes (Table 4), and it found that 40% of the whole fish weight is fillet, about 400 g/kg.

Delivery model and monitoring and evaluation

One of PADTL2's main priorities was to guarantee availability to sustain a consistent tilapia supply to the 10 schools. The team engaged with aquaculture producers to plan the productive capability and stock cycles in each cluster to ensure that the supply of fish of adequate size was available. Close communication and coordination were essential for the pilot's success.

Next, the team developed an innovative approach to transport and deliver the freshly harvested tilapia to schools and ensure quality and safety (Figure 6). LSPs, who are entrepreneurs from rural and remote areas operating as private sector actors and trained by the PADTL2 project in business skills, collected fresh fish from aquaculture producers and transported them in iceboxes with ice using motorcycles to the schools for a fee. The motorcycles were kitted with a saddlebag large enough to fit a 26 L icebox on each side, carrying 13 kg of fish and ice in each. The project also provided each school with an icebox to receive and store the fish until preparation started and then served the fish meal to students. An engaging video, recorded during the implementation, depicts this process, from "pond to plate" (Annex 2).

Fish samples	Number of fish	Average weight of whole fish (g)	Total weight (g)		Weight of fillet over whole (%)
			Whole	Fillet	
Sample 1 (small)	7	152	1064	415	39
Sample 2 (medium)	5	207	1035	360	35
Sample 3 (large)	4	254	1016	480	47
				Average	40

Table 4. Weight of fillets obtained from tilapia of different sizes.

Figure 6. Innovative approach to distribute fresh fish from producers to schools.

The team conducted several tests with the iceboxes filled with fish and ice and concluded that the fish stayed fresh for up to 4 hours. Travel time between producers and schools was 1–1.5 hours, at most, so the fish transported using this delivery system ought to be fresh and food safety ensured. The majority of roads in Ermera are not paved, and road conditions in Atsabe, particularly during rainy season, are quite challenging for cars. As such, motorbikes were used to transport the fish despite the challenging road conditions. This innovative delivery model ensured that quality was preserved during transportation so that the children received nutritious and safe fish meals.

The pilot engaged two LSPs, each with their own motorbike and one from each administrative post. Doing so supported employment opportunities and income generation in rural areas. The LSPs signed an agreement with WorldFish to ensure clarity in the delivery schedule and accountability. The PADTL2 project supported them with a pair of saddlebags and iceboxes.

PADTL2 contracted a dedicated project officer to oversee the operations in the field and implement the M&E plan by collecting data from "pond to plate" throughout the pilot's implementation period. The officer visited each school on the

An LSP adds ice to an icebox full of tilapia ready for delivery.

An innovative fish delivery model uses motorbikes with saddlebags carrying iceboxes.

delivery day, alternating one week in each administrative post so that he could visit all of the schools in person every second week. The project also used phone calls to monitor the schools remotely and to collect key data from non-visited schools. Two e-questionnaires were developed in KoboToolbox to collect monitoring data and to solve problems promptly.

Support for schools

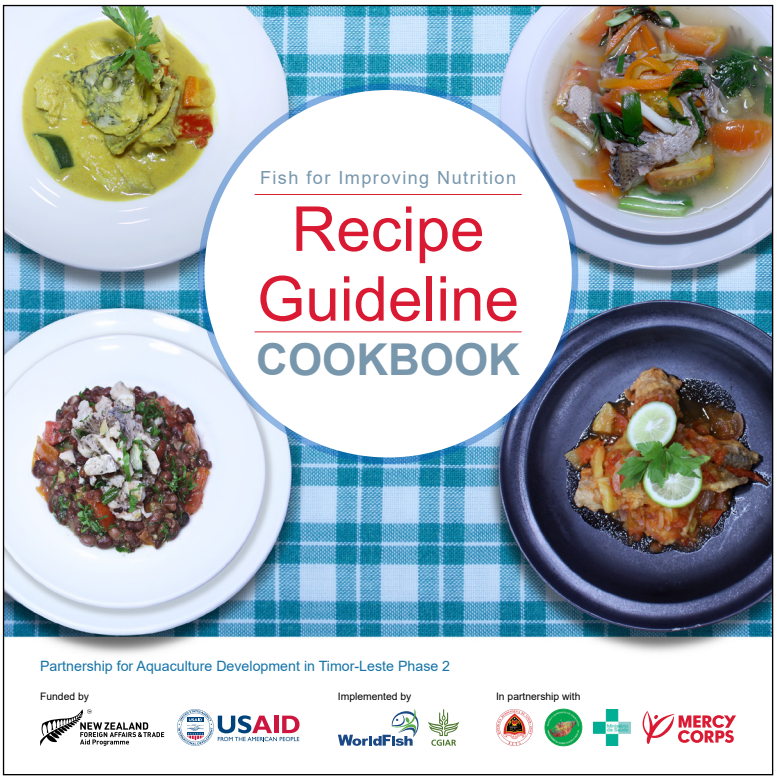
The Fish in School Meals pilot provided support to schools in two forms: (1) training their cooks on how to clean fish and prepare delicious recipes using tilapia and (2) supplying the required items to process fish safely and serve meals to students.

Training school cooks

On July 8, 2023, 14 cooks from the selected pilot schools participated in training in Ermera Vila, organized jointly by WorldFish and Mercy Corps. The objective of the training was to support the cooks' confidence and skills on how to clean and prepare fresh fish safely and to demonstrate some recipes that they could use to prepare the fish in a school setting, using basic ingredients and minimal equipment. The training demonstrated how to make recipes using fish and reinforced general hygiene and food safety measures, such as washing hands, ingredients and utensils.

The PATDL2 project engaged two chefs from the East Timor Development Agency (ETDA), a local nongovernmental organization (NGO), as lead facilitators. Mercy Corps had previously contracted ETDA to co-develop the fish recipes cookbook as part of PADTL2's activities, described in detail in Annex 1, and to deliver training of trainers (TOT) at master chef events as part of PADTL2 community outreach activities promoting fish consumption. Two additional staff, from WorldFish and the Directorate General of Fisheries, Aquaculture and Marine Resources, facilitated a session on fish handling and fish food safety and demonstrated how to clean fish and process them safely.

All of the participants received a copy of the cookbook (Klumpyan et al. 2023) and the fish handling guidelines (Li et al. 2021) (Figure 7). An engaging video captured the training event and the cooks' experience and reflections (Annex 2).



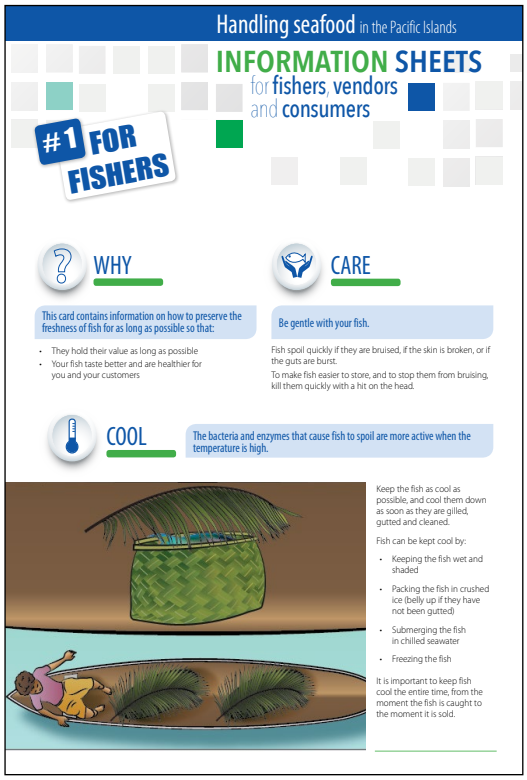


Figure 7. Printed materials provided to school cooks during the TOT: the fish cookbook and fish handling guidelines.

School cooks participate in training on fish handling and fish recipes as part of the Fish in School Meals pilot in Ermera.

Materials and equipment

An initial school assessment identified the available facilities and equipment. The 10 participating schools received a well-equipped starter kit, which included an icebox, cooking pots, cutting boards, knives and other cooking utensils, including a metal strainer and ladle to prepare fish broth. Schools that did not have enough plates and bowls were also provided with additional ones to ensure students had access to the necessary serving equipment to eat their meals, which meant tailoring the starter kit to each school context. The starter kit also included cleaning supplies to ensure hygiene standards and costed about USD 3000 (Table 5). As mentioned above, each school also received a fish cookbook.

School kitchens were simple, often lacking access to running water and electricity, and none had access to refrigeration facilities. Some had access to a rice cooker, and most food was cooked on fire stoves.

Item	Cost (USD)
Cooking utensils	1359.25
Cleaning supplies	233.00
Serving utensils	377.50
Iceboxes	1104.60
Total	**3074.35**

Note: The iceboxes include those for the LSPs and their saddlebags.

Table 5. Cost of equipment and materials provided to schools and LSPs.

Examples of school kitchens from PE Filial Hatuleta, PE Municipal Ermera Vila and EBF Biabote.

4. Pilot implementation

Implementation included launches in all schools, planning for and addressing the challenges of fish sourcing and delivery to schools, and collecting monitoring data.

School launches

The Fish in School Meals pilot was launched at the Pre-Eskolár Nino Conis Santana in Gleno on Monday, July 17, 2023. This preschool had 115 students, one cook and two turns for eating lunch, at 10:00 and 12:00. The objective of the event was to inaugurate the pilot with key stakeholders with a simple ceremony during a normal class day.

Activities included watching a short video on the training that school cooks took part in earlier that month, which focused on handling fish safely and on practical skills needed to prepare recipes using tilapia from the fish cookbook. Guests visited students while they ate their lunch, a meal cooked with tilapia, and a photographer took photos with the children (consent signed by parents was obtained for all photos). Guests then gathered for a coffee and local snack and observed a stall with information on the pilot and educational resources. There they met some of the key actors in the "pond to plate" approach being tested, such as a tilapia producer, a fish distributor (LSP) and school representatives, including the cook.

Guests included the national director of food security (MALFF), Rufino Gusmão; *Charge d'Affaires* a.i. / deputy head of mission of New Zealand to Timor-Leste, Nick Borthwick; USAID technical director, Rebecca Robinson; the deputy president of Ermera; municipal directors from the MALFF, MEYS, MSA and MOH and other authorities; as well as representatives from WorldFish and Mercy Corps. In total, there were 38 attendees (26 males and 12 females).

Dr. Jharendu Pant, the PADTL2 project leader, provided an overview of the objectives and importance of the Fish in School Meals pilot. This initiative has the potential to be scaled across the country to enhance nutrition security among children. Additionally, locally produced fish can be directly linked to nutrition support programs.

A preschool student enjoying a nutritious meal of fresh farmed tilapia in Ermera.

All of the speakers commended the activity. The deputy head of mission of the New Zealand embassy reinforced the excellent properties of fish as a source of essential nutrients such as protein, omega-3, vitamins and minerals, and he also reflected on the health impacts of incorporating fish into school meals. Afterward, the national director of food security (MALFF) highlighted how the pilot exemplifies the collaborative efforts of ministries and partners, underscoring the government's commitment to creating a healthier future for Timorese children.

PADTL2 produced a video and a blog post on the launch of the pilot (Annex 2).

Smaller launches were organized at the other nine schools on the first day of fish delivery. They were attended by 181 municipal representatives from the MEYS and the MOH, village authorities, school representatives and parents involved in the PME.

A representative from USAID attends the pilot launch at the preschool in Gleno.

Fish sourcing and delivery to schools

A key aspect of the pilot was to ensure that the supply of fish of adequate size (minimum of 100 g) was consistent throughout the implementation period. This required detailed planning and careful consideration of stocking cycles and fish growth rates.

Producers faced challenges because of the non-continuous nature of the PME's calendar, as it does not operate during national examinations and holidays. Between July and November, meals were not served for four and a half weeks (Figure 8). Despite the PME's breaks, the pilot was implemented effectively for 16 weeks in Ermera preschools and 15 weeks in Atsabe primary schools.

From the producers' perspective, these breaks in the supply for schools were disruptive and resulted in aquaculture farmers in Atsabe selling some of their fishstock during the PME's breaks, which then hampered supply for later requirements. For the last few weeks of the implementation, the team then had a producers' cluster in Leohitu, from the neighboring municipality of Bobonaro, supply fish to schools in Atsabe. Moreover, the rainy season started in November and made delivering fish more challenging, especially to remote schools, because of high river crossings and unstable muddy roads.

Access to ice

The pilot was designed to supply fresh fish in an icebox with ice to all schools. However, this was not possible in all instances, for a variety of reasons. Some schools were very close to the producers, making the time between fish harvest and cleaning under 2 hours. Following WorldFish guidelines on fish handling, the team recommended that fresh fish can be kept safely for only 2 hours when not refrigerated or not stored on ice (Li et al. 2021).

In other instances, particularly in the remote and mountainous area in Atsabe, access to electricity and therefore ice was intermittent and not always available. When there was no power, the field team proposed delivering tilapia to the school cook the evening before in order to clean, fry and store the fish until the next day, when other ingredients would be added. Although this approach entailed a degree of food safety risk, it was the only workable solution. Most schools in Atsabe were above 700 m and cool in the nighttime.

Figure 8. The PME's 2023 calendar, by the MEYS.

Monitoring

Meals served

During the implementation period of the pilot, close to 10,000 meals with fresh fish were served to an average of 1014 students every week (Table 6). Throughout the pilot's duration, there were 121 "fish days" across all schools.

The overall pilot was implemented for 16 weeks in Ermera and 15 in Atsabe. For multiple reasons, however, such as school closures for cultural celebrations as well as issues with access to the PME's budget that precluded serving meals, the average number of fish days per school was 14 for Ermera (range 11–17) and 11 for Atsabe (range 9–13). Moreover, as reported by the school cooks, the number of students served a fish meal was lower when compared to enrolment data used for planning purposes. This indicates that there is also a need to encourage parents to send their children to school regularly.

Recipes, cooks' confidence and student feedback

Although the school cooks were trained to prepare various fish dishes, PADTL2 aimed to ensure consistency by serving a cooked boneless fillet over rice and fish broth, made by boiling fish heads and bones, to each student throughout the pilot. The main reason for this was that there is a high degree of concern about children choking on fish bones when eating fish. The recipe of choice among school cooks was also fish fillets.

Monitoring data showed that, of main tilapia meals served 84% were fish fillets, 5% were fish soup with beans, another 5% were rice porridge with fish, and 4% were fried fish and fish soup. Filleting the fish produced a lot of waste, and the team encouraged all school cooks to also prepare fish broth as a side to the main meal. This approach ensured that children received the maximum nutrients from the supplied fish. Sixty-eight percent of meals were served with fish broth. However, the broth was not popular among students despite encouragement from school staff on the importance of consuming it. This suggests that promoting fish soup with beans or other substitutes could be an alternative to clear broth.

Cooks were asked about their perceived confidence in preparing and cooking fish. Thirty-five percent said that they were confident, while the remaining 65% said their confidence was only okay or so-so. As the fish was provided free-of-charge, during "fish days," schools saved the budget allocated to protein foods, averaging USD 21 per day. Most cooks reported buying other ingredients with those funds. A minority of cooks and staff mentioned issues accessing PME funds in a timely manner because of unclear funding administration and/or issues with the bank, which affected PME provision for a few days.

During each physical visit, the project officer asked three random students to rate the meal with fish they ate that day. Out of the 180 respondents, 98% reported liking the meal, 2% liked it a little, and less than 1% stated they did not like it. This data gives us strong confidence that fish is a well-accepted meal among school-aged children in Timor-Leste.

School	Number of meals	School	Number of meals
E1 - PE Filial Nino Conis Santana Gleno	1539	A1 - EBF 1.2 Sirui Lesumanu	918
E2 - PE Municipal Ermera Vila	990	A2 - EBF Tiarlelo	1104
E3 - PE Filial Abeigo Nino Conis	374	A3 - EBF Malabe	1494
E4 - PE Filial Hatuleta	495	A4 - EBC 1.2.3 Batumanu	1524
E5 - PE Mirtutu	640	A5 - EBF 1.2 Laubono Biabote	765
Ermera	**4038**	**Atsabe**	**5805**
Total	**9843**		

Table 6. Number of meals with fresh fish served, by school.

Preparing fish fillets, carcasses and broth to reduce waste and maximize nutritional intake.

A monitoring visit to the PE Hatuleta with Joaquim Martins, the national director of the school meals program, and mana Ligia Madeira, the preschool's cook, on November 9, 2023.

5. Pilot evaluation

The Fish in Schools Meals pilot aimed to establish and test systems to supply fresh tilapia to selected schools and assess its future scalability while helping to boost fish consumption in rural and remote areas among school-aged children. To evaluate the pilot, the team conducted KIIs with school staff, further considered M&E data, analyzed the cost per meal of providing fish and the impact on the local economy. A summary of key challenges and lessons learned during the pilot is presented next. Additionally, we include a nutrient content analysis of tilapia and fish powder made with tilapia to provide a comprehensive understanding of the substantial nutritional potential of scaling up fish supply to all schools in Timor-Leste. However, the pilot implementation was short and impacts on dietary or nutrition indicators were not possible to monitor, which is a limitation of the project.

Key informant interviews

To evaluate the pilot, the project officer conducted 17 KIIs from the participating schools toward the end of its implementation: eight school cooks, five school meal coordinators and four teachers. The objective was to interview one school cook and another staff member in each school. However, some were unavailable during the interview period, which lasted November 16–24, 2023.

Including fish as part of school meals was widely appreciated, and all respondents recommended continuing the Fish in School Meals pilot beyond its initial duration. Most schools reported higher attendance during the fish days and observed health benefits among students. Some mentioned that the impact on health could only be measured by a sustained supply of fish. Many respondents explained that it took some time for students to get used to eating fish, as fish is not a common food for many of them because the sea is far from Ermera. However, it was surprising how children learned quickly to like and look forward to the fish days.

"The consumption of fish is good for the health of the children. Continuity [of fish supply] is necessary to provide physical and brain benefits for the children. The number of students has increased."

"Konsumo ikan ne'e diak ba labarik nia saude, presija kontinuidade atu nune bele fo benefisiu fisiko no kakutak diak ba labarik sira. Numeru estudante aumenta."

– Tome Gonsalves, teacher, EBC 1.2.3 Batumanu

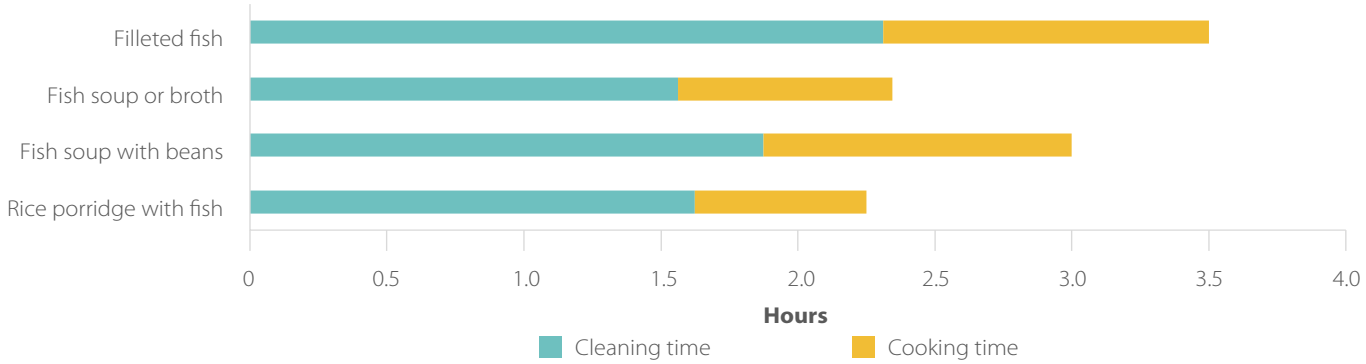
Among students, fish fillets were the most liked recipe across all of the schools. For their part, cooks felt comfortable serving it because it addresses an important concern among parents, and adults in general, regarding the risk of choking with fish bones when children consume fish. One school cook mentioned that the training she received based on the recipes in the fish cookbook gave her enough confidence to explain to the students' parents that serving fish fillets is safe, as no bones are included in the meal.

"[Initially], there were doubts from the parents about the fish bones. But with the capacity I have obtained from the training, I can respond to the doubts and now the parents are happy."

"Iha duvidas husi inan aman konaba ikan ruin maibe ho kapasidade ne'ebe hau hetan husi treinamentu responde ba duviodas sira no ohin loron inan aman sira kontente."

– Aguida Soares da Silva, school cook, PE Filial Abeigo Nino Conis

A key challenge mentioned often among the KIIs was the time required to prepare the fish, particularly cleaning them (de-scaling, gutting, and chopping or filleting). Cooks reported the time dedicated to cleaning the fish and cooking each recipe (Figure 9). For example, to prepare fish fillets, the most popular recipe, it took an average of three and a half hours between cleaning (2.3 hours) and cooking (1.2 hours), while fish soup or broth needed 2.25 hours of preparation. Given that lunches are served as early as 10:00, dedicating 3.5 hours to prepare fish fillets is a considerable workload and time demand for school cooks, which requires that the fish are delivered very early and on time. It is foreseeable, though, that the cooks may become more skilled in cleaning and filleting the fish, which would reduce the preparation time.



Note: All school cooks prepared the first two recipes, and half the last two recipes.

Figure 9. Time required to prepare (clean and cook) each recipe, as reported by eight school cooks.

Another important challenge raised was access to ice, particularly in the schools in Atsabe, where electricity access is less stable. Making sure that sufficient ice was provided or available was a source of concern among respondents, as it can affect fish quality. Many cooks mentioned that they would prefer having scales to ensure that the weight of fish received aligned with those stated and required. A minority of KII respondents said that there had been issues with late fish supply, delaying the time lunch was served. Lack of water access also affected implementing the pilot adequately. Overall, however, the pilot was highly rated—not only among staff from participating schools, but also among municipal and national authorities, which strongly recommended continuing the pilot during the National Aquaculture Forum in early December 2023.

Cost per meal

This subsection presents some analyses on the budget allocated per meal and the actual cost of serving fresh tilapia as part of the national PME.

The PME implementation guidelines recommend allocating USD 18 cents, on average, per meal and student to the protein food group (MEYS and MSA 2023), to which fresh fish belongs.

Table 7 shows that the planned quantity of fish supplied according to enrolled students cost USD 70 cents per student and meal, which was USD 52 cents higher than what the PME's budget allocated for protein foods. When considering the actual number of meals served during the pilot (in other words, the number of students having a meal), the cost per meal was higher, at USD 87 cents per student, because of differences between the number of enrolled students and school attendance.

The current allocation of the PME for protein foods is insufficient to purchase fresh fish at market retail value. Nonetheless, there are opportunities to lower the cost of fresh fish by developing contracts with producers that enable planning for larger quantities and a more constant demand.

Tilapia supply	Weight (kg)	Cost (USD)	Notes
Total fish supply – PLANNED	**165**	**895.67**	Following pilot plan, per week
Per meal (based on enrolments)	0.130	**0.70**	**Cost of fish per meal**
Cost difference with PME budget (USD 0.18 cents)		**0.52**	**Subsidized difference**
Total fish supply – ACTUAL*	**2,091**	**11,330.35**	During pilot implementation
Per meal (accounts for attendance)	0.212	0.87	Cost of fish per meal
Cost difference with PME budget (USD 0.18 cents)		0.69	Subsidized difference

Note: Kilogram per meal of tilapia is raw whole fish weight.
** Actual fish supply does not include 40 kg provided for the school cooks' training, worth USD 210.*

Table 7. Cost per meal, planned versus actual, and a comparison to the budget for protein foods.

Impact on the local economy

Although the pilot was intended to assess the feasibility of incorporating fish into school meals, the fish was subsidized, and the PATDL2 project covered the expenses related to the fish.

The price of fish paid to aquaculture farmers was USD 4/kg, based on the real fish price at the farmer level to producers. LSPs charged a fee for sourcing and transporting the fish with their own motorbikes, plus a service charge, as well as fuel and ice costs. The fee for the LSPs was USD 1.25/kg in Ermera and USD 1.50/kg in Atsabe. Input costs are higher in remote areas, and their net income is estimated at 50%.

Importantly, the revenue the pilot generated was over USD 11,500, which was a substantial injection into the local economy in Ermera for a 4-month period. Revenue was distributed among producers, who made USD 8500 in fish sales and supplied over 2.1 t of fresh fish to schools, and LSPs, who generated over USD 3000 in revenue (Table 8).

School location	Supply (kg)	Producer revenue (USD 4/kg)	LSP fee	LSP revenue	Total revenue
Ermera	720.60	2882.40	1.25	900.75	
Atsabe	1410.40	5641.60	1.50	2115.60	
Total	**2131.00**	8524.00		3016.35	**11,540.35**

Note. The total includes USD 210 from the 40 kg of tilapia provided for the school cooks' training in Ermera.

Table 8. Actual quantity of fish supplied and revenue generated by producers and LSPs during the 4-month pilot.

Summary of challenges and lessons

The pilot supplied locally farmed fresh tilapia to schools and contributed to a weekly fish dish as part of the PME to help boost fish consumption in rural and remote areas among school-aged children. Its aim was to assess the establishment and testing of systems to supply fresh tilapia to selected schools and its future scalability. The activity was well received by all participating schools and appreciated by all stakeholders. However, there were some challenges faced and key lessons learned that need to be taken into consideration to scale Fish in School Meals in Timor-Leste (Tables 9 and 10).

Children eating a balanced meal with fresh tilapia, vegetables and rice as part of the school meal program.

Balanced and nutritious meals with fresh tilapia, rice and vegetables ready to be served at EBF 1.2 Sirui Lesumanu.

Challenges		Potential solutions
Supply		
Ensure a consistent supply despite breaks in the PME's calendar.	Producers need assistance with planning fish stocking and harvesting cycles to (i) align with school requirements, which are affected by several PME breaks during the school calendar and (ii) ensure that fish weighing at least 100 g are available through out the delivery period, which requires careful planning and coordination.	Tilapia can be stocked and harvested year-round in Timor-Leste because of its favorable temperatures. Encourage farmers to stock at various times, and maintain a strategy of multiple harvests for a consistent fish supply.
Ensure minimum fish size.		Tilapia can grow to over 250 g in weight within 4–6 months. To consistently supply the preferred size of fish, it is recommended to practice single stocking and multiple harvesting of larger fish only.
Delivery		
Road access and weather are poor.	Road conditions are poor, particularly in remote areas, and are exacerbated during the seasonal rains (November–April). This impacts the transportation options and requires motorized delivery, which limits the amount of fish transported and excludes large schools because of the number of students and the amount of fish needed.	In the long term, accessibility to schools will increase with improvement of rural roads.
Motorbikes can transport limited volumes of fish.		Motorbikes are the only option for transporting fish when the road conditions are bad.
The availability of ice is unreliable.	Access to ice, particularly in remote areas, is not reliable, compromising fish quality and food safety.	There is a good business opportunity for LSPs and local entrepreneurs to start a small ice plant in local areas to supply ice for fish transportation and markets.
Punctual and early delivery is required.	Fish needs to be delivered to schools early and on time to ensure cooks have enough time to prepare the fish. This requires very early harvesting by producers and limits the distance or travel time between producers and schools.	Farmers need to be advised to collect fish in hapas 1 day before supplying them to schools so that it will be convenient to supply fish early in the morning.
Preparation		
Schools lack refrigeration.	None of the selected schools had access to refrigeration, limiting fish delivery options.	The problem can be solved only with a consistent supply of electricity in the area.
Food preparation starts early.	School cooks start preparing food as early as 07:00 and often have two turns to cook for.	Schools can adjust working hours for cooks so that they can come early and leave early.
Cleaning fresh fish takes time.	Cleaning and cooking fresh fish is time-intensive and laborious. This increases the workload of school cooks and often requires additional volunteers to help with the task.	Cleaning fish should not take as long once cooks and helpers develop skills and become used to the process over time.
Consumption		
Children are not used to consuming fish broth.	School-aged children enjoyed eating the fish fillets, but most did not like consuming the fish broth despite its nutrient-richness.	Repeated and frequent exposure to new flavors and textures can help children learn to like fish broth. Schools can try preparing preferred legume or vegetable soups using fish broth.
Operational issues		
There are challenges with how the PME's funds are administered.	Some schools faced issues managing and accessing the PME's budget and new implementation system. This impacts their ability to purchase basic food items to provide a meal. The supply of fish, which is in the protein food group, as part of the PME requires that schools have access to carbohydrate and protective foods groups to provide a balanced meal.	A coordinated approach among stakeholders is required to address this issue.
School attendance and closures impact the supply schedule.	The quantity of fish supplied is calculated based on enrolment numbers, and lower attendance impacts the cost per meal analysis. Absenteeism among students and unplanned school closures, for cultural celebrations for example, were more frequent in remote schools.	Consider the school calendar in detail when planning the supply of fish for school meals. School teachers and local authorities can lead campaigns to encourage parents to send their children to school regularly.
Affordability		
The PME's budget does not cover the cost of fresh fish.	Fresh fish is expensive and the PME's current budget per meal for protein foods (USD 18 cents) does not cover the actual cost of supplying fresh tilapia to schools (USD 70 cents). A subsidized approach is needed (USD 52 cents) to continue supplying fresh fish as part of the PME.	Opportunities exist for producers and schools to negotiate contracts at wholesale prices by ensuring reliable demand. To improve nutrition, a coordinated effort is needed among all stakeholders (government, donors, development partners, private sector). Stakeholders should come together to discuss possible funding for including fish into school meals regularly.

Table 9. Main challenges faced during the pilot while providing fresh fish to schools as part of the PME and potential solutions.

Lessons learned	
Supply	
Fish farmers may choose to sell their stock to alternative buyers.	Tilapia producers may sell their stock when a suitable opportunity arises. The current high demand and limited supply of fish sometimes cause them to forget their commitments and sell to those offering a better price. Breaks in the PME's provision during the school year influenced opportunistic behavior. This could be addressed by implementing year-round contracts between producers and schools.
Delivery	
The proximity of the school to producers is key.	It is very clear that there is a radius of operability for delivering fresh fish from producers to schools. The team found that a radius with a maximum travel time of about 1.5 hours between producers and schools was manageable. This is because schools have no refrigeration facilities, and cooks need the fish early in the morning. In terms of distance, that depends on road conditions.
The innovative delivery approach was effective.	This innovative system using motorbikes with saddlebags and iceboxes with ice proved to be an effective approach for transporting fresh fish, given the circumstances of the terrain.
Developing contracts with LSPs or delivery drivers is recommended.	Setting clear delivery schedules, including the required time of delivery and school contact in a contract with LSPs, proved a useful approach to ensure a smooth service and minimize late deliveries, which can stress cooks.
Preparation	
Fish bones are a concern, but fish fillets overcome this worry.	School staff and parents have strong concerns about the choking risks of fish bones. The fish fillet recipe was the most popular, as it overcame this fear, and the students liked the texture of the fish a lot. However, this recipe generates a lot of fish waste, so the team encouraged cooks to prepare fish broth to maximize the consumption of nutrients and the use of the whole fish.
Fish fillets generate waste, but fish broth can maximize nutrition.	
Starter kits should also include scales for schools.	School starter kits should also include a set of scales to ensure cooks can weigh fish delivered and keep the supply and delivery systems accountable. This suggests that facilitating trust among actors involved is essential.
Consumption	
Most children like eating fish.	M&E data shows that 98% of 180 children asked "like" eating fish. This indicates that this is a culturally appropriate and acceptable food for children and the PME.
Continued exposure to new flavors and textures can widen children's palates.	In the evaluation, school staff commented on how some children "learned" to eat fish, as this is not part of their regular diet for many of them because Ermera is a landlocked municipality where access to fish is limited. This suggests that to develop an acquired taste and texture may take some time, and it is a very positive outcome of the pilot that young children have been exposed to fish. Fish broth, however, may need longer exposure among students, as many did not like it.
Stakeholder input	
Fish days incentivized school attendance.	During the KIIs, most school staff reported higher student attendance on the days when the meal with fish was served. They also observed its health benefits among students.
Continue the pilot and expand its coverage.	Through several platforms, stakeholders involved in the pilot asked to continue the fish deliveries and expand the coverage in Ermera, as well as in other municipalities where PADTL2 supports producers. This feedback was collected from school staff during the KIIs and from government partners during the National Aquaculture Forum.
Affordability	
Advocate to raise the PME's budget and include fish in meals.	Advocacy efforts are needed to raise the budget of the PME to afford nutritious meals, such as by including fish (government) and to subsidize the cost difference (public–private partnership, development partners, donors, philanthropy).
Impact on nutrition	
Including fresh fish in student meals has a significant impact on their nutrient intakes.	The pilot supplied fish quantities according to the recommendations for preschool students (45 g) and primary school students (60 g). For example, for preschool children aged 3–5 years, consuming a 45-g tilapia fillet contributes 61% of their daily protein needs, 48% of vitamin B12, 35% of iron and 32% of calcium requirements. The nutritional contribution of tilapia to the recommended nutrient intakes of children is outstanding.

Table 10. Main lessons learned during the pilot while providing fresh fish to schools as part of the PME.

Tilapia nutrient content analysis

WorldFish has an agreement with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) laboratory in Brisbane, Australia, through the Nutrition-Sensitive Fisheries Management project. In mid-2023, laboratory analyses were conducted on the nutrient composition of tilapia, whole and fillet only, and other marine fish, as well as fish-based products such as fish powder made with tilapia and flying fish. Nutrient analyses included proximates, minerals and fatty acids. In addition, other commercial laboratories in Australia conducted analyses of vitamin A and vitamin B12. Dr. Jessica Bogard from CSIRO oversaw these analyses in conjunction with laboratory technicians. The PADTL2 project shared some of these results during the National Aquaculture Forum in December 2023.

Findings show that tilapia and fish powder made with tilapia, all pellet-fed, are nutrient-dense foods rich in protein, vitamin B12, iron and calcium (Table 11). Tilapia and fish powder can significantly contribute to the recommended nutrient intake (RNI) of school-aged children, young children, and pregnant and lactating women, as well as women of reproductive age. The RNIs are based on values defined by the World Health Organization (WHO and FAO 2004) and other UN sources. Findings show the percentage that the recommended serving of fresh fish and fish powder can make to the distinct RNIs of preschool children aged 3–5 years old (Table 12) and primary school children aged 6–9 years old (Table 13), as well as for women of reproductive age (Table 14).

	Composition (per 100 g of edible parts)							
Tilapia	**Protein (g)**	**Fat (g)**	**Iron (mg)**	**Zinc (mg)**	**Calcium (mg)**	**Omega 3 DHA+EPA (mg)**	**Vitamin A (ug RAE)**	**Vitamin B12 (ug)**
Whole fish	15.1	6.3	17.6	1.7	1,279	0	nd	6.7
Fillet	20.2	2.3	4.8	0.4	409	29.3	nd	1.2
Fish powder*	38.6	22.3	34.6	5.8	4,400	68.2	217.5	1.1

Note: RAE = retinol activity equivalents; nd = none detected.
**Ingredients: tilapia (approx. 30%), shrimp, sesame seeds, moringa leaves, garlic, red onion, salt, sugar, chili, palm oil, pepper.*

Table 11. Nutrient composition (per 100 g of edible parts) for whole tilapia, tilapia fillet and tilapia fish powder.

	Contribution to nutrient requirements for students 3–5 years olds (45 g of fresh fish or 10 g of fish powder)							
Tilapia	**Protein (%)**	**Fat (%)**	**Iron (%)**	**Zinc (%)**	**Calcium (%)**	**Omega 3 DHA+ EPA (%)**	**Vitamin A (%)**	**Vitamin B12 (%)**
Whole fish	45	6	129	16	102	0	0	275
Fillet	61	2	35	4	32	8	0	48
Fish powder*	26	5	56	13	78	4	5	10

**Ingredients: tilapia (approx. 30%), shrimp, sesame seeds, moringa leaves, garlic, red onion, salt, sugar, chili, palm oil, pepper.*

Table 12. Contribution to the daily requirements (%) for children 3–5 years old from 45 g of fresh fish and 10 g (1 tablespoon) of tilapia fish powder.

	Contribution to nutrient requirements for students 6–9 years olds (60 g of fresh fish or 10 g of fish powder)							
Tilapia	**Protein (%)**	**Fat (%)**	**Iron (%)**	**Zinc (%)**	**Calcium (%)**	**Omega 3 DHA+ EPA (%)**	**Vitamin A (%)**	**Vitamin B12 (%)**
Whole fish	42	7	128	19	114	0	0	244
Fillet	56	3	35	5	36	8	0	43
Fish powder*	18	4	42	11	65	3	4	7

**Ingredients: tilapia (approx. 30%), shrimp, sesame seeds, moringa leaves, garlic, red onion, salt, sugar, chili, palm oil, pepper.*

Table 13. Contribution to the daily requirements (%) for children 6–9 years old from 60 g of fresh fish and 10 g (1 tablespoon) of tilapia fish powder.

	Contribution to nutrient requirements for women of reproductive age (100 g of fresh fish or 20 g of fish powder)							
Tilapia	**Protein (%)**	**Fat (%)**	**Iron (%)**	**Zinc (%)**	**Calcium (%)**	**Omega 3 DHA+ EPA (%)**	**Vitamin A (%)**	**Vitamin B12 (%)**
Whole fish	33	10	60	34	128	0	0	280
Fillet	44	4	16	9	41	12	0	49
Fish powder*	17	7	24	24	89	5	9	9

**Ingredients: tilapia (approx. 30%), shrimp, sesame seeds, moringa leaves, garlic, red onion, salt, sugar, chili, palm oil, pepper.*

Note: The omega-3 levels reported in the tables are lower than initially presented in preliminary presentations. The laboratory reanalyzed the samples in triplicate in May 2024, and these are the final results.

Table 14. Contribution to the daily requirements (%) for women of reproductive age (15–49 years old) from 100 g of fresh fish and 20 g (2 tablespoons) of tilapia fish powder.

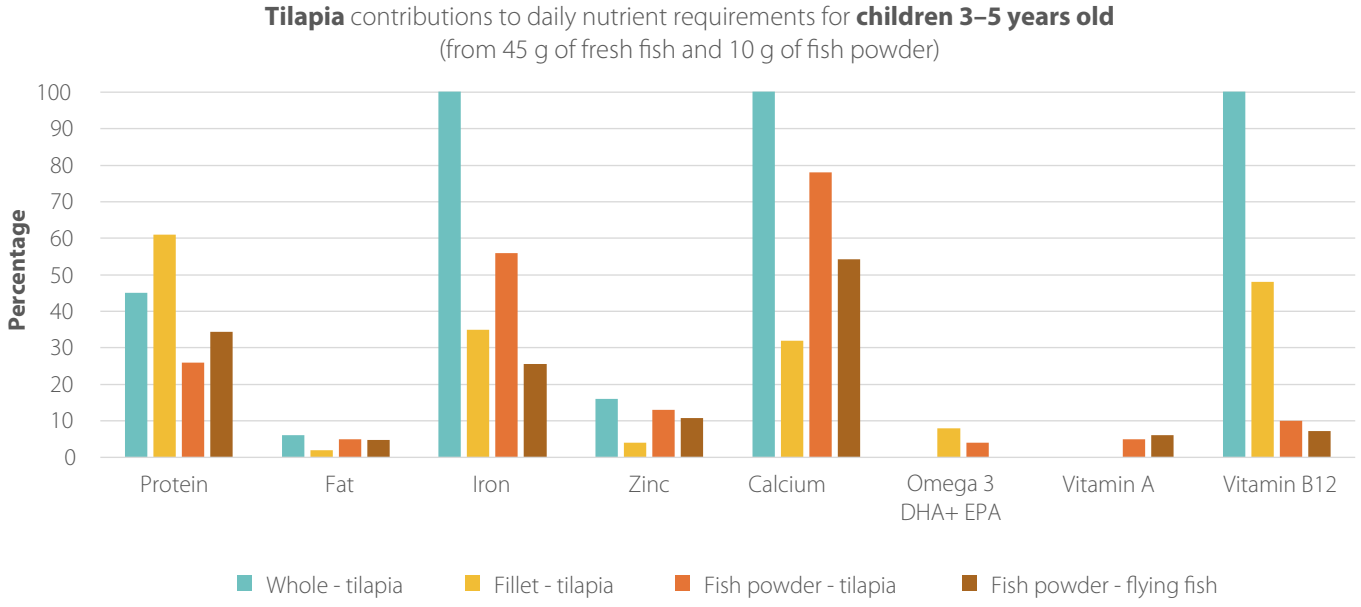
The pilot supplied sufficient tilapia to serve the recommended quantity of fresh fish to preschool (45 g) and primary school (60 g) students (MEYS and MSA 2023). The pilot predominantly offered tilapia fillets, providing a convenient and safe option for children to consume fish. This initiative significantly enhanced the nutritional intake of children, contributing to meeting their RNI.

For example, Figure 10 visualizes the outstanding contribution of tilapia fillets and tilapia fish powder to the daily RNI for preschool children 3–5 years old.

The chart shows that a 45-g tilapia fillet meets 61% of the daily protein needs of children this age, 48% of vitamin B12, 35% of iron and 32% of calcium requirements, with more modest contributions of 8% of omega-3 fatty acids, 4% of zinc and 2% of fat.

For tilapia fish powder, serving one tablespoon, or 10 g, would meet 26% of the daily protein requirements of children aged 3–5 years old, 78% of calcium, 56% of iron, 13% of zinc and 10% of vitamin B12, with more modest contributions of 5% of fat, 5% of vitamin A and 4% of omega-3.

Despite the impressive results from the whole tilapia, the team does not recommend serving it in schools because of widespread concerns about children choking on fish bones.



Note: Contributions are capped at 100% of the RNI.
**Ingredients: tilapia (approx. 30%), shrimp, sesame seeds, moringa leaves, garlic, red onion, salt, sugar, chili, palm oil, pepper.*

Figure 10. Contribution to the daily nutrient requirements (%) for children 3–5 years old from 45 g of fresh tilapia and 10 g (1 tablespoon) of tilapia fish powder.

6. Recommendations

This section provides recommendations to scale up the supply of fish to schools in Timor-Leste.

Scaling up fish supply

Supplying fish to all schools in Timor-Leste is recommended because of its remarkable nutritional benefits, incentives for student attendance and its accumulative long-term benefits. Given the circumstances of most schools in the country, where refrigeration facilities are not yet available, supplying fish as part of the Programa Merenda Eskolár (PME) requires a "mosaic of approaches" and diversified fish products.

Our main recommendation from the pilot is that a "mosaic of approaches"—incorporating fresh fish and a variety of fish-based products tailored to production systems, seasonality, agroecological and sociocultural contexts—is essential for ensuring a consistent supply of fish and fish-based products in the PME across Timor-Leste.

Increasing the availability of fish is a prerequisite for scaling the Fish in Schools Meals pilot in Timor-Leste. Although PADTL2 has developed a successful model for scaling aquaculture, it is essential to implement this model across the country to guarantee a consistent fish supply in the required volume. Furthermore, it is important to complement it by ensuring efficient post-harvest handling and using capture fisheries resources, which vary seasonally.

For schools located close to the coast and to aquaculture producers, it is possible and recommended to scale up the supply of fresh fish. Students have shown a preference and affinity for fish fillets, and this addresses parental concerns over the risks of choking on fish bones. As such, where possible, fresh fish should be provided as part of the PME. However, this option is only applicable to a selection of schools that fit such criteria—those located within a radius of approximately 1.5 hours of travel time from either coastal areas or fish farmers.

For all other schools, those far from the coast and aquaculture producers, which are likely the majority in the country, processed fish-based products, such as dried fish or fish powder, are recommended to scale up the supply of fish to the PME. Safe and convenient to prepare, fish-based products that do not require refrigeration and have a stable shelf life can increase schools' reach in accessing meals containing nutritious fish. Opportunities to produce diversified fish products need to be considered. Given this, exploring models to produce fish powder and other products using marine and farmed fish is strongly recommended.

Fish-based products present further opportunities to scale up the supply of fish to the PME:

- Fish-based products can bridge the gap in situations where fresh fish is not readily available.
- Marine capture fisheries are seasonal, and any surplus beyond fresh consumption can be used for processing, including fish powder.
- Tilapia, when scaled, may also present an opportunity for processing into powder or other products in the future, generating rural employment prospects.
- Food processing is typically a female-led agribusiness activity in Timor-Leste, indicating that this could support nutrition gains and income generation among rural women.
- Fish powder has a grounded texture, overcoming concerns about fish bones, and it is an acceptable food among children. It is currently served as part of the PME in some municipalities by the HATUTAN program, some of which is locally produced by PARCIC (Bonis-Profumo et al. 2023).
- The effectiveness of including a variety of fish products needs to be researched in multiple locations (tilapia farming areas, areas with easy accessibility, remote areas) to develop recommendations for incorporating fresh fish or diverse fish-based products into the school meal program.

Key recommendations

As stated, the key recommendation from the pilot is that a "mosaic of approaches" and diversified fish-based products according to geography and production systems are required to supply fish as part of the PME in Timor-Leste.

Additionally, scaling up fish provision to all schools requires the following:

- Coordinate efforts between the government, development partners, donors and the private sector.
- Increase fish supply, including aquaculture tilapia, through public–private partnership enterprises.
- Replicate a refined pilot in another municipality to apply the lessons learned and validate the model.
- Conduct a study to assess the feasibility of incorporating fresh fish and fish powder in school meals across diverse agroecological and geographical contexts in Timor-Leste.
- Explore models to produce fish powder and other unrefrigerated fish-based products using marine and farmed fish.
- Connect producers to schools and support the development and formalization of contracts.
- Leverage the PME budget by advocating for a rise in food allocation by the government to afford nutritious foods, such fish.
- Explore approaches to subsidize the cost difference with the PME's budget to include fish in school meals by (i) promoting public–private partnerships with technical assistance from development partners or (ii) appealing to philanthropic contributions from large private companies as part of their corporate social responsibility.
- Strengthen fish demand in schools and communities using SBC strategies and materials.

This pilot study has confirmed that incorporating locally produced fresh tilapia into school lunches can be a successful initiative, especially in schools situated near fish farming areas, and it has been positively received by children and other stakeholders. However, ensuring a consistent supply of fresh fish in all locations throughout the year may be challenging. Therefore, it is also important to explore alternative approaches and types of fish products, such as fish powder, to cater to schools with limited accessibility and areas unsuitable for fish farming.

The nutritional gains generated from the supply of fish to schools cannot be overstated in the Timorese context. Fish has a big part to play in realizing a more nutritious PME in the country.

Representatives from MFAT and USAID, along with Ermera municipal authorities, attend the pilot launch at the preschool in Gleno.

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Annex 1. Fish cookbook and other social and behavior change components

As part of the PADTL2 project, Mercy Corps developed an SBC strategy aimed at guiding fish consumption behaviors with target audiences by developing multiplatform communication materials that promote key nutrition and hygiene messages.

A key SBC material developed for use in the Fish in School Meals pilot is a fish recipe book.

Fish cookbook

The Fish Improving Nutrition Cookbook features creative, local fish recipes. This recipe book includes nutrition information on a balanced diet and the benefits of consuming fish throughout the life cycle, as well as hygiene messages and adequate fish handling.

This cookbook has been produced as part of the PADTL2 project in collaboration with Mercy Corps and the Ministry of Health. The cookbook features 12 culturally grounded and nutritious tilapia recipes, encouraging greater fish consumption. It is the first of its kind in Timor-Leste. The cookbook's aim is to promote increased fish consumption by educating people about the benefits of fish and encouraging regular fish consumption in households, school meal programs and hospitals through delicious recipes using local ingredients. Eating fish, which is rich in protein and vital nutrients for health and child development, can boost local economies when sourced from nearby fish farmers and fishers. The recipes are easy to follow, with step-by-step photos and ingredient quantities provided for families (5–10 people) and public institutions (25, 50 and 100 people) (Figure 11).

Figure 11. Example of a fish recipe using a step-by-step visual approach.

Cookbook development

The process of developing communication products has been undertaken with rigor and care to produce high-quality and well-contextualized SBC materials.

Mercy Corps partnered with the ETDA to design 10 simple yet creative recipes that use tilapia as the main ingredient to promote fish consumption. These new recipes, along with two popular fish recipes used under previous programs (dried fish flakes and a fish porridge targeted for young children) are featured in the Fish Improving Nutrition Cookbook. The cookbook reinforces the same messages used throughout the program's SBC package and focuses on the benefits of fish and reasons to include fish in school or hospitals meals and in family meals.

Cookbook field test

Ten pilot tests of the Fish Improving Nutrition Cookbook were conducted in the four PADTL2 municipalities to validate recipe acceptance with selected farmer clusters, schools and hospitals. The recipes were piloted with 66 people (53 females, 13 males), such as school cooks from 12 schools in three municipalities (Baucau, Bobonaro and Ermera), caterers for three hospitals, including one municipal hospital in Ermera and two referral hospitals in Baucau and Bobonaro, and two village savings and loan association (VSLA) groups from Lautem.

The pilot tests focused on comprehension of the content, acceptance and relevance to meals they prepare every day, motivation to practice the promoted behaviors, and what needs to be improved in the cookbook. Adaptations were made to the cookbook based on the feedback, and then the cookbook was retested.

Of all of the participants, only four mentioned that they know of people in their community that have used a cookbook. Most participants indicated that "all the recipes they know are in their minds." Schools and hospital meal providers mentioned they are provided with the menu (ingredients to cook), and they determine what to make with it. Often they were not the ones purchasing the foods. Those involved in the field test were extremely interested in the cookbook. They made suggestions for recipe substitutions, and without being asked or prompted spoke of wanting to try these recipes in their homes. Based on the feedback, the cookbook is now in final form.

Testing the cookbook with school cooks from four different schools in Baucau: SDK Bercoli, EBF Bercoli, and EBC Bercoli. Fish salad. Baucau Municipality, April 14, 2023.

Additional social and behavior change strategy components

The SBC strategy had four target audiences and five key behaviors promoted through a multichannel approach and multiple custom-made materials. Some of the materials of the SBC package reached producers and may have reached communities in Ermera prior to the beginning of the pilot.

Primary audiences

The four primary audiences identified for the SBC intervention are (1) aquaculture farming family members (fish farmers)–members of VSLAs, (2) pregnant and lactating women with children under 5 years old as part of fish farming families, (3) buyers for schools (school cooks, those buying for the school meal) and (4) hospitals, including vendors or restaurants providing catering for meals.

Key behaviors promoted

1. Incorporate fish into family meals at least two times per week.
2. Parents pick bones out of fish for small children and start offering fish to infants at 6 months of age.
3. Saving groups save with the purpose of purchasing aquaculture inputs for fish farming.
4. Fish are consumed at the household level before sale.
5. Couples initiate conversations on a weekly basis about how to allocate resources for aquaculture inputs as well as weekly protein purchases.

The social and behavior change strategy package included

Social and behavior change materials

Fish Improving Nutrition (FIN) Flipbook

The FIN Flipbook promotes fish consumption, builds fish deboning and budgeting skills, and includes four interactive lessons: (1) nutrition, (2) importance of protein and the benefits of consuming fish, (3) gender awareness and resource allocation, (4) fish handling, hygiene and a cooking demonstration.

Reality style video

The reality style interactive video focused on household decision-making regarding protein consumption, specifically fish, nutrition and dietary diversity. This innovative and engaging video has a choose-your-own ending, as well as real footage and animation.

Lafaek Magazine

A fish promotion (right), targeting young children and pregnant and lactating women, was conducted through the Lafaek Community Magazine. National dissemination through Lafaek started in February 2023 and reached approximately 50% of households in Timor-Leste. Printed as a banner for World Food Day events, an additional two pages displayed two tilapia-based recipes that were published in the September 2023 edition of the Lafaek Community Magazine.

Radio drama

A radio drama was designed based on the storyline of the reality style video promoting fish consumption, and it reinforces key messages in the FIN Flipbook. The drama focuses on common barriers communities face when making decisions on fish consumption to include cost, fear of young children choking and the influence of mothers-in-law.

Nutrition sessions with tilapia farmers and community members

VSLAs are an entry point for activities at the household level with fish farming families. Each VSLA is composed of fish farmers (list provided by WorldFish) and other community members (men with children under 5 years old, pregnant and lactating women) to assure VSLAs include 15 members. Interested fish farmers are prioritized as members of the VSLA.

VSLA formation and training including a facilitated interactive video

Since September 2022, Mercy Corps and WorldFish have established 39 VSLAs with 674 members (57% females) in four municipalities. Up to April 2023, facilitators have run most lessons for all VSLAs. The training participants were enthusiastic and gave positive feedback, saying that this training is important to their families, particularly for their children and family members. Participants include those from 283 fish farmer households (183 from WorldFish-supported households and an additional 100 households that have fishponds).

Food fairs to reach the broader population

World Food Day Events

Through coordination with the National Directorate of Food Security and the National Council for Food Security, Sovereignty and Nutrition, the program supported World Food Day events in three municipalities: Ermera, Bobonaro and Lautem. More than 655 people (362 females and 293 males) attended. The main activities were to promote fish consumption through cooking competitions and the local food fair/expo, which included a display of information and education materials from various implementing partners focused on nutrition and food security.

Photo credit: Gianna Bonis Profumo/WorldFish

Cooking competition using fresh tilapia at the World Food Day 2023 event in Balibo, Bobonaro.

Annex 2. Pilot communication products

List of media products and publications associated with the pilot:

1. Blog – "Fish in School Meals: A nutritious initiative for children in Timor-Leste." August 9, 2023. https://worldfishcenter.org/blog/fish-school-meals-nutritious-initiative-children-timor-leste

1. Video – TOT school cooks: "Nutritious fish for kids: School cooks in Timor-Leste master tilapia cooking." August 28, 2023. https://www.youtube.com/watch?v=zmoyGwuuw1o&ab_channel=WorldFish

1. Video – Pilot launch: "Nourishing students: Fish in School Meals pilot launched in Timor-Leste." September 27, 2023. https://www.youtube.com/watch?v=llap97Wueb0&ab_channel=WorldFish

2. Video – Pond to plate, December 18, 2023.
   - "From pond to plate: Fish in School Meals pilot in Timor-Leste" (English) https://www.youtube.com/watch?v=l0fAwNWsx6E&ab_channel=WorldFish
   - "Hosi kolan to'o bikan: Pilotu Ikan iha Merenda Eskolar iha Timor-Leste" (Tetum) https://www.youtube.com/watch?v=4LxcdytVi3U&ab_channel=WorldFish

3. Fish cookbook, 2023.
   - Fish Improving Nutrition Cookbook (English) https://digitalarchive.worldfishcenter.org/handle/20.500.12348/5658
   - Livru Te'in ba Ikan Hadi'ak Nutrisaun (Tetum) https://digitalarchive.worldfishcenter.org/handle/20.500.12348/5659

4. Program brief, 2023
   - Bonis-Profumo G, Hunnam K, Duarte A, Pinto A, Das Dores Faria Simões N, Martins J, Monteiro M, Deolinda Marques E, da Cunha Barreto C, de Sousa A, Soares Z, Hayashi T, Saha S, Klumpyan K, Soriano A, Pant J and Eriksson H. 2023. Fish and fish-based products in Timor-Leste's school meal program: Understanding existing use, challenges, opportunities and research needs. Penang, Malaysia: WorldFish. Program brief. https://digitalarchive.worldfishcenter.org/handle/20.500.12348/5715

List of additional media products associated with the nutrition component of PADTL2:

1. PADTL2 Nutrition Baseline Survey, 2022. https://hdl.handle.net/20.500.12348/5293

2. Blog – "Building knowledge of nutrition benefits of aquatic foods in Timor-Leste." April 21, 2023. https://worldfishcenter.org/blog/building-knowledge-nutrition-benefits-aquatic-foods-timor-leste

3. Fish Improving Nutrition Flipbook "Ikan Hadi'ak Nutrisaun" (Tetum), 2022. https://hdl.handle.net/20.500.12348/5479

4. Video – Reality style interactive video on the nutrition benefits of fish (Tetum), March 14, 2023. https://www.youtube.com/watch?v=fxRUJSAFG9w

5. Lafaek Magazine (Tetum), 2022.

6. Eat fish for good health poster "Han ikan di'ak ba saúde." (Tetum) https://hdl.handle.net/20.500.12348/5480

(Note: Only materials available through electronic links have been provided.)

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