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Diet quality and aquatic food consumption in Timor-Leste: A scoping review

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Diet quality and aquatic food consumption in Timor-Leste: A scoping review

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1. Background

The first 1000 days of life are an opportune period to break the cycle of malnutrition. It is during this time that important foundations for lifelong health are built (Black et al. 2013). In Timor-Leste, malnutrition, particularly among and women of reproductive age (WRA) and children, remains a major public health challenge (Democratic Republic of Timor-Leste 2022). The prevalence of stunting is one of the highest in the world, and infant and young child feeding practices are unsatisfactory (Democratic Republic of Timor-Leste 2022). Although there have been some improvements in maternal undernutrition, there has been a significant increase in overweight and obesity among women (Democratic Republic of Timor-Leste 2022). Although the 2020 National Food and Nutrition Survey assessed diet quality among women and children (Democratic Republic of Timor-Leste 2022), it is unclear how other studies in the country have assessed diet and what important insights these additional studies may provide.

Animal-sourced foods, including aquatic foods (AFs), are rich sources of nutrients that are essential for growth and development. For Timor-Leste, they offer an opportunity to reduce the burden of malnutrition in the country. However, the most comprehensive survey of AF consumption across five municipalities is over a decade old and points toward low consumption rates (AMSAT International 2011).

WorldFish and the Commonwealth Scientific and Industrial Research Organization (CSIRO), with support from the Directorate General of Fisheries, Aquaculture and Marine Resources of the Timor-Leste Government, have undertaken a research project that takes a nutrition-sensitive approach to fisheries management in Timor-Leste ([ACIAR] Australian Centre for International Agricultural Research 2021). One of the objectives of the study is to assess the consumption of AFs and their potential to reduce undernutrition, particularly among women and children in the first 1000 days of life. But to support this objective, a better understanding of existing efforts to assess diet quality and AF consumption in Timor-Leste is required.

The aim of this scoping review was to better understand the assessment profile of diet quality and AF consumption in Timor-Leste. It has four objectives: (1) understand the extent and range of methods used to assess diet, particularly AF consumption, (2) identify any relevant gaps in assessment, (3) provide an overview of diet quality and AF consumption and (4) provide an overview of knowledge and attitudes in relation to AF consumption.

Vegetable stall in Dili, Timor-Leste.

2. Methods

We reviewed the peer-reviewed and grey literature on the topic based on an existing repository of resources developed by WorldFish and an additional search conducted via Google Scholar and Web of Science. We also sought secondary data for more detailed analysis of existing nationally representative surveys, though these were unavailable. Studies conducted among a sample size greater than 50, using a clear methodology, were included. The time period for inclusion was the previous 5 years for general dietary studies and the previous 15 years for AF consumption studies, since there are far fewer studies.

We present summary information from the most recent reports for intervention studies where food and/or AF consumption was assessed at several time points, such as baseline, midline or endline. Information on the population surveyed, assessment method and recall period were extracted and recorded. A meta-analysis of findings was not possible, given the limited data available and lack of comparability across studies.

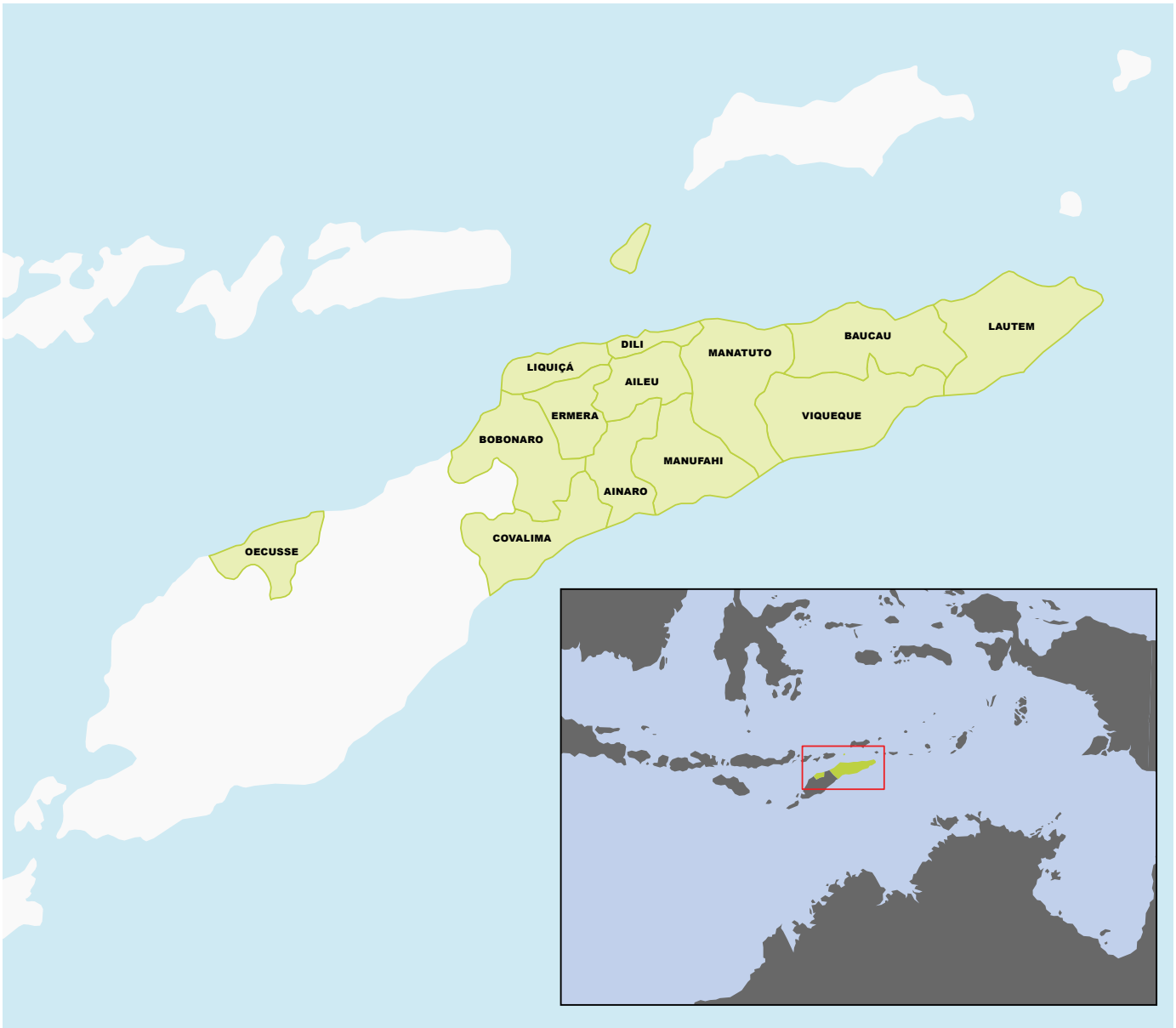

Figure 1. Map of Timor-Leste and its municipalities.

3. Findings

3.1. Dietary assessment

Dietary intake was assessed in 13 studies in Timor-Leste, from 2018 to the time of the review. Twelve of these studies assessed diet qualitatively, using population-level indicators for micronutrient adequacy—predominantly the Minimum Dietary Diversity for Women of Reproductive Age (MDD-W) and the Minimum Dietary Diversity for Infants and Young Children (MDD-IYC) aged 6 to 23 months, with two studies measuring the Household Dietary Diversity Score (HDDS). A comparison of these different scores and the food groups included in each is available in Appendix 1.

Five of these studies disaggregated the food group categories from the dietary diversity recalls to assess intakes of animal-source foods. No studies were identified that assessed dietary intake quantitatively. The most comprehensive assessment of dietary diversity was conducted as part of the nationally representative Timor-Leste Food and Nutrition Survey (TLFNS) in 2020 among nearly 13,000 households (Democratic Republic of Timor-Leste 2022). Most other studies that assessed dietary diversity had relatively small sample sizes, apart from the World Vision study, which was conducted in 2,129 households across four districts (World Vision 2023). Around half of the studies that assessed dietary diversity did so in relation to a program outcome, highlighting the importance of tools such as the MDD-W and MDD-IYC in the inexpensive and practical collection and analysis of dietary data. Although these are validated measures of micronutrient adequacy ([FAO] Food and Agriculture Organization and FHI360 2016), there may be differences between methods used that can hamper comparability of findings, such as food items included, food items aggregated, number of food groups and the cutoff points indicating a minimally diverse diet.

Initially for infants and young children, consumption of four out of seven food groups indicated that the minimum dietary diversity (MDD) was met. However, in 2017 the World Health Organization (WHO) revised the cutoffs to five out of eight food groups ([WHO] World Health Organization 2017). Additional limitations of these tools include respondent bias. This could result in reporting desirable intakes and only providing a snapshot of intakes over one day, which may not be representative of usual intake, especially given the varying climatic seasons in which dietary intake was assessed. One of the studies was a midline assessment of a program to improve nutrition, so the programmatic effects may not truly reflect current consumption levels (TOMAK 2021).

Five studies assessed food insecurity using the Food Insecurity Experience Scale (Ballard et al. 2013), two studies used the Household Hunger Scale (Ballard et al. 2011), and three studies assessed food consumption using the Food Consumption Score ([WFP] United Nations World Food Program 2008). Other aspects of diet assessed included school feeding practices, consumption of nutrient-rich foods, eating habits and meal frequency. Five studies reported the minimum acceptable diet (MAD), a composite indicator calculating the proportion of infants (6–23 months of age) that consumed both the minimum dietary diversity and the minimum meal frequency ([WHO] World Health Organization and [UNICEF] United Nations Children's Fund 2010). The majority of studies assessed diet in four municipalities, with only one national study assessing dietary intakes included in this report (Democratic Republic of Timor-Leste 2022). A methodological overview of studies assessing diet diversity in Timor-Leste is provided as this was the predominant dietary assessment method used (Table 1).

Local fruits, vegetables and eggs sold in a market in Lautem.

Study details	Sample size, population and geographic location	Measure of consumption					Target group					Recall period		
		Diversity	Frequency	ASF	Food insecurity	Other	Household	WRA	Infants (6–23 m)	Children (2–5 y)	Other	24 hours	7 days	Other
CARE International 2023	741 intervention households 602 control households	✓						✓	✓			✓		
HATUTAN program (2018–2023): Endline evaluation 2023	Ainaro, Ermera, Liquiça, Manatuto (intervention), Aileu, Bobonaro, Covalima, Manufahi (control)					✓					✓			
WorldFish 2022	189 intervention households 93 control households	✓						✓	✓			✓		
PADTL2 aquaculture project (2020–2024): Baseline survey 2022	279 WRA 43 infants			✓			✓	✓	✓				✓	✓
	Baucau, Bobonaro, Ermera, Lautem				✓		✓							✓
Tilley et al. in press	758 households 577 WRA	✓						✓	✓			✓		
RCT on FADs and SBC 2021–2022[*]	133 infants			✓			✓						✓	
	Bobonaro, Covalima, Dili, Liquiça, Manatuto, Manufahi				✓		✓							✓
Bonis-Profumo et al. 2021a, 2021b, 2022	161 mother-child (12–59 months) pairs			✓				✓	✓	✓		✓	✓	
	156 mother-child (12–59 months) pairs	✓						✓	✓	✓		✓		
	167 mother-child (6–59 months) pairs	✓		✓				✓	✓	✓		✓		
			✓						✓	✓		✓		
	Baucau, Viqueque (all studies)				✓									✓
Guizzo Dri et al. 2022	98 households	✓						✓				✓		
	Manatuto, Viqueque													
World Vision 2023	1,542 intervention households 587 control households	✓						✓	✓	✓		✓		
Better Food, Better Health project (2017–2022): Endline report 2021–2022	2,182 WRA 1,762 children (6–59 months)					✓		✓	✓	✓		✓		
	Aileu, Baucau, Bobonaro, Covalima													
TOMAK 2021	986 WRA 240 intervention infants	✓						✓	✓			✓		
TOMAK program phase 1 (2016–2022): Midline evaluation 2020	240 control infants	✓	✓				✓						✓	
	Baucau, Bobonaro, Viqueque				✓		✓							✓
TLFNS 2022	12,881 households 13,370 WRA	✓						✓	✓			✓		
Food and Nutrition Survey 2020	11,246 infants	✓	✓				✓						✓	
					✓		✓							✓
	All districts					✓		✓	✓			✓		
USAID 2020	306 households 298 WRA	✓						✓						✓
Avansa Agrikultura project (2015–2020): Endline survey 2020	86 infants	✓							✓			✓		
	Aileu, Ainaro, Bobonaro, Dili, Ermera, Liquiça				✓		✓							✓
Bonis-Profumo and Meyanathan 2018	96 adolescents (10–19 years)	✓	✓	✓							✓		✓	
Adolescent nutrition 2018	Baucau, Bobonaro, Dili, Ermera													
Spencer et al. 2018	190 households	✓					✓					✓		
	Manatuto, Viqueque													
Wong et al. 2018	203 households 197 WRA	✓		✓				✓	✓			✓		
	147 infants Aileu, Bobonaro, Lautem													
de Paulo Correia et al. 2018	415 household farmers (60% male) Intervention adopters and non-adopters	✓						✓			✓	✓		
			✓			✓			✓	✓				✓
Conservation agriculture impact 2018	Ermera, Manufahi					✓	✓							✓
Total studies out of 13		**13**	**5**	**5**	**6**	**4**	**7**	**11**	**10**	**3**	**3**	**12**	**6**	**7**

Note: ASF = animal-source foods; WRA = women of reproductive age. We provide the date of data collection for projects/programs, study reports and national surveys, and the year of publication for peer-reviewed publications. Nationally representative surveys are shown in bold.

[*]*Data were provided by the study author (not published in the paper).*

Table 1. Summary of studies and methods used to assess diet quality in Timor-Leste (2018–2023).

3.2. Diet diversity findings

3.2.1. Minimum Dietary Diversity for Infants and Young Children (MDD-IYC)

Evidence points toward very low dietary diversity among infants in Timor-Leste. The TLFNS in 2020 applied the more recent MDD-IYC cutoffs and reported that over one-third (35%) of infants met the MDD (Democratic Republic of Timor-Leste 2022). There were higher proportions of infants whose mothers had at least a secondary education (28%) and those from the highest income quintile (45%), which meet the MDD-IYC, compared with those with lower education (18%) and from lower income backgrounds (30%). However, similar proportions of infants from rural (24%) and urban (22%) districts met the MDD-IYC (Democratic Republic of Timor-Leste 2022). A recent survey of rural inland communities in six districts showed a comparable proportion meeting the MDD-IYC (27%) (Tilley et al. (in press)). A midline evaluation of the TOMAK program, which aimed to improve nutrition, indicated that a similar proportion (28%) of their control group met the MDD-IYC (TOMAK 2021). This was higher than that reported in their baseline report (16%) (TOMAK 2018), even after re-estimating the baseline MDD using the revised WHO cutoffs (11%) (TOMAK 2021). Perhaps promisingly, a higher proportion (35%) of those involved in the nutrition education component of this program met the MDD-IYC at midline (TOMAK 2021).

The TOMAK (2018) baseline report showed that only 16% of infants met the MDD with even smaller proportions of infants from Baucau (13%) and Viqueque (10%), respectively, meeting the MDD-IYC. Similar figures were reported elsewhere, with 16% of infants 6–23 months old in Baucau and Viqueque (Bonis-Profumo et al. 2021a), and 11% in Baucau (World Vision 2018), meeting the MDD. That said, the latter survey found concerning findings in Aileu and Covalima, where only 2% met the MDD-IYC in both districts (World Vision 2018).

This same survey also analyzed the MDD-IYC among infants and children between the ages of 6–59 months to include breastmilk in the dairy food group. The results indicated higher proportions meeting the MDD-IYC: 16% in Aileu, 15% in Baucau, 11% in Bobonaro and 4% in Covalima (World Vision 2018).

Recent studies reported a mean dietary diversity score (DDS) of only 2.4 among children between the ages of 6–59 months in Viqueque and Baucau, with only a slightly higher mean (2.5) among children in coastal areas (Bonis-Profumo et al. 2021a; Bonis-Profumo et al. 2021b). Even lower scores (1.9) were reported among intervention groups in the endline evaluation of the HATUTAN program, which found little difference from baseline to endline (CARE International and Consilient 2023). However, results from a World Vision project show improvements in 0.3 food groups in the DDS for children aged 6–59 months in the project area, after controlling at endline for changes in control areas (World Vision 2023).

3.2.2. Minimum Dietary Diversity for Women (MDD-W)

Slightly more promising were the findings from the recent TLFNS 2020 survey in which 65% of mothers nationally met the MDD-W (Democratic Republic of Timor-Leste 2022). Despite this, there is still an opportunity to improve these proportions, especially among mothers from the districts of Manatuto (45%) and Baucau (50%), those in rural areas (58%) and those from the lowest income quintile (50%) (Democratic Republic of Timor-Leste 2022). The same year, a survey conducted among 306 households across six districts found high mean DDS among women in program evaluations (6.8 out of 10 at baseline and 7.5 out of 10 at endline) (USAID 2020).

However, findings from other studies are of concern. A couple of surveys report less than 10% of women meeting the MDD-W (Bonis-Profumo et al. 2021a; de Paulo Correia et al. 2018), while a recent survey of inland communities had even more concerning figures (4.3%) (Tilley et al. (in press)). The TOMAK baseline report also found a low proportion meeting the MDD-W (15%) (TOMAK 2018).

The proportion of women who reported eating four to eight food groups declined following the HATUTAN program to improve nutrition (33% at baseline and 18% at midline). This decline was consistent across both control and intervention groups and did not show improvements at endline (CARE International and Consilient 2023). This suggests that the program had no impact on dietary diversity for women in intervention areas. Although this could indicate poor nutrition practices, it could also be an effect of the "hungry season" or limitations to financial access to purchase food during the COVID-19 pandemic (CARE International

and Consilient 2021). It could also indicate that the MDD-W may not be sensitive to other dietary improvements such as frequency or quantity of healthy foods consumption. Overall, most mothers consumed three (47%) to four (21%) food groups the previous day at baseline and only two (35%) to three (37%) food groups at midline (CARE International and Consilient 2021), a trend that continued to endline (CARE International and Consilient 2023). On the contrary, the TOMAK midline evaluation showed promising improvements from baseline, with the proportion of mothers meeting the MDD-W increasing from 16% to 49%, even to 45% among the control group (TOMAK 2021).

3.2.3. Household Dietary Diversity Score (HDDS)

The limited evidence available suggests low HDDSs in Timor-Leste. Most recently, one study found mean HDDS of just 2.8 out of 9 food groups (3 in Manatuto and 2.7 in Viqueque) (Spencer et al. 2018). The most recent data indicates seasonal differences in household diet diversity in Natarbora, with only 22% reporting consumption of five or more food groups out of nine post-rainy season and 41% reporting the same amount post-harvest (Guizzo Dri et al. 2022).

3.3. Assessment of aquatic food consumption

Table 2 outlines 13 studies that have assessed AF consumption in Timor-Leste over the past 15 years, including four nationally representative studies. Five were dietary diversity studies, which then disaggregated the animal-source foods group to present data on consumption of AFs.

Of the 13 studies, five show whether or not the individual ate aquatic foods within a certain timeframe, six provide information on the frequency of consumption and five on the quantity consumed among different groups. Other qualitative methods to assess consumption include two studies that used food piles and focus group discussions. One study specified household expenditure on AFs, while three assessed the species or type of AF consumed.

In terms of geographic coverage and study size, five studies were nationally representative but were limited in other aspects of their scope and methodology ([GDS] General Directorate of Statistics et al. 2018; Democratic Republic of Timor-Leste 2015; 2022; National Statistics Directorate 2012). The TLFNS 2020 study did not disaggregate AFs from other animal-sourced foods in their results, the DHS was only among infants aged 6–23 months and the TLFNS 2013 presented consumption frequency at the household level with no data on individual patterns. The next largest studies were the AMSAT study conducted in five districts among 820 households and a randomized controlled trial in six districts among 758 households as well as two program evaluation surveys among 415–580 households. The rest of the studies either had small sample sizes under 300 or were conducted in two to four districts.

Among the studies that estimated quantities of AFs consumed, three measured consumption at the household level (Tilley et al. (in press)), including two nationally representative surveys (HIES and TLSLS) (National Statistics Directorate 2012), and two measured consumption at the individual level using semi-quantitative food frequency questionnaires in four-six municipalities (AMSAT International 2011; Bonis-Profumo et al. 2022). In terms of target groups, seven studies assessed consumption patterns among households, five for WRA, five for infants aged 6–23 months and one for children aged 24–59 months. One study examined consumption practices among adolescents (Bonis-Profumo and Meyanathan 2018). No studies examined practices specifically among pregnant or lactating women.

In terms of recall period, seven studies examined consumption practices in the previous 7 days, while six did so for the previous 24 hours, again posing challenges for comparability of findings. Assessing consumption in the previous 24 hours reduces respondent recall bias but is likely to underestimate true AF consumption if they are eaten weekly rather than daily, particularly with small sample sizes. Recent work by WorldFish indicates that short recall periods, such as 1 day or 1 week, are likely to underestimate the contribution of AFs sourced from gleaning activities, which are done according to moon and tide cycles (Bogard et al. 2023).

The categories of AFs assessed varied from broad categorization (e.g. aquatic foods), to slightly more specific (e.g. fish or seafood), types (e.g. freshwater, marine, dried, processed or canned) and species (Table 2 and Appendix 2). This poses further challenges for comparing findings where, for example, some studies specifically assessed fish consumption while others examined consumption of AFs more broadly.

3.4. Aquatic food consumption findings

The limited information available on AF consumption in Timor-Leste indicates low consumption among populations studied. Studies among inland communities found significant differences in fish consumption among fish farming and rural non-coastal villages (average 11.8kg and 6.5kg/year, respectively) (Bonis-Profumo et al. 2022; Tilley et al. (in press)). Annual per capita fish consumption was estimated at 6.1 kg nationally (16.7 g daily), 17.6 kg in coastal areas (48.2 g daily) and 4 kg in noncoastal areas (11 g daily) in 2011 (AMSAT International 2011). Two nationally representative studies have also measured household-level consumption quantitatively. In 2011, the HIES reported an annual average of 6.2 kg (9.4 kg in urban areas and 5.2 kg in rural areas), while in 2007 the TLSLS reported 8.3 kg (National Statistics Directorate 2012). These results are relatively consistent with supply data from 2017 of 7.7 kg ([FAO] Food and Agriculture Organization 2017) (Table 2).

3.4.1. Infants and children

The only nationally representative data on AF consumption among infants is from DHS 2016, which found that 14% of breastfed and 21% of non-breastfed infants consumed AFs in the previous 24 hours ([GDS] General Directorate of Statistics et al. 2018). The proportion of consumers was higher among infants aged 12–23 months compared with infants aged 6–11 months. Unfortunately, data from the nationally representative TLFNSs (2020 and 2013), which measure dietary diversity among infants, do not disaggregate AFs from flesh foods.

Consumption patterns in rural inland communities appear to be lower than national averages. Recent data from a study assessing fish consumption among infants in the previous 24 hours indicates that very few infants from rural inland communities consume fresh (7%) or tinned fish (2%) (Tilley et al. (in press)). Similar results were found in a recent baseline survey among aquaculture farmers, where 10% of infants aged 6–23 months consumed any fish during the previous day (Bonis-Profumo et al. 2022). Similarly, in the TOMAK study 9%–10% of children had eaten fish or seafood in the previous 24 hours. In a survey of coastal and mid-altitude communities, only 14% of infants aged 6–23 months had eaten fish during the dry season and only 6% of children 1–5 years old had consumed AFs (Bonis-Profumo et al. 2022; Bonis-Profumo et al. 2021a). The different findings could be due to the various types of fish assessed and methodologies used.

3.4.2. Adolescents

There is a paucity of information on fish consumption among adolescents. Formative research in four districts indicated that adolescents in some areas may be consuming fish two to three times per week (Bonis-Profumo and Meyanathan 2018). In urban Baucau, for example, fresh fish was the most consumed protein food, as many reported consuming fish two or three times weekly. Similarly, fish was considered the main protein source among surveyed adolescents in coastal Atabae (Bobonaro). In Dili, fish consumption appeared slightly lower, as many ate fish one or two times per week. Those from rural areas perceived fish as a prized commodity and a means of supplementing diets. Adolescents from these areas ate fish only two or three times per month, from either household ponds or nearby rivers.

3.4.3. Women

The most comprehensive study on AF consumption among women was the AMSAT study in 2011, which studied 820 women across five districts. The study measured average annual consumption among women and extrapolated these values to 6.1 kg nationally (16.7 g daily) and 17.6 kg in coastal areas (48.2 g daily) (AMSAT International 2011). This study also measured frequency of AF consumption, though the report presents this data together with meat consumption data.

More recent surveys examining AF consumption over the previous 24 hours indicate that only 9% of women had eaten AFs (Bonis-Profumo et al. 2022) and 15% had done so during the dry season (Bonis-Profumo et al. 2021a). These results are consistent with the TOMAK baseline survey, which found that 11%–16% of women had consumed fish or seafood in the previous 24 hours (TOMAK 2018). However, a 2022 baseline survey found that 26% of WRA from aquaculture farming households had eaten fish the previous day, suggesting that greater availability and access may lead to

Study details	Sample size, population and geographic location	Measure of consumption				Target group					Recall period			Key findings*
		Quantity	Frequency	Yes/No consumption	Other	Household	WRA	Infants (6–23 m)	Children (2–5 y)	Other	24 hours	7 days	Other	
WorldFish 2022 *PADTL2 Aquaculture project (2020–2024): Baseline survey 2022*	189 intervention households 93 control households 279 WRA 43 infants Baucau, Bobonaro, Ermera, Lautem	✓	✓	✓	✓		✓	✓			✓		✓	Annual consumption of cooked fish per capita, on average once a week, was 11.8 kg for WRA and 2.6 kg for infants.
			✓	✓	✓	✓						✓		Household fish consumption in the previous week was 33.3% for the intervention group and 22.6% for control.
Tilley et al. in press *RCT on FADs and SBC 2021–2022***	758 households 577 WRA 133 infants Bobonaro, Covalima, Dili, Liquiça, Manatuto, Manufahi	✓		✓	✓	✓						✓		Annual consumption of purchased fish per capita among household members was 4.3 kg at baseline and 6.5 kg at endline.
				✓	✓			✓			✓			9% of infants consumed fish (7% fresh, 2% tinned) in the previous 24 hours.
Bonis-Profumo et al. 2021a and 2022	161 mother-child pairs			✓			✓			✓	✓	✓		8.7% of WRA and 5.6% of children consumed AFs in the previous 24 hours and 35%–39% overall the previous week.
	167 mother-child pairs Baucau, Viqueque (all studies)			✓			✓	✓	✓	✓	✓			16.9%–19.9% of children and WRA consumed fish during the wet season and 6.3%–7.6% in the early dry season.
Tilley et al. 2020	32 women fishers (21–66 years) Ataura, Baucau, Bobonaro, Dili, Lautem, Viqueque				✓		✓						✓	Among women, 71% of gleaning trips were for consumption, 14% for income and 14% for both, with shelled mollusks and fish the most numerous species caught.
TOMAK 2018 *TOMAK program Phase 1 (2016–2022): Baseline study 2017*	580 households 240 WRA 240 infants		✓				✓	✓			✓			11%–16% of WRA and 9%–10% of infants consumed fish, shellfish or seafood in the previous 24 hours.
	Baucau, Bobonaro, Viqueque		✓			✓						✓		36% of households consumed fish, shellfish or seafood twice weekly, on average.
de Paulo Correia et al. 2018 *Conservation agriculture impact 2018*	415 household farmers (60% male) Ermera, Manufahi			✓						✓	✓	✓		6% of farmers consumed fish in the previous 24 hours and 49% during the previous week.[b]
Bonis-Profumo and Meyanathan 2018 *Adolescents nutrition 2018*	96 adolescents (10–19 years) Baucau, Bobonaro, Dili, Ermera		✓		✓					✓			✓	Average fish consumption was 1–3 times weekly among adolescents in urban areas and 2–3 times monthly among those in rural areas.
Mercy Corps 2016 *COMAPCT-TL aquaculture program (2013–2016): Endline evaluation 2016*	242 households Ainaro, Baucau, Covalima, Lautem, Manufahi, Viqueque		✓		✓	✓							✓	37.1% of households consumed freshwater fish twice weekly at endline, while 71.8% had not at baseline.
DHS 2018 ***Demographic and Health Survey 2016***	11,502 households 12,607 WRA 1,978 infants All districts			✓				✓			✓			14% of breastfed and 21% of non-breastfed infants consumed fresh, dried fish or shellfish in the previous 24 hours.
TLFNS 2015 ***Food and Nutrition Survey 2013***	9,460 households All districts		✓			✓						✓		36.2% of households consumed fish 1–2 days per week, 7.8% 3–4 days and 5.1% 5–7 days, while 50.9% ate no fish at all.
AMSAT International 2011 *Fish and animal protein consumption 2011*	820 households Baucau, Bobanaro, Covalima, Dili, Oecusse	✓	✓				✓						✓	Annual fish consumption per capita was 6.1 kg nationally, 17.6 kg in coastal areas and 4 kg in noncoastal areas.
HIES 2012 ***Household Income and Expenditure Survey 2011–2012***	4,800 households All districts	✓			✓	✓						✓		Per capita consumption of purchased fish in the previous week was 6.2 kg nationally, 9.4 kg in urban areas and 5.2 kg in rural areas, with USD 1.50 spent on fish per household.
TLSLS 2008*** ***Survey of Living Standards 2007***	4,477 households All districts	✓				✓						✓		Per capita consumption of purchased fish in the previous week was 8.3 kg nationally.
Total studies out of 13		**5**	**6**	**5**	**6**	**7**	**5**	**5**	**1**	**3**	**6**	**7**	**5**	

Note: WRA = women of reproductive age. We provide the date of data collection for projects/programs, study reports and national surveys, and the year of publication for peer-reviewed publications. Nationally representative surveys are shown in bold.

* *To enable comparability of quantity of fish consumed, we calculated annual consumption per capita in kilograms from available data by multiplying weekly amounts by 52 and monthly amounts by 12.*

** *Data were provided by the study author (not published in the paper or report).*

*** *Cited in HIES 2012:30.*

Table 2. Summary of studies and methods used to assess AF consumption in Timor-Leste.

increased consumption (Bonis-Profumo et al. 2022). As mentioned in Section 3.1 of this report, it is important to note that assessing intakes in the previous 24 hours may only provide a snapshot of overall fish consumption. Still, secondary analysis of data from a program to improve nutrition practices among infants and pregnant and lactating women showed that 73% did not eat any fish over the previous week and only 1% of women had eaten fish daily over the previous week (TOMAK 2016).

3.4.4. Households

Nationally representative data from the TLFNS in 2013 found that 50.9% of households consumed no AFs in the previous 7 days, 36.2% ate them 1–2 days, 7.8% 3–4 days and 5.1% 5–7 days in the last week. The most detailed assessment of fish consumption was undertaken in 2011 (AMSAT International 2011). Chicken was eaten in the majority of households (54%), followed by marine fish or other seafood (14%). Almost half of households in coastal communities ate marine fish or other seafood, compared with just 7% of urban and 10% of noncoastal communities, though the consumption timeframe is unclear making it difficult to compare it to other surveys.

Few households (2%) in noncoastal communities ate freshwater fish. Low levels of consumption are reflected in the study's assessment of average annual intakes, at only 6.1 kg, which is much lower than regional averages. However, once again, those living in coastal areas reported higher annual consumption, at 18 kg. Average annual fish consumption in Bobonaro district was very low (2.7 kg) compared with other districts. The highest level occurred in Dili (7.7 kg), which was almost three times greater than in Bobonaro. These results must be interpreted with caution, however, as there were only a small sample of households across just five of the 13 municipalities. In fact, reports suggest that these figures may be significantly underestimated, as most households (80%) in coastal communities conduct gleaning activities that are not captured in supply estimations.

Recent data among rural inland households points toward a low purchasing level of 45% for any fish or seafood over the previous 7 days (Tilley et al. (in press)). Approximately half of those surveyed in Bobonaro, Liquiça, Manatuto and Manufahi bought fish; however, fewer purchased fish in Dili (41%) and Covalima (26%). Fresh (27%) and tinned fish (25%) were the most common types bought (Tilley et al. (in press)). It is important to note that purchasing fish is only a proxy for fish consumption. Still, it does reflect other recent data where almost half of farming households had eaten fish in the previous 7 days during the wet season, based on unpublished secondary analysis of de Paulo Correira et al. (2018). Lower consumption has been reported during the dry season, with over one-third (36%) of households consuming fish, shellfish or seafood in the previous 7 days (TOMAK 2018). This could be an overestimation, as focus group participants reported eating very little fish (TOMAK 2018). Similarly, another study found around a third of households had eaten fish in the previous week, with a higher proportion of fish farming respondents (33%) consuming fish compared to the control group (23%), as expected (Bonis-Profumo et al. 2022). This proportion was lower, however, when compared to the rural inland household study.

3.4.5. Types of species consumed

Information on the different types (never-mind species) of seafood eaten in Timor-Leste is also limited. Preliminary findings from a survey among rural inland communities indicates that sardines (33%), scads (24%), tuna (11%) and long tom (10%) are the mostly commonly purchased fish species (Tilley et al. (in press)). Similarly, in the survey by AMSAT International sardines were the most commonly eaten seafood (58%), followed by longtail tuna, kombong/mackerel (23%), snapper (23%) and prawn (22%) (AMSAT International 2011) (Appendix 2).

In addition to the caveat related to this survey mentioned earlier, it is important to consider that types of fish consumed may reflect the timing of the survey. The types of fish consumed differed among municipalities; however, the percentage consuming longtail tuna/tongkol was relatively high in all municipalities. A comparison of fish consumption patterns by areas within districts showed that sardines were the most consumed fish in urban, coastal and noncoastal areas, with noncoastal the highest (63%). Snapper consumption was highest in Dili, whereas prawns were eaten mostly by coastal and urban

participants. Market availability and price was a factor influencing the low consumption of squid, prawns and crabs. At the time of the survey, most supermarkets in Dili sold imported frozen fish, which was cheaper than the price of local fresh fish. Approximately 80% of the participants purchased prepared or cooked fish, with almost one-third (31%) of these having purchased dried or grilled fish or seafood. Smoked (47%) and boiled or steamed (17%) fish or seafood were the least frequently purchased prepared or cooked fish products, i.e. fewer than once a month. Respondents from coastal areas also showed higher consumption rates of prepared or cooked fish products than noncoastal areas.

A recent study examining the contribution of women's fisheries found that reef and seagrass dwelling herbivores and grazers, crabs, moray, urchins and peanut worms were the main aquatic species that women fishers caught for household consumption (Tilley et al. 2020). Most (84%) bivalve and gastropod species, which are available throughout the year, were caught exclusively for home consumption, indicating their important role in diets during times of shortage. Moray eels and small reef crabs were eaten at the household level. There is additional data available on tilapia consumption among participants of the Partnership for Aquaculture Development in Timor-Leste Phase 2 (PADTL2) program, where women from fish farming households ate 674 g of cooked tilapia per month (Bonis-Profumo et al. 2022). However, this is unlikely to be representative of tilapia consumption among communities not involved in this program because aquaculture production is limited to areas where water is accessible year-round.

3.5. Knowledge and attitudes towards aquatic food consumption

Assessments of nutrition-based Knowledge, Attitudes and Practices (KAP) explore nutrition, diet, foods and related health and hygiene issues and tend to be used to evaluate nutrition education interventions (Macias and Glaasauer 2014). Practices, defined as the observable actions of a person that could affect their or others' nutrition, such as eating, feeding, washing hands, cooking and selecting foods (Macias and Glaasauer 2014), are presented in relation to AF consumption in Section 3.4. In the following section, we provide an overview of the information on knowledge and attitudes, acknowledging that the concepts of attitudes, perceptions and beliefs are interchangeable. Knowledge is the understanding of a given topic (Macias and Glaasauer 2014). Attitudes are emotional, motivational, perceptive and cognitive beliefs that influence the behavior or practice of an individual (Macias and Glaasauer 2014). Despite a person´s knowledge, attitudes influence future behavior and help explain why a person adopts practices but not other alternatives. It is therefore vital that attitudes in particular are considered when developing strategies to promote AF consumption. The results shown in the following section present a brief overview of findings on knowledge and attitudes in relation to AF consumption in Timor-Leste. Although the findings must be interpreted with caution because of the varying sample sizes and contexts, we outline some key messages that may have relevance for future research, policy and practice.

3.5.1. Infants and children

Perceived healthfulness of AFs for children has not been explored extensively, and studies show mixed results. Reports from WorldFish and the TOMAK program have found that AF consumption was perceived to be healthy for young children (Bonis-Profumo et al. 2022; TOMAK 2017; 2019; 2021). However, it is evident in these and other studies that there are different perceptions as to when AFs should be introduced to infants and children (UNICEF 2017; Mercy Corps et al. 2016; TOMAK 2019). There is some indication from the findings that as children grow older their parents' perception of AF consumption changes from undesirable to desirable. These changes are worthy of further exploration, as younger infants may not be benefitting from fish consumption. A study found that a key challenge for mothers when giving fish to infants and young children seems to be concerns about choking on fish bones (Bonis-Profumo et al. 2022). Some studies report a strong influence on perceptions of AF consumption from other household members, particularly mothers-in-law (UNICEF 2017; TOMAK 2019). Negative perceptions may be species-specific—for example, colored AF (goldfish) consumption may cause poor child health, such as severe sickness and even death (Catholic Relief Services and Monash University 2016). This highlights the need for more research on species-specific perceptions.

3.5.2. Pregnant and lactating women

Negative connotations associated with AF consumption during pregnancy are also evident, not just in relation to marine seafood but also freshwater fish (Mercy Corps et al. 2016). One study reported negative perceptions in relation to mothers eating fish after childbirth (Castro 2013). However, another study found that 18% of WRA thought they should avoid some AFs during pregnancy or lactation, referring to different types of fish and seafood, which suggests a lack of clearly established social norms on this topic (Bonis-Profumo et al. 2022). Again, caution is warranted when interpreting findings because of the small number of studies across varying contexts. The perceived consequences of eating AF during pregnancy include miscarriages, stillbirths, difficult births, complications and even death (Catholic Relief Services and Monash University 2016). Extended family may also have an influence on fish consumption during pregnancy (Castro 2013; TOMAK 2019).

3.5.3. Adolescents

Again, a limited area of research among adolescents indicates that they want to eat more AFs and classify local animal-source protein as "healthy" (Bonis-Profumo and Meyanathan 2018). That said, the same study found that adolescents think tinned fish is unhealthy. Further research on adolescents' perceptions and knowledge of AF consumption is warranted, as this lone study had a sample size of just 96 adolescents across four municipalities.

3.5.4. Others

There is limited research available on the perceived recommended frequency of AF consumption among the general population (Mercy Corps et al. 2016; TOMAK 2018). Although there is some indication that some consumers believe that AFs may have nutritional benefits, there are too few studies to make any definitive inferences (Mercy Corps et al. 2016; TOMAK 2019). The only large survey, now more than 10 years old, found that while almost half (46%) of participants reported that the taste of AFs was the main reason for eating them, just over a quarter (26%) nationally (and 44% of urban participants) said nutrition was a reason for preferring AFs (AMSAT International 2011). Few respondents (14%) ate AFs for health reasons (AMSAT International 2011). In fact, some said health was their reason for not eating fish (AMSAT International 2011). In particular, high blood pressure and allergies were seen to be associated with processed fish consumption (AMSAT International 2011). Little data on cooking preferences in relation to AFs exist. Cooking preferences were similar among those districts assessed by the aforementioned survey (AMSAT International 2011) and in another study (Mercy Corps et al. 2016). Deep frying was the most popular way to cook AFs in all districts, followed by grilling and steaming (AMSAT International 2011) as well as boiling (Mercy Corps et al. 2016).

Taboos related to fish consumption are not limited to pregnant and lactating women (Catholic Relief Services and Monash University 2016). The believed consequences of eating AFs, among others, includes (i) full or partial morphosis into an animal or food, (ii) individual or family illness, (iii) body becoming covered with sores that go rotten and (iv) disrespecting the ancestors (Catholic Relief Services and Monash University 2016). The same study highlighted that taboos can be source-specific, such as fish from the river versus fish from the sea and may apply differently to men and women. Another study indicates that taboos may be site-specific within a community (Castro 2013). Although few studies examine taboos in relation to AF consumption, there are larger surveys that indicate taboos do exist. The TLFNS 2013 survey found that some communities held taboos related to fish consumption. In Oecusse, for example, there were reports of beliefs that if a child eats fish, he/she will be involved in an accident (Democratic Republic of Timor-Leste 2015). The AMSAT survey also found that some groups in Oecusse avoid fish because of perceived negative potential consequences (AMSAT International 2011). Some respondents compromised by cooking fish outside the house and/or not keeping the utensils used to cook fish in the house (AMSAT International 2011). The survey also found other factors that may influence AF consumption, including economic and physical access, especially in noncoastal areas (AMSAT International 2011). A more recent survey reflected the findings of the AMSAT survey, as 83% of men and 68% of WRA respondents said that limited access to fish was the main barrier to increased consumption (TOMAK 2019). Affordability was the next most significant barrier (TOMAK 2019).

It is clear that a better understanding is needed regarding perceptions and attitudes between different communities and subpopulations, particularly among women. Although there is some evidence of taboos in relation to AF consumption, these could be site- and species-specific, highlighting the need to consider context when developing approaches to improve consumption. The findings also indicate that whole community and/or household approaches are needed to improve knowledge of the nutritional benefits of AF consumption and the appropriate age of introduction—targeting mothers but also extended family members who may have a strong influence on AF consumption among infants and children (TOMAK 2019). A critical area also to consider is women's decision-making power related to purchasing animal-sourced foods, as men often make the final decision regarding household expenditures on expensive foods, such as AFs (Bonis-Profumo et al. 2022). These findings also highlight the need to consider physical and economic access in efforts to promote AF consumption.

Cooked fish, Atauro Island, Timor-Leste.

4. Conclusions and recommendations

Although this scoping review points to low dietary diversity and AF consumption in Timor-Leste, more comprehensive assessments are needed. Studies have relied heavily on dietary diversity tools, including for assessing AF consumption. Box 1 outlines key recommendations for future research on dietary assessment, particularly AF consumption, in Timor-Leste. The evidence generated could help develop appropriate policy and program solutions to reduce malnutrition, especially among children and WRA in the country.

Box 1. Recommendations for future research on dietary assessment and AF consumption in Timor-Leste.

Conduct more comprehensive quantitative assessments of AF consumption: There is significant scope to assess the quantities of AFs consumed, across a range of species, fisheries and climatic seasons. Quantitative methods are recommended, such as validated quantitative Food Frequency Questionnaires. These can assess intake over a long period of time, capture a range of food items adapted to a specific context, assess portion sizes and have relatively low respondent and administrator burden ([FAO] Food and Agriculture Organization 2018). Efforts to quantify and validate portion sizes for different types of species are encouraged. Assessments of specific species eaten are recommended, especially among varying contexts to better understand the differences in consumption between communities, such as by geography and demography. Gaining an understanding of the means of production (fishing or culture methods, fishing habitats, gendered engagement) of fish consumed will facilitate nutrition outcomes being considered in management policy, actions and investments.

Conduct qualitative assessments of knowledge and attitudes: Qualitative methods to assess knowledge and attitudes (Macias and Glaasauer 2014) in relation to AF consumption could also add valuable insights, which may have important implications for any strategies to promote consumption.

Assess diet quality and AF consumption among different subpopulations: Efforts to assess diet quality and AF consumption among women and children are vital and must continue. Furthermore, understanding consumption practices specifically among pregnant and lactating women, rather than all WRA, may help identify opportunities to improve nutrition during this critical window of child development. More research on men and adolescents is also warranted. It is also recommended that AF consumption be analyzed among various socioeconomic groups based on education and wealth. This data is lacking, which may lead to more vulnerable populations being overlooked.

Use context-specific standard assessment methodology to assess diet quality: Recently, a new tool, the Diet Quality Questionnaire (DQQ), has been developed to assess diet quality globally, with country-specific adaptations, including in Timor-Leste (Global Diet Quality Project 2023). Although this tool may have similar limitations to the dietary diversity assessments, it offers a standard context-specific approach that could support further valid dietary data collection efforts in the country.

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Appendix 1. Comparison of dietary diversity scores

The Minimum Dietary Diversity Score for children 6-23 months old (MDD-IYC) is a population-level indicator designed by the World Health Organization to assess dietary diversity as part of infant and young child feeding practices among children 6–23 months old. Child dietary diversity is associated with mean micronutrient adequacy of the diet, so the MDD-IYC can be useful in capturing infant and young child diet quality at a population level (FANTA 2014; FANTA Working Group on Infant and Young Child Feeding Indicators 2006). The proportion meeting the MDD-IYC was initially defined as the "proportion of children 6–23 months of age who receive foods from four or more food groups" ([WHO] World Health Organization and [UNICEF] United Nations Children's Fund 2010). Therefore, children who received four or more food groups out of seven during the previous day were more likely to have an adequate diet than those who ate from less than four. Based on a 2017 expert consultation, however, these have been updated to reflect the inclusion of breast milk as an eighth food group. The MDD-IYC is now defined as the "proportion of 6–23 months of age who receive foods from 5 or more food groups" (Table 3); however, to report on this indicator, countries may need to expand the age range covered in existing surveys (WHO 2017).

The proportion of women 15–49 years of age who have met the MDD-W are those who have consumed at least five out of 10 defined food groups the previous day or night (Table 3) ([FAO] Food and Agriculture Organization and FHI360 2016). Similar to the infant MDD, the MDD-W can be used as a proxy indicator for higher micronutrient adequacy, which is one important dimension of diet quality.

Household-level surveys measure household economic access to food, so items that require household resources to obtain, such as oil, condiments, sugar and sugary foods, and beverages, are included in the score ([FAO] Food and Agriculture Organization 2013). There is no consensus on which food groups to include in the scores, but 12 food groups are generally proposed for the HDDS and so the potential score range is 0–12 (Table 3) ([FAO] Food and Agriculture Organization 2013). There are also no established cutoff points in terms of number of food groups to indicate adequate or inadequate dietary diversity for the HDDS. Rather, the mean score or distribution of scores is used for analytical purposes and to set program targets or goals. It is a valid indicator of household economic access to food but not dietary quality.

MDD-IYC	MDD-W	HDDS
1. Breast milk	NA	NA
2. Grains, roots and tubers	1. Grains, white roots and tubers, and plantains	1. Cereals
		2. White tubers and roots
3. Legumes and nuts	2. Pulses (beans, peas and lentils)	8. Legumes, nuts and seeds
	3. Nuts and seeds	
4. Dairy products	4. Dairy	9. Milk and milk products
5. Flesh foods	5. Meat, poultry and fish	5. Meat
		7. Fish and other seafood
6. Eggs	6. Eggs	6. Eggs
7. Vitamin A-rich fruits and vegetables	7. Dark green leafy vegetables	3. Vegetables 4. Fruits
	8. Other vitamin A-rich fruits and vegetables	
8. Other fruits and vegetables	9. Other vegetables	
	10. Other fruits	
NA	NA	10. Oils and fats
		11. Sweets
		12. Spices, condiments and beverages

Table 3. Comparison of food groups used in different dietary diversity calculations.

Appendix 2. Species of fish or seafood consumed

Type/species	Urban	Coastal	Noncoastal	Total
Sardina/Sardine	55.1 (1)	42.6 (1)	63.0 (1)	58.1
Kakap/Snapper	44.9 (2)	30.0 (2)	13.0	22.5
Kombong/Mackerel	16.7	34.3 (2)	23.1 (3)	23.4
Tongkol/Longtail tuna	34.8 (3)	39.2 (1)	36.1 (2)	36.3
Terbang/Flying fish	7.2	8.7	8.2	8.1
Kitan/Spinefoot	1.4	9.1	2.7	3.4
Daun/Long tom	11.6	4.9	15.5	13.0
Tuna/Tuna	9.4	1.0	1.7	3.3
Kerapu/Grouper	1.4	0.0	0.2	0.5
Koku/*Bubara*/Trevally	5.1	15.7	3.0	5.4
Lele/Catfish	0.0	0.0	2.6	1.6
Teri/Anchovies	0.0	0.0	2.6	1.7
Ikan Mas/Goldfish	0.0	1.9	3.1	2.2
Prawn	30.4 (3)	38.6 (1)	15.6	22.3
Crab	8.0	15.9	5.5	7.7
Squid	18.8	21.0 (3)	2.2	8.7
Sea snail	0.7	12.1	1.5	2.9
Oyster/Clam	1.4	1.0	1.2	1.2
Other	0.7	1.0	1.2	1.1

Note: The ranks 1 to 3 given in parentheses are based on the highest percentages (grouped approximately to closest values).

Table 4. Species of fish/seafood consumed by area (% within area).

Fish soup cooking on a fire cooking stove.

About WorldFish

WorldFish is a leading international research organization working to transform aquatic food systems to reduce hunger, malnutrition, and poverty. It collaborates with international, regional, and national partners to co-develop and deliver scientific innovations, evidence for policy, and knowledge to enable equitable and inclusive impact for millions who depend on fish for their livelihoods. As a member of CGIAR, WorldFish contributes to building a food- and nutrition-secure future and restoring natural resources. Headquartered in Penang, Malaysia, with country offices across Africa, Asia, and the Pacific, WorldFish strives to create resilient and inclusive food systems for shared prosperity.

For more information, please visit www.worldfishcenter.org