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Abstract

2020 Elsevier Ltd The important role of fish in food and nutrition security is becoming more widely acknowledged by the fishery sector and within food policy. Integration of fish and food policy, at national, regional or global levels, is required to ensure the contribution of fisheries and aquaculture to human health is supported through governance arrangements. We explore this aspect of food policy integration in Timor-Leste, where malnutrition is a critical health problem. Consumption of fish is low by international standards and only a small proportion of the population engages in fishing. We used a mixed method approach involving desktop policy analysis, interviews and social network analysis to explore interactions among sectoral instruments and organisations. Our results show generally good integration of food security into fisheries policies, but a lack of integration of fish into food policies. Policy network analysis revealed evidence of collaboration and cooperation between sectors, however, consideration of fish and food concerns was not well embedded across all organisations. We discuss challenges and options for future integration of fisheries into sustainable food systems in Timor-Leste and more broadly, including the need for greater political will and resources, combined with clearer targets and actions within instruments.

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1 **Integrating fisheries, food and nutrition – insights from people** 2 **and policies in Timor-Leste**

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13 [Abstract](#)

14 The important role of fish in food and nutrition security is becoming more widely
15 acknowledged by the fishery sector and within food policy. Integration of fish and food policy,
16 at national, regional or global levels, is required to ensure the contribution of fisheries and
17 aquaculture to human health is supported through governance arrangements. We explore
18 this aspect of food policy integration in Timor-Leste, where malnutrition is a critical health
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22 instruments and organisations. Our results show generally good integration of food security
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24 analysis revealed evidence of collaboration and cooperation between sectors, however,
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28 combined with clearer targets and actions within instruments.

29 [Key words](#)

30 Policy integration, food security, seafood, aquaculture, food systems, fisheries management
31

32 [1. Introduction](#)

33 More integrated food policy is needed to overcome problems facing the food system,
34 including food insecurity, malnutrition, non-communicable diseases (NCDs) and
35 environmental degradation (see for e.g. Barling et al., 2002; Candel and Pereira, 2017).
36 Fisheries and aquaculture make important contributions to national food systems (Béné et
37 al., 2016; Bogard et al., 2019; Kawarazuka and Béné, 2011; Loring et al., 2019; McClanahan et
38 al., 2013; Thilsted et al., 2016), however, this role was all but ignored until recently (Béné et
39 al., 2015; Farmery et al., 2017; HLPE, 2014; Kurien and López Ríos, 2013). Fisheries and
40 aquaculture have typically been considered separately from other parts of food and
41 agricultural systems in food and nutrition security (FNS) research and policy-making
42 (Kawarazuka and Béné, 2011). The contribution of fish (including all marine and fresh water
43 farmed and capture species) to food systems has been limited by a lack of coordination across
44 the respective policy domains (FAO, 2017).

45

46 The call for closer integration of fish into the FNS debate (Béné et al., 2015) has resonated
47 with researchers and policy makers alike. The literature on the role of fisheries and
48 aquaculture in FNS has increased dramatically in recent years (Bennett et al., 2018) and the
49 international community has highlighted the need to integrate fish into local and national
50 food systems, to establish nutrition-sensitive fisheries and to improve future diets (FAO, 2017;
51 Thilsted et al., 2016). The need for capture fisheries and aquaculture to be addressed
52 comprehensively through coordinated public policies (Chan et al., 2019; FAO/WHO, 2014) to
53 improve FNS has also been promoted.

54

55 Recent efforts to improve the integration of fisheries and food policy include the
56 development of voluntary guidelines to support the role of small-scale fisheries in efforts to
57 eradicate hunger and poverty (FAO, 2015). The Asia-Pacific Fishery Commission (APFIC) have
58 promoted better communication around fish for FNS in policy decision-making, and increased
59 efforts to provide information on fish, and fish consumption, at national and sub-national
60 levels (Needham and Funge-Smith, 2014). In East Asia, a number of regional ocean programs
61 and partnerships have identified the need to manage fisheries for FNS, including the
62 Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ten countries
63 in the Association of Southeast Asian Nations (ASEAN) Region.

64

65 The Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF), a
66 multilateral partnership formed by the governments of the six Coral Triangle countries has
67 also identified the need to manage fisheries for FNS. The success of these programs in

68 integrating fish and FNS is uncertain, however, as they have been limited by the lack of clear
69 targets on improving access or consumption of fish (Foale et al., 2013).

70

71 Despite increased focus, the way in which fisheries, aquaculture, food and health are being
72 integrated, at national, regional or global levels, and the implications for both fisheries
73 management and food and health outcomes, remains an under-researched area. We begin
74 to explore this emerging aspect of food policy integration through an examination of policy
75 instruments and actors in Timor-Leste where malnutrition is a critical health problem and
76 existing policy has not captured the potential contribution of fish to food systems (Mills et al.,
77 2017). Our approach is applicable to other countries, where the integration of fish and food
78 policy can support the range of actions required to overcome malnutrition and food
79 insecurity.

80

81

82 1.1 Case study – Timor-Leste

83 Timor-Leste is a small Southeast Asian nation with a population of approximately 1.3 million
84 people. It is a post-conflict country emerging from a history of occupation, a violent struggle
85 for independence, and internal conflicts between 1999 and 2006 (Provo et al., 2016). Timor-
86 Leste occupies half of the island of Timor and is predominantly agricultural. Food insecurity is
87 a major problem resulting from past conflicts, environmental degradation, disrupted land
88 tenure and farm practices, severe seasonal weather fluctuations, and dependence on food
89 imports (Anderson, 2006). Most families suffer from chronic food insecurity and practice food
90 rationing between one and six months of the year (Borges et al., 2009). Timor-Leste was

91 ranked 110 out of 119 countries included in the 2018 Global Hunger Index, and is one of only
92 two where more than 50% of children under five are stunted (von Grebmer et al., 2018). The
93 overall nutrition situation of the country is poor with 38% of children under five years of age
94 underweight and 11% wasting. In addition, micronutrient deficiencies exist among children
95 and non-pregnant mothers, especially anaemia (Democratic Republic of Timor-Leste,
96 2015). FNS is addressed through a number of national policies and plans, as well as regional
97 instruments. For example, Timor-Leste is a member of the Community of Portuguese
98 Language Communities (CPLP) which has developed the *ESAN-CPLP Regional Strategy for*
99 *Food and Nutrition Security 2011*. The country is an observer to the regional
100 intergovernmental organisation ASEAN, who have developed an *Integrated Food Security*
101 *Framework and Strategic Plan of Action on Food Security in the ASEAN Region (SPA-FS) 2015-*
102 *2020*.

103 Fish is a highly nutritious food and its consumption has been linked to reduced rates of
104 malnutrition (Golden et al., 2016). Average fish consumption in Timor-Leste is estimated to
105 be 6.1 kg/person/year (17 kg in coastal areas and 4 kg in inland communities), which is less
106 than the current global average of 20.3 kg (FAO, 2018). Increasing the consumption of fish
107 may, therefore, be part of the solution to help improve the country's nutrition situation. The
108 Timorese Government has supported the role of fish in its populations' diet through initiatives
109 such as the Food Based Dietary Guidelines (Government of Timor Leste, 2015).

110 Fish landings, which peaked in the 1990s during Indonesian occupation, declined after 1999
111 following post-referendum conflicts in which Indonesian militias destroyed approximately
112 90% of boats, fishing gear and onshore processing infrastructure (Barbosa and Booth, 2009).
113 In contrast to many other nations, the Timor-Leste wild capture fisheries sector is currently

114 considered to be 'undeveloped', although there are indications of localised overfishing
115 (Alonso Población, 2013). The sector is dominated by small-scale fisheries (SSF) with
116 approximately 5% of total households involved in SSF to some degree (López-Angarita et al.,
117 2019). Inland capture fisheries are largely limited to the monsoon season and predominantly
118 carried out for subsistence (FAO, 2019). The number of households involved in aquaculture
119 was estimated at around 3500 (1.75 % of total households) in 2016 (WorldFish, 2019). Fishery
120 resources are managed through a mix of co-management and customary laws and national
121 regulations (Alonso-Población et al., 2018; Tilley et al., 2019). Several marine protected areas
122 (MPAs) have also been established with varied levels of engagement from government,
123 environmental non-government organisations and community groups. Timor-Leste is a
124 signatory to the *Regional Plan of Action to Promote Responsible Fishing Practices including*
125 *Combating Illegal, Unreported and Unregulated Fishing in the Region*, and the Coral Triangle
126 Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF).

127

128 The majority of capture fisheries production, estimated to be around 3200t, is consumed
129 domestically. Freshwater aquaculture production is estimated at over 350t, and 15t of
130 seaweed were produced for export, with a greater volume reportedly produced for the local
131 market (WorldFish, 2019). Fresh fish is most commonly purchased from fishers or at market
132 and some households also purchase imported canned or frozen fish (AMSAT International,
133 2011). The topography of the country makes transport of fresh fish difficult. Lack of processing
134 and landing infrastructure also limits fish marketing and trade. The domestic market for fish
135 remains underdeveloped and for many upland communities in the country's interior, fish is
136 rarely consumed (FAO, 2019).

137

138 2. Methods

139 Food insecurity is a trans-disciplinary, multi-sectoral policy field requiring an integrated policy
140 approach (Barling et al., 2002; Candel and Pereira, 2017). Policy integration, where certain
141 policy objectives are integrated into other policy sectors (Mickwitz and Kivimaa, 2007), is
142 required alongside actions at multiple levels and across different sectors to overcome the
143 range of factors that lead to malnutrition and chronic conditions such as stunting (Bhutta et
144 al., 2013).

145 We examine policy coordination and cooperation between the fisheries and food sectors as
146 components of policy integration, which is understood here as a process of both policy and
147 institutional change and design (Candel and Biesbroek, 2016). Integrated policy often requires
148 self-standing policy networks, or subsystems to be integrated (Meijers and Stead, 2004).
149 These networks can be defined as patterns of social relationships between independent
150 actors which take shape around policy problems or programs (Kickert et al., 1997). We used
151 a mixed methods approach, building on methods recently described in the literature on policy
152 coherence (Cohen et al., 2017; Nilsson et al., 2012), processual policy integration (Candel and
153 Biesbroek, 2016, 2018), and social network analysis (SNA) (Freeman, 2004; Wasserman and
154 Faust, 1994). Research was conducted during 2018 and 2019 through desk-based analysis of
155 relevant instruments (legislation, policies, strategies or plans), followed by stakeholder
156 interviews.

157

158 2.1 Policy integration analysis

159 Firstly, we examined the key instruments in the sectors of fisheries, aquaculture, food,
160 nutrition and health. A total of 20 relevant documents were identified via internet keyword
161 searches, references to policy instruments within identified instruments, conversations with
162 academics and staff of the Ministry of Agriculture and Fisheries, and through targeted
163 questions in formal interviews with stakeholders (see supplementary information Table S1).
164 Instruments included in the analysis were limited to regional and national documents
165 containing stated goals or objectives relating to food, nutrition, and health or fisheries and
166 aquaculture. This approach resulted in the inclusion of several multi-sectoral instruments that
167 lie outside the fish and food sectors, for example the *Environment Basic Law 2012* and the
168 *National Biodiversity Strategy and Action Plan 2011-2020*, as they included specific objectives
169 on fisheries or FNS. Instruments such as the *National Disaster Risk Management Policy 2008*
170 which mentions that food insecurity must be addressed, or the *National Tourism Policy 2015*
171 that mentions food in relation to tourist needs, were not included. Key development partner
172 strategies were examined but not included in the analysis as they were not formal
173 government instruments. A summary of the inclusion of fish and FNS objectives in these
174 documents is available in the supplementary material (see Table S2).

175 Secondly, we examined the stated objectives within the selected instruments, including
176 national policies, plans, strategies, legislation, and relevant regional strategies and plans. This
177 analysis was undertaken to assess the extent of integration of FNS considerations into
178 national and regional fisheries, ocean and aquaculture instruments (referred to as the
179 fisheries, ocean and aquaculture sector); and how fish considerations are included in national
180 and regional FNS instruments (referred to as the food, nutrition and health sector). An

181 inventory of all relevant stated objectives was developed following the approach used by
182 Nilsson et al. (2012). This process resulted in the identification of a large number of objectives,
183 which were sorted into groups or ‘themes’, where commonalities between specific objectives
184 existed. These themes were used to report results. Nutritional intake and food security were
185 separated in the analysis to capture the extent to which policies addressing food security also
186 considered nutrition, given the historical focus of food security on food quantity rather than
187 quality, and the particular role that fish can play in addressing malnutrition.

188

189 A number of ‘shared’ objectives were identified, i.e., the same theme was present in one or
190 more sectors. We considered such shared objectives as critical to the process of reconciling
191 different policy instruments and to achieving full policy integration (Candel, 2018). Shared
192 objective themes were further examined to understand the level of coherence, or ‘mutual
193 consistency’, between different sectors. The objectives that were not shared among sectors,
194 i.e., they were articulated in the instruments of a single sector only, or were poorly
195 represented within and across sectors, were examined as potential obstacles or opportunities
196 for integration. The level of integration or commitment, based on whether or not the
197 objective was linked to a clear strategic action or target which it can be measured against, or
198 identification of who was responsible for implementation, was noted during this stage.

199

200 [2.2 Stakeholder interviews](#)

201 Stakeholders from government, academia, intergovernmental organisations and NGOs
202 actively engaged in management, policy development and implementation relevant to

203 fisheries, oceans, aquaculture, and food, nutrition and health were interviewed to provide
204 insight into the sector networks and how, or where, these food policy subsystems
205 interconnect. Interviewees were identified through mention of their name or organisation in
206 the desk-based policy analysis, and via the snowball approach through conversations and
207 formal interviews. A small number of interviewees were identified from additional
208 subsystems, including environment and agriculture, and our analysis captures a fraction of
209 the objectives of these sectors, as they relate to fisheries and food, rather than the full
210 spectrum of sectoral objectives. A total of 31 structured interviews were conducted to explore
211 the objectives interviewees were trying to achieve in their professional capacities, the
212 instruments they used, and the networks that exist with other professionals and
213 organisations. Interviews were also used to identify new members of the network and were
214 conducted with as many members as was possible. Interviews, conducted face-to-face or over
215 Skype, were carried out in English or Timorese, with assistance from a translator to ensure
216 accuracy and detail of nuanced discussions. Two interviewees completed interview questions
217 via return email where a conversation was not possible. Results were de-identified and
218 analysed using thematic analysis and SNA software.

219 [2.3 Social Network Analysis](#)

220 Social network analysis was used to provide an indication of the strength of relationships
221 between organisations that cannot be captured through analysis of policy documents on their
222 own. The aim of the network analysis was to examine the food policy subsystems and identify
223 the policy network linking the fisheries, ocean and aquaculture sector and the food, nutrition
224 and health sector. Interviewees were asked to name the organisations that were important
225 for their work as well as the instruments they used. The results of individual interviews were

226 aggregated, analysed and graphed to show these interactions. Open source software (Gephi
227 0.9.2; Force Atlas 2 Projection) was used to measure relative distance, or relationships,
228 between organisations and between instruments. For the relationships between
229 organisations we present results for betweenness centrality, based on the centrality of
230 organisations in providing links, or 'bridges' between organisations. For the relationship
231 between organisations and instruments we present results on the indegree or 'popularity',
232 which is a measure of centrality based on the number of references to an instrument.

233 To analyse the results, we assigned organisations (based on interviewee organisation) and
234 instruments to sectors. Organisations were assigned based on the main focus of the
235 interviewees. For example the Ministry of Agriculture and Fisheries and several tertiary
236 institutions were assigned to 'fisheries, oceans and aquaculture', as all interviewees from
237 these organisations identified primarily with this sector, despite their organisation
238 representing multiple sectors. We note the difficulty in determining boundaries to allocate
239 people and organisations to sectors and recognise that they are analytical constructs to help
240 interpret results rather than firm demarcations (Nohrstedt and Weible, 2010). In some cases
241 more than one person was interviewed, or completed the survey, per organisation (see Tables
242 S3 and S4). In other cases interviewees were not available for organisations identified as part
243 of the network. Given these limitations, some links between organisations or instruments
244 may not be represented in the results, and the bridging role of some organisations may be
245 under-represented (betweenness value). Our results should, therefore, be interpreted in
246 terms of general patterns presented in the results section, rather than the exact values (see
247 Tables S3-5 for indegree, betweenness and eigenvector centrality values).

248

249 3. Results

250

251 3.1 Integration of fish and food within sectoral instruments

252 Instruments (legislation, policies, strategies or plans) were categorised into the following
253 sectors: food, nutrition and health; fisheries, oceans and aquaculture; strategic development;
254 and environment. Fisheries, ocean and aquaculture-specific objectives were articulated by a
255 third of instruments categorised in the food, nutrition and health sector (Table 1, and see
256 Table S6 for detail of specific instruments) demonstrating a degree of policy integration. For
257 example, the *National Food and Nutrition Security Policy 2017* includes an objective to
258 increase fish consumption from 6 kg to 15 kg per capita. However, some key instruments had
259 no objectives related to fish (for e.g. the *National Nutrition Strategy 2014-2019*) illustrating a
260 clear lack of integration. Within the fisheries, ocean and aquaculture sector, there was a high
261 level of integration with 80% of instruments including FNS objectives. For example, the
262 *National Aquaculture Development Strategy 2012-2030* also included an objective to increase
263 annual fish consumption to 15kg per capita.

264 Table 1 Policy integration as a function of presence of objectives across sectors

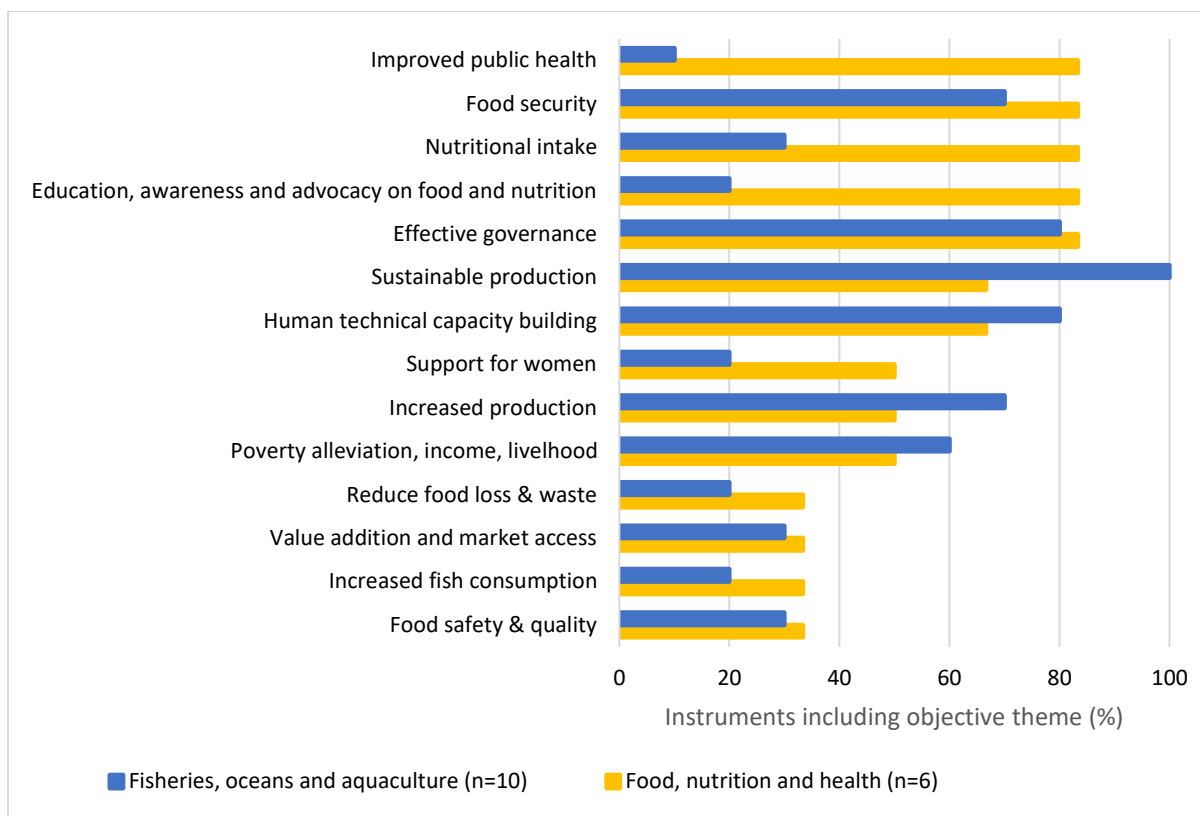
	Instruments with objectives addressing:	
Sector	Food and nutrition security	Fish, fisheries or aquaculture
Food, nutrition and health	100% (n=6)	33% (n=2)
Fisheries, aquaculture and oceans	80% (n=8)	100% (n=10)

265

266 While many instruments demonstrated a degree of integration in terms of expressed
267 commitment or acknowledgement of issues related to fisheries and to FNS, many instruments
268 contained broad objectives that did not include clear strategic actions or targets to be
269 measured against, an indication of how or by who the commitment would be implemented
270 (Table S1). For example, the *National Food and Nutrition Security Policy 2017* does not detail
271 how fish consumption would increase to meet the target of 15kg per year. Some objectives
272 constituted vague statements only, for example the *Decree-Law No. 6/2004, the General
273 Bases of the Legal Regime for the Management and Regulation of Fisheries and Aquaculture*,
274 acknowledged the importance of fishing “in improving the food diet of the populations”, with
275 no further information.

276 *3.1.1 Common and shared themes in instruments*

277 A range of shared objective themes were identified in the food, nutrition and health
278 instruments, and the fisheries, oceans and aquaculture sector instruments (Table S1 lists all
279 shared objective themes for all instruments and sectors). The most common food, nutrition
280 and health objective themes, i.e., the themes that were stated in the most instruments for
281 that sector, included ‘improved public health’, ‘food security’, ‘nutritional intake’, ‘education,
282 awareness and advocacy on food and nutrition’, and ‘effective governance’ (Figure 1). These
283 objective themes appeared in over 80% of instruments in the food, nutrition and health
284 sector.



285

286 *Figure 1 Sectoral coverage of the most common food, nutrition and health objective themes, i.e., the*
 287 *themes that were stated in the most instruments for that sector*

288

289 Objective themes ‘sustainable production’ and ‘human technical capacity building’ were
 290 present in 67% of food, nutrition and health instruments and these commonly articulated
 291 objective themes were well represented in the strategic plans. Some of the objectives around
 292 sustainable production were quite broad. For example, the objective “Enhance capacities of
 293 rural communities, land owners and farmers to use natural resources in a sustainable manner
 294 to support an adequate and stable supply of locally produced nutritious food” in the *Food and*
 295 *Nutrition Security Policy 2017*, was not accompanied by implementation actions or targets.
 296 Some of these themes were also frequently articulated, or shared, in fisheries, oceans and

297 aquaculture instruments, including ‘sustainable production’ (100%), ‘effective governance’
298 ‘human technical capacity building’ (80%), and ‘food security’ (70%).

299 The most common objective themes for fishery, oceans and aquaculture related to
300 ‘sustainable production’ (100%), ‘effective governance’ and ‘human technical capacity
301 building’ (80%), ‘food security’ and ‘increasing production’ (70%), ‘reducing poverty’ and
302 ‘compliance and enforcement of regulations’ (60%) (Fig 1 and Fig S1).

303 *3.1.2 Under-represented themes in instruments*

304 Several common food and health themes were under-represented in fisheries instruments,
305 for example ‘improved public health’ (10%) ‘education, awareness and advocacy on food and
306 nutrition’ (20%), and ‘nutritional intake’ (30%) (Figure 1). Some common fisheries objective
307 themes, including ‘conservation’ (70%) and ‘creating new economic opportunities/ livelihood
308 diversification’ (50%) were not articulated in any FNS instruments (Table 2, Figure S1), while
309 others such as (compliance and enforcement of national and international regulations’,
310 ‘small-scale and traditional fisher/farmer support’ and ‘industry/sector development’ were
311 articulated in a third or less of food, nutrition and health sector instruments (Figure S1).

312 A number of objective themes were shared across sectors yet remained under-represented
313 (33% or less) in one or both sectors, including ‘support for women’, ‘reduced food waste and
314 loss’, ‘value addition and market access’, ‘increased fish consumption’, ‘small-scale fishers
315 and farmers’, ‘industry development’ and ‘food safety and quality’. Some of these themes
316 were also shared by the strategic development and agriculture sector instruments included
317 in this analysis (Table S1, S7), although this is not reflective of these sectors as a whole.

318 Some less common, but arguably important, FNS objective themes were absent in fisheries,
319 oceans and aquaculture instruments and also under-represented in food, nutrition and health

320 instruments. These included ‘food price stability and affordability’, ‘improving nutritional
 321 behaviour’ and ‘food self-sufficiency’ (Table 2). Several FNS objectives, including ‘education
 322 and awareness on food and nutrition’, ‘improving the nutritional value of food’ and ‘human
 323 rights’, were included in ASEAN instruments but remained gaps in national instruments.

324 Shared objectives were expected across instruments that focus on both fisheries and food
 325 security, such as the ASEAN Resolution and Plan of Action on Sustainable Fisheries and Food
 326 Security, and the regional and national plans of the Coral Triangle Initiative on Fisheries and
 327 Food Security (CTI), however, these documents demonstrated gaps in relation to key food
 328 and nutrition objectives. For example, neither CTI instrument contained objectives related to
 329 ‘increased production of food’, ‘nutritional intake’, ‘food safety/quality’, or ‘increased food
 330 consumption’.

331 *Table 2 Thematic areas where objectives were absent or under-represented across sectors.*
 332 *The values indicate the percentage of instruments, in a sectoral group, and the total number,*
 333 *that articulated a particular objective theme. Blank spaces represent zero presence of*
 334 *objectives.*

	FNS objective themes						Fish objective themes							
Sector	Education, awareness and advocacy on food and nutrition	Food price stability and affordability	Human rights, working conditions	Improve nutritional value of food	Improve nutrition behaviour and practices	Food self-sufficiency/ reduce import dependency	Sovereign rights	Social resilience	Strengthen competitive advantage	Climate change mitigation	Develop export industry	Economic growth and security	Creating new economic opportunities	Conservation
Food, nutrition & health	83% (n=5)	67% (n=4)	50% (n=3)	33% (n=2)	50% (n=3)	33% (n=2)	17% (n=1)							
Fisheries, oceans & aquaculture	10% (n=1)		10% (n=1)	10% (n=1)			10% (n=1)	10% (n=1)	10% (n=1)	20% (n=2)	10% (n=1)	30% (n=3)	50% (n=5)	70% (n=7)

335

336

337 3.2 Integration through networks

338 Interviewees and their organisations were categorised into fisheries, oceans and aquaculture;
339 food, nutrition and health; and agriculture sectors. More than 63% of interviewees (n=12) in
340 the ‘fisheries, oceans and aquaculture’ sector listed food security as an additional primary or
341 secondary work sector. In contrast, only one of eight interviewees in the food, nutrition and
342 health sector identified fisheries or aquaculture as an additional sector. Half of the
343 interviewees in the agriculture sector (n=2) listed fisheries or aquaculture as a secondary
344 sector.

345

346 3.2.1 Common and shared themes in interviews

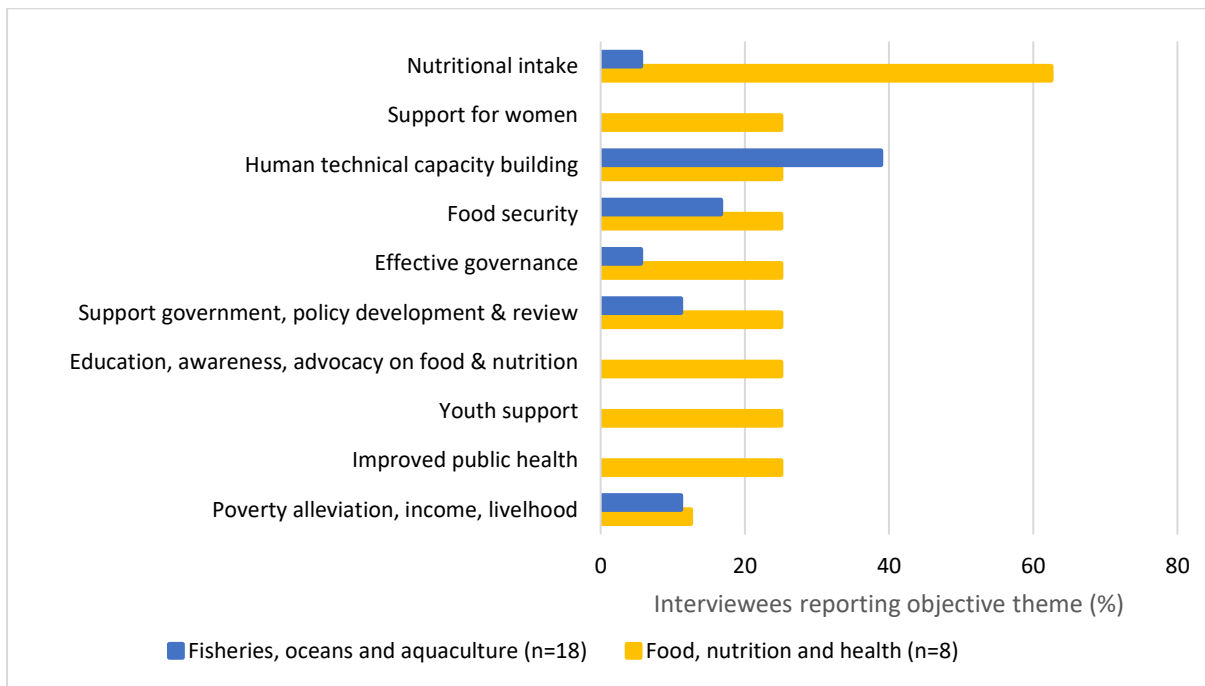
347 The objective theme most commonly reported by interviewees in the food, nutrition and
348 health sector related to ‘nutritional intake’ (63%). For example, interviewees reported
349 objectives such as “contribute to nutrition intake for households”. Objectives linked to this
350 theme were reported by one interviewee in fisheries, aquaculture and oceans sector. Several
351 other objective themes reported by two or more interviewees in the food, nutrition and
352 health sector ($\geq 25\%$) were also reported by interviewees working in fisheries, oceans and
353 aquaculture (Figure 2, also see Table S8 for more detail). These shared objectives included
354 ‘Human technical capacity building’ (reported by 39% fisheries, oceans and aquaculture
355 sector, 25% food, nutrition and health sector), for example “capacity development through
356 training students in communities”, ‘food security’ (17%, 25%), and ‘support for government’
357 (11%, 25%). Shared objectives also included ‘Effective governance’ (6%, 25%) and ‘Poverty,

358 alleviation, income and livelihoods’ (11%, 13%), for example “contribute to household
359 income”.

360

361 *3.2.2 Under-represented themes in interviews*

362 Several objective themes reported by food, nutrition and health sector interviewees were not
363 reported by any interviewees from the fisheries, oceans and aquaculture sector, including
364 ‘education, awareness and advocacy on food and nutrition’ (25%), ‘youth support’ (25%), and
365 ‘improved public health’ (25%). Objectives related to ‘support for women’ were reported by
366 25% of food, nutrition and health sector interviewees and 50% of agriculture sector
367 interviewees (Table S8, noting that this does not reflect the sector as whole given the limited
368 number of interviewees), but not by any fisheries, ocean and aquaculture interviewees.



369

370 *Figure 2 Sectoral coverage of the most commonly reported food, nutrition and health objective*
371 *themes.*

372

373 Some of the objective themes reported by interviewees in fisheries, oceans and aquaculture
374 were not mentioned as objectives by interviewees in the food, nutrition and health sector.
375 These included ‘sustainable production’ (reported by 28% of respondents in the fisheries,
376 ocean and aquaculture sector), ‘collection, monitoring and sharing of data’ (28%),
377 ‘compliance with and enforcement of national or international regulations’ (22%) and
378 ‘industry innovation/sector development (17%)’ (Table S8, Figure S2).

379

380 *3.2.3 Theme trends across instruments and interviews*

381 The objective themes most commonly shared by sectors, across instruments and interviews,
382 related to capacity building and food security. Several interviewees stated that fisheries were
383 not a political priority in Timor-Leste, with very low budget allocation. Effective governance
384 was reported as an objective by only one fisheries, ocean and aquaculture interviewees,
385 despite being present in 80% of sector instruments. This may be a result of allocation of
386 coding themes, as ‘support for government’ was a commonly reported objective by
387 interviewees but was not in instruments, and the two themes may in reality be mutually
388 supportive. Sustainable production and effective governance themes were also commonly
389 present across instruments and interviews, however, sustainable production was not
390 reported by food, nutrition and health sector interviewees, despite being present in 67% of
391 sector instruments.

392 A number of objectives that are broadly recognised as important for achieving FNS were
393 under-represented across both the fishery, ocean and aquaculture sector as well as the food,
394 nutrition and health sector. For example, objectives supporting ‘increased fish consumption’
395 were present in two of six food, nutrition and health sector instruments, and two of ten

396 fishery, ocean and aquaculture sector instruments. A total of two interviewees reported
397 working toward increasing fish consumption, both were from the fishery, ocean and
398 aquaculture sector.

399 Improving the nutritional value of fish (or food) was identified in only one national instrument,
400 and two regional instruments. None of the interviewees described improving the nutritional
401 value of fish (or food) as an objective. Objectives relating to ‘food price stability and
402 affordability’ were present in 67% of food, nutrition and health instruments but were absent
403 from fishery, ocean and aquaculture sector instruments and were not identified through any
404 interviews. ‘Food quality and safety’ was not identified as an objective theme by any
405 interviewees, although it was an objective theme present in approximately a third of fishery,
406 ocean and aquaculture, and food, nutrition and health sector instruments.

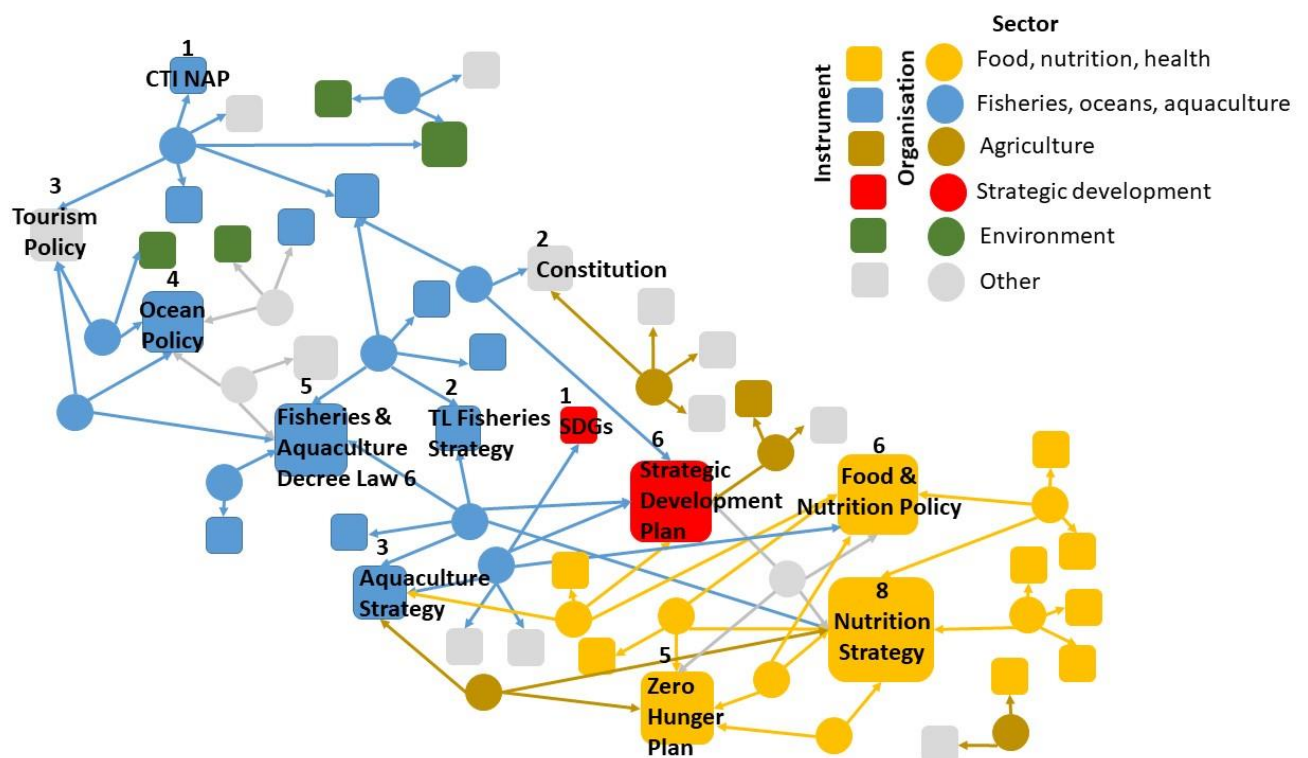
407 The objective themes that had the lowest representation in instruments and interviews
408 included some important areas such as equity; support for youth; reduced food loss and
409 waste; education, awareness and advocacy on food and nutrition; improve nutrition
410 behaviour and practices; and respecting cultural and traditional values (Table S1 and S5).
411 Education and awareness raising is particularly important in Timor-Leste, as one interviewee
412 stated, given the “poor general knowledge of food security, sovereignty, and nutrition” in the
413 country. A number of the findings from the instrument analysis were supported through
414 interviews. For example, the finding that some instruments contained very broad objectives
415 was articulated through interviews “... the documents are all broad and not followed up on,
416 multisector documents overlap, and the links with sectoral plans are not strong.”

417

418 3.3 Policy network analysis

419 3.3.1 Organisation and instrument interaction

420 Many interviewees identified instruments in their own sector, including internal instruments
 421 within their own organisation, as most important to their work. One multi-sectoral
 422 instrument, the *Strategic Development Plan 2011-2030*, emerged as a key instrument across
 423 sectors (Fig 3). A second key instrument linking the Timor-Leste FNS and fisheries networks
 424 was the *National Nutritional Strategy 2014-2019*. The prominence of this instrument for
 425 linking the network is notable given it does not include any specific fisheries or aquaculture
 426 objectives. Of the five most significant bridging instruments identified, three were outside the
 427 fisheries sector.



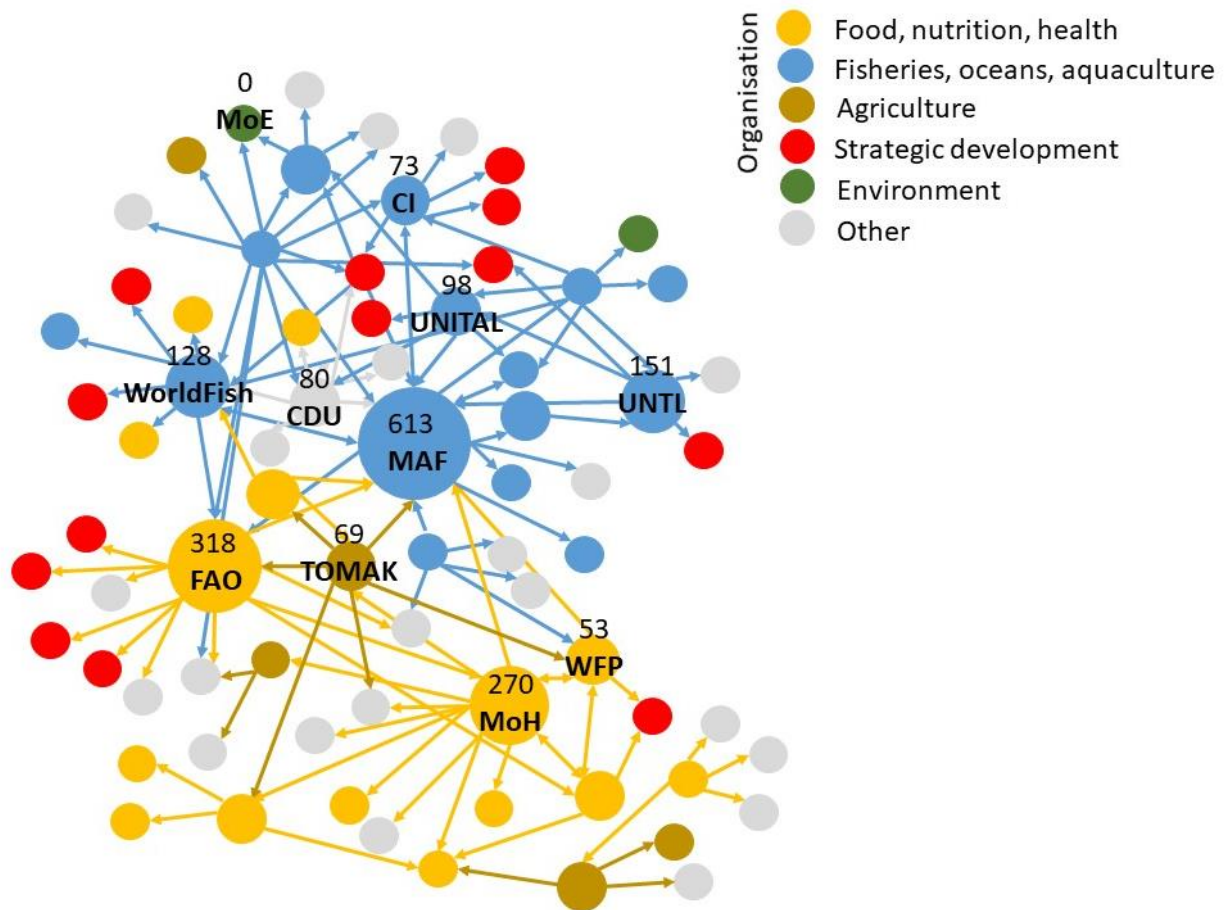
428
 429 *Figure 3 Instruments (squares) used by organisations (circles). The size of the instrument marker is*
 430 *based on in-degree and indicates ‘popularity’ of usage, or number of mentions. Indegree values*
 431 *displayed for select instruments, all values available in Table S5. Key: Coral Triangle Initiative*
 432 *National Action Plan (CTI NAP), Sustainable Development Goals (SDGs).*

433

434 *3.3.2 Organisational interactions*

435 Interviewees were asked to name the organisations of importance for their work. The results
436 highlight the position of one organisation, the Ministry of Agriculture and Fisheries (MAF) as
437 a key linking organisation for collaboration across diverse sectors (Fig. 4). Potential limitations
438 of MAF's role in the network were raised by interviewees who stated the organisation has "...
439 no capacity to go beyond food and nutrition security to systems of delivery." The *MAF*
440 *Strategic Plan 2014-2020* was not identified as a key linking instrument, despite the
441 prominence of the organisation in the network. MAF has a broader mandate than fisheries,
442 oceans and aquaculture, however, it has been categorised in this sector based on the focus
443 of interviewees. The two other key linking organisations were the FAO and the Ministry of
444 Health. The results demonstrate a level of cooperation and collaboration between sectors,
445 although it is clear that full integration has not occurred across all organisations. In addition,
446 some sectoral disconnect was evident, in particular between organisations linked to the
447 environment sector and those most closely linked to the food, nutrition and health sector.
448 This disconnect may not represent a complete lack of interconnectedness, as connections
449 through informal and formal working groups, and links with organisations that are considered
450 less important, are not represented here. The results do indicate that only a small number of
451 organisations outside of each sector were considered 'important' for achieving objectives.
452 These organisations act as bridges to link other organisations that would otherwise be less
453 connected within the network and without these organisations the network would risk lack
454 of connectivity.

455



456

457 *Figure 4 Network of organisations based on between-ness centrality or linkages between*
 458 *organisations. The size of the marker indicates ‘popularity’, or number of mentions. Examples of*
 459 *values shown for select organisations, all values available in Table S3. Key: Ministry of Environment*
 460 *(MoE), Charles Darwin University (CDU), Ministry of Agriculture and Fisheries (MAF), Universidade*
 461 *Oriental Timor Lorosa'e (UNITAL), Conservation International (CI), National University of Timor-*
 462 *Leste (UNTL), Food and Agriculture Organization of the United Nations (FAO), To'os ba Moris Di'ak)*
 463 *program (TOMAK), World Food Program (WFP), Ministry of Health (MoH).*

464

465

466

467 4. Discussion

468 Integration of fisheries in food policy is occurring in Timor-Leste as a result of coordination
 469 among both instruments and organisational networks. The integration of FNS concerns
 470 appears more widespread in fisheries, oceans and aquaculture instruments and networks

471 than the integration of fish by the food, nutrition and health sector. This finding suggests that
472 the role of fish in FNS remains a lower priority for the FNS sector than for fisheries, and that
473 the disconnect in the system may be an effect of the directionality of the network links, rather
474 than the extent of the connections. Policy integration is also constrained by the limited
475 breadth of objectives of instruments and organisations, with several key FNS objectives
476 remaining under-represented across sectors. There is opportunity to build on existing
477 instruments and networks, as well as to coordinate activities between sectors to better
478 integrate fish to achieve FNS outcomes.

479

480 [4.1 Indications of integration in instruments, organisations and networks](#)

481 Food security was articulated as an objective in the vast majority of instruments, as well as
482 interviews, in the fisheries, oceans and aquaculture sector. While nutritional intake was not
483 as frequently articulated, results indicate the fisheries sector has been proactive in integrating
484 FNS concerns and objectives articulated in policies are being implemented through
485 organisations, or organisations are being supported through policy to implement FNS
486 objectives. In contrast, there was limited integration of fish-related objectives within
487 instruments or interviews in the food, nutrition and health sector, with one key instrument,
488 the *National Nutritional Strategy 2014-2019*, containing no objective themes related to fish.

489 The policy network analysis revealed evidence of cooperation and collaboration among
490 sectors on issues of fisheries and food, although they were not well embedded across all
491 organisations. There was also a degree of sectoral disconnect, in particular in relation to
492 agriculture and environment. The fact that only a limited number of agricultural organisations

493 were identified as being important to the fishery and food policy network may be indicative
494 of a broader disconnect between fisheries and agriculture.

495

496 4.2 Challenges to policy integration

497 4.2.1 Range and depth of objective themes

498 Despite the promising level of integration of FNS objectives visible in the fisheries, ocean and
499 aquaculture sector, the extent of integration was limited in terms of both coverage of FNS
500 themes as well as clear paths to achieve stated objectives. The vagueness of some statements
501 relating to FNS in many of the fisheries instruments represents a possible explanation for the
502 mismatch between the seemingly good level of integration and the reality that fish does not
503 currently play a strong role in alleviating hunger and malnutrition in Timor-Leste. For example,
504 clear actions and targets on increasing production and consumption, and on nutrition intake
505 and behaviour were lacking in regional and national instruments. The lack of clarity of many
506 objectives was also evident in some food, nutrition and health sector instruments, in
507 particular in relation to increasing consumption of fish. A loss of specificity of designing
508 actions was also identified in an assessment of integration of fish into food and nutrition
509 policy in East Africa (Kurien and López Ríos, 2013). Identifying clear actions and targets in
510 objectives is an important aspect for integration, particularly within key linking instruments.

511 Lack of clear targets may result in limited implementation, or worse in incoherent or
512 countervailing objectives. For example, there are potential synergies and trade-offs between
513 marine conservation, resource management, and FNS concerns which need to be considered
514 (HLPE, 2014). Conservation related objectives were not mentioned by interviewees in the
515 food, nutrition and health sector, however, given the predicted growth of Blue Economy

516 activities in Timor-Leste, the interactions between fisheries production, conservation and FNS
517 will need to be clarified and managed across sectors (Quirk et al., in review). Several fisheries,
518 oceans and aquaculture sector organisations that listed tourism and conservation as
519 additional sectors also reported food security as one of their key objectives. Some of these
520 organisations were linked to the CTI National Action Plan. The CTI on Coral Reefs, Fisheries
521 and Food Security (CTI-CFF) has set a target to improve income, livelihoods and food security
522 in coastal communities across the Coral Triangle region in their regional plan of action (Coral
523 Triangle Initiative, 2009). While the CTI has explicit goals and defined targets for marine
524 biodiversity conservation, pathways for achieving FNS outcomes will need to be clarified to
525 help overcome food insecurity in the region. We found that the CTI network was linked to
526 tourism, fisheries and environmental instruments, but not to any FNS instruments or
527 organisations. Establishing these links is important given that MPAs are used globally as a
528 fisheries management and conservation tool, and their design is critical to their success in
529 relation to food security (Cabral et al., 2019). In Timor-Leste, the success of MPAs has not
530 been critically assessed (López-Angarita et al., 2019) and there is a need to ensure legitimate
531 community engagement in fisheries governance to avoid external appropriation and
532 marginalisation of certain user groups or customary power hierarchies (Tilley et al., 2019).

533 It has been argued that promoting ‘food security’, without clear actions and targets, may
534 benefit proponents of intensifying food production and trade liberalisation more than those
535 who are food insecure (Jarosz, 2011; Rosin, 2013; Tomlinson, 2013). Clear pathways are
536 required for objectives on increasing fish production, and on developing the export industry
537 in developing countries, to ensure their contribution to overcoming food and nutrition
538 insecurity and meeting sustainable development goals. Sustainable production and use was

539 a common objective for instruments across sectors, and for fishery, ocean and aquaculture
540 organisation, however, it was not reported by any interviewees in FNS. This may be a function
541 of a lack of detail on implementation in instruments. Objectives for sustainable production
542 will need to be closely linked to objectives to increase the production of fish, which was a
543 focus across sectors. Weak links between environmental sustainability of fisheries and food
544 security has been identified as an impediment to securing sustainability in fisheries (Hall et
545 al., 2013).

546

547 *4.2.2 Political will and resources*

548

549 The lack of clear pathways for implementation is compounded in Timor-Leste by limited
550 political support. A lack of political will and resources can limit organisations in moving
551 beyond discursive or symbolic action (Jacob et al., 2008). MAF was identified as a key linking
552 organisation, however, the Ministry is tasked with multiple objectives across multiple sectors
553 and has limited financial and technical resources. For MAF to enhance integration around one
554 issue, such as fisheries, it will likely require transferring resources from other areas,
555 potentially resulting in a loss of performance elsewhere (Candel and Biesbroek, 2016). When
556 addressing the integration of fisheries and FNS, it will be essential to maintain resources for
557 key fishery activities such as effective management. Integrated approaches can face financial
558 and logistical barriers for large-scale initiatives, and may be easier to consider more
559 integrated, multiple livelihood strategies for FNS interventions at the project level (Fisher et
560 al., 2017). Engaging development partners, who currently have very limited inclusion of fish
561 in their development strategies, through joint programming will be an important driver of
562 future projects and resource allocation.

563

564 Lack of political motivation has also been linked to the low priority for food and nutrition
565 globally (Cheng et al., 2014) and a lack of cohesion within the food and nutrition policy
566 community is recognised as a challenge in the food and nutrition sector (Heaver, 2005; Menon
567 and Stoltzfus, 2012; Natalicchio et al., 2009). Timor-Leste has a generally high level of
568 expressed commitment to food and nutrition, however, it performs poorly on ‘institutional’
569 and ‘budgetary’ commitments, including the adoption of laws and policies supportive of
570 formulating and implementing the food and nutrition agenda, and adequate resource
571 allocations to accomplish programmatic initiatives (Cheng et al., 2014).

572

573 In many countries, including Sierra Leone and Timor Leste, the development of the fisheries
574 sector, and its contribution to FNS, is challenged by the effects of past conflict and the success
575 of post-conflict governance and interventions (Khan and Sei, 2015; López-Angarita et al.,
576 2019). Civil conflict can negatively affect fishery economic development over a long time
577 frame, through reduced fish catch, redeployment of fishers into other sectors and the
578 potential increase in illegal, unreported and unregulated fishing as a result of ineffective
579 management (Hendrix and Glaser, 2011). In Timor-Leste, the fisheries sector has been
580 negatively affected through the creation of a personnel void in fisheries administration (ADB,
581 2001), as well as through the destruction of fishing infrastructure during the Indonesian
582 withdrawal. Timorese staff were intentionally kept out of senior management positions in the
583 government during the Indonesian administration. After the election in 1999, over 7,000
584 Indonesian public servants fled Timor-Leste, creating a vacuum in the public service, with a
585 limited number of qualified personnel available in the administration (Miyazawa, 2013). As a
586 result, governance of fisheries, and other sectors, in Timor-Leste has been dependent on

587 external human and financial resources, which has been shown to shape policy and practice
588 according to international expectations in other post-conflict situations (Poole et al., 2018).
589 While these governance issues are important in respect to the integration of fish and food,
590 they are also relevant to the integration of food and nutrition security in national policy and
591 to development challenges more broadly.

592

593 4.3 Opportunities for improving policy integration

594 Ideally, FNS programs and all development programs would be designed in a way that
595 facilitated policy integration, or at least reduced conflicts (Candel and Biesbroek, 2016).
596 Where the integration of fisheries and FNS may not be fully realisable, due to lack of support
597 or lack of defined targets for example, the coordination of programs becomes critically
598 important (Peters, 2018). Strategies to integrated fisheries and nutrition to improve health
599 need to be layered and iterative over time or risk having limited impact. For example, efforts
600 to integrate nutrition concerns into water, sanitation and hygiene interventions has had no
601 effect on childhood stunting (Cumming et al., 2019). While the ambition to fully integrate
602 fisheries and food policy nationally and internationally helps to envisage the desired future
603 direction, in the face of challenges, a short-term approach may be to take the most immediate
604 options to ensure that actions continue along the preferred path (Candel and Biesbroek,
605 2018), and to ensure more inclusive governance which actively engages fishers in decision-
606 making processes (HLPE, 2014), in particular small-scale fishers and farmers.

607 Specific action for Timor-Leste to both improve integration of fisheries and aquaculture across
608 sectors and contribute to improving FNS, include building on existing policy networks and
609 working groups to:

- 610 - Strengthen connections across shared objectives that are actively supported by key
611 linking organisations and instruments. For example capacity building, sustainable
612 production, increased production, poverty alleviation and food safety and quality.
- 613 - Prioritise integration efforts in key linking instruments. The *Strategic Development*
614 *Plan 2011-2030* was identified as a key bridging document between sectors. This plan
615 is aligned with the SDGs and also contains planned actions to enhance the
616 performance of the fisheries and aquaculture sectors. The *National Nutritional*
617 *Strategy 2014-2019* was also identified, however, it lacks fishery and aquaculture
618 objectives and represents an opportunity to improve integration in the drafting of the
619 new strategy.
- 620 - Prioritise shared objectives that will achieve inter-sectoral outcomes, such as
621 supporting women’s role in fisheries and FNS, which will enhance the role of fisheries
622 in FNS, while simultaneously helping to create more sustainable and healthy food
623 systems, with minimal need for additional time and resources.

624

625 4.4 Integration of under-represented objective themes to improve food and nutrition security

626 In the longer-term, coordination of programs across under-represented themes will
627 strengthen integration and improve FNS outcomes across multiple sectors. This approach will
628 also help overcome the trend for programmatic interventions that address FNS to take a
629 single-sectoral approach (Fisher et al., 2017). We discuss some of these less integrated
630 themes in more detail.

631

632 4.4.1 Promoting fish consumption and improving nutritional behaviour

633

634 Timor-Leste differs to other developing island nations, such as those in the Pacific, in that
635 consumption of fish is low and food policy integration needs to also consider increasing
636 consumption. Instruments including objectives to increase consumption typically also
637 included detailed targets, however, they did not discuss how consumption will be increased
638 and targets met. One exception is the *National Aquaculture Development Strategy 2012-2030*
639 that identifies the Ministry of Agriculture and Fisheries, the Ministry of Education, as well as
640 the private sector, farmers and I/NGOs as key partners in actions to increase fish
641 consumption. Several key documents with a specific focus on fisheries and food security did
642 not include any objectives relating to increased consumption, or to nutritional intake. This
643 finding extends to regional documents, such as the CTI, which lacks targets for improving
644 access or consumption of fish (Foale et al., 2013). Increasing consumption may be less
645 important for countries that already have high consumption, however, it is crucial for
646 countries such as Timor-Leste where only small amount of fish and other animal protein are
647 consumed (Wong et al., 2018). Promoting fish consumption may also be required in countries
648 where a transition away from traditional foods, such as fish, toward 'modern' diets is resulting
649 in higher rates of non-communicable diseases and food insecurity (Charlton et al., 2016).

650

651 Related objectives that would form important pathways for increasing consumption, for
652 example, those relating to education and awareness, improving nutrition behaviour and food
653 affordability were generally absent in fisheries policies and limited within food policy
654 generally. Food price volatility is closely connected to the concept of FNS (FAO et al., 2015)
655 and an understanding of the causes of volatility is important in order to implement
656 appropriate policy responses (Kalkuhl et al., 2016), particularly in regions with higher fish

657 price volatility (Tveteras et al., 2012). High prices were identified in consumption surveys as
658 main reasons for not eating fish in Timor-Leste (López-Angarita et al., 2019).

659

660 Several interviewees noted activities in relation to improving nutrition behaviour and
661 practices that linked to fish consumption, even if they were not directly involved. For example,
662 the distribution of information on fish through comics and school magazines. Including fish
663 consumption in education around food and nutrition is an important step toward integrating
664 fish and food. Developing a better understanding of the nutrient composition of fish, and
665 varied nutrient yields among fisheries, is required in all countries to facilitate the policy shifts
666 needed to realise the potential of fish for FNS (Hicks et al., 2019; Thilsted et al., 2016).

667

668 Taboos around eating fish exist in many countries, including Timor-Leste (Fidalgo Castro,
669 2013). A reported social norm hindering increased fish consumption is that women need
670 specific approval from men and children in order to cook and serve fish-based meals
671 (Nugroho, 2017). Fish is also an expensive foodstuff that is not part of the ritual exchange
672 system, unlike meat which is tightly linked to rituals and is valued beyond its consumption or
673 exchange value (Alonso Población, 2013). The less important customary role of fish may
674 represent a potential opportunity, as fish may be consumed directly unlike other animal
675 proteins. Given the potential influence of taboos, interventions to increase fish consumption
676 should recognise cultural importance, ritual exchange systems and patterns of consumption,
677 as both the market economy and non-market exchanges influence the current development
678 status of the country's fishery sector (Alonso Población, 2013). This is an important area to
679 develop, particularly given that objectives relating to cultural and traditional values were

680 lacking across all sectors and organisations, and that it is easier to change policy instruments
681 than to change policy paradigms or core belief systems (Candel and Biesbroek, 2016). Cultural
682 objectives must be incorporated into policy and practice, in particular as a means of providing
683 practical examples to people in order to overcome barriers to fish consumption. For example,
684 supporting women from coastal areas with young children to visit pregnant women living
685 inland to share their experience and reinforce that eating fish will not negatively affect the
686 baby.

687

688 *4.4.2 Supporting the role of women in fisheries*

689

690 Supporting the role of women in fisheries is an opportunity to link fisheries with FNS
691 outcomes, given the links between improved gender equality in fisheries and to poverty
692 reduction and development (Harper et al., 2013), as well as to improved FNS more broadly
693 (Quisumbing et al., 1996). Our finding that objectives to support women were not well
694 integrated into fishery policies reflects the global situation in which the role of women in
695 fisheries and their contribution to food security has typically been overlooked in food policy
696 (Harper et al., 2013). Women play an important role in the fisheries sector in Timor-Leste, in
697 particular through gleaning and fish processing (Tilley et al., in review). The main role of
698 women in the sector is predominantly to provide food for the family. This role is recognised
699 through the recently developed *National Fisheries Strategy 2018*, although there are no
700 strategic actions relating to support for women or for gender more broadly. Involving more
701 women in decision making at every level, from national to community, across all countries, is
702 an important aspect of the integration of fisheries in food policy. The *Maubisse Declaration*

703 2018 is a positive step toward improved integration and cross-sectoral engagement on
704 improving the lives of women in Timor-Leste.

705

706 4.4.3 Increasing production

707

708 Globally, fisheries policy tends to focus on maximising profit or yield (Stephenson et al., 2017).

709 While increasing production is a common theme of fisheries policy in Timor-Leste, increased
710 availability does not automatically lead to improved FNS (Allison, 2011; Bogard et al., 2017).

711 Refocussing fisheries policy towards more efficient and equitable distribution, and towards

712 improving eating patterns to meet local nutritional needs, is required (Alonso Población,

713 2013) to overcome both geographic and socio-economic barriers. This finding is applicable to

714 fisheries and food policy more broadly, given the links between access to fish and fisheries

715 and FNS (Béné et al., 2016). Increased production also needs to be undertaken within

716 biological limits. Sustainable production was a common objective theme within fishery

717 organisations and instruments, however, it was less integrated within the FNS policy network.

718 4.4.4 Value addition and market access

719

720 The fisheries value chain has been identified as a means to improve the contribution of fish

721 to FNS, in regions of both high and low fish consumption, by improving access, reducing loss

722 and waste, and creating employment (HLPE, 2014). Fish-based value chains were identified

723 as high potential areas for development in the *Ministry of Agriculture and Fisheries Strategic*

724 *Plan 2014-2020*, and improving value chains was identified as a strategic action to improve

725 FNS in the *National Fisheries Strategy 2018*. However, very little has reportedly been

726 completed or planned to develop market infrastructure, reduce post-harvest loss or

727 encourage and support private sector investment (Ministry of Agriculture and Fisheries,
728 2013).

729

730 Value chain improvement is hindered by the prior destruction of an estimated 70% of physical
731 infrastructure by Indonesian militia during the conflict in Timor-Leste (World Bank, 2002). Loss
732 of infrastructure required for food production and distribution reduces resilience and
733 increases vulnerability to food insecurity (Westlund et al., 2007). Damage to fishing
734 infrastructure, in particular, can lead to substantial losses across supply chains and prevent
735 sector development. The Hera Port ice machine, as well as a number of main public markets
736 and fish landing sites, for example, were destroyed in Timor-Leste (Barbosa and Booth, 2009).
737 Similarly in Yemen, damages from conflict affected all aspects of the fishing sector, including
738 infrastructure and fishing operations, as well as all stakeholders involved in fish processing
739 and marketing (Al-Fareh, 2018).

740

741 Objectives relating to ‘reduce food loss and waste’, ‘value addition and market access’ and
742 ‘industry innovation/sector development’, which require improved infrastructure, were
743 lacking across sectors in instruments and interviews, particularly the food, nutrition and
744 health sector. Several instruments across sectors had objectives relating to food safety and
745 quality, however, this objective was not reported by any interviewees, despite some reported
746 concern over fish quality from the use of formaldehyde.

747

748 Food insecurity in Timor-Leste is partly the result of low levels of food production combined
749 with high food losses, both pre- and post-harvest (Borges et al., 2009). A lack of road side
750 refrigeration has previously been identified as an issue in Timor-Leste, and the consolidation

751 of an ice distribution system, combined with food safety promotion, should be considered as
752 part of intervention into the fishery sector (Alonso Población, 2013). Engagement of both the
753 government as a regulator of law and the private sector as an implementation agent will be
754 important for improving value chains for fish, and other foods, and for developing new
755 markets. Consideration will also need to be given to market integration, which has been
756 highlighted as an issue when attempting to harmonise fisheries and aquaculture policies with
757 FNS concerns (FAO, 2017).

758

759 5. Conclusion

760 Food security is well-integrated into fisheries policy Timor-Leste, but there is little evidence
761 of the reciprocal integration of fish into food policy. A range of shared objective themes were
762 identified between sectors and building on these will be a key step toward reconciling the
763 competing demands of different policy instruments and achieving policy integration. Scope
764 exists to improve the range of objectives themes covered. For example despite good
765 integration of food within fisheries policies, a number of key FNS concerns were not well
766 addressed. Integrating a broad range of objectives is important for supporting the role of fish
767 in FNS, in particular those relating to the role of women, developing value chains, and
768 increasing production and consumption. Policy network analysis revealed evidence of
769 collaboration and cooperation between sectors, however, fish and food concerns are not well
770 embedded across all organisations. Increased political will and resources, combined with
771 clearer targets and actions within key instruments in particular, will help to better integrate
772 fish and food policy and ultimately improve food and nutrition security.

773

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