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2 Executive summary

2.1 Key findings

This project undertook research to support the development of systematic socio-economic assessments, and the establishment of related monitoring systems in Indonesian tuna fisheries. The focus was to explore the use of fisheries dependency indicators for assessing potential impacts of alternative management measures on vulnerable communities. It is intended that assessments of dependency and vulnerability should be used alongside biological and economic assessments to support the development and testing of harvest strategies for the main tuna species in Indonesia's Archipelagic Waters (IAW).

Fisheries dependency (FD) in its simplest sense is the concept that some individuals, communities, regions or nations are more reliant on fisheries than others, and that for some, fishing is an essential aspect of life in that place. Vulnerable regions and communities can be defined as the subset of the total dependent population who have relatively high levels of exposure and sensitivity to processes of social or ecological change, and relatively low adaptive capacity. Vulnerability in the broadest sense is a basic aspect of FD studies, in that all FD studies assume that a higher level of fisheries dependency leads to vulnerability to a stock decline or changes in fisheries policy (Symes 2000). A number of studies also utilise vulnerability indicators as an explicit, additional aspect of analysis, to assess characteristics of regions and communities that make them more or less vulnerable to specific processes of change or specific risks. The following diagram displays the basic relationship between dependency and vulnerability.

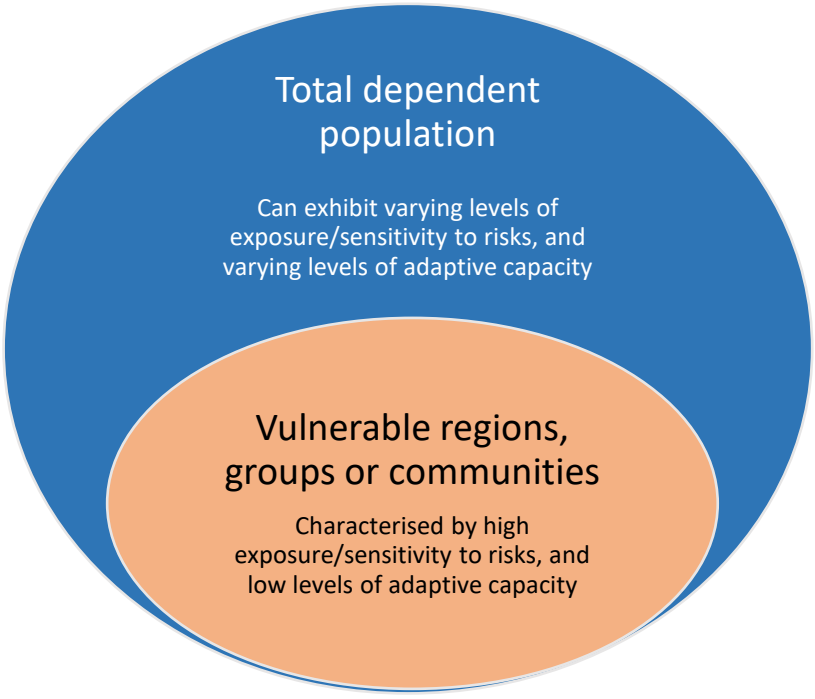


Figure 1. Relationship between fisheries dependency and vulnerability.

A harvest strategy for Indonesian tuna requires assessments at a scale relevant to the management system, and needs to be functional over a time period of decades. Therefore, monitoring systems for these purposes will not be able to capture all data points of potential interest, across all sites, but instead need to be able to highlight key trends in important indices. These need to be, primarily, of relevance to setting catch and effort limits to meet sustainability objectives under the Indonesian Fisheries Management Act 2009 (FMA). At the same time the Indonesian Ministry of Marine Affairs and Fisheries (MMAF) needs to be able to demonstrate that it is meeting objectives under the FMA related to food and nutrition provision, and improving the living standards of fishing dependent communities.

In many cases, these social objectives will be balanced via separate, parallel initiatives that are not addressed directly in a harvest strategy. However, the possibility of objectives conflicting under certain circumstances raises the prospect of consciously assessing socio-economic outcomes from different harvest strategies in order to optimise outcomes from management (Davies et al., 2023).

In this context, and on the basis of the data and research findings presented in the body of this report, we highlight three major conclusions that are of relevance to the harvest strategy and associated national level monitoring systems.

1. Assessment of Indonesian tuna fisheries requires consideration of both broadscale fisheries dependency, and household level vulnerability

The basic characteristics of the fishery and the scale at which it operates indicate that broad-scale assessments of tuna dependency across Indonesia's provinces are important for developing functional management systems that can forecast likely socio-economic impacts of different management strategies. Tuna fishing occurs across the archipelago, and Indonesia's tuna fisheries are unique in the context of Indo-Pacific tuna fisheries due to the extent of catch from small and medium scale vessels alongside large scale fleets (Proctor et al. 2016, Davies et al., 2023). Of further note is the variations between fleets and value chains across provinces, the high degree of interaction between the different tuna fleets and associated value chains, and the reliance of communities on these fisheries for basic income and food needs (McClean et al., 2019).

These issues raise the possibility of unintended consequences from the implementation of management measures that do not take fisheries dependency across provinces and in different fleets into account. The history of regulatory interventions in tuna fisheries further suggests that assessing relative dependency between provinces and fleets will improve the capacity for the Indonesian government to design management measures that are more likely to be effective, while minimising unintended socio-economic impacts (see e.g. Satria et al., 2018).

A second key high-level conclusion of this project is that for Indonesia, assessments of household level vulnerability across provinces are also required to be able to identify those regions and communities that have a low capacity to cope with change. This is based on findings of pilot data collection that indicate:

- High levels of dependency in tuna earning households, with 88% of household income on average coming from tuna and with consistent median values of 100% across most gear types (n=235). Our research indicates that for 70% of tuna workers

in Kendari (n=114) and 75% in Ternate (n=121), 100% of household income comes from tuna fishing or other value chain activities.

- Limited alternative income sources or potential for alternative livelihood options, as evidenced by high household income dependency rates coupled with low levels of education, low levels of skills and experience outside tuna fishing, and a low willingness to exit tuna fisheries. Interviews in Ternate (n=148) in particular highlighted that:
    - Only 19% of tuna fishers interviewed stated they had an alternative livelihood available to them.
    - Only 16% have access to gardening land for basic subsistence in the event of a decline in tuna income.
    - Tuna fishers appear to have a low willingness to exit the fishery, with only 9% of respondents having considered moving into another livelihood, and 91% of respondents stating that that would seek to stay in tuna fishing (different vessel or role) if they could not continue in their current role.

- Limited financial reserves and assets to facilitate a change in occupation among a substantial proportion of tuna workers, as evidenced by between 7.4% (lowest value, Ternate n=121) and 30.7% (highest value, Kendari n=114) of tuna dependent households considered to either be experiencing poverty or at risk of poverty in the event of a reduction in access to tuna. Variations across provinces in poverty risk indicators are significant and highlight the need for profiling across the main tuna fishing areas for household vulnerability, which may vary considerably.

- Potential for low living standards in alternative livelihoods for which tuna fishers and workers have skills and experience. In particular, our findings show that household food insecurity is likely to be significantly higher in non-tuna fishing households than in tuna dependent households, and household poverty rates likely to be somewhat higher on average in non-tuna fisheries households than in tuna dependent households. This would likely provide a disincentive to exit tuna fishing and enter non-tuna fishing livelihoods.

If ever there was a substantial change in access to tuna in the ports where we piloted methods to assess household vulnerability, our data suggests that:

1. A proportion of tuna dependent households may not have the willingness or capacity to readily exit the fishery or move into other more sustainable livelihood options.
2. A proportion of tuna dependent households risk slipping into, or further into, poverty.
3. The level of tuna dependent households at risk of poverty is likely to influence the proportion of households with the capacity to exit the fishery.

These findings indicate that household level vulnerability assessments are likely to be important in Indonesian tuna fisheries for both social welfare reasons, to ensure that vulnerable groups are not pushed into poverty as a result of changes to their access to tuna, and for ecological reasons, to ensure that, in the event of sustainable management interventions being required to limit catch or effort, vulnerable groups with low adaptive capacity are supported to exit the fishery and avoid possible “effort shifts” into other tuna vessels or fleets. These considerations should be integrated into fisheries dependency

assessments, as one aspect of ongoing socio-economic assessments in Indonesian tuna fisheries.

We highlight that the pilot nature of data collection means these conclusions should in the first instance stimulate more research into household vulnerability such that these results can be validated and further quantified across a representative sample of regions and communities.

2. *Available government data can, with progressive improvements in quality over time, measure tuna fisheries dependency across provinces.*

A positive finding of this research is that, with progressive improvements over time being made, the basis for a sound fisheries dependency monitoring system exists in existing data collected by MMAF and the Indonesian Bureau of Statistics (*Badan Pusat Statistik* – BPS). Specifically, data collection already occurs for the following core dependency measures:

- Production - PIPP port level data collected by MMAF
- Employment – SARKENAS National Labour Force Survey conducted by BPS.
- Revenue (Gross Value of Production) – PIPP port level data on per vessel trip costs collected by MMAF.
- Tuna consumption – SUSENAS household expenditure and consumption data collected by BPS.

In particular, household tuna consumption data contained in SUSENAS household surveys provides a readily available measure that shows the dependency on tuna across the population, across provinces.

In addition, the existence of household poverty and food insecurity rates in all fishing households per province, based on SUSENAS data collected by BPS, provides an initial readily available measure at the provincial scale that can be easily incorporated into a provincial fisheries dependency assessment. This can assist by providing contextual information on household vulnerability across provinces that can be considered in decision-making in the short-medium term.

However, issues of data quality and the inability to disaggregate for tuna species for some key datasets are key issues that will need to be addressed over time for this national scale system to be functional for the purposes of assessing management options in tuna fisheries.

3. *Income data can generate relatively cost-effective information on household level vulnerability in Indonesian tuna fisheries*

An encouraging finding is that our research suggests collection of household income data via new data collection initiatives (i.e. in addition to existing government data) provides the basis for relatively cost-effective, targeted household vulnerability assessments in Indonesian tuna fisheries, and potential for ongoing monitoring, through recording:

- Average monthly household income from tuna.
- Average monthly household income from all sources.

Availability of these household income data points would facilitate assessment of:

- Average household income across the dependent population
- Household income dependency on tuna (% of income from tuna).
- Availability of alternative income sources.
- Household poverty risk, measured as % of tuna households whose total monthly household income is below the provincial household poverty line.

- Household food insecurity risk, measured as the % of tuna households whose total monthly household income is less than the provincial household food poverty line.

These indices would provide a valuable data set for assessing household vulnerability, especially when coupled with detailed baseline information on available livelihoods and household expenditure and consumption. Mixed methods livelihoods data would provide important information on how fisheries operate and interact with communities across different provinces/sites, including the presence of alternative livelihoods, and inform assessments of willingness and capacity to exit the fishery. Expenditure/consumption data would validate regular income-based monitoring data and through so doing support generation of proxies that over time may reduce the need for regular household monitoring.

Additionally, such data would enable the development of relatively simple composite indexes of household vulnerability, that could enable decision-makers to integrate these socio-economic considerations into management processes and decision-making.

2.2 Recommendations

1. The Indonesian government undertake initial baseline assessments, and determine the feasibility of an ongoing socio-economic monitoring system, according to a three-step process:
    a. Assess provincial tuna dependency based on existing government data, to highlight the relative impacts of fisheries policy at a broad scale (i.e. across provinces). This should include standard FD indicators of production, employment, revenue and tuna consumption across provinces.
    b. Assess household vulnerability based on new data collection, to identify provinces, fleets and ports with high numbers of tuna fishing households with a low ability to cope with change. This should include indicators of household income dependency, alternative livelihoods potential, poverty and food insecurity, and willingness/capacity to exit the fishery, in tuna dependent households per province.
    c. Improve the ability to disaggregate data to be able to assess dependency and vulnerability in relation to different species, gears, sectors, value chains, markets, roles and social groups.
2. That this system be established so as to support national monitoring of tuna fisheries, and also be used as a template for future socio-economic monitoring in non-tuna fisheries such as demersal and reef based coastal fisheries.

With respect to next steps, an initial baseline assessment across provinces in the Indonesian Archipelagic Waters region is achievable in a follow-on initiative.

It is worth noting however that numerous factors will influence the feasibility of adopting a socio-economic component within a regular monitoring system. For example:

- Improving the quality of government data sources for use in tuna fisheries management requires substantial effort across multiple agencies.
- Developing processes for how socio-economic data shall be considered in decision making is a substantial effort in itself and will require work on policy and management procedures and protocols within MMAF.

- It is highly likely that until fine scale effort data is produced, the ability to link socio-economic indicators to quantitative models in a harvest strategy development process will be limited (see Davies et al., 2023).
- The cost and burden of undertaking regular (i.e. annual) field surveys to collect household data as a feature of the SE monitoring process needs to be carefully considered with respect to:
    - Priorities to support resource monitoring and economic data collection.
    - The additional value of collecting socio-economic data, vis-a-vis tracking the achievement of priority management objectives for the tuna fishery.
    - Alternative means of collecting household data or assessing household vulnerability that are not reliant on field surveys and may be more cost-effective.
    - The ability for a baseline study and periodic livelihoods and vulnerability assessments (e.g. every 5-10 years) to provide sufficient information for the purposes of harvest strategy development, testing and review.

Thus, our recommendations need to be couched within a realistic understanding that while initial baseline assessments are achievable, implementation of an effective monitoring system will take time to develop, be reliant on multiple co-ordinated efforts, and therefore will be impacted by factors outside of the socio-economic monitoring process itself.

A baseline study of dependency and vulnerability across IAW provinces would also enable the assessment of the feasibility of regular socio-economic monitoring, further highlighting its' value.

2.3 Draft socio-economic monitoring framework for assessing the impacts of alternative management measures on vulnerable, tuna dependent communities

The following draft framework can be utilised initially to inform thorough baseline assessments across provinces in the IAW region, and consideration of the feasibility and cost-efficiency of regular (i.e. annual) income-based monitoring of household vulnerability.

Step #1 – Provincial level fisheries dependency assessment

Utilising available government data

- *Tuna/Cakalang/Tongkol* production per province utilising MMAF catch data.
- Gross value of tuna production per province utilising MMAF vessel data.
- Employment contribution of the tuna fishing sector per province utilising SARKENAS Labour Force Survey data.
- *Tuna/Cakalang/Tongkol* consumption per province, utilising SUSENAS household income and expenditure survey data.
- Poverty rates in fishing households per province, utilising SUSENAS household income and expenditure survey data.
- Food insecurity rates in fishing households per province, utilising SUSENAS household income and expenditure survey data.

Step #2 – Profile regions for vulnerability to a reduction in access to tuna, utilising household level vulnerability indicators.

Utilising thorough livelihoods, income, expenditure and consumption data (as a baseline and every 5-10 years):

- Average household income in tuna HH per province.
- % of household (HH) income from tuna per province.
- % of tuna HH with alternatives/second incomes per province.
- % of tuna HH classified as poor per province.
- % of tuna HH classified as food insecure per province.
- Seasonality of tuna fisheries and implications for household vulnerability.
- Willingness and capacity to exit tuna fisheries per province.
- Available alternative livelihoods per province.

Utilising basic income data from new household data collection (e.g. annually, if deemed feasible and cost-efficient relative to it's additional value):

- Average household income in tuna dependent households.
- % of household (HH) income from tuna per province.
- % of tuna HH with alternative incomes per province.
- % of tuna HH earning below provincial poverty line (i.e. at risk of poverty per province).
- % of tuna HH earning below food poverty line (i.e. at risk of food insecurity per province).

Step #3/Priority #3 Disaggregation of data

Fisheries dependency and vulnerability indicators are more useful if they can be disaggregated. Findings indicate the importance for future work to disaggregate for the following key attributes:

- **By species:** generate information specific to the main important fish species, that can help track impacts of management efforts.
- **By fleet**: Compare between different fleets or fleet segments (handline, pole and line, purse seine, longline; small, medium and large vessels).
- **By value chain:** Canned, fresh, frozen and smoked products.
- **By market**: Local markets (i.e in the surrounding areas of fishing and landing sites), domestic markets (i.e. in larger urban centres and non-tuna fishing areas), and export markets.
- **By sector:** Compare between fishing and post-harvest sectors, formal/informal sectors.
- **By role:** Compare betwen crew, skippers, owner/operators, vessel owners, processors, traders and other relevant pre- and post-harvest roles.
- **By household livelihood, economic or nutrition status:** Compare between tuna fishing/non-tuna fishing households, poor/non-poor households, food secure/insecure households.
- **By social group:** Compare benefits between, for example, men and women, between migrant and local workers.

3 Background

Indonesia is the largest tuna fishing nation globally (FAO 2023), being responsible for between 15-22% of global production (Davies 2023, CEA 2018). While tuna fisheries globally are commonly associated with large industrial fleets (FFA 2022, Webb 2020) tuna industries in Indonesia are highly varied in their nature, supporting an estimated 300,000 vessels across small, medium and large-scale fleets (Davies et al., 2023). Although such estimates are highly uncertain they nonetheless provide an indication of the scale of tuna fishing in Indonesia. Fishing occurs across the archipelago and, depending on the nature of the gear and value chain, relies on large ports, as well as occurring in smaller provincial towns, and in thousands of villages scattered across the archipelago. These fleets catch and supply fish to value chains processing large amounts of tuna in Indonesia both for domestic consumption and for export (Proctor et al., 2016, McClean et al., 2019, Hoshino et al. 2024). As a result, tuna fishing is an important economic sector and livelihood option in provincial centres and remote islands and villages. In particular Eastern Indonesia, where major centres for tuna production and export are concentrated, is the least developed region of the country (World Bank 2015), and fisheries dependency is high (McClean 2017, McClean et al., 2019, Muawanah et al., 2020). Catch of both tuna and non-tuna species occur regularly within single fishing operations (Hoshino et al., 2020, 2024, McClean et al., 2019), and the ability to target different species supplying different market chains are important aspects of livelihood/business strategies among tuna fishers (McClean et al., 2019).

These basic characteristics bring into focus the socio-economic dimensions of the fishery as an important consideration in its sustainable management. However, Indonesian tuna fisheries operate at a scale and a level of complexity that make assessing the social and economic impacts of fisheries management challenging. Both the size and wide geographic spread of the fishery, as well as functional interactions between multiple species, fleets, sectors and market chains (Proctor et al., 2016, Satriojiae & Yuniarta 2018, McClean et al., 2019), mean that considerable social, economic and biological risks are associated with implementing management measures that are not tested in a modelling setting first.

Such risks raise the prospect of unintended consequences, including the possibility of substantial impacts on poor and food insecure groups. Given the quantum of fishing effort involved, unintended consequences of management efforts also raise the possibility of significant negative impacts ecologically. In the longer run, there is a need to enable assessment of the socio-economic impacts of alternative management measures in terms of their impacts on regions and communities, utilising regularly collected monitoring data.

The Indonesian Ministry of Marine Affairs and Fisheries (MMAF) has been working towards developing an operational harvest strategy for its IAW tuna fisheries since 2014, covering the major fishing grounds in Eastern Indonesia. The harvest strategy aims to develop robust management systems appropriate to the Indonesian context and the multi-jurisdictional nature of tuna fisheries. In particular, the large-scale, inter-linked nature of this system needs to be addressed in the harvest strategy development process, and monitored at scale to be useful in the context of implementing effective management systems.

Thus far the harvest strategy has considered social and economic objectives and measures (see Hoshino et al., 2020, 2024, also McClean 2017), yet these have been consciously deferred (i.e. a biomass target reference point was not agreed in the harvest strategy

framework – see MMAF 2018). This was considered prudent as the conventional economic objective of Maximum Economic Yield, and associated approaches to valuing fisheries utilised in Australia, North America and Europe, take a “wealth-based” approach to fisheries management (see Béné at al., 2010, Cunningham et al., 2008). Such an approach is not necessarily appropriate in a context where food security and employment are high priority objectives. For example, maximizing economic returns favours reducing labour costs. Moreover, it is important to consider the benefits and risks associated with different roles, and the distribution of those benefits and risks among poor or food insecure groups, and along gender lines. Furthermore, conventional approaches focus on harvest, whereas the social and economic benefits that fishing generates, and therefore the impacts of management measures, occur along whole value chains.

The harvest strategy, and Indonesian tuna fisheries management more generally, is therefore at a point where it requires a context specific approach to valuing tuna fisheries, and assessing the social and economic impacts of management measures. This would enable the design of practical and acceptable management interventions that minimise impacts on the most vulnerable regions and communities, while still reducing the risk of reduction in productivity of tuna stocks. In this context, how to assess and monitor the social and economic contributions of tuna fisheries is a crucial challenge for the practical management of the fishery.

So far, a small but increasing number of studies on social and economic issues in Indonesian tuna fisheries exist. These have typically focused on a single sector, port or region, and in many cases sectors are treated largely as separate entities. There is a need to synthesise these localised case studies into a wider framework, such that future social and economic monitoring may be undertaken in a co-ordinated way, feeding into a national monitoring and evaluation system. There is also a need to assess the broad field of socio-economic dependency, to ensure that indicators not only account for standard aspects of fisheries management, but are also fit for purpose for the Indonesian context, and the likelihood of dependency on tuna having considerable impacts on poor or food insecure regions and communities.

Our aim through in this project was to assist the Indonesian government and stakeholders to build the basis for system-wide monitoring and evaluation of alternative management measures, in terms of their impacts on vulnerable, tuna fisheries dependent regions and communities.

4 Objectives

1. Synthesise existing knowledge and identify appropriate methods in relation to determining fisheries dependency in Indonesian tuna fisheries.
2. Review national and provincial scale data sources to assess their value for system-wide social and economic monitoring and evaluation.
3. Produce a draft conceptual framework for the purposes of identifying potential impacts of alternative management measures on vulnerable, tuna fishing dependent communities.
4. Coordinate activities with MMAF staff and others working on the Management Strategy Evaluation as part of the tuna harvest strategy development process, to ensure the data assessments and framework development undertaken are suitable for potential use in the MSE.

5 Methodology

Objective 1 - Synthesise existing knowledge and identify appropriate methods in relation to determining fisheries dependency in Indonesian tuna fisheries.

This was undertaken through:

- Desktop overview of relevant studies of fisheries dependency and vulnerability.
- Desktop overview of relevant literature on Indonesian tuna fisheries, including wider policy and legislative objectives.
- Consultations with CSIRO and MMAF researchers early in the project, to identify possible methods, key issues and focus areas for the research to address.
- A mid-term review including MMAF, BRIN and CSIRO researchers associated with the harvest strategy process (Day 1), and subsequently with wider stakeholders (Day 2), to share emerging results and seek endorsement of a draft framework, and further data collection and analysis activities for the remainder of the project.

Objective 2 - Review national and provincial scale data sources to assess their value for system-wide social and economic monitoring and evaluation.

This was undertaken through:

1. Collate relevant statistical data/reports from:
    - *Badan Pusat Statistik* (Indonesian statistics bureau);
    - Port level fisheries data collected at national and provincial levels;
2. Undertake review of these datasets to identify the extent to which these data are able to provide a basis for monitoring key socio-economic issues and core elements of tuna fisheries dependency.
3. Collate and analyse all tuna relevant information from SUSENAS national household surveys.
4. Due to gaps in national government socio-economic data with respect to disaggregating for tuna earning households, pilot methods for generating tuna specific data in two ports.
5. Identify needs for additional data collection, or adjustments to existing data collection processes, to enable the development of a social and economic monitoring and evaluation system for Indonesian tuna fisheries.

Objective 3 - Synthesise information gathered in Activities 1 and 2, to develop a draft conceptual framework of the social and economic aspects of Indonesian tuna fisheries.

This was achieved through:

- Online project team workshops throughout the project.
- Consultations with CSIRO and MMAF researchers early in the project, contributing to identification of possible methods, key issues and focus areas for the research to address.

- A mid-term review including MMAF, BRIN and CSIRO researchers associated with the harvest strategy process (Day 1), and subsequently with wider stakeholders (Day 2), to share emerging results, seek broad endorsement of an early draft framework, and further data collection and analysis activities for the remainder of the project.
- Analysis workshops in Sydney (May 2023) and Jakarta (October 2023) to review and integrate data from national assessments and pilots in 2 provinces.
- Presentation of results and a draft framework at a stakeholder feedback workshop in Jakarta October 2023 at which MMAF representatives from Directorate-General of Capture Fisheries, the research Centre for Marine and Fisheries Socio-economic MMAF, and BRIN research teams associated with the harvest strategy development process and were present.

Objective 4 - Conduct regular meetings and workshop-based activities with MMAF and CSIRO staff involved in the Harvest Strategy development to ensure alignment of activities.

This was undertaken through:

- Online project inception meeting including MMAF, Badan Riset dan Innovasi (BRIN) and Commonwealth Scientific and Industrial Organisation (CSIRO) researchers to provide initial input into the project.
- Two half-day informal workshop sessions with CSIRO researchers to explore system structures and possibly useful indicators for research and monitoring. Summary of outcomes was included as background materials to the technical meeting of the project mid-term review.
- A mid-term review at which emerging draft framework was presented to MMAF, CSIRO and wider stakeholders.
- A stakeholder feedback workshop in Jakarta October 2023 attended by MMAF representatives from Directorate-General of Capture Fisheries, the Research Centre for Marine and Fisheries Socio-economic MMAF, and BRIN research teams associated with the harvest strategy development process.

6 Achievements against activities and outputs/milestones

Objective 1: Synthesise existing knowledge and identify appropriate methods in relation to determining fisheries dependency in Indonesian tuna fisheries.

no.	activity	outputs/ milestones	completion date	comments
1.1	Identify at a broad scale key issues and existing knowledge regarding the social and economic aspects of Indonesian tuna fisheries, and particularly in relation to key interdependencies between sectors, and in relation to vulnerable, tuna fishing dependent communities.	Literature reviews	June 2022.	See key results and discussion section of this report, and Section 11.1 of this report.
		Summary of UTS-CSIRO informal workshop sessions included in background materials to technical session of mid-term review (MTR).	May 2021.	Summary report informed development of key issues identified for further research. See Section 7.1
		Presentation and initial findings and key issues to MMAF, CSIRO and wider stakeholders as part of mid-term review.	June 2022.	Key issues to guide further research endorsed at MTR.
1.2	Undertake a review of existing methods for determining fisheries dependency, poverty and food insecurity, and assess their value for identifying potential impacts on vulnerable, fishing dependent communities in Indonesian tuna fisheries.	Literature reviews.	June 2022.	See key results and discussion section of this report, and Section 11.1.
		Presentation of initial/early framework based on national data assessments and literature reviews to MMAF, CSIRO and wider stakeholders as part of MTR.	June 2022.	The initial/early framework was endorsed at the MTR to take forward and inform project activities.

Objective 2: Review national and provincial scale data sources to assess their value for system-wide social and economic monitoring and evaluation.

no.	activity	outputs/ milestones	completion date	comments
2.1	Collate relevant statistical data/reports from: *Badan Pusat Statistik* (Indonesian statistics bureau); port level data collected at national and provincial levels; parallel/previous social and economic studies on Indonesian tuna fisheries.	Data collation and review.	Dec 2021.	See Section 7.1
2.2	Undertake analysis of these datasets to identify the extent to which these data are able to provide a basis for monitoring key issues and core elements of fisheries dependency methods.to management (e.g. IAW). Where necessary/data gaps exist, pilot methods in one or two provinces.	Data compendium of tuna related information in SUSENAS 2019.	May 2022.	See Section 11.3 of this report for full compendium, and Section 7.2 for high level findings based on the compendium.
		Pilot household socio-economic survey undertaken in Kendari and Ternate.	Survey completed Kendari October 2021 Ternate May 2022. Analysis completed May 2023.	See Section 7.3 for survey results.
		Pilot livelihoods interviews in Ternate.	Interviews completed Ternate May 2022. Analysis completed May 2023.	See Section 7.4 for interview results.
2.3	Identify needs for additional data collection, or adjustments to existing data collection processes, to enable the development of a social and economic monitoring and evaluation system for Indonesian tuna fisheries.	Presentations of recommendations for updated data collection protocols, especially with regard to BPS data, at a stakeholder workshop in Jakarta at which MMAF, BPS and non-government stakeholders were present.	October 2023.	See Section 7.6 of this report.

Objective 3: Produce a draft conceptual framework for the purposes of identifying potential impacts of alternative management measures on vulnerable, tuna fishing dependent communities.

no.	activity	outputs/ milestones	completion date	comments
3.1	Synthesise information gathered in Activities 1 and 2, to develop a draft conceptual framework of the social and economic aspects of Indonesian tuna fisheries.	Presentations of initial/early draft framework based on national data assessments and literature reviews to MMAF, CSIRO and wider stakeholders as part of MTR.	June 2022.	The initial/early draft framework was endorsed at the MTR to take forward and inform project activities.
		Integration of survey data into framework in internal project team analysis workshop.	May 2023.	Indonesian team members from BRIN and MMAF came to Sydney for a 3-day analysis workshop.
		Presentations of final draft framework for input from MMAF, BPS and key stakeholders in workshop in Jakarta.	October 2023.	Draft framework was well received by senior representatives from the Directorate-General of Capture Fisheries and the Research Centre for Marine and Fisheries Socio-economics as addressing clear needs for SE monitoring over time. These two units agreed to participate in a follow-on project funded by DFAT and administered by ACIAR at which a national SE monitoring process will be further developed.

Objective 4: Coordinate activities with MMAF staff and others working on the Management Strategy Evaluation as part of the tuna harvest strategy development process, to ensure the data assessments and framework development undertaken are suitable for potential use in the MSE.

no.	activity	outputs/ milestones	completion date	comments
4.1	Participate in regular meetings with the FIS/2016/116 Steering Committee and relevant experts where required to input into key project deliberations, support project activities, and review outputs (data assessments, frameworks).	Presentations at various meetings and workshops detailed at right in comments box.	Throughout project.	Formal engagement and presentations of ongoing results included: - An online inception workshop to introduce the project and seek initial inputs. - A Mid Term Review which presented results of literature reviews, key issues for research to focus on and an early draft of monitoring framework. - Indonesian team presented data and indicators from SRA to the Walton Tuna Consortium Socio-economic Working Group throughout 2022-23. - A stakeholder feedback workshop in October 2023, at which BRIN team members, MMAF staff leading the HS implementation process attended, and Director of MMAF Marine and Fisheries Socio-economic Research Unit attended.
4.2	Identify parameters required for conceptual framework and recommended monitoring and evaluation processes to be congruent with the Management Strategy Evaluation being implemented in the harvest strategy development process.	Presentation and endorsement of initial framework based on national data assessments and literature reviews to MMAF, CSIRO and wider stakeholders as part of Mid-Term Review.	June 2021.	The initial framework was endorsed by the participants to take forward and inform project activities.
		Discussion throughout project with CSIRO International Fisheries team as part of PI McClean's role as Visiting Scientist at CSIRO Environments Division.	June 2023.	

2.3	Undertake capacity building activities with MMAF staff in social research methods/techniques and conceptual framework development.	1-week Bayesian modelling course undertaken with MMAF and BRIN staff.	June 2022.	This was an informative and fruitful activity as a learning experience. However, this did not progress for two reasons: 1. Consultations under Activity 4.1 and 4.2 indicated that improving data collection by the Indonesian government and partners was a key first step that can support robust modelling processes in the future. 2. Due to Covid travel restrictions it was not possible for Australian researchers to undertake face to face participatory workshops that may have supported the appropriate development of qualitative models/BBNs as part of the project's activities.
		Co-PI Barclay spent a considerable amount of time in the final 18 months of the project working with the Indonesia project team on developing analysis of their gender focused interview data in Kendari, and mentoring project team members in gender research methods, and publication.	April 2024.	This work has now been submitted for publication as a journal article (currently under review).

7 Key results and discussion

7.1 Fisheries dependency and vulnerability: concepts and approaches

In this section we discuss concepts, methods and examples of fisheries dependency and vulnerability assessments that have informed the work done in the project. In Appendix 1 (Section 11.1) we provide a list of studies of fisheries dependency and vulnerability that have been used to develop the analysis presented in this section.

7.1.1 Fisheries dependency – an overview

Fisheries dependency (FD) in its simplest sense is the concept that some individuals, communities, regions or nations are more reliant on fisheries than others, and that for some, fishing is an essential aspect of the life of that place.

> *Meaningful measures of fisheries dependent regions need to capture the sense that "the industry provides an essential backbone to its economic or social structure" Phillipson, as quoted in Stanford et al. (2013)*

> *[A fisheries dependent community] is a population in a specific territorial location which relies upon the fishing industry for its continued economic, social and cultural success. (Brookfield 2005)*

Our review of literature found that the major linking factor of FD studies is that their purpose is to develop a comparative understanding of the social and economic aspects of a fishery, primarily between geographic regions, whether that is comparisons between nations, provinces, districts, or local communities. Within geographic regions the literature also shows that further comparisons may be permitted – for example between economic sectors (fishing/agriculture/construction), between fisheries, between fleets in a fishery (large scale small scale, different gear types), between sectors (catching/processing/trading) or even between social groups (women/men, migrants/non-migrants, different ethnic or cultural groups).

Fisheries dependency as a method of assessment is therefore an important tool in large scale fisheries management settings that cover many regions or communities with different characteristics, and consequently has been used as a systematic monitoring and assessment tool in places such as the EU and North America (see e.g. Symes 2000, Hall-Arbor et al., 2001, Salz & Macfadyen 2007).

Once applied to a specific fishery, region or community considerable variation in fisheries dependency can be evident. This includes variations in the ways in which a fishery operates, the nature of the wider socio-ecological system, and the ways in which people utilise that fishery as a means of securing a livelihood.

In one jurisdiction, governments, stakeholders and communities may agree that increasing the total number of people employed in a fishery is the most important objective, while in another, increasing the economic value generated from fisheries, or ensuring accessibility of fish to local communities for consumption may be important objectives. In each case, a

fisheries dependency approach provides a method for assessing the relevant aspects of the fishery across different geographic regions, using the suite of indicators that allow for meaningful assessment for the purposes of managing that fishery. Depending therefore on the characteristics of fisheries in a region, and the objectives of management, different FD indicators will be more or less relevant and useful to the decisions being made (IOTC 2019).

As a method oriented towards fisheries management across multiple regions or communities, it aims initially to support baseline assessments of the relative social and economic dependency of different regions to be made, for assessment of potential impacts of fisheries management and policy to be made, and for the social and economic impacts of fisheries policy to be tracked over time across regions and communities (Hall-Arber et al. 2001, Symes 2000, Fofana 2006).

7.1.2 Vulnerability as an aspect of dependency

Vulnerability in its simplest form is the concept that an individual, a community, a nation, a species or an ecosystem, is subject to the risk or possibility of harm. A helpful technical definition of vulnerability from Adger (2006) as it has emerged in the context of socio-ecological systems is as follows.

> *Vulnerability is the state of susceptibility to harm from exposure to stresses associated with environmental and social change, and from the absence of capacity to adapt.*

Our review finds that vulnerability is a basic aspect of fisheries dependency studies. Fisheries dependency is founded on the basic notion that regions or communities with a higher reliance on fishing are, by definition, taken to be more vulnerable to changes in fisheries policy or a change in the stock (Symes 2000, Fofana 2006).

A good example this can be found in the EU fisheries dependency assessments, which are the most comprehensive fisheries dependency monitoring and assessment program globally and underpin decision-making under the EU Fisheries Common Policy. The EU has a two-step process for assessing fisheries dependency (as cited in Stanford, Wiryawan et al., 2013).

- **Step 1** identifies fisheries dependent areas using absolute and relative fishing activity rates (employment, landings and fleet data) to determine the activity level and regional distribution of fishing areas. This is typically based on readily available government data (see e.g. SETFC 2023, Salz & Macfadyen 2007, Frere & Failler 2001).
- **Step 2** involves economic and social profiling to highlight those areas particularly vulnerable to a decline in fisheries activity by using a wide range of indicators including demography, health, education and housing. This is often undertaken as targeted geographical studies to build on the EU wide dependency assessments (see e.g. Natale et al., 2013, Pinto et al., 2022).

Most if not all FD studies undertake Step 1 in the schema above – to highlight the relative differences in dependency across regions or communities, utilising readily available information.

Where studies advance on this basic FD analysis and undertake the equivalent of Step 2, this is done by highlighting a more detailed set of characteristics that are specific to the context of management and the specific policy or management interventions being considered.

This links to the third major theme we identified in the literature in relation to vulnerability as an aspect of fisheries dependency, where vulnerability assessments are used as a standalone assessment method that links to fisheries dependency.

These studies draw more on vulnerability as it has been developed as a standalone field since the early 2000s.[1] This coalescence occurred most obviously particularly in response the emergence of climate change (Béné et al., 2014, Brugere & Young 2015). However two other common streams of vulnerability analysis are assessments of the sustainability of local livelihoods which includes the associated risk of poverty and food insecurity, and studies which sought to understand vulnerabilities in whole socio-ecological systems (Adger 2006).

Most typically, studies of vulnerability drawing from these trajectories operate around a common methodological focus and development of indicators of:

- **Exposure** to a specific risk/harm
- **Sensitivity** to the risk/harm
- **Adaptive capacity** in response to the risk/harm.

Dependency and vulnerability as concepts utilised in socio-economic fisheries assessments are therefore a natural conceptual fit with a long history in mainstream fisheries management. However, our review finds that engaging with the Exposure/Sensitivity/Adaptive Capacity method can advance our understanding of vulnerability as an explicit aspect of FD analysis and provides additional tools and concepts with which to address risks impacting on fishery dependent communities.

Utilising these approaches, vulnerability is best understood as a function of:

- The nature of the risk present.
- The interaction the risk and the nature and level of dependence on a fishery within a particular nation, region or community (exposure and sensitivity).
- The capacity to respond effectively to that change (adaptive capacity).

Vulnerable regions and communities can therefore be defined as a subset of the total dependent population who have relatively high levels of exposure and sensitivity to a process of social or ecological change, such as fisheries decline or management intervention, and relatively low adaptive capacity.

The following simplified diagram depicts the relationship between fisheries dependency and vulnerability in terms of this definition. A more elaborated version of this diagram is provided in Appendix 1 (Section 11.1) which depicts these relationships in the context of fishery socio-ecological systems and linkages to risk identification, and fisheries management processes.

[1] See Adger (2006) for an overview of this field which still has much resonance with current practice and scholarship on vulnerability.

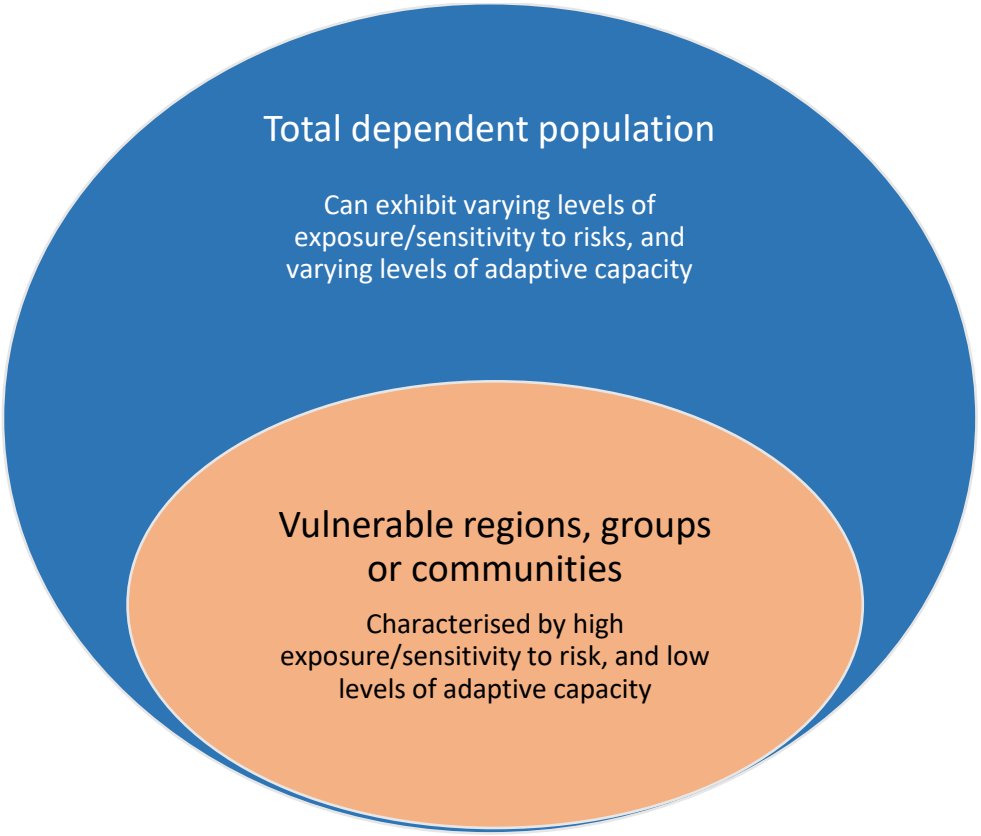


Figure 2. Relationship between fisheries dependency and vulnerability.

7.1.3 Common indicators and methods to measure dependency and vulnerability

Summarising the results of our review contained in Appendix 1 (Section 11.1) we found that four indicators are commonly used in FD studies that are of value for Indonesian tuna fisheries:

- Fish catch/production. Most often this is recorded as landed catch.
- Employment. Typically, this involves identifying regions or communities whose total fishing employment is above 5% of the total economy, which can then be considered fisheries dependent.
- Revenue and regional economic contribution. Often this is measures as gross value of production however this can also include added value if considered relevant and practical.
- Fish consumption. This provides a view of the nutritional contribution of fisheries, and is most commonly used in dependency studies in the developing world.

Furthermore, in highlighting the value of these indicators as a broad structure for a FD study, we also note that to enable meaningful comparison between geographies, FD indicators need to:

- Be spatially explicit.
- Record both absolute and relative measures, so that both the total number of people and the % of the total population dependent on fisheries can be understood.

- Be recorded at the appropriate scale for the context being monitored. While this is most often at a national scale, FD studies are also commonly undertaken at a provincial scale and can also highlight differences between local communities.
- Develop robust quantitative indicators to enable comparative monitoring, while also ensuring qualitative/descriptive information is gathered to assist in interpreting indicators and understanding what a change in a statistical indicator may mean in a particular region or locality.
- Be designed to be amenable for use in multi-indicator indexes, so that relatively efficient monitoring can be undertaken, through providing decision makers with single composite measures to display relative dependency.

7.1.4 Examples of fisheries dependency and vulnerability indicators in use

European Union - A prominent example of fisheries dependency indicators in use

The following examples of FD indicators in use are drawn from the EU. The EU has the most extensive system of using FD indicators to inform management globally, developing comprehensive studies of dependence across regions, fleets and sub-sectors (catching, processing). This system is used to administer the EU Fisheries Common Policy and to identify potential changes in fisheries dependence under different policy or management regimes.

The following maps display examples of fisheries dependence analysis (Step 1) utilising the single indicator of employment, displayed in a spatially explicit format, and presenting both absolute and relative measures.

Figure 3. Total fisheries sector employment in the EU by NUTS-2 region (total # of employees). Source: Salz and MacFadyen 2007.

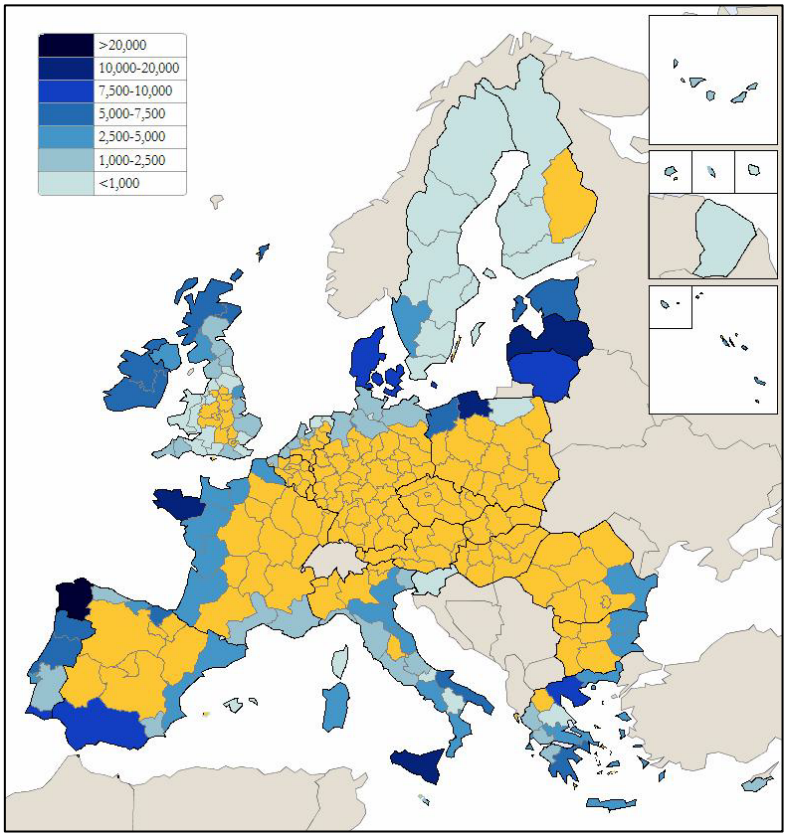
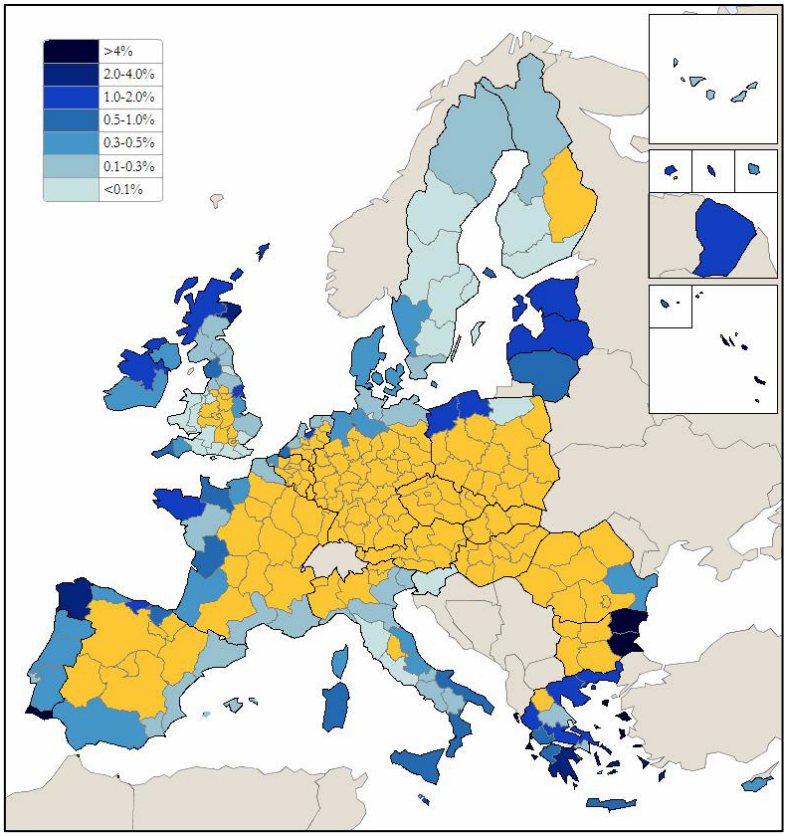


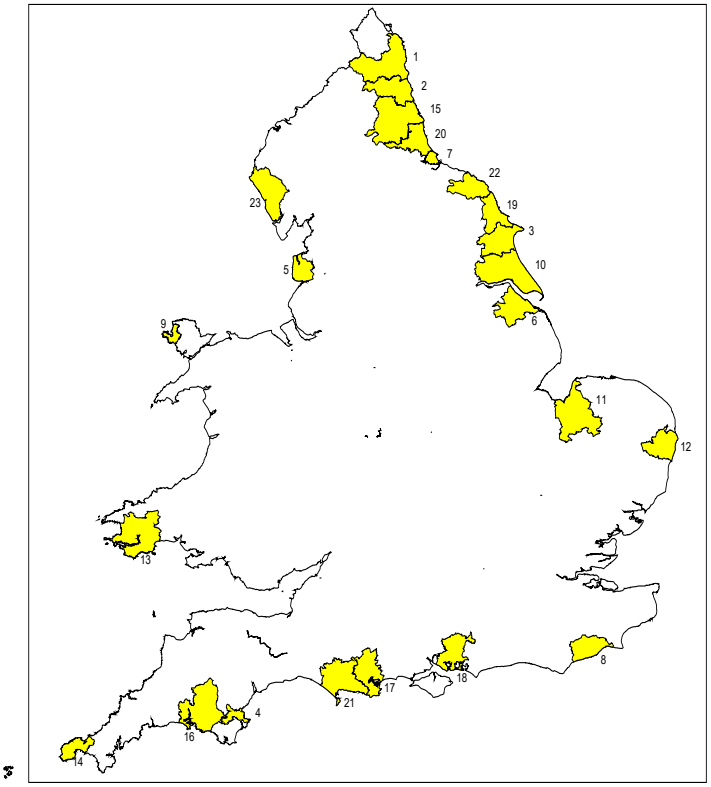
Figure 4. Total fisheries sector employment in the EU by NUTS-2 region (as % of total workforce). Source: Salz and MacFadyen 2007.



The following map displays the use of a threshold-based index for identifying fisheries dependent regions in the UK, drawn from EU FD studies. This map displays fishery dependent areas in England and Wales based on combined analysis of:

- Value added from fishing and fishing related activities (proportion of GDP).
- Total employment in fishing and fishing related activities as a proportion of total regional employment.
- Share of regional landings subject to quota management as a proportion of total regional catches.

Figure 5. Fisheries dependant areas in England and Wales based on 3 fisheries dependency indicators.
Source: Frere & Failler (2001)



Studies explicitly incorporating vulnerability into dependency assessments

A range of studies have explicitly combined fisheries dependency and vulnerability analysis. Here we highlight four examples that are instructive for this project.

Vulnerability of Pacific tuna fisheries to climate change

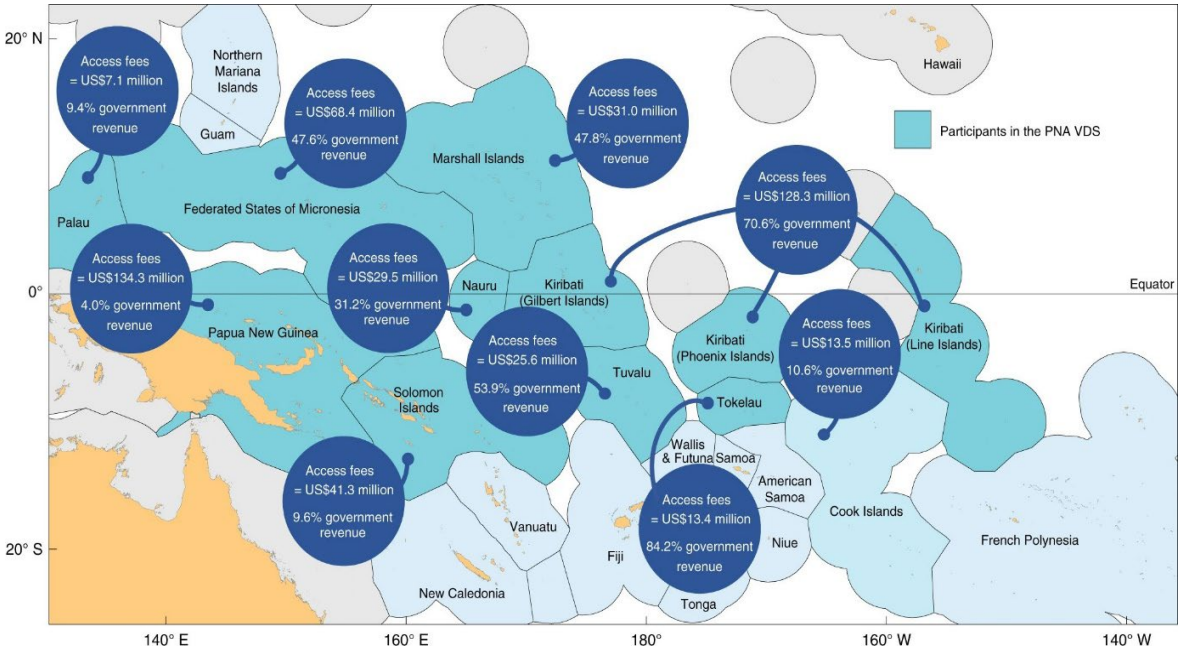
Bell et al (2021) utilised national level fisheries dependency indicators to develop an assessment of the vulnerability of Pacific Island national economies to the impacts of climate change on tuna stocks.

This included initially, an analysis of the relative dependency of Pacific Island nations on government revenue from tuna, expressed in:

- Absolute and relative terms (as total USD and as a % of total government revenue).
- Spatially explicit, visual format.

The following image contains the results of that analysis.

Figure 6. Dependency of Pacific Islands nations on government revenue from tuna fisheries. Source: Bell et al. (2021)



The authors subsequently undertook an assessment of the likely change in biomass availability of tuna in each of the Exclusive Economic Zones of these countries under climate change projections, highlighting that on average Pacific Island nations will have reduced biomass availability of 13%. They then identified the likely impacts of projected declines on:

- Purse seine catch in ten Pacific Island nations.
- Fishing access fees and government revenue in ten Pacific Island nations.

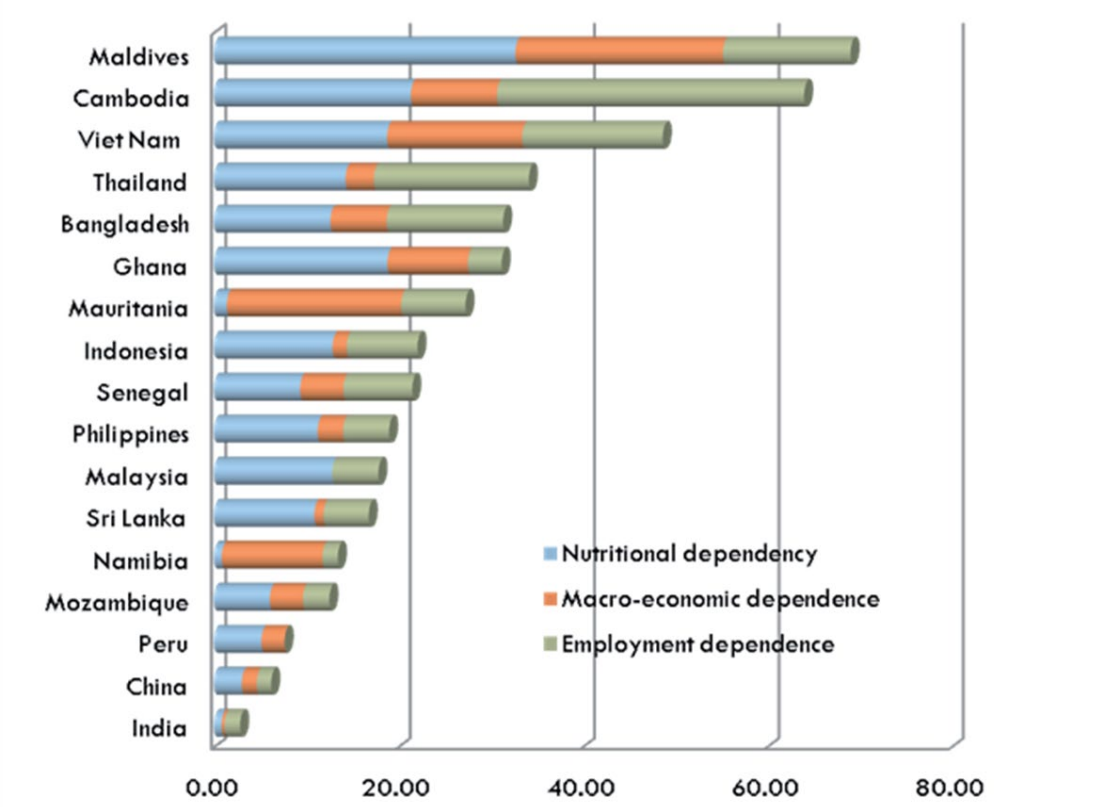
Through identifying the level of dependence on tuna fishing for government revenue, the authors identified the nature and degree of exposure to climate related risks of different nations. By projecting the likely decline in fishing and resultant access fees and revenue, the authors highlighted the sensitivity of different nations to the risk. By identifying actions that can be taken at a regional and global scale to reduce the risk, the authors identified some elements of adaptive capacity of Pacific Island nations with respect to mitigating these risks. In effect Bell et al., utilised fisheries dependency indicators to undertake a vulnerability analysis of Pacific Island nations to the risk of reduced tuna catch in their territories under climate change projections, highlighting that a high degree of dependence on tuna fisheries is one key factor in a high degree of vulnerability to climate induced impacts related to tuna stocks.

Vulnerability of fishing nations to poverty and food insecurity

Allison et al. (2011) used national level fisheries dependency indicators to develop an assessment of the vulnerability of fishing nations to poverty and food insecurity. They developed an ‘additive’ Fisheries Dependency index, which combines nutritional (percentage of food consumption from fish), employment (percentage of workforce employed in fisheries) and macro-economic indicators (percentage of GDP from fisheries) of dependency to assist in comparing the vulnerability of different fishing dependent countries to poverty and food insecurity. Allison’s basic conclusion is that those countries with a higher dependency on

fisheries across these combined indicators, exhibit more vulnerability to changing circumstances.

Figure 7. An additive fisheries dependency index to assess vulnerability of fishing nations to poverty and food insecurity. Source: Allison (2011)



Socio-economic indicators of vulnerability in Pacific coastal fisheries

Kronen et al. (2010) utilised socio-economic dependency and household indicators to assess the vulnerability of artisanal coastal fishers in 17 Pacific island nations to changing circumstances.

As well as highlighting a relationship between vulnerability and high dependency on fisheries, a critical finding was to uncover some of the mechanisms and contextual factors underpinning this relationship. Specifically, the existence of quantifiable relationships between macro-economic conditions, as displayed by the diversity of the national economy, micro-economic conditions (measured through the presence of alternative livelihoods), and fishing dependency (measured by percentage of household income from fisheries).

Kronen et al.'s (2010) findings are highly relevant to the present study and are copied here:

> *Communities within countries with unfavourable [economic] conditions and limited access to alternatives, and fishing households within communities embedded in favourable overall economic conditions, are most vulnerable [to changing socio-economic or ecological conditions] as they have the highest dependence on coastal fisheries resources. Hence, relationships in Pacific Islands Countries and Territories between different stages of welfare and resource exploitation not only apply for fisheries households within communities, but also at the community level.*
>
> *Multivariate and bivariate results all suggest that unfavourable economic conditions at the national scale often go hand in hand with limited access to alternative income sources [at the local scale], putting more importance on coastal marine resources and leading to higher dependency on them.*

Exploring fisheries dependency and poverty in Indonesian fisheries

Stanford et al. (2013) similarly utilised fisheries dependency and household vulnerability indicators to explore the links between fisheries dependency and poverty in coastal West Sumatra, Indonesia, and particularly to highlight the multiple factors that impact upon fishing community vulnerability.

Noting that detailed understandings of household livelihood strategies that may often vary between seasons, villages and districts require a large amount of labour-intensive data collection, they utilised readily available statistics routinely collected by the Indonesian national government under decadal the census, to assess:

a) Fishery dependent districts in West Sumatra as measured by employment in fisheries utilising Census data.
b) Levels of poverty in fishing dependent communities utilising Social Welfare Data.
c) The wider economic conditions in these districts and how these impact on poverty rates in fishing households utilising Census data.

Their findings included that a direct correlation between high fisheries dependency and high poverty rates at the household level was not evident, but that poverty rates in fishing households were increasing. However, correlations between wider provincial dependency on agriculture as a whole (which includes fisheries), and high poverty rates in agricultural households, did exist. Given the tendency for coastal fishers in West Sumatra to exist on mixed livelihoods, rather than solely focus on fishing, their study suggests a complex relationship between wider economic conditions, the availability of rural agricultural livelihoods, of which fishing is one, and poverty outcomes.

Perhaps of equal importance from this study is the proof of concept for utilising Indonesian government collected Census and social welfare data to assess these dynamics at a local scale, being able to utilise these data sources to conduct fisheries dependency analysis, and the level of vulnerability to poverty that exists as a result of dependence on these livelihoods.

7.1.5 Dependency and vulnerability in Indonesia's tuna fisheries

In advancing the use of dependency and vulnerability indicators in Indonesia's tuna fisheries, we provide here a set of issues and research questions which support the use of these indicators, and have been used to structure research efforts presented in this report.

Identification of these issues was based on:

- Initial reviews of literature and policy documents.
- Consideration of the project scope (i.e. focus on dependency/vulnerability indicators, focus on existing and available government data).
- Early consultations with CSIRO researchers involved in harvest strategy development process.
- Presentation of initial review findings and identification of key issues and research questions to a mid-term review in July 2022.

Broadly speaking, the need to address the following issues support exploring the use of fisheries dependency and vulnerability indicators in socio-economic monitoring in Indonesian tuna fisheries.

1. **Broad-scale regulatory impacts across provinces, species and fleets**

Firstly, the wide geographical distribution of Indonesia's tuna fisheries across a range of provinces, which is a highly fished and consumed species across the entire archipelago (Proctor et al., 2016, Davies et al., 2023), leads to the need for assessment of socio-economic dependency on tuna fisheries and comparison across different provinces (McClean et al., 2017, Hoshino et al., 2019).

Secondly, considered in terms of species targeted, vessel size, gear type, product and destination market, and the substantial differences between provinces within Indonesia with respect to these fleets/sectors (Duggan & Kochen 2016, Proctor et al., 2016, McClean et al., 2019, Davies et al., 2023), Indonesia has a highly complex tuna sector that also leads to variations in dependence, and therefore vulnerability, across fleets and value chains. This leads to the need for assessment of the dependency on different fleets/sectors by province, and the need for information that can assess the potential for different provinces to be more vulnerable than others, based on their dependence on a particular fleet/sector.

It is also noteworthy that the historical experience of regulatory interventions to support sustainability in Indonesian tuna fisheries is that management measures have typically been implemented without explicit consideration of the likely impacts on dependent communities (see e.g. Satria et al., 2018, Khan et al., 2018, McClean et al., 2019, Muawanah et al., 2020), and that the effects of interventions have been substantial on domestic tuna catches, and dependent communities. Following the implementation of foreign vessels and at sea transhipment in 2014, for example, catches in Bitung, the major port and export hub in Eastern Indonesia, halved and as many as 5,000 workers lost employment (USAID Oceans 2018, McClean 2019, see also Satria 2018, Khan & Polunin for other discussions on this intervention).

These thee issues support the development of research that can inform methods of assessing broad scale regulatory impacts, comparing commonly used dependency indicators across provinces, fleets and species. This is a key issue at the scale of AW harvest strategy and management processes, as there are 15 provinces that have coastal areas that intersect with the management jurisdiction of the AW harvest strategy.

2. **Impacts on those least able to cope with change**

The need for consideration of how potential management interventions interact with dependent communities raises the need to consider impacts on those in a vulnerable condition. That is, groups who are both exposed and sensitive to a reduction in access to the fishery, yet have low ability to transition out of tuna fishing.

With respect to an explicit analysis of vulnerability, and the characteristics of different provinces that might influence the responses of dependent communities to stock declines or management interventions, a key issue to highlight is that Indonesia's coastal communities are characterised by high levels of poverty and food insecurity and low levels of alternative income/livelihood sources (Stanford et al., 2013, World Bank 2015, Chaijaroen 2019). Eastern Indonesia, which is covered by the IAW Harvest Strategy area of jurisdiction, is

generally recognised as an underdeveloped region with high levels of economic poverty and malnutrition (McClean et al., 2019, Gibson et al., 2020, 2021).

Moreover, existing studies on tuna fisheries indicate the likelihood that economic and social vulnerability, such as seasonal poverty from insecure incomes and low levels of education, and the use of tuna livelihoods for basic income and food needs, are evident in sections of tuna dependent communities (Duggan et al., 2017, McClean et al., 2019).

This leads to the need for assessment of the level of household vulnerability in tuna fishing provinces, with respect to poverty, food insecurity and alternative incomes/livelihoods. The key questions to address here are, in addition to assessing broad scale impacts of regulatory intervention on dependency, does a management measure or a change in the fishery impact on dependent communities least able to cope with change? Comparison of household poverty, food insecurity and alternative livelihoods indicators per province would be a valuable means of considering these issues.

3. Management intervention influencing effort per fleet

A specific issue that arises where substantial small, medium and large-scale fleets are evident, where fishing is distributed throughout remote coastal areas, and in communities already experiencing economic hardship and with potentially few alternatives, is the question of labour force mobility between fleets.

This issue emerged from early consultations and literature reviews, and is focused on the potential for linkages and interactions between fleets, that may lead to unexpected or unintended consequences of management measures. Specifically, it is both a logically valid possibility, and there is evidence available from Indonesian fisheries (see Buchary 1999) to suggest that a change in effort in one fleet (say by limiting effort in the large-scale sector), might lead to changes in effort, and therefore catch, in another fleet (say an increase in the small- or medium-scale sectors). It is important to note that there are no direct studies as yet of this phenomenon within tuna fisheries specifically, however some studies suggest this may have occurred in the past, or highlight conditions which increase the possibility of this occurring (see e.g. USAID Oceans 2018, Satria et al., 2018, McClean et al., 2019, World Bank & MMAF 2024).

The clearest, evidence-based example of this in Indonesian is documented by Bailey (1997) and Buchary (1999), evaluating the impacts of the 1980 Java Sea trawl ban. Model analysis of ecological, fisheries and socio-economic data indicated that as of the late 1990s “the trawl ban has so far not been able to provide enough opportunity for most of the heavily impacted fish groups to recover. The failure to recover is partly due to the concurrent and continual increase in fishing pressure from purse seiners and small-scale gears” (Buchary 1999).

Bailey (1999) noted that this effort replacement was driven by landless farmers in Java taking up the newly available economic opportunity in this fishery, that the removal of the large-scale trawl fleet provided. This is an example of the classic macro-economic “safety valve” function that fisheries play in poverty alleviation, where changes in one sector of the economy lead to an influx of labour into the fisheries sector, which is typically open access and unregulated and therefore readily available as a means of fulfilling basic needs under conditions of hardship (Béné et al., 2010).

> *Through [the trawl ban], the government effectively eliminated the most powerful fishing technology available for utilizing demersal resources. The effect has been to reallocate resource access to small-scale fishers as a class. In so doing, the government has recognized traditional resource use rights of small-scale fishers to be politically important.*
>
> *The elimination of trawlers has created new employment opportunities which were quickly filled. The rapid rush into the fishery is not surprising. As an open access resource, marine fisheries play an important role as a safety valve for surplus labor from other sectors of the Indonesian economy. Particularly on Java, where population densities are extreme and landlessness among agriculturalists is common, the sea often offers a chance for a new start. Similar conditions exist elsewhere in Indonesia as well, though not in such extreme a form.*
>
> *When trawlers were eliminated in 1980, new entrants to the fisheries were attracted and established fishers increased their investments in productive capacity. Taken alone, these can be seen as positive developments. However, the expansion of fishing effort by small-scale fishers may have the same effect on the resource base as did the trawlers. (Bailey 1997).*

From the perspective of the IAW harvest strategy for tuna, the existence of linkages between fleets that may lead to outcomes such as these, were they to be demonstrated, would be an important consideration for designing long-term sustainable management systems in Indonesian tuna fisheries. For example, if incentives for smaller vessels to fish more when effort in large scale fleets is reduced exist, or there are incentives for crew to switch fleets when effort in one fleet reduces, rather than exit the fleet, then there is a possibility that management measures only targeting one fleet segment may not lead to overall reductions in fishing effort, compromising the long-term sustainability of the fishery.

The key questions to answer here are, does a management measure lead to labour (and therefore effort) in one tuna fleet moving to another? More specifically - what socio-economic factors influence labour mobility and effort per fleet?

Comparison of poverty and alternative livelihoods/livelihoods diversity indicators per province and in the future per fleet, as well as information on the willingness of fishers to exit tuna fishing, are of value here. It is important to note that identifying socio-economic information on alternative livelihoods/livelihood diversity however will be a valuable initial step, but will not be able to fully address all aspects of this issue. To do so thoroughly would likely also require linking catch data, and fleet data such as effort and revenue information (see discussion Davies et al., 2023). This is a complex modelling process which is beyond the scope of this study.

Relevance of key issues to management and policy objectives

Given the importance of management objectives in characterising the nature of the fishery, and identifying meaningful issues that can be addressed through collecting indicators of fisheries dependency and vulnerability, we highlight here the objectives in the Indonesian Fishery Management Act 2009:

1. Improve the living standards of small-scale fishers/traders and fish farmers
2. Increase state revenues and foreign exchange
3. Increase employment opportunities
4. Increase the availability and consumption of fish protein
5. Optimise the management of fish resources
6. Increase productivity, quality, added value and competitiveness
7. Increase the availability of raw materials for the industry fish processing
8. Achieve optimal utilisation of fish resources, aquaculture
9. Guarantee the sustainability of fish resources and aquaculture.

Key socio-economic issues listed above address the following objectives:

- Broad scale regulatory impact – 3, 4, 6, 7 directly, 1, 2 indirectly.
- Poverty, food insecurity and alternative livelihoods – 1, 4 directly, 9 indirectly.
- Labour force dynamics and effort per fleet – 9 directly, all others indirectly.

7.1.6 Review of national and provincial datasets

Data reviews covered the following information sources

Fisheries ministry data

- Pusat Informasi Perikanan Pelabuhan (PIPP) – Catch monitoring data at the major ports (collected daily, reported annually).
- Bakai Karantina Ikan Pengeldaliam Mutu – Fisheries Quarantine Inter Regional Tuna Traffic Data (annual).

Central Statistics Bureau data

- General census including the Agricultural Census module (every 10 years).
- SARKENAS – Labour force survey (annual).
- SUSENAS – Household socio-economic survey (annual).

Social welfare ministry data

- Integrated Social Security Scheme database – *DTKS: Data Terpadu Kesejahteraan Sosial* (Updated Monthly).

Fisheries ministry and BPS data was reviewed in early 2021 prior to fieldwork being undertaken. Social welfare data was reviewed in mid-2023, after it became apparent this local scale data may be of value.

National data review findings

Fisheries ministry data is potentially very useful for generating production statistics, economic value statistics (such as gross value of production, GVP) and potentially some labour force statistics due to recording vessel operation costs including crew. The main limitation is that the PPIP database only covers ~30% of ports. Detailed review of this data would be of value from specialists with catch/landings data expertise (i.e. out of scope for this project).

Census, Agricultural Census and SARKENAS (Labour force) data cannot be disaggregated for tuna earning households. Improving the ability to disaggregate these data for tuna earning households would be of considerable value in the future.

In general, a key gap is in **the post-harvest sector**. Where information on tuna fisheries exists, it is typically at the fishing sector level.

SUSENAS has the most readily useful data for advancing SE monitoring at this point in time. In particular:

- *Tuna* (yellowfin and bigeye tunas), *Cakalang* (skipjack tuna), *Tongkol* (coastal tunas), collectively referred to as *TCT,* consumption is data available for all households, covering all provinces.

- Poverty and food security data for all households, and for fishing households in all provinces is available and is useful for baseline scoping of vulnerability.

- TCT consumption, food security and poverty data can be disaggregated for different household types – fishing/non-fishing, poor/non-poor, food secure/insecure, coastal/inland.

- SUSENAS data cannot be disaggregated for tuna earning households. Improving this would be of high value.

Table 1. Summary table of review of available MMAF and BPS datasets

Data	Main variables of interest	Ability to disaggregate for tuna species?	Scale and coverage (household, port, province etc)	Collected since when	Frequency
PPIP - KKP Port monitoring survey	Catch data per vessel Fish price by species by province Vessel costs per trip	Yes	Port level data, by gear/fleet, by species.	Unclear. Currently available in BBRSCE-KP is the data from 2018-2020	Reported annually (collection may be more fine scale).
BKIPM Inter Regional Tuna Traffic Data	Tonnage and price of fish entering/exiting quarantine units.	Yes	All fish quarantine units across Indonesia	Available since 2017	Reported annually (collection may be more fine scale).

SUSENAS (NATIONAL HOUSEHOLD SOCIO-ECONOMIC SURVEY)	Household income Household expenditure Household food consumption HH socio-demographics Can be used to analyse Poverty, Food insecurity, Fish consumption	Consumption of yellowfin/bigeye tuna (*tuna*), skipjack (*cakalang)* and neritic tuna (*tongkol*), are recorded as a single variable and consumption data can be disaggregated by HH type (poor, food insecure, etc). Poverty and food security data cannot be disaggregated for tuna fishers.	The survey samples all Indonesia by province and district, the respondent is household head. The number of respondents is approximately 325,000 households per year, of which approx. 15,000 are fishing households, based on 2019 population calculations.	Since 1963.	Annual
Agricultural Census	Total # of agriculture and fishing households Age, education of fishing households Ethnicity of fishers	No, only total number of fishers and percentage agricultural workforce employed as fishers	The census samples all Indonesia by province and district, the respondent is household head. Sample is all agricultural households. Total sample size is approx. 29,360,833 households of which 1,893,767 are fishing households	Since 1963	Every 10 years, last Census at 2023
SAKERNAS (NATIONAL LABOUR FORCE SURVEY)	Estimation of total participation in fishing sector Wages of fishing employees # of hours worked Estimation of total participation in fishing sector Wages of fishing employees # of hours worked Age, education of fishing households House ownership, electricity wattage, sanitation and type of floor (these all give some indication of welfare status)	No, it only No, it only separate fishers into three categories (fisheries labourers, fishers, fishfarmers) to provide employment data such as the number of people working in the fisheries sector, fisheries processing sector and aquaculture sector.	The survey samples all Indonesia by province and district, the respondent is household head. Sample size is approx. 300,000 households	Since 1976.	Annual

Social welfare data review

Subsequent to initial broadscale assessments and pilots described below, the potential value of social welfare data on fishing households collected at a local scale as a possible method of understanding vulnerability in fishing communities became evident. A review of this data was undertaken by Richard Stanford, a researcher based in Padang, West Sumatra. Dr Stanford is lead author of a key paper on utilising publicly available data to assess fisheries dependency and poverty in Indonesia (Stanford et al., 2013). For the 2013 paper Dr Stanford was able to access fishery statistics, census and social welfare data to inform research on fisheries dependency and poverty at provincial, regional and district levels in Indonesia. While some of these data sources are questionable and difficult to verify (e.g. fish catches), others were detailed 'by-name-by address' lists of fishers in a state of poverty (i.e. those classified as *Rumah Tangga Miskin* – poor households under government classifications).

For the current project Dr Stanford was asked to assess whether these data are still collected and available for research, and its potential value in undertaking vulnerability assessments. Key findings are as follows:

Strengths of social welfare data

- By-name and by-address lists of poor households are still available, and these identify fishing households, which are further separated into catching fish (code 4 - *perikanan tangkap*) or fish farming (code 5 – *perikanan budidaya).*
- It should be possible to access a list of poor fishers by district anywhere in Indonesia because this data is routinely collected as part of the Integrated Social Security Scheme (*DTKS - Data Terpadu Kesejahteraan Sosial*).
- Although DTKS includes the poorest families (*fakir miskin*) that are unable to meet their basic needs, it also includes families that are able to provide for their basic needs but who cannot afford to pay for health insurance. These families are called underprivileged/vulnerable to entering poverty *(tidak mampu/rentan miskin).* In total, the poorest 40 % of Indonesian society are registered in DTKS.

Limitations of social welfare data for fisheries analysis

- DTKS does not specify the type of fisher (tuna, snapper, squid etc).
- Some households involved in the fishing industry may be listed in other sectors e.g. 'trade', 'processing'.
- Some households listed as operating in the fishing sector may actually be retired from other sectors and fish as a 'hobby'. They should not qualify as DTKS but have found a way to get on the database.
- DTKS only lists poor fishers. It does not provide us with the total number of fishers in an area.
- DTKS does not disaggregate individuals on the extent of their poverty.
- Changes in the database may reflect changes in government policy rather than in the welfare status of households. E.g. a reduction in households listed as receiving social security is because of changes to who is eligible rather than people escaping poverty.

Conclusions

DTKS is a powerful data set that can be used with other data (e.g. fisheries, census, SUSENAS) to build up a picture of the state of livelihoods in fishing communities in a geographical area.

Desk-based analyses in particular using these data would help us to understand trends and prioritize further in-depth research prior to going to the field. In particular these can assist in identifying:

- Where are the most fishery dependent areas?
- In which areas are fishers relatively poor/prosperous?
- How does poverty in the fisheries sector relate to poverty in other economic sectors?

These data would be important for initiatives that seeks to understand vulnerability across a range of fisheries/in the fisheries sector as a whole. It may be possible to utilize this data, in tandem with information on the geographical distribution of different fisheries, such as district/province level catch data, to identify the likelihood of high levels of poverty associated with specific fisheries.

Use of national data review for development of project research strategy

Based on the results of initial reviews of Fisheries Ministry and BPS data in early 2021, a research strategy to advance on the basis of these data reviews was developed, and endorsed by a mid-term review of the project.

This included the following activities.

a) Broad-scale assessments based on SUSENAS data, focusing on poverty, food security and tuna consumption indicators at the provincial level. This full assessment of all tuna related information contained in SUSENAS is included in Appendix 2.
b) Household level pilot data collection in two provinces to compare tuna earning households with all fishing households for key metrics.
c) Individual mixed methods interviews in one province to explore issues related to livelihoods and occupational mobility in tuna fisheries.

Catch and economic data was not included in this research strategy as that was considered as being more appropriately addressed by colleagues involved in the harvest strategy development process with specific expertise in these areas, and engaged in existing processes of review and analysis of these data.

Sites for data collection were selected on the basis of provincial assessments in step (a), selecting sites which are centres of tuna fishing activity in Eastern Indonesia, and which ranked highly in vulnerability assessments based on the 2019 SUSENAS survey, including being ranked top 10 across multiple measures of vulnerability.

→ Kendari, capital of Southeast Sulawesi province, which ranked #1 in provincial assessments for poverty in fishing households, #8 for TCT consumption in fishing households, and #10 for food insecurity in fishing households.
→ Ternate, capital of North Maluku province, ranked #4 in provincial assessments food insecurity in fishing households and #1 for TCT consumption.

7.2 Provincial assessments utilising SUSENAS data

Relevant data from the 2019 SUSENAS nation-wide survey was extracted and analysed to provide a picture of key metrics of provincial dependency and vulnerability. The raw data was processed by BBRSCE-KP (MMAF Fisheries Socio-economics Research Unit) staff and descriptive statistics produced in map and tabular form, displaying absolute (total sample size per province) and relative values, as relevant to the data.

Full tables and maps produced are included in Appendix 3. Those presented here summarise key metrics with relevant findings related to:

- Poverty rates in fishing households per province.
- Food insecurity rates in fishing households per province.
- TCT consumption (kg/per capita/per year) in fishing households.
- A cumulative vulnerability analysis, displaying provinces who rank in the top 10 across multiple vulnerability metrics (food insecurity rates, poverty rates, TCT consumption rates).

Poverty rates in fishing households

Figure 8. Top 10 provinces – poverty rates in fishing households. Source: SUSENAS (2019).

Table 2. Top 10 provinces – poverty rates in fishing households. Source: SUSENAS (2019).

Rank	Province	% fishing households classified as poor	Within IAW Harvest Strategy area of jurisdiction?
1	Southeast Sulawesi	31.46%	Yes
2	Papua	25.86%	Yes
3	East Nusa Tenggara	25.44%	Yes
4	Gorontalo	23.17%	Yes
5	West Papua	22.55%	Yes
6	West Sulawesi	20.81%	Yes
7	South Sumatra	19.01%	No
8	South Sulawesi	16.62%	Yes
9	North Sulawesi	13.85%	Yes
10	Special Region of Yogyakarta	12.50%	No

Food insecurity rates in fishing households

Figure 9. Top 10 provinces – Food insecurity rates in fishing households. Source: SUSENAS (2019).

Table 3. Top 10 provinces – Food insecurity rates in fishing households. Source: SUSENAS (2019).

Rank	Province	% fishing households classified as food insecure or very food insecure	Within IAW Harvest Strategy area of jurisdiction?
1	Maluku	58%	Yes
2	Papua	51%	Yes
3	West Papua	51%	Yes
4	North Maluku	48%	Yes
5	East Nusa Tenggara	45%	Yes
6	Special Region of Yogyakarta	44%	No
7	West Kalimantan	41%	No
8	Gorontalo	39%	Yes
9	North Kalimantan	39%	No
10	Southeast Sulawesi	38%	Yes

TCT consumption rates

Figure 10. Top 10 provinces for Tuna, Cakalang and Tongkol consumption rates. Source: SUSENAS (2019).

Table 4. Top 10 provinces for Tuna, Cakalang and Tongkol consumption rates. Source: SUSENAS (2019).

Rank	Province	Kg/cap/year TCT consumption in fishing households	Within IAW Harvest Strategy area of jurisdiction?
1	North Maluku	19.13	Yes
2	North Sulawesi	18.17	Yes
3	West Sulawesi	16.84	Yes
4	Aceh	15.84	No
5	Gorontalo	12.31	Yes
6	Central Sulawesi	11.76	Yes
7	West Papua	10.50	Yes
8	Southeast Sulawesi	10.40	Yes
9	West Sumatra	10.18	No
10	Special Capital Region of Jakarta	9.95	No

Provinces that rank in the top 10 in multiple categories under provincial vulnerability assessments

Figure 11. Provinces that rank in the top 10 in multiple categories under provincial vulnerability assessments. Source: SUSENAS (2019).

Table 5. Provinces that rank in the top 10 in multiple categories under provincial vulnerability assessments. Source: SUSENAS 2019.

Province	Ranked top 10 for fishing households in which categories?	Within IAW Harvest Strategy area of jurisdiction?
North Sulawesi	Poverty, food insecurity, TCT consumption	Yes
Gorontalo	Poverty, food insecurity, TCT consumption	Yes
West Papua	Poverty, food insecurity, TCT consumption	Yes
Southeast Sulawesi	Poverty, food insecurity, TCT consumption	Yes
North Maluku	Food insecurity, TCT consumption	Yes
West Sulawesi	Poverty, TCT consumption	Yes
Papua	Poverty, food insecurity	Yes
Special Region of Yogyakarta	Poverty, food insecurity	No
East Nusa Tenggara	Poverty, Food insecurity	Yes

Key findings from SUSENAS assessments of relevance to national tuna fisheries management.

- From a poverty perspective, 8 of the top 10 provinces across Indonesia for poverty rates in fishing households are in the area of jurisdiction of the AW Harvest Strategy.
- From a food insecurity perspective, 7 of the top 10 provinces across Indonesia for poverty rates in fishing households are in the area of jurisdiction of the AW Harvest Strategy.
- From a tuna consumption perspective, major areas where high levels of tuna consumption exist are throughout Eastern Indonesia, as well as on the western coast of Sumatra and in Aceh, all areas with substantial levels of tuna fishing. 7 of the top 10 provinces across Indonesia for poverty rates in fishing households are in the area of jurisdiction of the AW Harvest Strategy.
- With respect to combined vulnerability as assessments, 8 of 9 provinces ranking top 10 in more than one measure of vulnerability are in the AW area of jurisdiction.
- Given Eastern Indonesia is a major centre of tuna fishing activity and the focus of the Indonesian government's IAW tuna harvest strategy, these assessments suggests that poverty and food insecurity rates in tuna earning households, and the contribution of tuna fisheries to poverty alleviation and food and nutrition security in a wide range of households (tuna earning households, fishing households, all households), are likely to be important metrics in considering the social and economic performance of these fisheries over time.

7.3 Pilot household income and expenditure surveys

Quantitative household surveys aimed to generate information on household dependency and vulnerability in tuna earning households, due to the inability to disaggregate most provincial and national level data for tuna dependent households. This survey was co-developed by UTS and Indonesian partner researchers and implemented by the BBRSCE-KP (MMAF Fisheries Socio-economics Research Unit), and following the establishment of BRIN, key partner researchers in the Centre for Economics of Industries, Services and Trade.

Survey and analysis methods

The survey included modules that allowed testing of 2 possible approaches to data collection of relevance to assessing household dependency and vulnerability – income-based assessments and expenditure/consumption-based assessments.

A module covering sources of income and employment allowed for an approach that can display monthly incomes in tuna earning households and the level of income dependency on tuna, and in a way that in theory would allow for household metrics to be linked to fisheries models which utilise effort and operational cost data. This also supports income-based analysis of household poverty in tuna dependent households, and assessment of the extent to which income-based metrics can be useful for comparing poverty rates in tuna dependent households to other household types (all households, all fishing households).

An expenditure/consumption module aimed to mirror the annual SUSENAS household survey, and develop directly comparable figures for household poverty and food insecurity in tuna dependent households with SUSENAS findings on poverty and food insecurity in all fishing households. Therefore, this module also enabled the exploration of the value of more detailed expenditure/consumption data and the feasibility of collecting this as an aspect of periodic monitoring and assessment.

The survey overall achieved high response rates and the employment/income module proved successful. However, the expenditure data proved time consuming and burdensome to collect, and require a large amount of data processing in order to calculate poverty and food insecurity rates utilising this data. While expenditure data could be collected in Kendari it proved quite challenging, and it was not possible in Ternate to collect this data due to respondents experiencing survey fatigue. This had two implications.

Firstly, we have explored to a much greater extent analysis of incomes data, and particularly for poverty metrics. Additionally, the calculation of food security classifications was not carried out due to the lack of expenditure data in Ternate and the time-consuming nature of that analysis for Kendari data. Instead, summary expenditure on different food items is presented for Kendari to illustrate what can be done with these data in the absence of the resources and technical skills to calculate food insecurity by calorie intake. For Ternate, a qualitative food security experience assessment was also included in livelihoods interviews (see section 7.4 below) based on the FAO Food Insecurity Experience Scale questionnaire method (Cafiero et al., 2018). This allowed for a basic analysis using rapid assessment methods of food security experienced in tuna households to be developed regardless of

whether expenditure data could be collected and analysed during the survey. These are presented below however it is noted that food consumption and food security data is not consistent across sites and so further work in future on feasible methods for assessing food security is considered necessary.

Sample spread and respondents

The following tables display the respondents to the survey according to role and gear type.

Table 6. Household survey respondents by role

Role	Respondents - Kendari	Respondents - Ternate
Crew	33	52
Captain/Owner operator	32	35
Trader	45	13
Vessel owner	20	27
Processor	11	11
Total	141	138

Table 7. Household survey respondents by gear type and role – Kendari.

Fishing Gear	Respondents - Kendari				
	Vessel Owner	Captain	Crew	Traders	Processors
Handline/Troll-line	6	17	7	-	-
Pole and line	3	4	7	-	-
Purse Seine	11	11	19	-	-
Processed tuna/cakalang	-	-	-	0	8
Fresh tuna	-	-	-	34	3
Fresh cakalang	-	-	-	4	0
Fresh tuna and cakalang	-	-	-	7	0
Total	**20**	**32**	**33**	**45**	**11**

Notes: Processors and traders were not categorised according to the gear type from which they sourced tuna, however this would be beneficial in future to gather this data if possible.

Table 8. Household survey respondents by gear type and role – Ternate.

Fishing Gear or Fish type	Respondents role – Ternate				
	Vessel Owner	Captain	Crew	Traders	Processors
Handline/Troll-line	27	33	40	-	-
Pole and line	0	2	12	-	-
Purse Seine	0	0	0	-	-
Processed products	-	-	-	1	11
Fresh tuna (large offshore tuna species)	-	-	-	7	0
Combined fresh, frozen, and processed products	-	-	-	5	0
Total	**27**	**35**	**52**	**13**	**11**

Notes: Processors and traders were not categorised according to the gear type from which they sourced tuna, however this would be beneficial in future to gather this data if possible.

The following box and whisker plots display the spread of respondents in the dataset according to monthly income from tuna.

Figure 12. Box and whisker plot of household income derived from tuna fishing, processing and trading activities in tuna earning households sampled, Kendari. n= 141

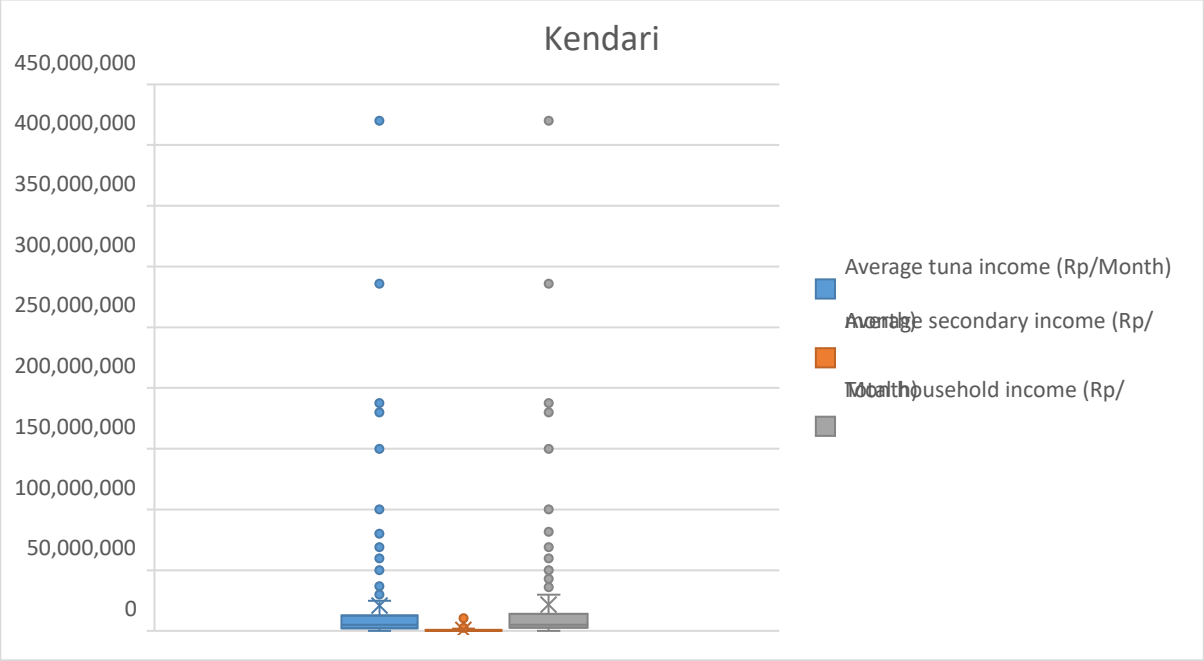
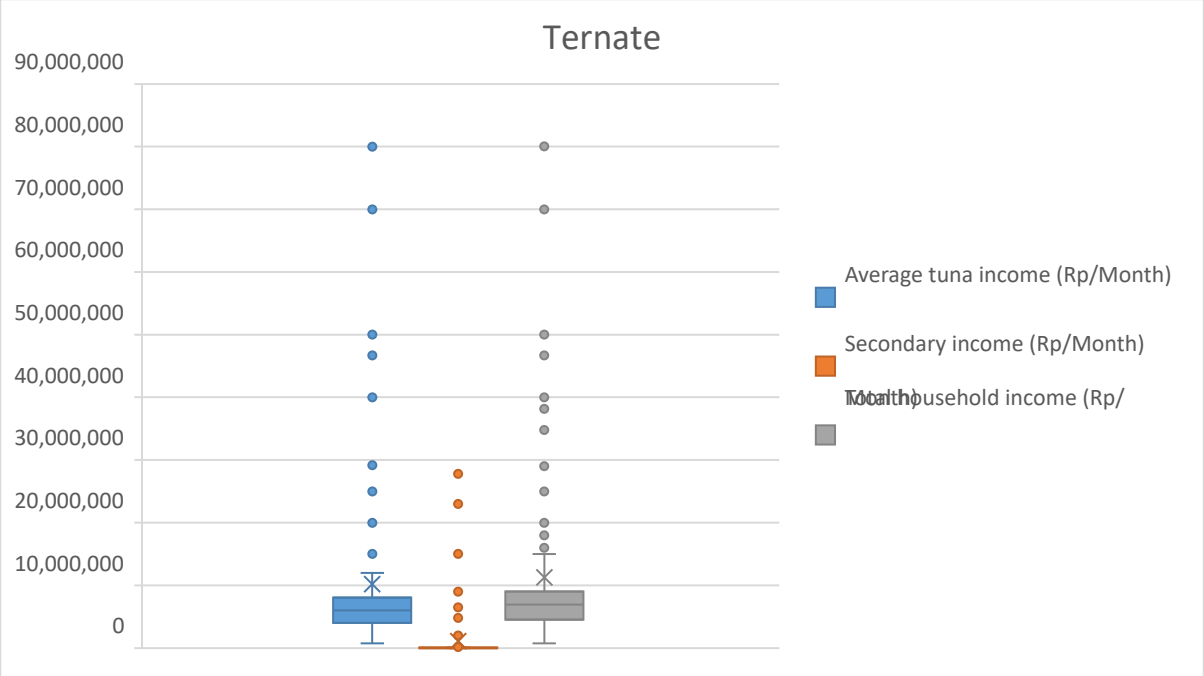


Figure 13. Box and whisker plot of household income derived from tuna fishing, processing and trading activities in tuna earning households sampled, Ternate. n= 138



These plots display that a wide spread of incomes exist, including some very high earning households, as well as very substantial numbers of lower earning households. Average incomes are therefore skewed upwards significantly by a few very high-income respondents. This is corroborated in high standard deviations for the sample which are shown in Tables 9-11 below. While some of these high earners may be outliers based on errors in data collection, it is also due to some very wealthy individuals participating in the survey. This is particularly so in Kendari, where values over 100 million rupiah per month are owners of companies with multiple large vessels and trading networks. These were consciously sampled by the Indonesian team, initially to explore what a representative spread of incomes is, in the context of tuna earning operations in these fisheries.

This indicates a general need firstly to differentiate sub-categories for gear types and roles in income surveys to be able to understand the dynamics of the fishery with respect to incomes, and to be able to interpret and address outliers that are likely to influence the calculation of averages. Specifically, it is important to note that averages will tend to mask income inequalities and produce averages that are unlikely to reflect the reality for most workers on the ground. This highlight a need to consciously investigate, from the perspective of vulnerability, those who are the lower end of the income earning spectrum.

It is also worth noting that while important fishery dynamics may be revealed by displaying data per gear type and per role, the sample sizes for these levels of disaggregation are very small in this survey and therefore prevent meaningful results being generated for these categorisations. This points to the potentially significant extra burden on data collection in any one survey to be able to ensure sample sizes are large enough for data that is disaggregated by more than one attribute to provide meaningful results. For example, to understand household income levels for a *processing worker* reliant on *skipjack tuna* caught by *purse seine vessels* requires targeted sampling of those specific workers to generate meaningful results in a single survey effort. Therefore, such disaggregation will be more

likely achievable once time series data are collected and rolling multi-year averages can be calculated for key data points.

Incomes in tuna households

Following this initial scoping of the data spread we removed outliers and calculated average tuna income, and average total household incomes (all sources) per respondent. Here we present aggregated figures and tables of income figures disaggregated by gear type and role.

Table 9. Income in tuna earning households

Site	Number of respondents	Income from tuna (Rp/Month)		Total HH income (Rp/Month)	
		Average (mean) (SD)	Median (MAD)	Average (mean) (SD)	Median (MAD)
Kendari	114	5,015,132 (4,663,659)	3,466,667 (1,958,334)	5,808,344 (5,207,484)	4,500,000 (2,208,334)
Ternate	121	5,773,485 (2,378,949)	6,000,000 (1,500,000)	6,857,642 (4,279,461)	6,065,000 (1,898,333)

Data source: Quantitative household survey data (2021), outliers removed. Outliers removed using the IQR method on the 'Average tuna income (Rp/Month)' column (values removed when equal to or below Q1 - 1.5*IQR, or equal to or above Q3 + 1.5*IQR). SD = standard deviation, MAD = median absolute deviation.

Table 10. Income in tuna earning households by gear type

Site	Gear type	Number of respondents	Average (mean) tuna Income (Rp/Month) (SD)	Median income from tuna (Rp/Month) (MAD)	Average (mean) Total HH income – all sources (Rp/Month) (SD)	Median Total HH income – all sources (Rp/Month) (MAD)
Kendari	**Handline/Troll-line**	30	4,390,556 (3,212,308)	4,458,334 (2,208,334)	5,659,206 (5,077,058)	4,666,667 (3,250,000)
	Pole and line	14	5,348,214 (3,502,884)	4,687,500 (2,083,334)	5,538,691 (3,461,420)	5,000,000 (1,958,333)
	Purse seine	32	5,208,333 (4,684,825)	3,666,667 (1,750,000)	5,755,208 (4,507,408)	4,833,334 (2,291,667)
	Post-harvest workers (gear type not recorded)	38	5,222,807 (5,933,168)	2,750,000 (1,750,000)	6,070,175 (6,423,867)	3,000,000 (1,500,000)
	Total	**114**	**5,015,132 (4,663,659)**	**3,466,667 (1,958,334)**	**5,808,344 (5,207,484)**	**4,500,000 (2,208,334)**

Site	Gear type	Number of respondents	Average (mean) tuna Income (Rp/Month) (SD)	Median income from tuna (Rp/Month) (MAD)	Average (mean) Total HH income – all sources (Rp/Month) (SD)	Median Total HH income – all sources (Rp/Month) (MAD)
Ternate	Handline/Troll-line	92	6,158,062 (2,446,470)	6,666,667 (1,666,667)	6,577,083 (2,858,912)	6,750,000 (1,916,667)
	Pole and line	10	3,475,000 (789,642)	3,416,667 (583,334)	4,475,000 (1,636,792)	4,000,000 (833,334)
	Post-harvest workers (gear type not recorded)	19	5,121,053 (1,737,440)	6,000,000 (1,000,000)	9,470,158 (8,286,783)	6,065,000 (1,038,000)
	Total	**121**	**5,773,485 (2,378,949)**	**6,000,000 (1,500,000)**	**6,857,642 (4,279,461)**	**6,065,000 (1,898,333)**

Data source: Quantitative household survey data (2021), outliers removed. Outliers removed using the IQR method on the 'Average tuna income (Rp/Month)' column (values removed when equal to or below Q1 - 1.5*IQR, or equal to or above Q3 + 1.5*IQR). SD = standard deviation, MAD = median absolute deviation.

Table 11. Income in tuna earning households by role

Site	Role	Number of respondents	Average (mean) tuna Income (Rp/Month) (SD)	Median income from tuna (Rp/Month) (MAD)	Average (mean) Total HH income – all sources (Rp/Month) (SD)	Median Total HH income – all sources (Rp/Month) (MAD)
Kendari	Crew	32	4,877,604 (4,809,358)	3,333,333 (1,666,667)	5,595,610 (5,095,569)	5,000,000 (2,041,667)
	Captain	32	4,842,448 (2,885,621)	4,520,834 (2,208,334)	5,774,740 (4,191,737)	4,666,667 (2,416,667)
	Vessel Owner	12	5,184,722 (4,005,945)	3,750,000 (2,416,667)	5,636,111 (4,083,576)	4,833,333 (2,541,667)
	Processor	11	4,128,788 (4,045,464)	3,000,000 (2,000,000)	5,856,061 (5,218,068)	3,916,667 (1,416,667)
	Trader	27	5,668,519 (6,564,194)	2,250,000 (1,333,333)	6,157,407 (6,944,429)	3,000,000 (1,500,000)
	Total	**114**	**5,015,132 (4,663,659)**	**3,466,667 (1,958,334)**	**5,808,344 (5,207,484)**	**4,500,000 (2,208,334)**

Site	Role	Number of respondents	Average (mean) tuna Income (Rp/Month) (SD)	Median income from tuna (Rp/Month) (MAD)	Average (mean) Total HH income – all sources (Rp/Month) (SD)	Median Total HH income – all sources (Rp/Month) (MAD)
Ternate	**Crew**	49	5,040,816 (2,087,019)	4,500,000 (1,500,000)	5,377,551 (5,095,569)	4,666,667 (2,041,667)
	Captain	30	6,827,778 (2,527,335)	7,500,000 (1,500,000)	7,297,778 (4,191,737)	7,500,000 (2,416,667)
	Vessel Owner	23	6,498,188 (2,616,975)	6,750,000 (1,750,000)	7,278,623 (4,083,576)	7,500,000 (2,541,667)
	Processor	10	5,005,000 (2,109,562)	6,000,000 (750,000)	8,424,500 (5,218,068)	6,065,000 (1,416,667)
	Trader	9	5,250,000 (1,322,876)	5,000,000 (1,000,000)	10,632,000 (6,944,429)	6,065,000 (1,500,000)
	Total	**121**	**5,773,485 (2,378,949)**	**6,000,000 (1,500,000)**	**6,857,642 (4,279,461)**	**6,065,000 (1,898,333)**

Data source: Quantitative household survey data (2021), outliers removed. Outliers removed using the IQR method on the 'Average tuna income (Rp/Month)' column (values removed when equal to or below Q1 - 1.5*IQR, or equal to or above Q3 + 1.5*IQR). SD = standard deviation, MAD = median absolute deviation.

Incomes in tuna households relative to the provincial household poverty line

In this section we compare household income data to the relevant provincial income poverty line. In Indonesia's statistical system, poverty rates per province are calculated using SUSENAS. A household is classified as a poor household if it has a total income or expenditure below the provincial poverty line, which is calculated as the total expenditure required to meet basic needs for food items (food poverty line) and non-food items (non-food poverty line) (Government of Indonesia 2020).

Comparing total household income to the provincial poverty line appears to be a viable indicator as to whether a household is able to meet basic needs from its' monetary income. However, it is not an absolute measure of poverty as a direct comparison with SUSENAS would need to be made utilising expenditure data. At this stage however it seems quite robust to assume that fishers with total household income below the provincial household poverty line would either be living in poverty, or at risk of poverty in the event of a major future shock.

The following tables display the percentage of households surveyed below the provincial household poverty line.

Table 11. % of tuna earning households with household income below provincial household poverty line.

Site	Number of surveyed households below threshold	Sample		% of households earning below income threshold for meeting basic needs	
		(outliers removed)	(outliers included)	(outliers included)	(outliers removed)
Kendari	35	114	141	24.8	30.7
Ternate	9	121	138	6.5	7.4

Table 13. % of tuna earning households with household income below provincial household poverty line, by gear type.

Site	Gear type	Provincial household poverty line (IDR)	# of respondent (outliers removed)	# households earning below poverty line	% households earning below poverty line	Average (mean) income for HH earning below poverty line (all sources) (IDR/Month)	Median income for HH earning below poverty line (all sources) (IDR/Month)
Kendari	Hand line/ Troll line	2,847,205	30	10	33.3	1,330,000	1,000,000
	Pole and line		14	3	21.4	2,027,778	2,083,333
	Purse seine		32	6	18.8	1,416,667	1,416,667
	Post-harvest workers (gear type not recorded)		38	16	42.1	1,862,500	2,000,000
	Total		**114**	**35**	**30.70**	**1,648,095**	**1,500,000**

Site	Gear type	Provincial household poverty line (IDR)	# of respondent (outliers removed)	# households earning below poverty line	% households earning below poverty line	Average (mean) income for HH earning below poverty line (all sources) (IDR/Month)	Median income for HH earning below poverty line (all sources) (IDR/Month)
Ternate	Handline Troll-line	2,786,703	92	7	7.6	1,964,286	2,000,000
	Pole and line		10	0	0	-	-
	Post-harvest workers (gear type not recorded)		19	2	10.5	2,057,500	2,057,500
	Total		**121**	**9**	**7.4**	**1,985,000**	**2,000,000**

Data source: Quantitative household survey data (2021), outliers removed. Outliers removed using the IQR method on the 'Average tuna income (Rp/Month)' column (values removed when equal to or below Q1 - 1.5*IQR, or equal to or above Q3 + 1.5*IQR). Kendari n = 114, Ternate n = 121.

Table 14. % of tuna earning households with household income below provincial poverty line, by role

Site	Role	Provincial household poverty line (IDR)	# of respondent (outliers removed)	# households earning below poverty lin	% households earning below poverty line	Average (mean) income for HH earning below poverty line (all sources) (IDR/Month)	Median income for HH earning below poverty line (all sources) (IDR/Month)
Kendari	Crew	2,847,205	32	8	25.0	1,291,667	1,416,667
	Captain		32	8	25.0	1,697,917	1,750,000
	Vessel owner		12	3	25.0	1,322,222	1,000,000
	Traders		**27**	12	44.4	1,733,333	1,958,334
	Processors		**11**	4	36.4	2,250,000	2,500,000
	Total		**114**	**35**	**30.7**	**1,648,095**	**1,500,000**

Site	Role	Provincial household poverty line (IDR)h)	# of respondent (outliers removed)	# households earning below income threshold for basic needs	% households earning below income threshold for basic needs	Average (mean) income for HH earning below poverty line (all sources) (IDR/Month)	Median income for HH earning below poverty line (all sources) (IDR/Month)
Ternate	Crew	2,786,703	49	3	6.1	1,916,667	2,333,333
	Captain		30	2	6.7	2,000,000	2,000,000
	Vessel owner		23	2	8.7	2,000,000	2,000,000
	Traders		9	1	11.1	2,315,000	2,315,000
	Processors		10	1	10.0	1,800,000	1,800,000
	Total		**121**	**9**	**7.4**	**1,985,000**	**2,000,000**

Data source: Quantitative household survey data (2021), outliers removed. Outliers removed using the IQR method on the 'Average tuna income (Rp/Month)' column (values removed when equal to or below Q1 - 1.5*IQR, or equal to or above Q3 + 1.5*IQR). Kendari n = 114, Ternate n = 121.

Income dependency in tuna earning households

The following tables display the dependency of households on tuna for income, and households reporting a second income source.

Table 12. Income dependency in tuna earning households

Site	Number of respondents	Average (mean) % of HH income from tuna activities	Median % of HH income from tuna activities	% of HH reporting 100% of income from tuna
Kendari	114	88%	100%	70%
Ternate	121	92%	100%	75%

Table 16. Income dependency in tuna households by gear type.

Site	Gear type	Total number of respondents	Average (mean) % of HH income from tuna activities	Median % of HH income from tuna activities	% of households reporting access to a second income source
Kendari	Handline/Troll line	30	88%	100%	33.3%
	Pole and line	14	96%	100%	14.3%
	Purse seine	32	90%	100%	25.0%
	Post-harvest workers (gear type not recorded)	38	84%	100%	36.8%
	Total	**114**	**88%**	**100%**	**29.8%**
Site	**Role**	**Total number of respondents**	**Average (mean) % of HH income from tuna activities**	**Median % of HH income from tuna activities**	**% of households reporting access to a second income source**
Ternate	Handline/troll line	92	96%	100%	9.8%
	Pole and line	10	84%	100%	30.0%
	Post-harvest workers (gear type not recorded)	19	80%	99%	94.7%
	Total	**121**	**92%**	**100%**	**24.8%**

Data source: Survey data (2022), outliers removed. Outliers removed using the IQR method on the 'Average tuna income (Rp/Month)' column (values removed when equal to or below Q1 - 1.5*IQR, or equal to or above Q3 + 1.5*IQR). Kendari n = 114, Ternate n = 121.

Table 17. Income dependency in tuna households by role

Site	Role	Total number of respondents	Average (mean) % of HH income from tuna activities	Median % of HH income from tuna activities	% of households reporting access to a second income source
Kendari	Crew	32	90%	100%	25.0%
	Captain	32	90%	100%	25.0%
	Vessel owner	12	92%	100%	33.3%
	Traders	27	88%	100%	37.0%

	Processors	11	76%	100%	36.4%
	Total	**114**	**88%**	**100%**	**29.8%**
Site	**Role**	**Total number of respondents**	**Average (mean) % of HH income from tuna activities**	**Median % of HH income from tuna activities**	**% of households reporting access to a second income source**
Ternate	Crew	49	96%	100%	8.1%
	Captain	30	95%	100%	13.3%
	Vessel owner	23	92%	100%	17.3%
	Trader	9	75%	98%	100.0%
	Processor	10	85%	99%	90.0%
	Total	**121**	**92%**	**100%**	**24.8%**

Data source: Survey data (2022), outliers removed. Outliers removed using the IQR method on the 'Average tuna income (Rp/Month)' column (values removed when equal to or below Q1 - 1.5*IQR, or equal to or above Q3 + 1.5*IQR). Kendari n = 114, Ternate n = 121.

Key findings

Survey results highlight that, on average (mean), tuna fishers earn a relatively good income in the context of their needs, with the average (mean) household typically earning several million rupiah per month above the provincial household poverty line across all categories. Moreover, some fishers are able to earn very good wages, with 50% of fishers in Kendari earning above the mean value of 4.5 million rp/month (or 54 million rp/annum) and 50% of fishers in Ternate earning above the mean value of 6.06 million rp/month (or 72.78 million rp/annum). Each of these amounts would be considered a relatively lucrative livelihood option in the context of rural Indonesia, especially given periodic windfall incomes would likely be above that in some cases.

Such results at least partially explain why tuna fishers are highly dependent on tuna, and household dependency data suggests sampled households appear to have heavily specialised in tuna fishing due to its relative economic attractiveness. Tuna fishing is by far the dominant source of income in tuna households, making up on average 85-90% of household income (n=235) on average. The sole exception to this is processors, who tend to have a lower level of dependence on tuna income than traders, crew/captains or vessel owners. 70% of households in Kendari and 75% in Ternate reported 100% reliance on tuna for household income. Furthermore, crew tend to have very low rates of access to secondary income sources. This suggests overall that a low level of alternative sources readily available to tuna dependent households and this is exacerbated in specific groups.

However, income data also suggests two other conclusions that are important for considering vulnerability in tuna dependent populations.

Firstly, there is a very high level of variation on tuna earnings across the sampled population, as evidenced by box and whisker plots and high standard deviations in the data collected. This suggests that in the first instance, taking an average wage as an indicator of overall socio-economic outcomes from tuna fisheries is not sufficient to assess the status of vulnerable households or to measure their economic progress over time. More fine-grained data is required if vulnerability to economic hardship is to be measured in this fishery. As a result, identifying those proportions of the population who experience economic hardship and undertaking specific analysis of these groups as a subset of the overall dependent population is required. This can be achieved by comparing average incomes to the provincial poverty line.

Upon undertaking this analysis, we highlight secondly that despite the overall attractiveness of tuna employment, a significant proportion of respondents reported earning less than what would be required to stay above the provincial household poverty line. Between 24.8% and 30.7% of all tuna earning households in Kendari and between 6.5% and 7.4% of tuna earning households in Ternate are estimated to be earning income that is below the provincial monthly household poverty line. In each case these findings are roughly equivalent to poverty rates in fishing households overall in each province – in Southeast Sulawesi 31% of all fishing HH are poor and this is the highest levels of poverty recorded in the 2019 SUSENAS. In North Maluku, 5% of all fishing households are poor.

Median values in Kendari indicate that 50% of tuna earning households earning below the provincial household poverty line earn below 1,500,000 rp per month, and that in Ternate 50% of tuna earning households earning below the provincial household poverty line earn below 2,000,000 rp per month. Each of these are well below both the relevant provincial household poverty line.

These findings need to be tempered against the following:

- Income measures provide a measure of the risk of poverty rather than a direct measure of poverty.
- For comparisons of income data against the provincial household poverty line to be taken as a poverty measure we also assume no other non-monetary forms of income or subsistence exist in households. Given that fish for wages is a commonly reported aspects of payment systems in Indonesian tuna fisheries (McClean et al., 2019), these figures would need to be assessed against indicators of consumption to assess the degree of estimation error that may be present.
- Seasonality of tuna incomes mean that poverty rates averaged across the year may mask periods of relative abundance in catch which may provide for key financial household needs at key times (e.g. school fees, investments in assets or homes), and that periods of relative scarcity may be associated with seasonal, rather than permanent (i.e. year-round), poverty. This is corroborated in previous surveys (see Duggan et al., 2016).

In general, we consider these figures to somewhat overestimate ***absolute*** poverty rates however conservative estimates (i.e. with no outliers removed) and median incomes of those earning below the provincial household poverty line indicate that even if overestimation has occurred a substantial proportion of the tuna dependent population are nonetheless either in poverty or are at risk of poverty, in the event of a substantial future shock. Furthermore, we consider that such figures are in fact likely to be an underestimate of poverty ***risk*** rates. For example, should a 20% drop in income occur due to a future ecological or economic shock, this would likely result in a number of tuna fishers not currently under the provincial household poverty line falling below that threshold. A fully elaborated poverty risk measure may therefore expand the sub-set of households considered vulnerable to include such respondents.

Tuna consumption, and food and nutrition security in tuna dependent households

As previously noted, expenditure and consumption data was collected in Kendari but could not be collected in Ternate, and calculation of food insecurity classifications was particularly labour intensive and beyond the resourcing and capabilities of the Indonesian team to undertake in this SRA. Therefore, the overall ability to build on SUSENAS assessments of consumption and food insecurity was less than information on income dependency. However, we present here findings of some initial analysis undertaken that do provide insights into this topic and provide insights into regular monitoring of tuna consumption, and food and nutrition security in tuna dependant households.

Table 13. Mean Tuna, Cakalang, Tongkol (TCT) Consumption in tuna, all fishing, and all households.

Site	Role	n	Mean TCT Consumption (kg/cap/year)
Kendari	All tuna households	140	28.28
	All fishing households (Southeast Sulawesi)	23	10.40
	All households (Southeast Sulawesi)	519	9.43
Ternate	All tuna households	119	43.13
	All fishing households (North Maluku Province)	9	19.13
	All households (North Maluku Province)	519	14.65

Table 14. Average (mean) food expenditure in Kendari based on Household type.

Site	Household Type	n	Source of Data	Average Food Expenditure (IDR/Cap/ Month)	Average Animal Protein Expenditure		Average Fish Expenditure		Average TCT Expenditure	
					IDR/Cap /Month	As % of food exp.	IDR/Cap /Month	As % of food exp.	IDR/Cap /Month	As % of food exp.
Kendari	All Household	519	SUSENAS 2019	741,128	130,631	18%	86,700	12%	16,685	2%
	Fisheries Household	23	SUSENAS 2019	570,506	105,591	19%	65,555	11%	13,571	2%
	Tuna Household	140	Data Survey 2021	802,904	238,768	30%	106,851	13%	66,522	8%
Ternate	All Household	519	SUSENAS 2019	809,810	104,839	13%	77,804	10%	26,591	3%
	Fisheries Household	9	SUSENAS 2019	719,349	93,977	13%	73,705	10%	30,129	4%
	Tuna Household	138	Data Survey 2022	1,190,477	**DATA NOT AVAILABLE**					

The following table displays food security information collected in Ternate as part of the livelihoods interviews, which enabled a comparison of provincial statistics with survey data.

This is included in this section due to a better conceptual fit to report in this section. In the future such data would be advantageous to include in quantitative household surveys. Interview methods are detailed in section 7.4 below.

Table 15. % of the population reported as experiencing food insecurity in Ternate

Household type	Source	% of the population reported as experiencing food insecurity
Fishing households (all North Maluku)	SUSENAS 2019	48%
Tuna households (Ternate)	Project survey 2022	15%

Key findings

TCT is a very important source of food in Eastern Indonesia, to tuna and non-tuna households. Typically, tuna fisheries are driven by export markets for both fresh and canned fish, however significant direct consumption occurs and significant local markets exist (McClean et al., 2019). Direct consumption in local communities is typically made up of small yellowfin tunas that are below size appropriate for export (~15kg), *cakalang* (skipjack) and *tongkol* (small coastal tunas).

Based on data presented, tuna makes key contributions to local diet and to food and nutrition security in the region in the following ways.

- Tuna fishers eat up to 28kg of tuna per year, a higher rate than non-fishing households and all fishing households, who eat a combined average of 15kg/year across Southeast Sulawesi and North Maluku, however this is up to 20kg in North Maluku.
- 15% of tuna fishers in Ternate reported issues with food insecurity based on food insecurity experience measures, compared to 48% of fishing HH in North Maluku who are classified in SUSENAS measures as food insecure.
- In Kendari, tuna dependant households spend more money on TCT, and TCT makes up a higher percentage of total food expenditure, compared to other households (fishing households, or all households).
- Tuna households have a higher overall expenditure on food than the average for other households (fishing households, or all households) in Kendari and Ternate.

7.4 Interviews on alternative livelihoods and occupational mobility in tuna households

Semi-structured interviews undertaken in parallel to quantitative surveys in Ternate with 150 tuna fishers, primarily in the small handline sector. The objective of this component of the research was to support development of an approach to regular monitoring capable of tracking changes in employment and livelihood outcomes, and in particular with reference to key issue #3, exploring occupational mobility in the tuna sector. This study component was was co-developed by UTS and Indonesian partner researchers in the Research Center for Society and Culture (initially LIPI and since 2021, BRIN).

Fisheries occupational mobility refers to the movement of workers in Indonesian tuna fisheries, including fishers, traders, and processors, either into or out of a tuna fishery/value chain (horizontal mobility), or a change in their participation within a tuna fishery/value chain that represents an improvement or deterioration in their standard of living, and therefore their

household livelihood outcomes (vertical mobility). Each of these occupational changes, which are qualitative in nature, can in theory be tracked alongside quantitative income related metrics, such as changes in income per month (increase/decrease) or changes in % of household income from tuna (increase/decrease).

The questions in the interview structure aim to be able to explore changes in employment and livelihoods and outcomes relevant to those changes based on historical information from informants, while also collecting relevant information for demographic analysis, analysis of factors influencing occupational mobility, and recording perceptions of potential future scenarios of change.

This included the following sections

1. Basic demographic data of respondent, and current household employment and livelihoods information.
2. Recent changes in tuna employment and household livelihoods.
3. Expectations of future and potential alternative livelihoods options.

Due to the fact that no historical data was available from data sources reviewed on tuna employment and livelihoods that may provide a time series that can assess changes at time of, for example, regulatory change or other external shocks that may lead to fisheries exit, semi-structured interviews employing a life history approach were undertaken to highlight both key themes of relevance to tuna livelihoods and occupational mobility, and assess the extent to which tuna workers have changed occupations since entering the industry. This life history interview approach asked informants, broadly speaking, to describe whether their role had changed in the fishery over time and consequently whether their household income, employment in the tuna sector, and access to non-tuna livelihoods had also changed over time since entering the tuna fishery.

This approach also aimed to assist in being able to explore options for regular data collection, analysis and reporting in this pilot/scoping phase. Specifically, by undertaking recall-based investigation of past livelihoods, and asking open ended questions on household livelihoods, it was possible to identify and categorise the spread of responses provided. This demonstrates a method for generating context specific livelihoods information that can be standardised and included in future monitoring efforts in ways that are more amenable to ongoing cost-effective monitoring to produce time series data, by providing 4-5 livelihoods categories that are relevant to respondents in that fishery or port.

The following tables provide the spread of respondents to these interviews and basic demographic and participation statistics.

Table 16. Interview respondents by gear and role, Ternate

Fishing Gear	Respondents (Ternate)					
	Captain, Owner/operator	Crew	Trader	Processor	Not specified	Total
Handline	95	21	0	0	0	116
Pole & Line	1	5	1	0	0	7
Purse Seine	3	3	1	0	0	7
Not specified	0	2	16	1	1	20
Total	**99**	**31**	**18**	**1**	**1**	**150**

Table 17. Current job/status in tuna fishery of interview respondents

Current job/status in tuna fishery	Percentage of respondents (%)
Fisher	93.5
Trader	5.9
Processor	0.6

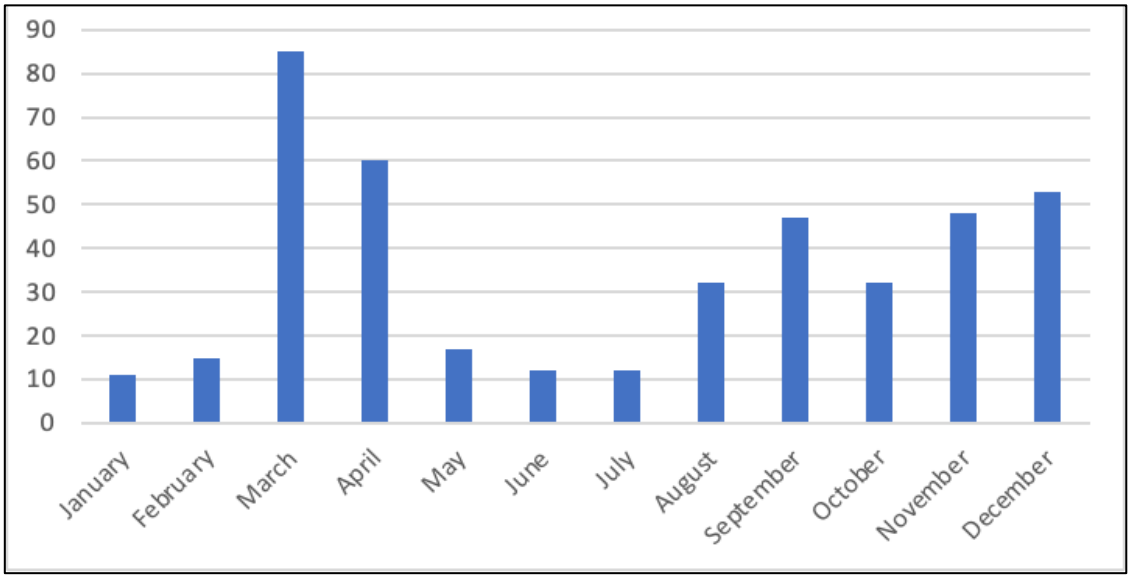
Table 18. Type of main tuna catch of interview respondents

Type of main tuna catch	Details	Percentage of respondents (%)
Large offshore tuna	Fishing using handline gear for large yellowfin and bigeye tunas, primarily for export market.	76.7
Small offshore tuna	Fishing for skipjack and juvenile yellowfin/bigeye tunas, primarily for local/domestic markets.	12.9
Neritic tuna	Fishing for small coastal tuna species, primarily for local/domestic markets.	4.9
Small pelagics	Primarily fishing for small pelagic species using small purse seine and gill nets.	5.5

Table 19. Destination of tuna caught/traded

Destination of tuna caught/traded	Percentage of respondents (%)
Local market	29.7
Export market	21.6
Local and export market	48.6

Figure 14. Seasonality of tuna fishing in Ternate based on number of respondents reporting fishing in each month



Vertical axis indicates # of fisherman reporting fishing activity for corresponding month.

This data indicates a peak season of fishing activity during March and April, and another season of fishing activity in August to December, and low seasons in January-February and May-July.

Alternative livelihoods available to tuna fishers

In the context of methods aimed at developing assessing fisheries dependency and the likely impacts on vulnerable regions and households, availability of alternative occupations that are readily available to tuna fishers, and that the presence of skills and experience in non-tuna fishing livelihoods are important to identify (Fofana et al., 2006). The following tables identify basic statistics on age, education, professional experience and alternative occupations/livelihoods among respondents.

Table 20. Education level of respondents.

Level of education	Percentage (%)
Elementary	44
Junior high	19
Senior high	35
Tertiary	2

Table 21. Experience working in tuna fishery (years)

Experience working in tuna fishery (years)	
16.22	Mean
14.00	Median

Table 22. Respondents reporting skills and experience in an alternative livelihood

Respondents reporting skills and experience in an alternative livelihood	Percentage of respondents (%)
Livelihood potential outside of tuna fishery	19.3
No other livelihood potential noted	80.7

These tables indicate that tuna fishing is a relatively accessible form of livelihood, with the majority of participants having only an elementary or junior high school education (63% combined), and with an average length of participation in the fishery of over a decade indicating it can be a reliable form of livelihood for these people. These findings corroborate previous studies (McClean et al., 2019) that suggest that tuna livelihoods are accessible to people from a range of socio-economic backgrounds, including those from the lower end of the socio-economic spectrum. That only 19% of participants reported skills and experience in livelihoods outside of the tuna fishery corroborates a finding that tuna fishing is a highly accessible livelihood for people without high levels of skills and experience, as well as potentially indicating that tuna fishing may be sufficiently lucrative for most fishers so as to incentivise specialisation into this livelihood, rather than diversification.

These observations are further corroborated by data on access to gardening land for small-scale agricultural production, which is traditionally a common livelihood in Eastern Indonesia that is combined with seasonal fisheries income. Agricultural land is traditionally owned in North Maluku and thus, the availability of land for gardening tends to suggest whether there are needs for supplemental income to mitigate periods of low income from fishing, but can also indicate whether local customary communities, or migrant fisheries, are accessing the fishing resource.

Table 23. Access to gardening or farming land

Access to gardening or farming land	Percentage of respondents (%)
Yes	16.2
No	83.8

Table 24. Type of produce farmed

If yes, what type of produce is farmed	Percentage of respondents (%)
Spices (nutmeg, cloves)	65.6
Vegetables	3.1
Fruit trees	21.9
Rice and other grains	3.1

Table 25. Use of garden/farm produce

Use of garden/farm produce	Percentage of respondents
For sale	94
For self-consumption	6

The following table is an UpSet plot that displays all the livelihoods combinations that were reported by fishers in the course of interviews, under any question. This plot allows for assessments of combinations of livelihoods to be made, based on both current livelihoods and potential livelihoods based on existing skills and experience among the interviewed cohort. For this plot, the main categories of livelihoods that respondents reported having worked in (currently or at some point in their adult lives) are shown at bottom left, including the total count for each livelihood category as represented in the horizontal bar at left of each option.

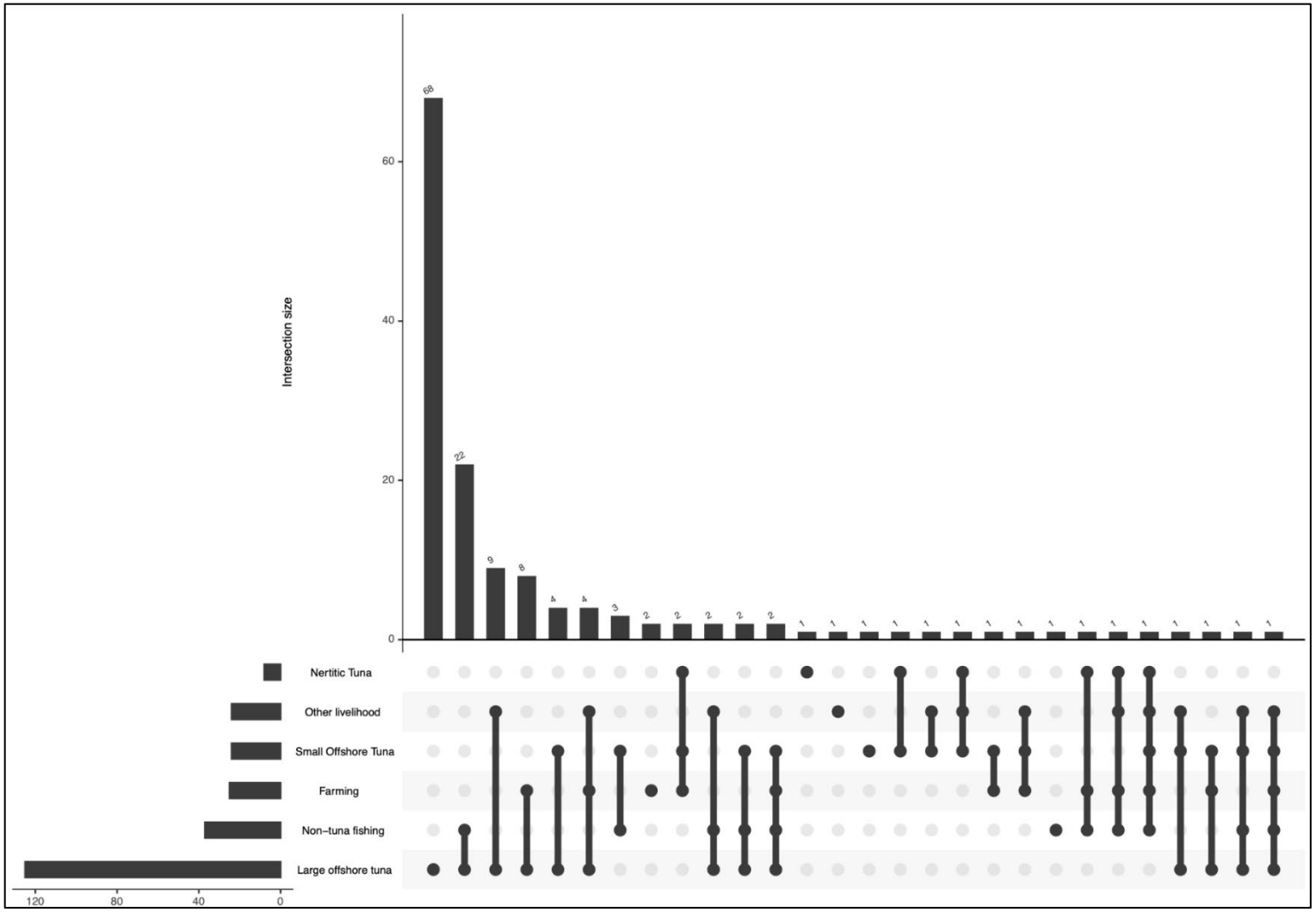
The combinations of livelihoods reported by respondents are displayed at the bottom of the plot. Where a respondent reported only one livelihood, that would be represented by a single dot corresponding to that livelihood. Where a respondent reported two livelihoods, that is represented by two dots, one corresponding to each livelihood, connected by a line. The vertical bar graph represents the count of livelihood combinations reported from highest to lowest.

This analysis relied on categorising current and historical livelihoods into the following groups, which were then plotted using the UpSet method.

Table 26. Livelihood categorisations used in analysis

Livelihood category	Details
Large offshore tuna	Fishing using handline gear for large yellowfin and bigeye tunas, primarily for export market.
Small offshore tuna	Fishing for skipjack and juvenile yellowfin/bigeye tunas, primarily for local/domestic markets.
Neritic tuna	Fishing for small coastal tuna species, primarily for local/domestic markets.
Non-tuna fishing	Primarily fishing for small pelagic species using small purse seine and gill nets. One respondent noted demersal fishing in the past.
Farming	Gardening primarily for spices, fruit trees, rice, and vegetables on traditionally owned land.
Other livelihoods	Any non-agricultural sector role. A variety of roles were noted including builder, transportation worker, policeman etc. Due to small respondent numbers for particular livelihood named here, these were aggregated into a single non-fishing livelihoods category.

Figure 15. Reported livelihoods combinations based on current and historical experience among Ternate interview respondents



The preceding tables and plots indicate that in Ternate, respondents have appeared to focus heavily on export-oriented tuna fishing as a sole income source over their working lives. 45% of fishers having no current or historical opportunity or experience in any other livelihoods, with large offshore tuna fishing the most common type of livelihood reported. The most common livelihood combination was large offshore tuna fishing and small pelagic fishing, which represents the major non-tuna fishing opportunity in Ternate, given a lack of fringing reefs in the region associated with steep island topographies influencing the coastal zone and leading to lower availability of reef fish. This combination of livelihoods in tandem with data on historical switching of livelihoods into non-tuna fishing (see table 29 below) suggests that there are functional interactions between labour involved in the "mini purse seine" fleet which target small pelagics, and tuna fishing fleets, which corroborates findings from previous research in Bitung (McClean et al., 2019).

Perhaps one of the counter-intuitive findings is that a relatively low number of fishers reported fishing for large offshore tuna and small offshore tuna (n=12), which is a common livelihood strategy reported in previous research (McClean et al., 2019). This is likely due to the fact that fishers were asked to note the main species they target on a regular basis, rather than all species they fish for at different times or under different conditions. Thus, these can be considered an underestimate. This is particularly likely when considered against data presented in the following section on occupational mobility.

Occupational mobility in the handline tuna sector

A series of questions on historical occupational mobility and the likely future behaviour of tuna fishers under changing circumstances was included and results displayed in the following tables.

When asked if they had ever changed their role over the course of their involvement in the tuna industry, either into a non-tuna job or a different role within the sector, 34% of respondents (n=58) indicated that they had changed into alternative roles or occupations at some point in their fishing career. The following table displays the nature of those shifts and the reasons why they had undertaken those shifts.

Table 27. Occupational shifts reported among tuna fishers in Ternate

Occupational shifts reported (historical)		% of respondents who answered Yes (n=58)
Move outside fisheries	**Total**	**6%**
	Need for alternative livelihood during low season or periods of bad weather	2%
	Have other livelihood skills and experience	2%
	Income is better from other sectors	2%
Move outside of tuna to another fishery (primarily to small pelagics)	**Total**	**67%**
	Need for alternative livelihood during low season or periods of bad weather	61%
	No reason provided	6%
Move within tuna fisheries	**Total**	**27%**
	Need for alternative livelihood during low season or periods of bad weather	27%

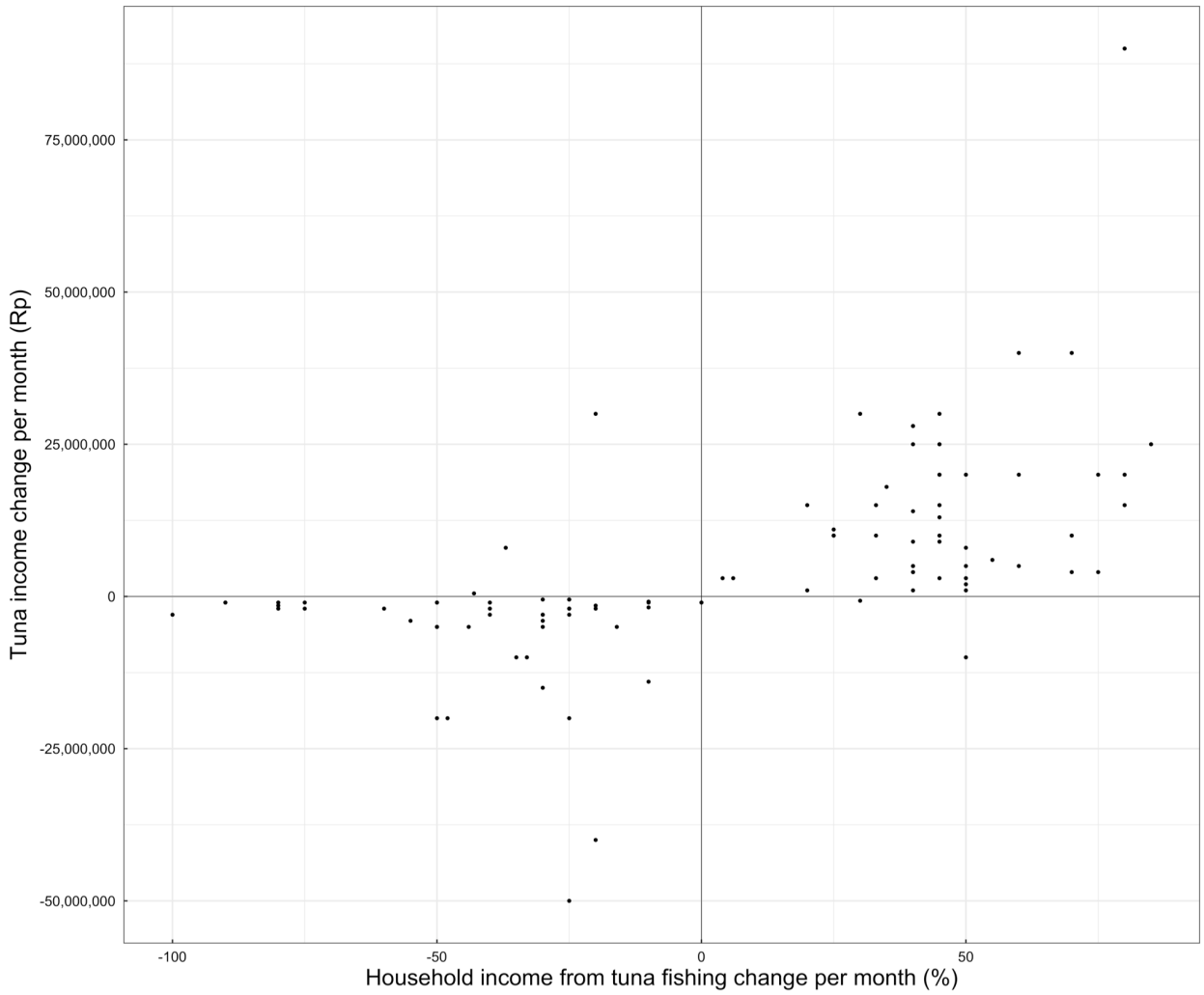
This table indicates that the seasonal nature of tuna fishing, as displayed in Figure 13, has an effect on occupational mobility in the fishery. 88% of those who had engaged in occupational shifts (39% of total respondent sample) cited the need for alternative income

sources during the low season or bad weather. Also, while relatively small numbers of respondents highlighted small pelagics as one of their main targeted species (n=4), these data suggest that on a seasonal basis, these species provide a fall back for fishers targeting large offshore tuna for the export market. 39 fishers cited small pelagics as a fallback in these cases, as opposed to only 4 who cited these as a main targeted species. 16 cited other tuna fishing options as a fall back in low season which was similar to those who highlighted small offshore and neritic tunas as a main targeted species (n=18). It is important to note that these data do not display information on the circumstances or number of people who do not have tuna fishing income during the low season or periods of bad weather but who cannot access alternative income sources.

The following plot shows information provided by respondents, that plots increases or decreases in income from tuna fishing, against increases or decreases in the overall household dependency on that income.

This is expressed in absolute values on the vertical axis (change in rupiah per month) and relative value on the horizontal axis (change in % of HH income from tuna per month).

Figure 16. Reported changes in household income levels and dependency over time



This data is based on recall of household income information from when respondents noted a change in their role or circumstances within the fishery. While this needs to be interpreted with caution as recall information is not considered wholly reliable and can be subject to considerable bias, the graph nonetheless suggests that when tuna income increases, household dependency on that income also increases, and vice versa. Only 3 respondents who noted an increase in tuna income also noted a decrease in the proportion of household income derived from tuna. Conversely only two respondents who noted a decrease in tuna income noted an increase in the proportion of household income derived from tuna. This suggests that tuna fishers have a tendency to specialise in this livelihood, potentially at the expense of other available livelihoods, where income from fishing increases over time. Occupational mobility is, in this view, reduced as tuna fishers increase their income from fishing.

The following tables highlight perceptions and expectations of future behaviour which may indicate the likely occupational mobility of respondents and particularly their willingness to exit the tuna fishery in in the event of a decline.

Table 28. Future intentions with respect to tuna fishing

Do you anticipate continuing to fish for tuna in the future?		**Response rate (n=141)**
Yes	**Total**	**99%**
	Tuna fishing provides a high income that is better than other available occupations	57%
	Tuna fishing is the principal available livelihood to meet basic household needs	28%
	Tuna fishing is the principal available livelihood AND provides good income	8%
	Sense of satisfaction from tuna fishing	3%
	No access to agricultural land	3%
No	**Total**	**1%**
	Preference for another livelihood other than tuna fishing	1%

Table 29. Have you ever considered moving to another livelihood?

Have you ever considered moving to another livelihood? (n=143)	
Yes	**No**
9%	91%

Table 30. Willingness to exit tuna fishing

If you had to leave your current role, would you (n=148)		Response rate (%)
Stay in tuna fishery (change ship or role)	**Total**	**90%**
	Tuna price is high and income is good	73%
	Lack of alternatives based on skills or available options	10%
	Attachment to tuna fishing as a lifestyle	4%
	Have skills and experience in other professions	1%
	No reason provided	3%
Move to another fishery (non-tuna)	**Total**	**3%**
	Income in other fisheries is sufficient	2%
	Have skills and experience in another fishery	1%
Move to another sector (non-fishery)	**Total**	**7%**
	Income potential in other sectors	3%
	Need to move out of fishing due to age	2%
	Income from tuna work is low	1%
	Have skills and experience in other professions	1%

These findings indicated that tuna fishers had a strong desire to continue fishing, with 140 of 141 respondents indicating their expectation is to continue tuna fishing in the future. The reasons for this were overwhelmingly, either that tuna fishing is considered to be desirable livelihood with capacity to earn a good wage in the context of the local economy, or alternatively that for a substantial proportion of fishers, it represents the sole available livelihood available to them to meet basic needs. In some cases fishers cited both reasons as supporting their interest in maintaining tuna fishing.

These findings also highlight that tuna fishers are, on the whole, not considering or are unwilling to move into other livelihoods in the event of future changes. This means that it is likely that tuna fishers would seek to take up roles on other tuna vessels or in other roles in the tuna value chain, if they were unable to continue in their current role. This analysis does not address the possibility that new alternative incomes sources/livelihoods could potentially be made available to fishers as part of fisheries reforms, should and alternative livelihoods scheme be developed.

7.4.1 Gendered division of labour

Indonesian partner researchers led additional research exploring aspects of the gendered division of labour in tuna value chains. According to previous studies in Indonesia (McClean et al., 2019) and wider tuna fisheries (Barclay et al., 2022), gender is one of the key social divisions within tuna value chains, households and communities that influences the nature and extent of dependency, and therefore can inform analysis of vulnerability to changes in a fishery according to different social groups.

Gender was incorporated into project research through review of data collection tools for the household income and expenditure survey to ensure these would elicit relevant data for gender analysis. Subsequently, household surveys and national statistics were analysed to identify the gendered division of labour in households with respondents working in tuna

value chains. The following section includes information directly relevant to considering ongoing monitoring of dependency and vulnerability. Information included here is:

- Participation by women and men in paid work in fisheries value chains in Indonesia, based on Indonesian National Census 2013.
- Figure 2. Income differences per month between men and women in the agriculture, forestry and fisheries sector, based on SARKENAS 2020 (National Labour Force Survey).
- Quantitative survey data on household employment and incomes disaggregated for gender.

These data provide additional insights into the possible use of existing datasets, particularly the Census and SARKENAS datasets, for more detailed disaggregation of fisheries data for the purposes of understanding gender in fisheries value chains. They also provide insights into how inclusion of gender specific variables in surveys can highlight aspects of dependency in tuna households.

Figure 17. Participation by women and men in paid work in fisheries value chains in Indonesia (%). Source: Agricultural Census (2013).

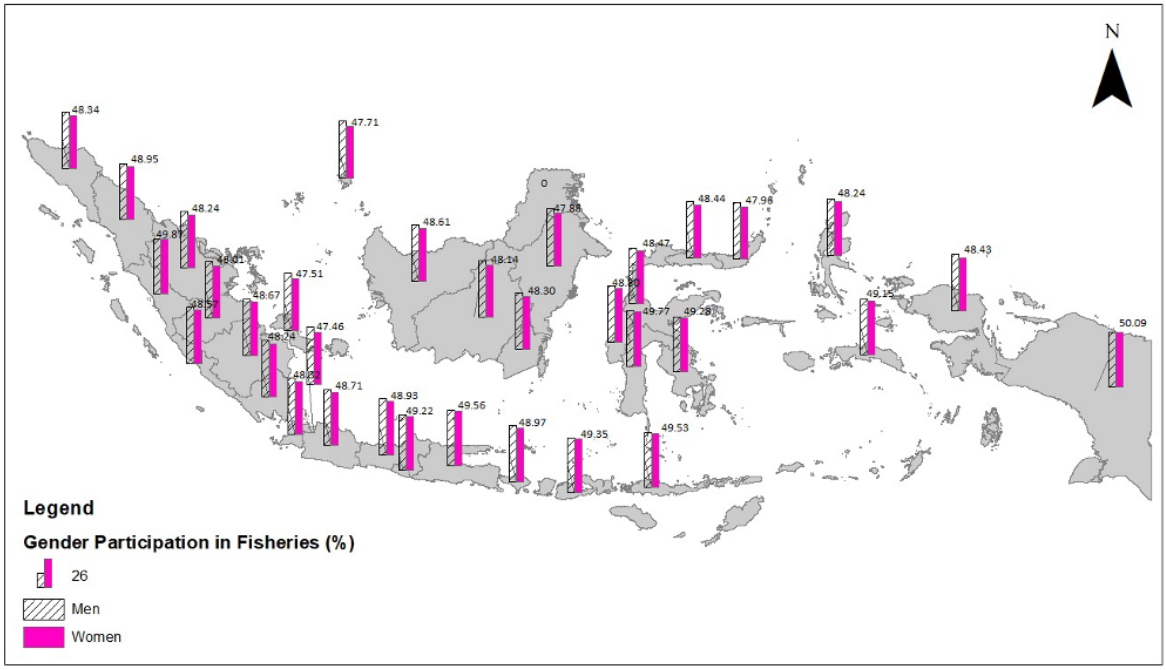


Figure 18. Income differences per month between men and women in the agriculture, forestry and fisheries sector. Source: Sarkenas (2020).

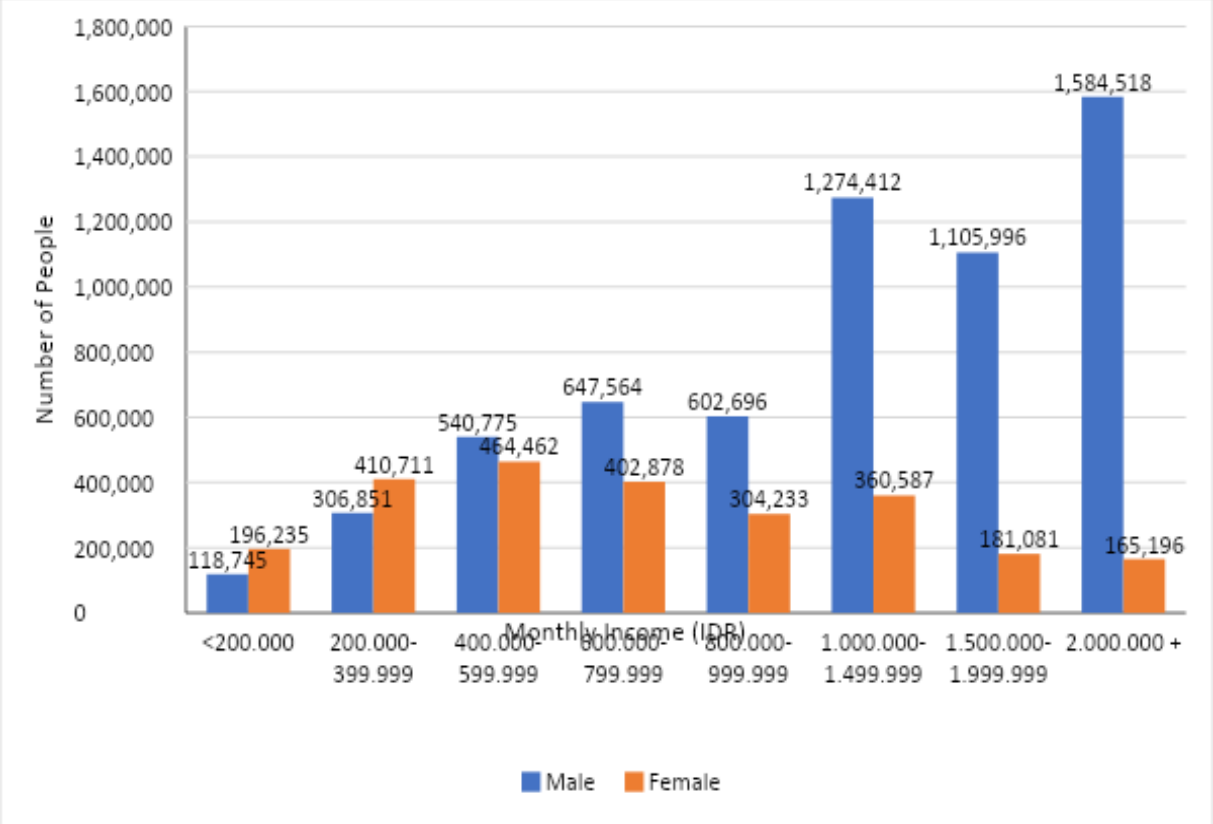
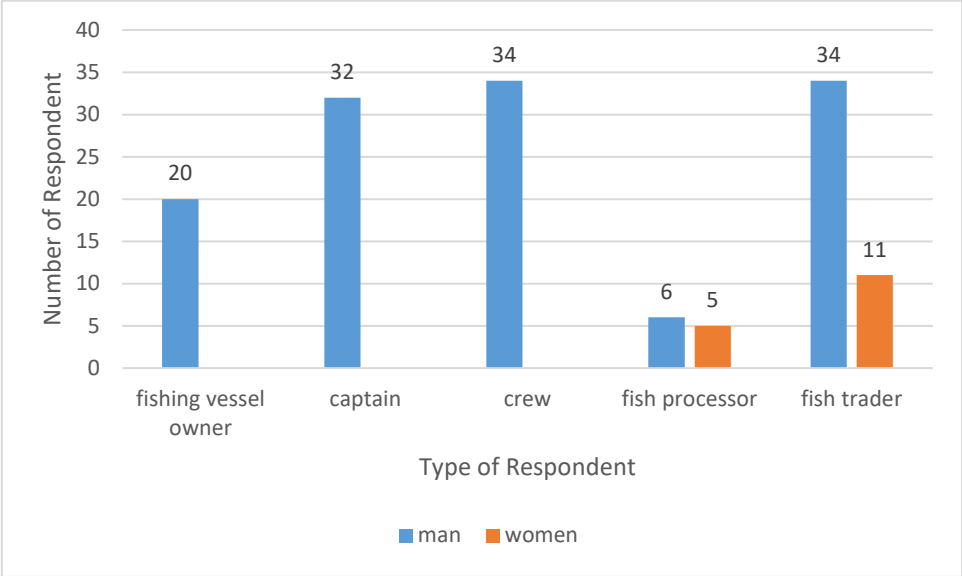


Figure 19. Number and gender of respondents in Kendari tuna value chains, November 2021. Source: Project household survey data.



The findings displayed here indicate that across the fisheries sector, men and women have a roughly equal participation in the fisheries sector. As displayed in Census data, all provinces report values of between 47% and 51% participation of women in fishing value chains.

However, women disproportionately occupy lower paid roles, with women making up the majority of roles that pay 0-400,000 rupiah per month, and men making up a majority or roles that pay above 400,000 rupiah per month.

In the Kendari survey women respondents were recruited only for the roles of fish processors and fish traders, and overall very few women were included in the sample. The second round of data collection at Ternate in 2022 achieved a more balanced sample. Tuna fishing on vessels out at sea is an almost completely male activity in Indonesia but there are small numbers of women tuna fishers (Satapornvanit & Parengkuan 2020). Researchers knew of at least one woman in Kendari who owned vessels but did not recruit her for the study, and were unable to find women working as captains or crew. Other studies on tuna fishing in Eastern Indonesia found the same general pattern that women were most heavily involved in offloading, trading and processing, with small numbers of women traders reported as being vessel owners and acting as patrons to small scale fishers (see McClean at al., 2019).

Collaborative work on the gender analysis revealed that while these findings show that the division of labour in fishery value chains is unequal in terms of numbers of women and men in different roles, it is not necessarily perceived by respondents to be unfair or unjust. The analysis highlighted that equity is not an objective concept but varies according to people's philosophies. In the majority Muslim context of Kendari, it is commonly held that the gendered division of labour within households should be 'complementary' – meaning that household members work together to meet collective needs, within religious and cultural norms that men should be the main income earners and women's first responsibility is to care for the family. It is important to note, however, that a review of Islamic scholarship revealed a variety of views on this point, with some Islamic feminists proposing grounds for more equal visions of gendered divisions of labour within families. Further qualitative research is needed to uncover what gender equity means to people in the research sites, how that relates to the gendered nature of participation in tuna value chains in Indonesia, and what kinds of development outcomes arise from a complementary model of gender equity.

Furthermore, these efforts also showed that the ability to disaggregate fisheries dependency and vulnerability data according to social and cultural variables, such as gender, religion and ethnicity, is of potential value to understanding dependency in Indonesia's tuna fisheries, confirming and elaborating on previous studies which have made similar conclusions (see McClean et al, 2019).

7.5 Future socio-economic monitoring in tuna dependent provinces and households

Here we discuss a number of issues that are relevant to ongoing efforts at socio-economic assessment and monitoring based on our research. These are for consideration in future phases, and also inform some of the higher-level findings and recommendations in the executive summary.

Inability to disaggregate national data for fish species

Most government datasets on socio-economics do not disaggregate for fish species, including tuna. This may limit capacity to be utilised in regular monitoring, and particularly if these data are to be connected to assessments of harvest strategies for the tuna fishery.

Given Indonesia is the world's largest fishing nation, and the world's second largest tuna producer, a public interest argument exists for Indonesia's national statistics agency BPS to tailor national surveys to fisheries households in certain ways. This practice is increasingly common in the Pacific for similar reasons of high dependency on fisheries and importance to national level economic development outcomes. One step would be to include a single question in SUSENAS, Census and SAKERNAS surveys, identifying the main fish species respondents catch when a respondent identifies fishing as their main household livelihood.

Furthermore, methods to downscale data utilising localised catch data or known species abundance and ranges exist, and can be explored to see if longer term monitoring on the basis of aggregated government data is feasible.

Where such efforts can be made, development of composite indexes of dependency and vulnerability could be developed and utilised in management efforts, such as:

- Utilising the Occupational Alternative Ratio as a means of assessing employment dependency and the likely impacts of changes in tuna policy or declines in stocks on labour supply in a region.
- Developing an additive index of household vulnerability that combines % based indicators of household income dependency, poverty risk and food insecurity risk.

It is also important to note that such efforts would have considerable value across Indonesia's fisheries, and that the value of these efforts should therefore not be considered in isolation, as an initiative solely to meet the needs of tuna fisheries management.

<u>Recommendations</u>

- Conduct a cost-benefit analysis of different data collection methods, including but not limited to adjusting national socio-economic surveys (Census, SUSENAS, SARKENAS) relative to undertaking targeted surveys of tuna earning households and fishing households in other large economically important fisheries over a 10-20 year period.
- Investigate methods of downscaling data that is aggregated at the fisheries sector level, utilising provincial and district level catch data.
- Investigate methods of developing simple yet robust composite indexes of dependency and vulnerability.
- Assess the value in non-tuna fisheries of socio-economic monitoring utilising species disaggregated government data.

Quality of data and usefulness of sample size in government surveys for modelling purposes

It was not possible during the project to develop a clear understanding of the quality of government data sets as a basis for robust ongoing analysis in a modelling setting. For example, SUSENAS provides a good basis for descriptive statistics of key indicators, however samples of fishing households can at a district or city level sometimes be relatively small, which may limit their accuracy and capacity to be used for modelling.

Recommendations

- Contract expertise to undertake detailed assessments of SUSENAS and SARKENAS with respect to data quality and sample strengths for assessment purposes, with particular reference to their use in modelling the fishery.

Inability to link datasets

BPS and MMAF surveys do not appear to utilise unique identifiers for households that might allow these to be linked, and for subsets of overlapping data (i.e. where the same household has participated in multiple surveys) to be created for the purposes of analysis. This could be highly beneficial if, for example, household poverty/food security and workforce data in key tuna ports could be linked.

Recommendations

- Investigate the use of unique identifiers for households surveyed that map across national data collection instruments.

Value and practicality of household surveys

Given the low level of available data on tuna fisheries, field surveys are likely to play a role in the development and implementation of a monitoring system. However, given the size of the fishery and the need for monitoring of the resource and economic data alongside SE data, the cost and burden of field surveys needs to be carefully considered. This is particularly in terms of tracking achievement of management objectives, the potential for survey fatigue, and the efficiency of alternative means of collecting SE data.

With respect to management objectives, the additional value of collecting socio-economic data is likely to revolve to a large degree around the nature of the management objectives adopted for the tuna fishery. Where food and nutrition security, and improving the living standards of fishers and traders are adopted, then vulnerability indicators such as those described in this study are likely to be critical. Where total economic profitability is adopted as a management objective, economic indicators are more likely to provide directly relevant data.

With respect to survey fatigue. Survey fatigue and the complexity of calculation methods for expenditure data limited the Indonesian research team's ability to collect robust household expenditure data in this project. In the context of the reality of Indonesian fishers working lives, ensuring that survey instruments can be completed in a relatively efficient window of time, for example 30-45 minutes, will minimise fatigue and ensure that field surveys, when used, are an achievable method. Undertaking more in-depth work on a semi-regular basis either to develop methods to monitor novel issues, or to thoroughly assess household SE outcomes (i.e. as needs or every 5-10 years) can reduce the need to develop very long survey instruments that are used regularly.

With respect to alternative means of collecting household data that are not reliant on field surveys and may be more cost-effective. The disaggregation of BPS surveys to include the main 5-10 economically important fish species as a data point when a fishing household is surveyed, as well as investigating means of fishers uploading household information through secure online platforms, are each methods that could be more cost-efficient than traditional face to face surveying. However, there is currently no information on these options to assess their feasibility and cost efficiency relative to implementing regular surveys.

Recommendations

- The Indonesian government clarify the management objectives for the tuna fishery to provide direction to the prioritisation of economic and/or socio-economic data collection and monitoring processes.
- Utilise targeted and relatively efficient modules/questions for monitoring on a regular basis (e.g. monthly, annually) and undertake more comprehensive assessments over longer time periods (e.g. every 5 years).
- To allow for new questions to be included in quantitative surveys in ways that are not burdensome and can answer context specific needs, utilise qualitative groundwork to identify the spread of common responses to key issues that need to be quantified and “test survey” new questions with a cohort of ~10 initial surveys prior to full survey rollout. These can subsequently be included in a regular survey as check boxes. This can assist in developing a set of pre-determined answers that are of relevance to management and reflect the reality of people’s situation on the ground.
- Undertake a thorough baseline study of livelihoods and vulnerability as a means of generating a baseline on these issues, and for assessing the need for regular (i.e. monthly, annual) monitoring of household socio-economic data.
- Conduct a cost-benefit analysis of different data collection methods, including but not limited to adjusting national socio-economic surveys (Census, SUSENAS, SARKENAS) relative to undertaking targeted surveys of tuna earning households and fishing households in other large economically important fisheries over a 10-20 year period.

8 Impacts

8.1 Scientific impacts – now and in 5 years

The scientific impacts of this work now are as follows.

- This study provides the first quantitative evidence of vulnerability in tuna dependent communities in the IAW harvest strategy area of jurisdiction.
- This study demonstrates the applicability of generalised and commonly used methods for determining dependency and vulnerability, and necessary adaptations required for utilisation in Indonesian tuna fisheries.
- The study highlights the need for initial assessments of livelihoods and vulnerability at the scale of the IAW harvest strategy to inform baseline that can be used in development and testing of potential harvest strategies.
- The study highlights steps required to assess the need for, and then establish regular socio-economic monitoring. This includes proposed methods that are likely to be relatively cost-effective for regular monitoring and can provide the basis for a simple yet robust composite household vulnerability index.

The intended scientific impacts of this work in 5 years' time are as follows.

- Baseline empirical evidence of dependency and vulnerability in the IAW harvest strategy area of jurisdiction has been gathered systematically.
- Methods and systems for assessing and monitoring vulnerability in Indonesian fisheries (both tuna and non-tuna) are advanced an in early implementation phase.

8.2 Capacity impacts – now and in 5 years

The capacity impacts of this work now are as follows.

- Improved understanding of methods for determining dependency and vulnerability among Indonesian team members, as well as technical and policy officers in the Indonesian government responsible for science and implementation of the IAW harvest strategy.
- Improved understanding of data sources available for determining dependency and vulnerability among Indonesian team members, as well as technical and policy officers in the Indonesian government responsible for science and implementation of the IAW harvest strategy.
- Improved understanding of the social and economic aspects of Indonesian tuna fisheries among Indonesian team members, as well as technical and policy officers in the Indonesian government responsible for science and implementation of the IAW harvest strategy, and stakeholders participating in that process.
- To meet the needs of this and related projects, recruitment into BRIN partner research centres of researchers with expertise in the use of national data sets for household socio-economic analysis, and food security analysis has occurred.

The intended capacity impacts of this work in 5 years' time are as follows.

- Fisheries related data collection/monitoring systems are generating information on dependency and vulnerability in tuna fishing communities that is amenable for use in national level decision-making.

9 Conclusions and recommendations

Based on available literature (see section 11.1), data source reviews (see section 7.1), assessments of provincial level dependency and vulnerability indices (see sections 7.2, 11.2), and pilot data collection in 2 provinces (see sections 7.3, 7.4 and 11.2), we recommend that, as one an aspect of harvest strategy development and testing in Indonesian tuna fisheries, socio-economic assessments of provincial level dependency and household level vulnerability are required.

Should these initial assessments confirm the need for regular monitoring of dependency and vulnerability, then as part of a wider monitoring framework incorporating other critical data such as resource monitoring and economic monitoring, socio-economic monitoring in Indonesian tuna fisheries should be established. While we have explored particular methods in this project which would likely be of value to such assessments, we also note that a range of possible methods could effectively meet these needs.

We propose however that, regardless of the specific methods utilised, these initial assessments, and potential ongoing monitoring processes, require a 3-step process.

- Step #1/Priority #1 – Undertake provincial level fisheries dependency assessments utilising available government data.
- Step #2/Priority #2 – Profile regions for vulnerability to a reduction in access to tuna, utilising household level livelihoods and vulnerability indicators.
- Step #3/Priority #3 Support the collection of data to enable disaggregation according to key variables such as species, fleets, value chain, market, role and social group.

Our findings with respect to the need to assess household level vulnerability in particular, are evidenced by the following findings from our research.

- High levels of dependency in tuna earning households, with 88% of household income on average coming from tuna and with consistent median values of 100% across most gear types (n=235). Our research indicates that for 70% of tuna workers in Kendari (n=114) and 75% in Ternate (n=121), 100% of household income comes from tuna fishing or other value chain activities.

- Limited alternative income sources or potential for alternative livelihood options, as evidenced by high household income dependency rates coupled with low levels of education, low levels of skills and experience outside tuna fishing, and a low willingness to exit tuna fisheries. Interviews in Ternate (n=148) in particular highlighted that:

    - Only 19% of tuna fishers interviewed stated they had an alternative livelihood available to them.
    - Only 16% have access to gardening land for basic subsistence in the event of a decline in tuna income.
    - Tuna fishers appear to have a low willingness to exit the fishery, with only 9% of respondents having considered moving into another livelihood, and 91% of respondents stating that that would seek to stay in tuna fishing (different vessel or role) if they could not continue in their current role.

- Limited financial reserves and assets to facilitate a change in occupation among a substantial proportion of tuna workers, as evidenced by between 7.4% (lowest value, Ternate n=121) and 30.7% (highest value, Kendari n=114) of tuna dependent households considered to either be experiencing poverty or at risk of poverty in the event of a reduction in access to tuna. Variations across provinces in poverty risk indicators are significant and highlight the need for profiling across the main tuna fishing areas for household vulnerability, which may vary considerably.

- Potential for low living standards in alternative livelihoods for which tuna fishers and workers have skills and experience. In particular, our findings show that household food insecurity is likely to be significantly higher in non-tuna fishing households than in tuna dependent households, and household poverty rates likely to be somewhat higher on average in non-tuna fisheries households than in tuna dependent households. This would likely provide a disincentive to exit tuna fishing and enter non-tuna fishing livelihoods.

While these pilots need to be considered with caution and validated against similar surveys in other tuna ports, the consequences of findings of high levels of vulnerability are significant. If ever there was a substantial change in access to tuna in these ports, these assessments suggest that:

1. A proportion of tuna dependent households may not have the capacity to readily exit the fishery or move into other more sustainable livelihood options.
2. A proportion of tuna dependent households risk slipping into, or further into, poverty. In some provinces this is likely to be a significant number of fishers.
3. The level of tuna dependent households in poverty or at risk of slipping into poverty is likely to influence the proportion of households with the capacity to exit the fishery.

These findings indicate that household level vulnerability assessments are likely to be important in Indonesian tuna fisheries for both social welfare reasons, to ensure that vulnerable groups are not pushed into poverty as a result of changes to their access to tuna, and for ecological reasons, to ensure that, in the event of sustainable management interventions being required to limit catch or effort, vulnerable groups with low adaptive capacity are supported to exit the fishery and avoid possible “effort shifts” into other tuna vessels or fleets. These considerations should be integrated into fisheries dependency assessments, as one aspect of ongoing socio-economic assessments in Indonesian tuna fisheries.

On this basis, key findings and recommendations are provided in full in the executive summary section and so are simply noted here in brief to reduce reader fatigue.

Key findings:

- Assessment of Indonesian tuna fisheries requires consideration of both broadscale fisheries dependency, and household level vulnerability.
- Available government data can, with progressive improvements in quality over time, measure tuna fisheries dependency across provinces.
- Income data can generate relatively cost-effective information on household level vulnerability in Indonesian tuna fisheries.

Key recommendations:

1. The Indonesian government establish an ongoing regular monitoring and assessment system that assesses fisheries dependency and household vulnerability.
2. That this system be established in the longer term so as to support national monitoring of tuna fisheries, and also be used as a template for SE monitoring in non-tuna fisheries such as demersal and reef based coastal fisheries.
3. That a follow-on initiative could generate baseline data on provincial dependency and household livelihoods and vulnerability in the main tuna fishing ports.
4. That establishment of effective SE assessments and supporting monitoring systems will take time to develop, be reliant on multiple co-ordinated efforts, and therefore will be impacted by factors outside of the socio-economic monitoring process itself. This is despite government commitment to socio-economic objectives and monitoring processes.

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10.2 List of publications produced by project

- Arthatiani, F, Muawanah, U, McClean, N (2021) Compendium of tuna related information recorded in SUSENAS national socio-economic surveys. Report prepared for Technical Meeting, Mid Term Review of project SRA 2021/109. Circulated to stakeholders. Regular compendiums due to be produced by BRIN participants in this project.
- McClean, N., Adhuri, D.S., Barclay, K., Fabinyi, M., Muawanah, U., Arthatiani, F. (in preparation) Vulnerability in tuna fishing dependent communities in the Indo-Pacific region. Manuscript in final editing stage. Target journal: *Environmental and Sustainability Indicators.*
- Armen Zulham, Umi Muawanah, Kate M. Barclay, Hikmah Madani and Hertria Maharani Putri (under review). Gender Inclusiveness in Fisheries Value Chains: Case Study of Tuna in Kendari, Indonesia. Submitted to *Journal of Rural Studies*.

11 Appendices

11.1 Overview of studies assessing fisheries dependency and vulnerability

In this appendix we highlight key indicators and methods used in fisheries dependency and vulnerability analysis, and present key literature that has informed development of a socio-economic monitoring framework for Indonesian tuna fisheries, with a focus on impacts on vulnerable tuna dependent communities. While there are a great many nuances that can and should be drawn out in specific studies of dependency and vulnerability in any one community, province or region, and which have been pursued in assessments of Indonesian tuna fisheries, the purpose of this section is to demonstrate work undertaken to support findings in section 7.1 as follows:

a) Establish the conceptual and methodological linkages between fisheries dependency and vulnerability assessments.
b) Highlight general methodological points from these approaches that are relevant to developing robust socio-economic monitoring systems in fisheries.
c) Identify key cases that can inform an approach to fisheries dependency and vulnerability in Indonesia.

Methodologically we follow FAO publications such as Brugere & Young (2015) which, rather than undertaking systematic literature reviews, rather provide overviews of relevant assessment concepts and methodologies, and illustrative examples of practice, focusing on issues relevant to support practitioners and specialists working with communities dependent on fisheries and aquaculture. In our case, we include both fisheries dependency and vulnerability assessment concepts, methods and examples in our scope, and seek to support practitioners and specialists working in Indonesia.

Fisheries dependency – an overview

Fisheries dependency (FD) in its simplest sense is the concept that some individuals, communities, regions or nations are more reliant on fisheries than others, and that for some, fishing is an essential aspect of the life of that place.

> *Meaningful measures of fisheries dependent regions need to capture the sense that "the industry provides an essential backbone to its economic or social structure" Phillipson, as quoted in Stanford et al. (2013)*

> *[A fisheries dependent community] is a population in a specific territorial location which relies upon the fishing industry for its continued economic, social and cultural success. (Brookfield 2005)*

Once applied to a specific fishery, region or community considerable variation in fisheries dependency can be evident. This includes variations in the ways in which a

fishery operates, the nature of the wider socio-ecological system, and the ways in which people utilise that fishery as a means of securing a livelihood.

The major linking factor of FD studies is that their purpose is to develop a comparative understanding of the social and economic aspects of a fishery, primarily between geographic regions, whether that is comparisons between nations, provinces, districts, or local communities. Within geographic regions the literature also shows that further comparisons may be permitted – for example between economic sectors (fishing/agriculture/construction), between fisheries, between fleets in a fishery (large scale small scale, different gear types), between sectors (catching/processing/trading) or even between social groups (women/men, migrants/non-migrants, different ethnic or cultural groups).

Fisheries dependency as a method of assessment is therefore an important tool in large scale fisheries management settings that cover many regions or communities with different characteristics, and consequently has been used as a systematic monitoring and assessment tool in places such as the EU and North America (see e.g. Symes 2000, Hall-Arbor et al., 2001, Salz & Macfadyen 2007).

> *Conceptually, "fisheries dependence" is a continuous dimension, or several dimensions, and hence a matter of degree…. permitting comparisons between many places within a nation. (Hamilton & Otterstad, 1998).*
>
> *Dependency is a relative and subjective term. Different countries have different interests, and see their dependence manifest itself in different ways. [Dependency] indicators are a way of trying to measure these things, making them more objective and comparable in a relative way.* (IOTC 2019)

In one jurisdiction, governments, stakeholders and communities may agree that increasing the total number of people employed in a fishery is the most important objective, while in another, increasing the economic value generated from fisheries, or ensuring accessibility of fish to local communities for consumption may be important objectives. In each case, a fisheries dependency approach provides a method for assessing the relevant aspects of the fishery across different geographic regions, using the suite of indicators that allow for meaningful assessment for the purposes of managing that fishery. Depending therefore on the characteristics of fisheries in a region, and the objectives of management, different FD indicators will be more or less relevant and useful to the decisions being made (IOTC 2019).

As a method oriented towards fisheries management across multiple regions or communities, it aims initially to support baseline assessments of the relative social and economic dependency of different regions to be made, for assessment of potential impacts of fisheries management and policy to be made, and for the social and economic impacts of fisheries policy to be tracked over time across regions and communities (Hall-Arber et al. 2001, Symes 2000, Fofana 2006).

Vulnerability as an aspect of dependency

Vulnerability in its simplest form is the concept that an individual, a community, a nation, a species or an ecosystem, is subject to the risk or possibility of harm. A helpful technical definition of vulnerability from Adger (2006) as it has emerged in the context of socio-ecological systems is as follows.

Vulnerability is the state of susceptibility to harm from exposure to stresses associated with environmental and social change, and from the absence of capacity to adapt.

It is worth noting that, conceptually, vulnerability is a basic aspect of fisheries dependency studies. Fisheries dependency is founded on the basic notion that regions or communities with a higher reliance on fishing are, by definition, taken to be more vulnerable to changes in fisheries policy or a change in the stock (Symes 2000, Fofana 2006).

Within this broad understanding, we have identified 3 ways in which vulnerability emerges in fisheries dependency studies, from our overview of the literature.

- Vulnerability as an implicit aspect of fisheries dependency
- Vulnerability as an explicit aspect of fisheries dependency
- Vulnerability as a standalone assessment method that links to fisheries dependency

The difference between an implicit or explicit use of vulnerability is partly to do with the language utilised – some FD studies make explicit that the aim of the study is to highlight areas with higher vulnerability to change than others, while others do not. However more substantively, where vulnerability is an explicit aspect of an FD assessment, additional steps of analysis aim to highlight specific vulnerabilities to specific risks.

A good example that illustrates both these steps can be found in the EU fisheries dependency assessments, which are the most comprehensive fisheries dependency monitoring and assessment program globally and underpin decision-making under the EU Fisheries Common Policy. The EU has a two-step process for assessing fisheries dependency (as cited in Stanford, Wiryawan et al., 2013).

- **Step 1** identifies fisheries dependent areas using absolute and relative fishing activity rates (employment, landings and fleet data) to determine the activity level and regional distribution of fishing areas. This is typically based on readily available government data (see e.g. SETFC 2023, Salz & Macfadyen 2007, Frere & Failler 2001).
- **Step 2** involves economic and social profiling to highlight those areas particularly vulnerable to a decline in fisheries activity by using a wide range of indicators including demography, health, education and housing. This is often undertaken as targeted geographical studies to build on the EU wide dependency assessments (see e.g. Natale et al., 2013, Pinto et al., 2022).

Most if not all FD studies undertake Step 1 in the schema above – to highlight the relative differences in dependency across regions or communities, utilising readily available information.

Where studies advance on this basic FD analysis and undertake the equivalent of Step 2, this is done by highlighting a more detailed set of characteristics that are specific to the context of management and the specific policy or management interventions being considered. This acknowledges that those indicators that highlight broad dependence, such as catch, employment or economic value, are necessary for identifying some aspects vulnerability, but may not be sufficient for understanding the responses of different regions or communities to specific risk. As a result, a viable assessment of vulnerability may also require information on the

capacity of different regions to respond to a change in their access to a fishery resource (and by extension a change in their level of dependency).

This links to the third major theme we identified in relation to vulnerability as an aspect of fisheries dependency, where vulnerability assessments are used as a standalone assessment method that links to fisheries dependency.

These studies draw more on vulnerability as it has been developed as a standalone field since the early 2000s.[2] This coalescence occurred most obviously particularly in response the emergence of climate change (Béné et al., 2014, Brugere & Young 2015). However two other common streams of vulnerability analysis are assessments of the sustainability of local livelihoods which includes the associated risk of poverty and food insecurity, and studies which sought to understand vulnerabilities in whole socio-ecological systems (Adger 2006).

Most typically, studies of vulnerability drawing from these trajectories operate around a common methodological focus and development of indicators of:

- **Exposure** to a specific risk/harm
- **Sensitivity** to the risk/harm
- **Adaptive capacity** in response to the risk/harm.

Dependency and vulnerability as concepts utilised in socio-economic fisheries assessments are therefore a natural conceptual fit with a long history in mainstream fisheries management. However, engaging with the Exposure/Sensitivity/Adaptive Capacity method can advance our understanding of vulnerability as an explicit aspect of FD analysis and provides additional tools and concepts with which to address risks impacting on fishery dependent communities.

Utilising these approaches, vulnerability is best understood as a function of:

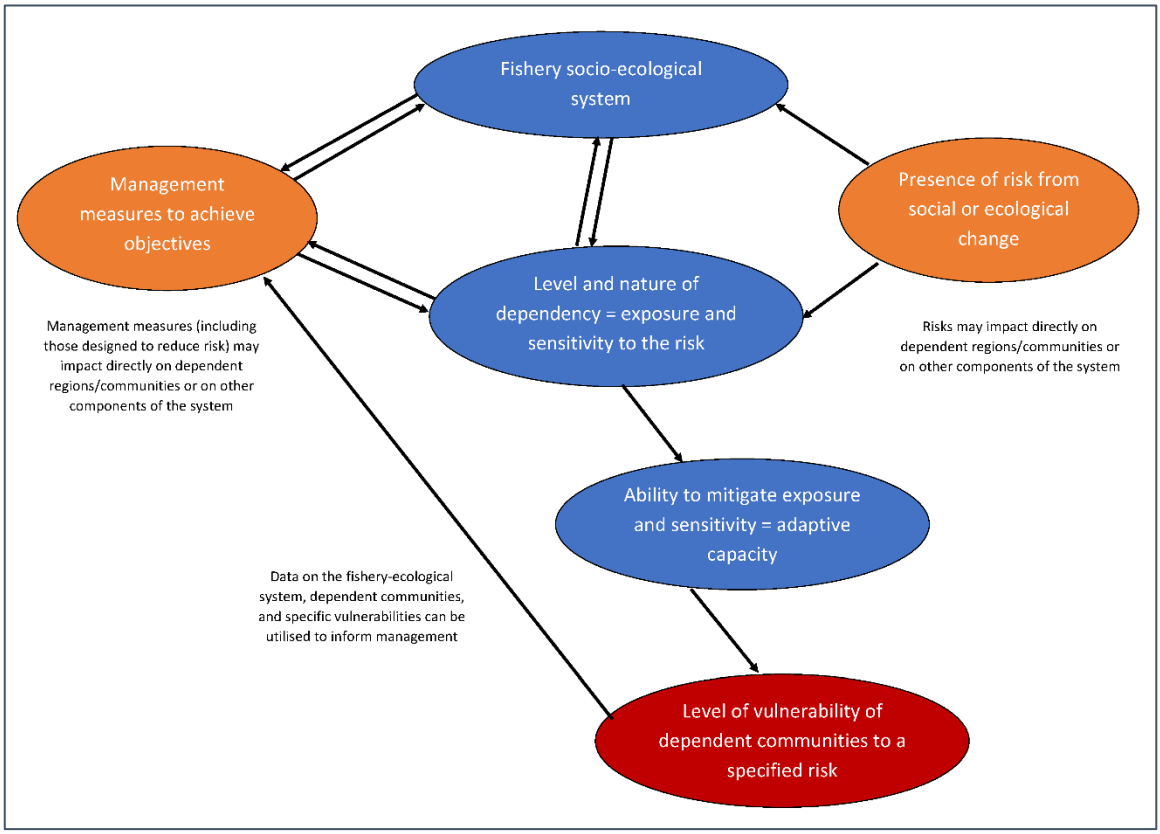
- The nature of the risk present.
- The interaction the risk and the nature and level of dependence on a fishery within a particular nation, region or community (exposure and sensitivity).
- The capacity to respond effectively to that change (adaptive capacity).

Vulnerable regions and communities can therefore be defined as a subset of the total dependent population who have relatively high levels of exposure and sensitivity to a process of social or ecological change, such as fisheries decline or management intervention, and relatively low adaptive capacity.

The following diagram highlights a conceptual framework linking FD and vulnerability analysis in the context of fishery socio-ecological systems.

[2] See Adger (2006) for an overview of this field which still has much resonance with current practice and scholarship on vulnerability.

Figure 20. Relationship between fisheries dependency and vulnerability in a socio-ecological systems context.



Common fisheries dependency indicators

Based on our review of studies below, we identified four commonly used FD indicators:

- Fish catch/production.
- Employment.
- Revenue and regional economic contribution.
- Fish consumption.

Fish production

Examples of production indicators used include the total production of fish and shellfish in a region by weight (Stanford 2013, SETFC 2023), total fishing mortality (Gascuel et al., 2012), and fishing imports/export (FFA 2022). Aggregate production values across species and fleets allow for a basic understanding of dependency on fisheries between geographic regions, while more fine-grained data can permit comparison of those regions in terms of their level of dependency on particular species (Gascuel 2012), as well as different fleets and gear types (SETFC 2023, Gascuel 2012).

Production or catch data of various types tend to be the primary and in many cases the most accessible form of data on dependency, and provide a basic starting point for assessing FD. However, as a measure of socio-economic dependency, production indicators are an indirect measure as they do not display the social and economic benefits accruing from fishing industries. As a result, they can be most useful in relation to understanding socio-economic dependency when used in tandem with other indicators.

Employment

Employment indicators are the most common indicator used that directly measures the social and economic benefits of fisheries, with a widely used rule of thumb for fishing dependence being that 5%-10% of a population being employed in fisheries is an appropriate threshold, above which a region is considered fisheries dependent in a meaningful sense (Lindkvist et al., 2000, Symes 2000).

While most typically these focus on the fishing sector. where data is available it is recognised assessing employment in fishing-related activity beyond catching alone, such as fish processing, trading, and jobs related to gear and boat maintenance, has considerable value for considering the relative impact of changes in a fishery (see e.g. Hamilton & Otterstad 1998, Brookfield et al., 2005, Salz & Macfadyen, 2007).

In some cases further detailed assessment of social groups employed within a fishery has been undertaken within a FD lens, such as in the EU where the number of men and women in different fishing roles has been utilised to understand geographic variations in dependency (Symes 2000, Salz & Macfadyen 2007), or in Indonesia where groups in different socio-economic positions within fishing communities, such as those experiencing poverty, have been examined within the comparative method of fisheries dependency analysis (Stanford et al., 2013, The et al., 2024).

In some cases, understanding employment from fishing and its interaction with other economic sectors can be developed, such as through understanding the relative levels of poverty in different economic sectors present in fishing dependent regions (see Stanford et al., 2013) or through calculating Occupational Alternative Ratios which allow for both analysis of the impact of fisheries policy on employment in the fisheries sector, as well as analysis of a decline in fisheries or changes in policy that reduce access to a fishery on the overall labour supply in a region, which can have implications for the outcomes for households who have to move out of fisheries into other work that may be less stable or well remunerated (Hall-Arber 2001, Fofana 2006).

Revenue and economic activity

Revenue generation and economic activity indicators are also a common form of indicator of dependency, and particularly in highlighting the contribution of fisheries to regional economies. Most commonly this is measured as gross value of production. However, in some cases, such as where national economic models exist for these purposes, the income generated by the fisheries sector as a percentage of the national or regional economy can be utilised (Salz & Macfadyen, 2007).

As well as showing direct or aggregate economic contributions, these indicators can also show where the revenue from fisheries flows. For example, in some Pacific Island countries the main source of income from tuna fisheries is government revenue from access fees paid by foreign fleets (Bell et al., 2021), while in others the existence of domestic flagged fleets and onshore processing means many more economic benefits flow directly into the local economy (Havice & Campling 2013). In this setting then, economic dependency can be understood across these diverse nations in multiple terms, by tracking both government revenue from fishing access, and economic activity associated with domestic fleet development and processing activities.

Building on this broad notion, it is worth highlighting studies of tuna fisheries in Indonesia and the Pacific that have measured value added from fisheries to different nations (Gillett

2009) and in major fishing centres within countries (see Hoshino et al., 2023). While these studies were not developed within an explicit lens of fisheries dependency, they demonstrate a viable method and indicator for understanding a key aspect of dependency, through assessing regional economic contributions along the value chain across different geographies.

Fish consumption

Indicators of dependency on fish for food and nutrition are particularly important for showing benefits to regions and communities that go beyond those who are directly engaged in fisheries. The most common and readily available indicator that can be utilised for food and nutrition purposes is total catch. A good example of this are indicators utilised to monitor Pacific tuna fisheries by the Forum Fisheries Agency, which includes the goal of enhancing food security. In this case, the total catch in national waters for 15 Pacific Island nations is documented annually as an aggregate indirect measure of fish availability for consumption (see FFA 2022). However, in this case further detailed studies are being developed to assess in more detail how much of that catch enters domestic markets, which highlights that fish production is an indirect measure of food and nutrition benefits. Specifically, it also does not measure the actual consumption of fish arising from this aggregate availability, which can vary considerably between locations, communities and social groups.

Consequently, a number of FD studies that have a specific focus on food and nutrition, and particularly in the developing world where undernutrition is common, have highlighted the use of fish consumption indicators as of key importance, such as percentage of protein intake from fish (see Allison et al., 2009, 2011, Teh et al., 2024). While fish consumption data is not as commonly used in fisheries dependency studies as the total production of fish, given the high rates of vitamin and mineral deficiencies globally, it is increasingly recognised as important to expand the use of nutrition indicators in fisheries research generally (Hicks et al., 2019), and the use of fish consumption data in fisheries dependency studies is one example of how progress can be made on this topic.

Fish consumption data is perhaps the least commonly used indicator of fisheries dependence however it is included in three major studies (Allison et al., 2009, Allison 2011, Teh et al., 2024) which are significant for their consideration of fisheries dependency in the developing world, and the linkage of these dependencies to poverty and food security alleviation in these countries. Moreover, consumption indicators have been highlighted in tuna management forums as a significant indicator for highlighting relevant aspects of dependency in developing coastal states (IOTC 2020).

As such these provide a cogent example of how indicators that may be non-standard in high capacity developed word fisheries do not necessarily display metrics that are important for considering outcomes in developing countries, where the contribution of fisheries to poverty and food insecurity alleviation are more pressing immediate concerns for fishing dependent regions and communities.

Methodological considerations for selecting and designing FD indicators

There are a number of relevant methodological considerations for selecting appropriate measures of fisheries dependency.

Absolute and relative measures

Quantitative fisheries dependency indicators are, ideally, reported in both absolute and relative measures.

Absolute measures are important as they display the precise number of people who are dependent on a fishery for a given indicator. Relative measures are useful as they measure the proportion of overall activity in a region that can be attributed to a fishery. Both data types are required to be able to understand the dynamics of dependency and allow for meaningful comparison.

An illustrative example is provided in Stanford et al. (2013) who studied fisheries dependence and poverty in coastal West Sumatra, Indonesia. In this study, the authors firstly identified districts that were fisheries dependent based on the percentage of workers employed in fisheries, deeming a region to be fisheries dependent if over 5% of the working population were employed in fisheries. However, the total number of fishers in some districts initially identified as not fisheries dependent was comparable to numbers in the regions identified as fishing dependent, yet the proportion of the population was only 2% of the total workforce, due to much higher total population levels in these districts.

Subsequently, based on use of the absolute measures of dependency, districts with less than 5% of total workforce as fishers but comparable total numbers to other dependent districts were included as fisheries dependent districts. Thus, using both absolute and relative values were important in this case to be able to effectively identify all districts that are fisheries dependent, despite these different characteristics.

Providing both absolute and relative measures is as a result a general methodological rule in FD studies, that should be met where possible, to ensure that meaningful comparison between geographies can be enabled where quantitative indicators are being used (Symes 2000, Stanford 2013).

Spatially explicit analysis

As a comparative method that primarily compares between geographies, fisheries dependency studies rely on spatially explicit data analysis (see e.g. Bell et al., 2021, Andrew 2011, Stanford et al., 2013, Salz & Macfadyen 2007). This may be displayed in table form, or through the generation of GIS based maps or, ideally, in both forms.

We provide a number of examples in the following sections of FD analysis presented in different spatially explicit formats.

Scale

Fisheries dependency can be measured at various scales, and it is a matter for each particular study to determine the meaningful unit of analysis in this respect - whether individual, household, community, provincial, national or regional scale.

That being said, most existing studies measure dependency at either a national level, to compare between nations, or at a provincial level, to compare between broad regions within a country (Allison, 2011, Pinto 2022).

Fewer studies have measured FD at the local level of community, household or individual level. Examples included in studies reviewed include Hamilton & Otterstad 1998, Watson, P., & Beieiks, N., 2009, Brookfield et al., 2005; Ross, 2013. Local scale measures are valid for the purposes of considering local scale issues, and there is no *methodological* barrier to utilising measures at a fine scale where the purpose of analysis requires this, or

where fine scale data (i.e. household data) can be aggregated upwards to a scale that is relevant to the management of a fishery (e.g. at a provincial or national scale).

It is worth noting that, depending on the issue to hand, the issue of data availability at sale can be crucial for developing effective assessment methods.

For example, Allison (2011) identifies a structural disconnect between major bodies of research on poverty, food insecurity and vulnerability in fisheries, and national level fisheries planning processes (see also Thorpe et al., 2007; Béné et al., 2016). In particular, Allison (2011) identifies as barriers:

> *'the limited utility of national level indicator data in assessing causal relationships between changes in fish production, trade and development outcomes… [and] fragmented case-study research on poverty and food security that cannot address questions on the scale of benefits derived from the sector at more aggregate levels.' (Allison 2011)*

Quantitative and qualitative measures

Fisheries dependency indicators may be either qualitative or quantitative. Most indicators described above are typically quantitative in nature and at a broad scale (province, nation). Moreover, fisheries dependence is often defined based on a quantitative threshold above which a community is considered "fisheries dependent."

Such quantitative indicators have appeal in a management setting as they can often be generated utilising existing government statistical data, and enable standardised comparison at a broad scale and across many geographical units (see e.g. Fofana 2006).

However qualitative indicators can be utilised in fisheries dependency assessments, and qualitative social studies can generate important contextual information about how fishing communities are integrated with wider social and economic structures, and how fishing contributes to the life of coastal communities as a whole.

For example, Griffith and Dyer (1996, quoted in Fofana 2006) developed a Fishery Dependence Index (FDI) in the US using the following measures of infrastructure and support related to fishing, which include indicators of social and cultural aspects of the local community:

- Numbers of repair and supply facilities and fish dealers and processors
- Presence or absence of religious and secular art and architecture dedicated to fishing
- Numbers of fishing permits and vessels.

In addition, they also utilised profiling of local fishery characteristics to contextualise and build on their Fisheries Dependence Index, which required the use of quantitative measures and assessments of the presence/absence of social and cultural characteristics and behaviours:

> *Variation in fishery dependency both between and within ports was also measured. Ports that were found to be more isolated and less flexible in terms of ability to move to other fish stocks and gear types were more fisheries dependent; ports where particular classes of fishermen within the industry were not well integrated into other fisheries or economic entities (e.g. tourism) were ranked more dependent on fishery. Ports with historical and cultural indicators of reliance on fishing (mariner museums*

etc.) were ranked more dependent. Competition and conflict amongst participants reflected perceptions that the resource was scarce and, therefore, that the participants were more dependent on it.

Hall-Arber et al. (2001), in developing a simple Occupational Alternative Ratio for fisheries dependency purposes, also noted that fisheries dependency indexes and measures are, by their nature, necessary approximations of the reality of how dependency operates in specific places, and with fishing as one aspect of community life in a coastal area. They therefore advocate the use of more fine-grained profiles of fishing communities as revealing critical elements of the context that will influence the effects and effectiveness of management measures.

[While] the Occupational Alternative Ratio index is a straightforward and easily interpreted measure it represents only a summary measure that fails to capture the richness of the cultural life that underlies fishing as an occupation and as a vocation. Specifically, the OAR does not address the question of occupational fungibility (i.e., interchangeability). While the movement of fishermen to other occupational roles is clearly possible, OAR implicitly assumes that the skills involved in fishing are readily transferable… While we use occupational census data to identify dependency on fishing in the context of the surrounding village, town or city … individual community profiles reveal critical details that temper the number-driven rankings of dependency. For example:

- *Ethnicity: ethnic and language barriers make it difficult to transfer to alternate occupational roles.*
- *Adaptive specialization, meaning people successful at fishing are not well suited for other occupational roles, and may be limited by these characteristics to fishing. Adaptive specialization includes a strong need for independence, inability to tolerate fixed temporal schedules, deferred gratification orientation, and tolerance of temporal periodicity in familial and other social relationships.*
- *High job satisfaction in fishing, and a correspondingly strong resistance to switching jobs due to the characteristics noted above.*
- *A strong sense of place, meaning fishermen and their families identify with a location on land and water that serves as a nexus for their sense of community… Further, sense of place both limits and grounds fisher folk's experiences to their location, while giving them familiarity and constancy—things that lead to a high quality of life including social, emotional, and cultural stability… Conditions which can abrogate this sense of place include forced seasonal migration when local stocks cannot provide income or fishing them is restricted by regulations, or complete collapse of local resource from environmental disaster or overexploitation.*

The predominance of quantitative measures is in part due to the nature of available existing data sources - such as fisheries production data, census data or broadscale economic data at the sector level. Reflecting the complexities of fisheries dependence in reality and the need for social and cultural characteristics and local variation across communities to be included in assessments, Brookfield et al (2005) defined a fisheries dependent community as "a population in a specific territorial location which relies upon

the fishing industry for its continued economic, social and cultural success." Stanford et al. (2013) highlights value in this definition because it:

> *1) Explicitly includes cultural aspects, 2) highlights the reliance of fisheries for 'success', therefore hinting that a community may survive without fishing, and 3) is not tied to a specific percentage of employment in the industry.*

Ideally fisheries dependency studies should consider the use of both qualitative and quantitative data, depending on the nature of the issues being addressed within a fishery, the scale of analysis, and the characteristics of the community and fishery itself.

Use of multiple indicators to create an index

FD indicators can either be used as standalone indicators presented "side by side" or in some cases, can be utilised as part of an index. These calculations can be relatively simple based on utilising publicly available descriptive statistics (see e.g. Allison 2011), or can be highly complex based on multiple stages of analysis of fisheries data and modelling of dependence (see e.g. Natale et al., 2013).

Two ways in which this can occur from the relevant literature reviewed which are useful to highlight here are as follows:

Additive or cumulative indexes

This adds multiple relative measures (%) of FD to compare the total across geographical areas (see Allison 2011). Some additive/cumulative indexes combine indicators by identifying those above an agreed upon threshold. Where a geographical area is above the threshold for a sufficient number of indicators, it is considered fisheries dependent (see e.g. Natale et al., 2013) and this provides an additional level of analysis than what is capable without having thresholds identified.

Use of ratios

In general ratios provide easily interpretable information on the proportion of an activity that is taken up by fishing in a region, such as economic value, catch, or employment and can be used in additive and threshold-based indexes. Hall-Arber et al. (2001) and Fofana (2006) use advanced dependence ratios of fishing employment as a proportion of the available occupational alternatives in a region in which fishers have skills and experience, demonstrating an example of how ratios specific to the needs of fisheries dependency studies can be generated.

As a more specific index, the Occupational Alternative Ratio requires multiple information sources to be able to calculate – for a given region, total fishers, and total employment in occupations fishers have transferable skills in. The latter requires contextually relevant information on the skills, experience and livelihoods of fishermen, and the transferability of those skills to be able to interpret effectively, as well as sector specific information on those occupations. The benefit is this ratio is that it provides more specific information than a basic ratio of fishing employment to all employment. Specifically, this allows for impacts of policy on employment in the fisheries sector to be addressed, as well as forecast impacts on the local labour supply in key livelihoods of interest to fisheries management, and the relative social and economic consequences for fishers of entering a different livelihood (i.e. a likely increase or decrease in living standards).

This latter method links to existing work in Indonesia (Stanford et al., 2013) that highlighted the relative poverty metrics in fishing livelihoods as compared to other available economic sectors in West Sumatra. Such analysis can be useful for highlighting the likely outcomes of changes in fisheries policy for dependent communities, by being able to forecast the likely living standards associated with livelihoods for which fishers have transferable skills.

Studies of fisheries dependency and vulnerability reviewed

In the following table we provide details of indicators noted in 26 studies that utilise fisheries dependency in various applications, including 14 that explicit assessed vulnerability indicators.

Table 31. Studies on fisheries dependency and vulnerability reviewed in project

Example or study	Indicator/Measure of dependency	Use of vulnerability (Explicit or implicit analysis off vulnerability, nature of indicators)
European Union Regional Fisheries Dependency studies. Various references available. We have reviewed the following: Scientific, Technical and Economic Committee for Fisheries (STECF) - FDI methodology (STECF-23-05), Zanzi, A., Hekim, Z. and Motova-Surmava, A. editor(s), Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/542525, JRC134663. Goulding, Hallam, Harrison-Mayfield, (2000) Regional Socio-economic Studies on Employment and the Level of Dependency on Fishing in the European Union. MegaPesca, Portugal. European Commission (2001) Regional Socio-economic Studies on Employment and the Level of Dependency on Fishing. Lot No.23: Coordination and Consolidation Study. Directorate-General for Fisheries, Brussels.	- (Ratio 1) Share of Fisheries Activity in the value added of the Area - (Ratio 2) Share of Fisheries Activity in the total regional employment - (Ratio 3) The share of catches subject to CFP quota management measures as a proportion of total catches Disaggregated where possible by - Industrial sector (fishing, processing, trading) - Gender - Hours worked	**Explicit.** df Once regional dependency has been assessed, a second stage of assessment can involve economic and social profiling to highlight those areas particularly vulnerable to a decline in fisheries activity by using a wide range of indicators including: - Demography - Health - Education - Housing

Frere, J and Failler, P (2001) Regional Socio-economic Studies on Employment and the Level of Fishing Dependency in England and Wales. European Commission, Brussels. Pavel Salz & Graeme Macfadyen. (2001) REGIONAL DEPENDENCY ON FISHERIES. Directorate General Internal Policies of the Union - the European Parliament's Committee on Fisheries.		
Stanford, R. J., Wiryawan, B., Bengen, D. G., Febriamansyah, R., & Haluan, J. (2013). Exploring fisheries dependency and its relationship to poverty: A case study of West Sumatra, Indonesia. *Ocean & coastal management*, 84, 140-152.	- Total number of fishers - % of the workforce employed as fishers - The total production of fish and shellfish - Total number of individuals in a state of poverty where their main income source was fisheries - Percentage of total fishers in a state of poverty	**Explicit** Utilises poverty indicators to highlight the proportion of the fishing population, and of other economic sectors in a district (agriculture, construction, etc) who are poor. This provides relative measures of social vulnerability across districts and economic sectors.
Edward H Allison (2011). Aquaculture, Fisheries, Poverty and Food Security Working Paper 2011-65/ World Fish Centre	- Contribution of fish value to GDP (%) - Contribution of fisheries to employment (%) - Protein intake from consumption of fish (%)	**Explicit** A high dependence on fisheries for macro-economic activity, employment and nutrition is taken to produce a high level of vulnerability to changes in fisheries among poor and food insecure populations. Indicators used are indirect measures of vulnerability with respect to poverty and food insecurity. Improvements in national data are recommended to ensure that more direct measures of vulnerability to poverty and food insecurity in fishing dependent areas can be developed.
Allison	In addition to biophysical variables, the following were used to determine dependency Composite index of employment and economic dependence on the fisheries sector - Number of fishers (most recent year 1990–1996) - Fisheries export value as proportion (%) of total export value (averaged over 1998–2001) - Proportion (%) of economically active population (1990) involved in the fishery sector - Total fisheries landings (tonnes, averaged over 1998–2001)	**Explicit** Fisheries dependence indexes were calculated as indicators of exposure and sensitivity to climate change impacts on fisheries. Adaptive capacity indicators included: - Healthy life expectancy (years) - Education Literacy rates (% of people ‡ 15 years) - School enrolment ratios (% in primary, secondary and tertiary education - Political stability - Government effectiveness - Regulatory Quality - Rule of law

	Index of nutritional dependence - Fish protein as proportion of all animal protein (%), averaged over 1998–2001	- Voice and accountability - Corruption - Size of economy Total GDP
Brookfield K, Gray TS, Hatchard JL. The concept of fisheries-dependent communities - A comparative analysis of four UK case studies: Shetland, Peterhead, North Shields and Lowestoft. *Fisheries Research* 2005, 72(1), 55-69.	- The number of fishermen - Contribution to GDP - Jobs that are directly dependent on fishing - Related industry that allows the fishing industry to function (forward and backward attachment) - Source of communal and personal identity - The role played by small fishermen in fisheries - The existence of other livelihoods - Changes in consumer preferences - Determination of TAC	**Implicit** A high dependence on fisheries is taken to produce vulnerability to changes in fisheries policy.
Hamilton, L., & Otterstad, O. (1998). Demographic change and fisheries dependence in the northern Atlantic. *Human Ecology Review*, 16-22.	- % of labour force/employment/labour devoted to fishing and processing - Fisheries dependent defined as "any municipality where at least 10% of employed persons in 1980 worked in the fishing industry"	**Implicit** A high dependence on fisheries is taken to produce vulnerability to changes in fisheries policy.
Neil Andrew, Kam Suan Pheng, Michael Phillips (2011) Mapping Fisheries Dependence and Aquaculture Development in Timor-Leste: A Scoping Study	At national and local scale: - Fisheries resources - Use of resources by communities (i.e. catch and consumption) - Contribution to food security and nutrition	**Implicit** A high dependence on fisheries is taken to produce vulnerability to changes in fisheries policy.
Surís-Regueiro, J. C., & Santiago, J. L. (2014). Characterization of fisheries dependence in Galicia (Spain). Marine Policy, 47, 99-109..	For each of 9 regions - Population (total #) - Output (Gross Value of Production) - Gross Value Added - Primary Gross Income across the fishing population - Total employment (#) - Total employment (FTE) Disaggregated by fishery or fleet - Shell-fishing on foot o Goose barnacle o Bivalves and others - Sea fishing o Artisanal fishing o Coastal fishing o Distant waters o Long-distance waters	**Implicit** A high dependence on fisheries is taken to produce vulnerability to changes in fisheries policy.
Watson, P., & Beieiks, N. (2009). Small community level social accounting matrices and their application to determining marine resource dependency. *Marine Resource Economics*, 24(3), 253-270.	For each of 2 regions, and across 15 economic sectors of which fisheries is one: Gross Regional Production (GRP) contribution - Contribution to GRP ($million) - Contribution to GRP (%) - Direct contribution ($mill) - Indirect contribution ($mill) - Base GRP Dependency (%) – takes into account direct and indirect contributions.	**Implicit** A high dependence on fisheries is taken to produce vulnerability to changes in fisheries policy.

	Regional employment contribution - Contribution to employment (#) - Contribution to employment (%) - Direct contribution (#) - Indirect contribution (#) - Base employment dependency (%) – takes into account direct and indirect contributions.	
Natale, F., Carvalho, N., Harrop, M., Guillen, J., & Frangoudes, K. (2013). Identifying fisheries dependent communities in EU coastal areas. *Marine policy*, *42*, 245-252.	Per region: - Employment dependency on fisheries - Total Employment Above 1% contribution to total employment in a region is considered the threshold of fisheries dependency.	**Implicit** A high dependence on fisheries is taken to produce vulnerability to changes in fisheries policy.
Kronen, M., Vunisea, A., Magron, F., & McArdle, B. (2010). Socio-economic drivers and indicators for artisanal coastal fisheries in Pacific island countries and territories and their use for fisheries management strategies. *Marine Policy*, 34(6), 1135-1143.	Across 17 Pacific Islands Countries and Territories and 63 communities Artisanal fishing catch by species (from survey data) - Finfish o Subsistence catch o Commercial catch - Invertebrates o Lobster o Clams o Crustaceans o Bivalves o Gastropods. o Octopus Macro-economic indicators (from government data) - Consumer price index - per capita GDP - percentage of urban population, - per capita export–import balance (USD) - total national population - population density (people km2 land - growth rate dependency ratio (age 15–64 - years), - gross migration (%) - total land surface (km2) Market accessibility (assessment by team based on site characteristics) - Low - Medium - High	**Explicit** A high dependence on fisheries is demonstrated to produce vulnerability to changes in fisheries using analysis of data, with this vulnerability mediated by various factors. Specifically, correlations between macro-economic conditions (diversity of economy), micro-economic conditions (availability of alternative livelihoods), community level dependency, and vulnerability to changes in a fishery are demonstrated with statistical analysis.
Olowe, O. S., Jacinto, H. S., Limbago, J. S., Folorunso, A., Sarfo, I., & Brown, C. (2023). Assessing Social Vulnerability to Climate Change in a Fishery-Dependent Village in South Central Vietnam. Environment & Natural Resources Journal, 21(5).	Did not measure dependency directkly bu among a wider suite of climate related indicators, the following fishery specific indicators were utilised: - Level of income diversification among fishers - Percentage of fishers above 60 years - Percentage of female-headed households (to see if gender influenced coping strategies) - Access to loan/credit availability	**Explicit** This study took fishing dependence as an assumed/established aspect of the life of this fishing village and then assessed vulnerability to climate change based on the Exposure/Sensitivity/Adaptive Capacity framework.

	- Percentage of fishers with secondary school education - Access to at least one social group (to identify presence of informal safety nets) - Percentage of fishers above the poverty line	
Gascuel, D., Merino, G., Döring, R., Druon, J. N., Goti, L., Guenette, S., ... & Mackinson, S. (2012). Towards the implementation of an integrated ecosystem fleet-based management of European fisheries. Marine Policy, 36(5), 1022-1032.	In order to assess impacts of changes in species abundance, categorised fleets by: - Country - Gear/ - Vessel size(m) - Value of catch - % of total fishery value	**Explicit** The implications of the interactions between species distributions/abundances and fleets characteristics were modelled to calculate changes in: - Fleet impact on stocks - Economic dependency on stocks - Sustainability
Bell, Johann D., et al. "Pathways to sustaining tuna-dependent Pacific Island economies during climate change." Nature Sustainability 4.10 (2021): 900-910.	- Government revenue from tuna fisheries at national level - Total catch from tuna fisheries at national level	**Explicit** Impacts of climate change on tuna distribution and abundance, and subsequent effects on revenue and catch in national waters across 13 pacific Island nations are modelled. This demonstrates the relative socio-economic vulnerability of these nations as an aspect of their dependence on tuna fisheries.
Colburn, L. L. et al. (2016). Indicators of climate change and social vulnerability in fishing dependent communities along the Eastern and Gulf Coasts of the United States. Marine Policy 74, 323–333	Developed a series of indexes based on combining the following indicators. Personal disruption index - Percent unemployed - Percent in poverty - Crime index - Percent females separated - Percent with no diploma Poverty index - Percent receiving assistance - Percent of families below poverty level - Percentage over 65 in poverty - Percentage under 18 in poverty Labor force structure index - Percent females employed - Percent population in the labor force - Percent self employed - Percent people receiving social - security Housing characteristics index - Median rent in dollars - Median mortgage in dollars - Median number of rooms - Percent mobile homes Commercial fishing engagement Index - Value of landings - Number of commercial fishing - permits - Number of dealers with landings	**Explicit** Indicators were used to assess the impact of sea level rise on critical commercial fishing infrastructure and the dependence of communities on species identified as vulnerable to the effects of climate change. The aim was for these indicators and findings to inform changes in fisheries management regimes to be cognisant of the impacts of climate change on fisheries, and fishery dependent communities. The addition of social vulnerability indicators and particularly poverty and personal disruption indexes included an additional step of identifying vulnerable groups within communities.

	- Pounds of landings Commercial fishing reliance index - Value of landings by population - Number of commercial fishing permits by - population - Dealers with landings by population - Percent in forestry, farming	
Brookfield, Katherine, Tim Gray, and Jenny Hatchard. "The concept of fisheries-dependent communities: a comparative analysis of four UK case studies: Shetland, Peterhead, North Shields and Lowestoft." Fisheries Research 72.1 (2005): 55-69.	Provides a detailed description of the economic and political constraints and opportunities facing 4 separate fishing communities in advancing community social and economic development based on where they are placed along a spectrum of fisheries dependence. Summary/comparative analysis included: - Description and location of community - Qualitative assessment of level of dependency based on level of seasonality, whether fishing was a primary or occasional source of employment. - Coping strategies to respond to change	**Explicit** The inclusion of economic and social barriers to social development, and the description of coping strategies for each community places this study in a vulnerability-oriented framing. Which communities are able to adjust over time in positive ways, and which are not?
Macfadyen, G., and V. Defaux. "Scoping study of socio-economic data and indicators of IOTC fisheries." Indian Ocean Tuna Commission: Victoria, Seychelles	Sought information to advance information on the following indicators. Employment in fishing, upstream, and downstream sectors - In FTE - By fleet (longline, purse seine, etc) - By gender - By age - By domestic/distant water vessel Food security from tuna catches - Retail prices of tuna - Domestic landings (aggregate and by species) - Imports Average annual crew earnings by fleet (gear type) and vessel (domestic flagged, distant water). Economic aspects of tuna fisheries - Ex vessel sales prices - Landed values - Export volumes - Export sales prices - Total export values - Vessel profitability of vessels, upstream businesses and downstream businesses based on costs and earnings data Government access and license fees from tuna fisheries	**Implicit** Consideration of vulnerability not explicit in assessments of available data however would support future assessments of vulnerability.

Ross, N. (2013). Exploring concepts of fisheries 'dependency' and 'community' in Scotland. Marine Policy, 37, 55-61.	Highlighted the importance of both quantitative and qualitative indicators of fishing dependency, including: - Employment - Income - Sense of personal and community identity from fishing - Co-operation and reciprocity between fishers	**Implicit** Did not explore vulnerability specifically however the paper seeks to expand beyond conventional notions of what is "at risk" in the event of a fisheries decline.
Hall-Arber (1998)	Development and use of an Occupational Alternative Ratio based on: - # of fishing employees - Information on alternative occupations for which fishers have existing skills and capabilities - Labour force dependency on these alternative occupations	**Explicit** The purpose of the OAR is to highlight those areas which have a high socio-economic vulnerability to changes in fisheries policy. This topic is discussed at length in the body of the text.
Fofana (2006)	Development and use of an Occupational Alternative Ratio based on: - # of fishing employees - Information on alternative occupations for which fishers have existing skills and capabilities - Labour force dependency on these alternative occupations	**Explicit** The purpose of the OAR is to highlight those areas which have a high socio-economic vulnerability to changes in fisheries policy. This topic is highlighted in the body of the text.
Pinto, M., Albo-Puigserver, M., Bueno-Pardo, J., Monteiro, J. N., Teodósio, M. A., & Leitão, F. (2023). Eco-socio-economic vulnerability assessment of Portuguese fisheries to climate change. Ecological Economics, 212, 107928.	– Population dedicated to fisheries – Fishing population dependency on immigrants – Fishing effort – Monthly income from fishery – Household fishery economic dependency – Pride on fishing activity	**Explicit** Fisheries dependency indicators at left were a subset of a wider set of 32 indicators of vulnerability that were categorised according to the Exposure/Sensitive/Adaptive Capacity method. Particular indicators of interest in the wider set of vulnerability indicators were occupational flexibility indicators, indicators of trends in the fisheries sector and the wider economy, and assessments of fisheries institutions/governance, and fisheries policy/management.
Chaijaroen 2019	In assessing the effects of coral bleaching on fishing households in Indonesia, the following indicators of dependence were used in sites where coral bleaching had occurred, for households where the main occupation of the household head was fishing: - HH head's age - Male HH head Y/N - Income - Migration - Working hours per week - Working weeks per year - Secondary job/income - HH members in fisheries - Non-food expenditure - Total food expenditure - Protein expenditure	**Explicit** Having identified fishing dependent households as a precondition for inclusion in the study treatment group, variables in standardised household income and expenditure surveys were used as indicators of vulnerability to coral bleaching.

11.2 An example of port level vulnerability assessments in Kendari and Ternate

The following table presents an illustrative assessment of vulnerability in tuna dependent households in Kendari and Ternate utilising the data presented in the main report and the exposure/sensitivity/adaptive capacity method as discussed in Appendix 1 (Section 11.1). This is provided to indicate how data collected under a proposed socio-economic monitoring framework might be utilised to inform management relevant considerations in Indonesia's tuna fishery.

To develop this assessment, we first identified a possible risk against which vulnerability could be assessed. The risk that is being assessed is a change in the access to tuna among tuna dependent households. This may be due to, for example, a decline in the stock or a shift in its range, leading to reductions in abundance (and therefore ability to access for fishers), or due government regulation (e.g. effort or catch restrictions) which might limit access to the fishery for a proportion of the fishing dependent population.

The data from assessments and pilot surveys are used cautiously here to indicate, rather than comprehensively assess, relevant dimensions of vulnerability. This is cognisant of the fact that:

a) data available are not comprehensive assessments but pilots of possibly useful monitoring methods and approaches.
b) comprehensive assessments of data and indicators for vulnerability may not be possible across all Indonesian tuna ports and communities, yet with adequate investments useful data may be gathered in a targeted/strategic way to support decision-making.

Illustrating how such data can be utilised in a vulnerability assessment to indicate possible high levels of vulnerability is therefore undertaken here to provide insights into ongoing monitoring, and incentivise agencies to undertake this data collection in the future. In developing this illustrative assessment, we considered the following steps and information.

Table 32. Description of indicators/data used in illustrative vulnerability assessment for Kendari and Ternate

Step	Data/indicator	Justification
Exposure	1. Tuna fishing port Y/N. 2. Level of fishing and fleets present.	1. Basic identification of exposure 2. Provides additional information on exposure, depending on the characteristics of the risk (e.g. if a regulation impacts only large vessels, or seeks to regulate all sectors).
Sensitivity	1. Income dependency on tuna at household scale 2. Levels of tuna consumption at provincial scale	1. Indicates the likely responsiveness of Tuna dependent households to a change in access to tuna. 2. Measures of the likely responsiveness of the wider population to a change in access to tuna.
Adaptive capacity	1. Access to alternative livelihoods in tuna dependent households	1. Indicates the capacity of Tuna dependent households to absorb a reduction in income from tuna fishing.

	2. % of tuna dependent households living below provincial household poverty line. 3. Tuna dependent households willing or able to exit tuna fishing 4. % of fishing households classified as poor at provincial scale 5. % of fishing households experiencing food insecurity at provincial scale	2. Indicates the proportion of Tuna dependent households at risk of slipping into poverty as a result of external shocks. 3. Indicates the likely behaviour of Tuna dependent households I response to reduced access to tuna. 4. Indicates the likely living standards associated with livelihoods for which Tuna dependent households have readily transferable skills. 5. Indicates the likely living standards associated with livelihoods for which Tuna dependent households have readily transferable skills.

Table 33. Port level vulnerability assessments for Kendari and Ternate

Site	Exposure	Sensitivity	Adaptive capacity	Level of vulnerability
Kendari	**High** Kendari is a major tuna port and processing site High levels of tuna fishing, across handline, pole and line and purse seine sectors.	**High** High levels of household dependency on tuna income - >90% on average. High levels of tuna consumption in the province - Ranked #8 nationally for per capita tuna consumption in fishing households, SUSENAS 2019.	**Low** Low access to alternative livelihoods among tuna dependent households – 30% of respondents reported access to alternative income source/livelihood options. High percentage of tuna fishers living below provincial household poverty wage – 29% based on survey results. High % of fishing households classified as poor – 31% based on SUSENAS 2019. High levels of food insecurity in fishing households – ranked #10 for food insecurity in fishing households.	**High**

Site	Exposure	Sensitivity	Adaptive capacity	Level of vulnerability
Ternate	**Medium-High** Ternate is a substantial provincial tuna port. It does not have local processing factories but does supply tuna to major processors/exporters in Bitung. High levels of tuna fishing in the small handline sector. Some tuna fishing among pole and line and purse seine vessels	**High** High levels of household dependency on tuna income - >90% on average. High levels of tuna consumption in the province – Ranked #1 nationally for per capita tuna consumption in fishing households, SUSENAS 2019.	**Medium-Low** Low access to alternative livelihoods among tuna dependent households - only 25% of respondents reported access to alternative income source/livelihood options. Relatively low percentage of tuna fishers earning below provincial household poverty line – 7% based on survey results. Low willingness to exit tuna fisheries – 91% of Tuna dependent households reported that they would shift to another tuna job in the event of a future change (another vessel, another role) Relatively low % of fishing households classified as poor – 5% based on SUSENAS 2019. High levels of food insecurity in fishing households – ranked #1 for food insecurity in fishing households.	**Medium-high** Ternate is exposed and sensitive to declines in access to tuna. Low access to alt livelihoods, low willingness to exit tuna fishing, and high levels of food insecurity in the province suggest low levels of adaptive capacity. However these are mitigated by low poverty rates in Tuna dependent households and wider fishing households, suggesting some capacity to absorb income reductions and that some viable alternatives may exist.

11.3 Compendium of tuna related information recorded in SUSENAS national socio-economic surveys

Compendium of tuna related information recorded in SUSENAS national socio-economic surveys

Data analysis by Freshty Arthianti. Map production Umi Muawanah. Report compiled by Nick McClean.

This compendium collates and presents data relevant to tuna fisheries management collected annually by the Indonesian government's national statistics bureau, *Badan Pusat Statistik*, in the SUSENAS annual household socio-economic survey. Information in this compendium is from the 2019 survey, in which 315,672 households across Indonesia's 32 provinces were surveyed. This included 11,191 households where working in the fishing sector is the primary occupation of the household head (known as *Rumah Tangga Perikanan* or fishing households).

SUSENAS collects a large amount of information of relevance to fisheries management generally, including information on household poverty and food security status, as well as household income and expenditure, consumption and demographics. However, as fishing households are not asked specific information about the main species of fish they target, the ability to disaggregate is limited for tuna fisheries. The exception to this is household food consumption data, which can be disaggregated for fish species. In this compendium we present information on tuna consumption which includes species in Indonesian refereed to variously as *tuna* (yellowfin and bigeye tunas), *cakalang* (skipjack tuna) and *tongkol* (a set of 6 coastal tunas including frigate tuna, bullet tuna and some small mackerel species). Together these are commonly referred to as TCT, and SUSENAS records consumption of TCT per household.

Included in this compendium is:

- Information on food security and poverty status in fishing households across all provinces.
- TCT consumption information across all provinces.

A household is classified based on food security level by the calorie consumption per day, which is stated as three-levels:

1. Very food insecure: Calorie capita consumption <1400 calories per day
2. Food Insecure: Calorie capita consumption 1400-1800 calories per day
3. Food Secure: Calorie capita consumption > 1800 calories per day

A household is classified as a poor household if it has a per capita expenditure below the March 2019 national poverty line, which is Rp. 425,250/capita/month.

TCT consumption information measured in the following ways.

- Consumption participation rate, indicating the % of households reporting consumption of TCT.
- Per capita consumption, recording the average kg of tuna consumed per capita per year.
- TCT consumption as a % of total fish consumption.
- TCT consumption as a % of total protein consumption.

Each of these four measures are displayed for each province, disaggregated in terms of the following variables.

- Primary occupation of household head: fishing household, non-fishing household.
- Household food security status: secure, insecure, very insecure.
- Poverty status: poor, non-poor.
- Proximity to coast: Average across coastal and inland districts.

Intended uses of this compendium

TCT consumption information presented here provides information that can be used to inform further research to support policy development, and aims to provide an example of what is possible with well-designed socio-economic monitoring and reporting systems. More specifically, this provides an example of how information at a provincial level can shed light on

- The level of dependency of different provinces on tuna fisheries, in this case for food and nutrition.
- Household level vulnerability, as measured by rates of poverty and food security in fishing households.

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Food security status by province

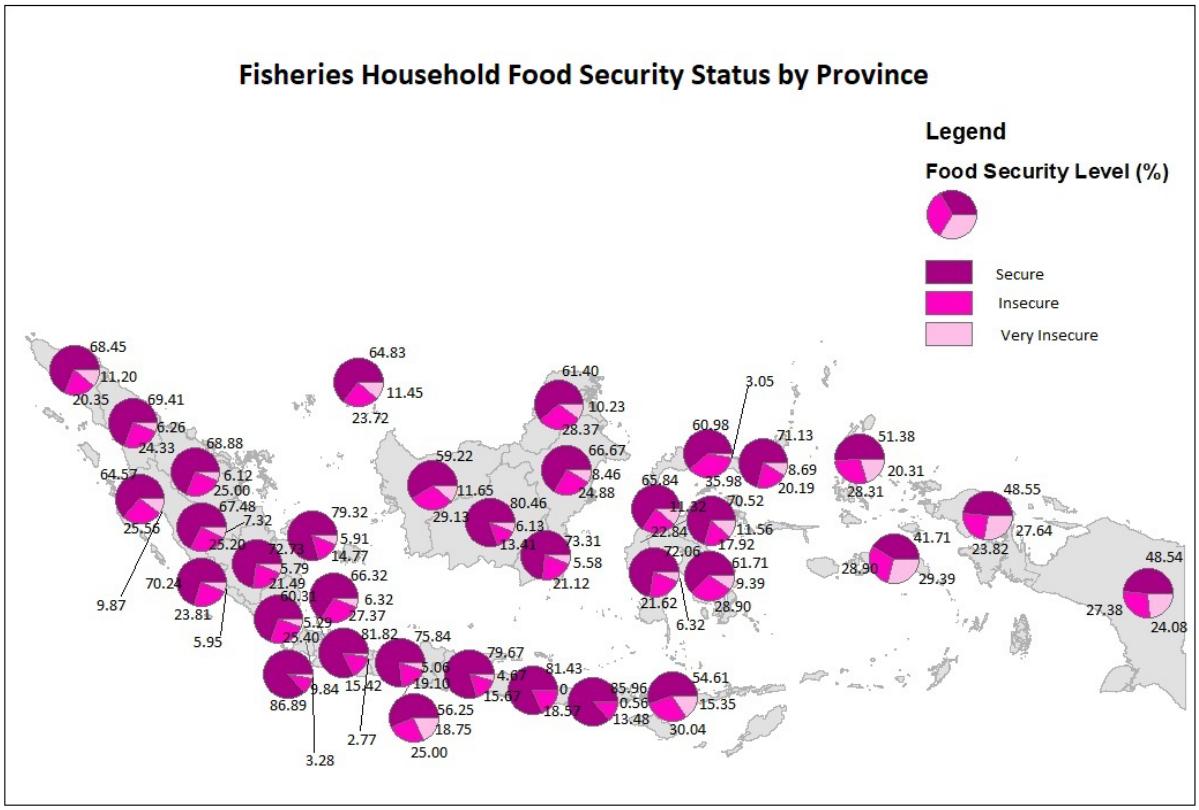

Figure 21. Fisheries household food security status by province

Table 34. Fisheries household food security status per province (total # of households and %)

No	Province	Number of Fishery Household/RTP	Food Security Level		
			Very Food Insecure	Food Insecure	Food Secure
1	Maluku	609	29,39%	28,90%	41,71%
2	Papua	789	24,08%	27,38%	48,54%
3	West Papua	550	27,64%	23,82%	48,55%
4	North Maluku	325	20,31%	28,31%	51,38%
5	East Nusa Tenggara	456	15,35%	30,04%	54,61%
6	Yogyakarta	16	18,75%	25,00%	56,25%
7	West Kalimantan	206	11,65%	29,13%	59,22%

8	Gorontalo	164	3,05%	35,98%	60,98%
9	North Kalimantan	215	10,23%	28,37%	61,40%
10	Southeast Sulawesi	820	9,39%	28,90%	61,71%
11	West Sumatra	223	9,87%	25,56%	64,57%
12	Riau Islands	489	11,45%	23,72%	64,83%
13	Central Sulawesi	486	11,32%	22,84%	65,84%
14	DKI Jakarta	190	6,32%	27,37%	66,32%
15	East Kalimantan	201	8,46%	24,88%	66,67%
16	Jambi	123	7,32%	25,20%	67,48%
17	Aceh	634	11,20%	20,35%	68,45%
18	Riau	196	6,12%	25,00%	68,88%
19	Lampung	189	5,29%	25,40%	69,31%
20	North Sumatra	559	6,26%	24,33%	69,41%
21	Bengkulu	84	5,95%	23,81%	70,24%
22	West Sulawesi	173	11,56%	17,92%	70,52%
23	North Sulawesi	426	8,69%	20,19%	71,13%
24	South Sulawesi	680	6,32%	21,62%	72,06%
25	South Sumatra	121	5,79%	21,49%	72,73%
26	South Kalimantan	251	5,58%	21,12%	73,31%
27	Central Java	356	5,06%	19,10%	75,84%
28	Bangka Belitung	237	5,91%	14,77%	79,32%
29	East Java	600	4,67%	15,67%	79,67%
30	Central Kalimantan	261	6,13%	13,41%	80,46%
31	Bali	70	0,00%	18,57%	81,43%
32	West Java	253	2,77%	15,42%	81,82%
33	West Nusa Tenggara	178	0,56%	13,48%	85,96%
34	Banten	61	3,28%	9,84%	86,89%
	Indonesia	11.191	11,61%	23,49%	64,90%

Source: SUSENAS 2019, processed by BBRSEKP 2021

Poverty status by province

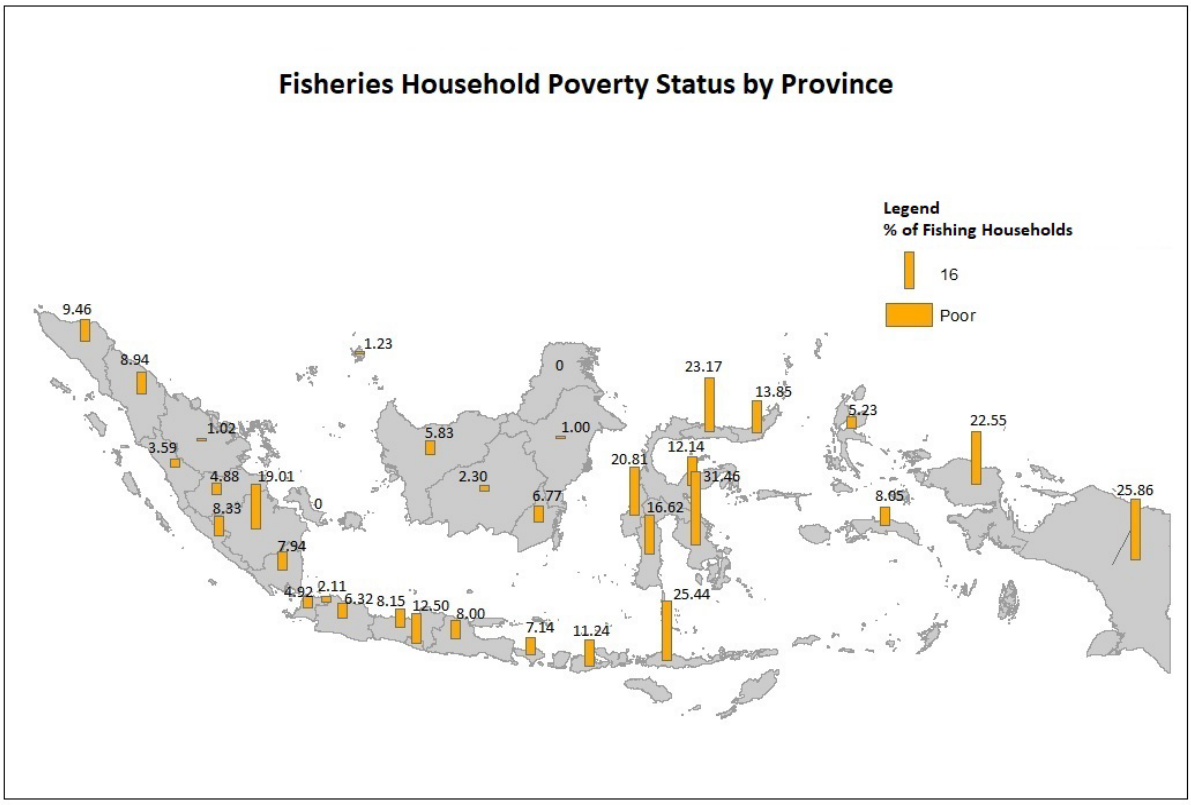

Figure 22. Fisheries household poverty status by province

Table 35. Fisheries household poverty status by province (raw # and %)

No	Province	Total Sample	Number of Fishery Household (RTP)	Number of Poor RTP	Percentage of poor RTP
1	Southeast Sulawesi	8.710	820	258	31.46%
2	Papua	13.635	789	204	25.86%
3	East Nusa Tenggara	11.681	456	116	25.44%
4	Gorontalo	3.190	164	38	23.17%
5	West Papua	3.251	173	124	22.55%
6	West Sulawesi	5.885	550	36	20.81%
7	South Sumatra	10.230	121	23	19.01%
8	South Sulawesi	14.093	680	113	16.62%
9	North Sulawesi	8.001	426	59	13.85%
10	Yogyakarta	6.410	178	2	12.50%

11	Central Sulawesi	5.838	70	59	12.14%
12	West Nusa Tenggara	7.005	486	20	11.24%
13	Aceh	19.520	559	60	9.46%
14	North Sumatra	3.734	16	50	8.94%
15	Bengkulu	12.295	634	7	8.33%
16	Central Java	5.303	84	29	8.15%
17	Maluku	9.653	189	49	8.05%
18	East Java	5.650	609	48	8.00%
19	Lampung	30.021	600	15	7.94%
20	Bali	27.517	356	5	7.14%
21	South Kalimantan	23.783	253	17	6.77%
22	West Java	7.616	251	16	6.32%
23	West Kalimantan	5.014	325	12	5.83%
24	North Maluku	6.377	123	17	5.23%
25	Banten	8.037	206	3	4.92%
26	Jambi	6.620	61	6	4.88%
27	West Sumatra	10.742	223	8	3.59%
28	Central Kalimantan	3.884	489	6	2.30%
29	DKI Jakarta	7.350	261	4	2.11%
30	Riau Islands	7.593	196	6	1.23%
31	Riau	5.255	190	2	1.02%
32	East Kalimantan	5.588	201	2	1.00%
33	Bangka Belitung Islands	2.484	215	0	0.00%
34	North Kalimantan	3.707	237	0	0.00%
	Indonesia	315.672	11.191	952	8,51%

Source: SUSENAS 2019, processed by BBRSEKP 2021

TCT consumption participation rate per province

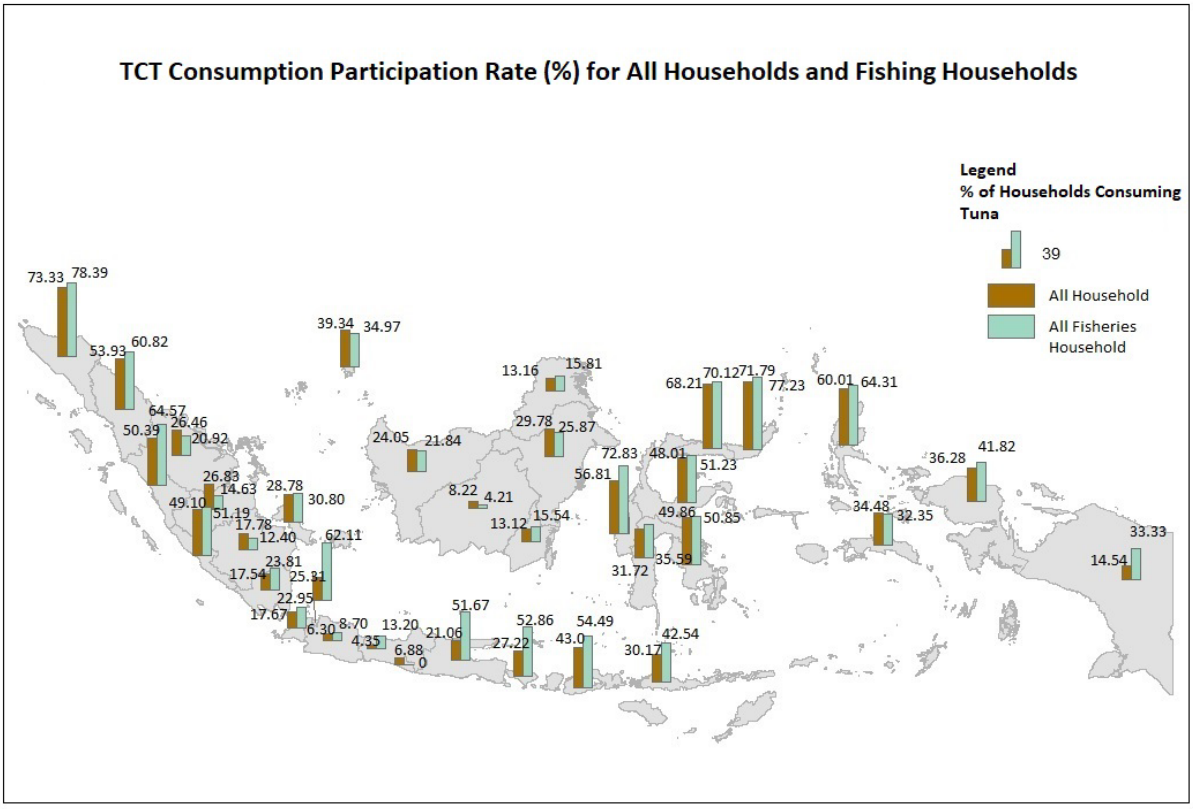

Figure 3. TCT consumption participation rate (%) for all households and fishing households

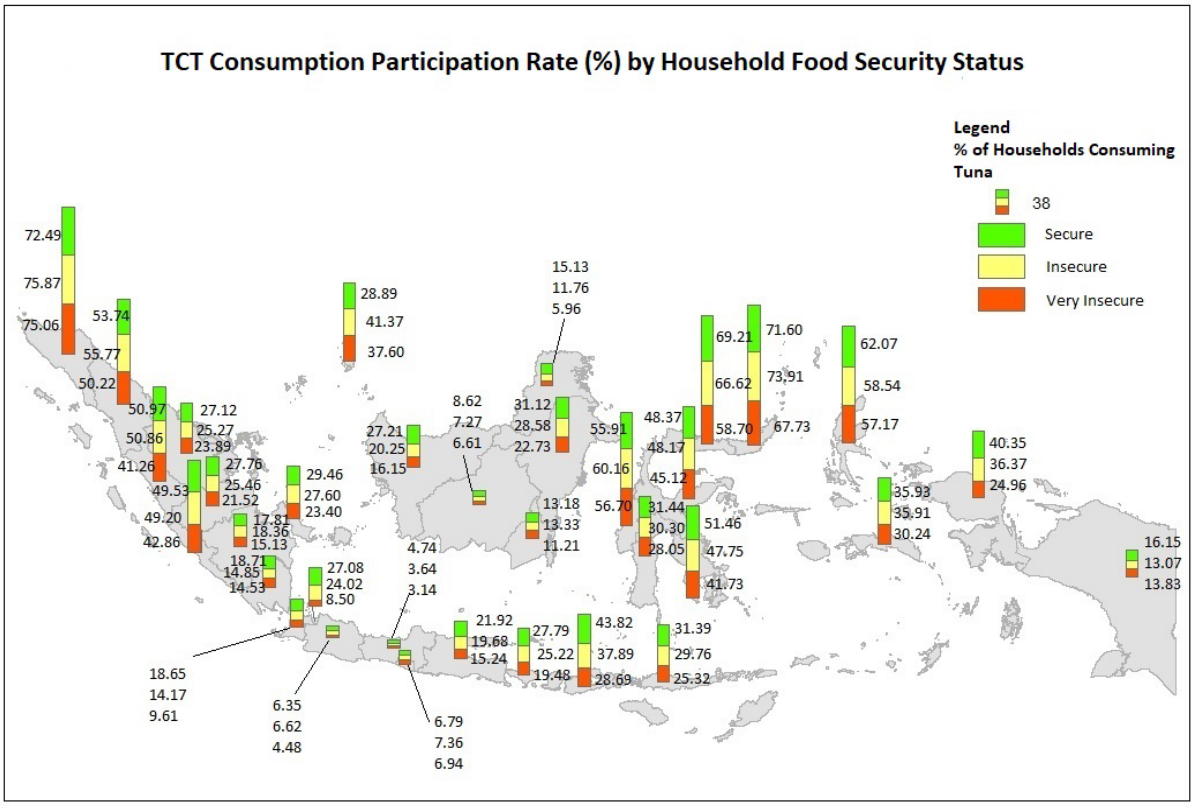

Figure 4. TCT consumption participation rate (%) by household food security status

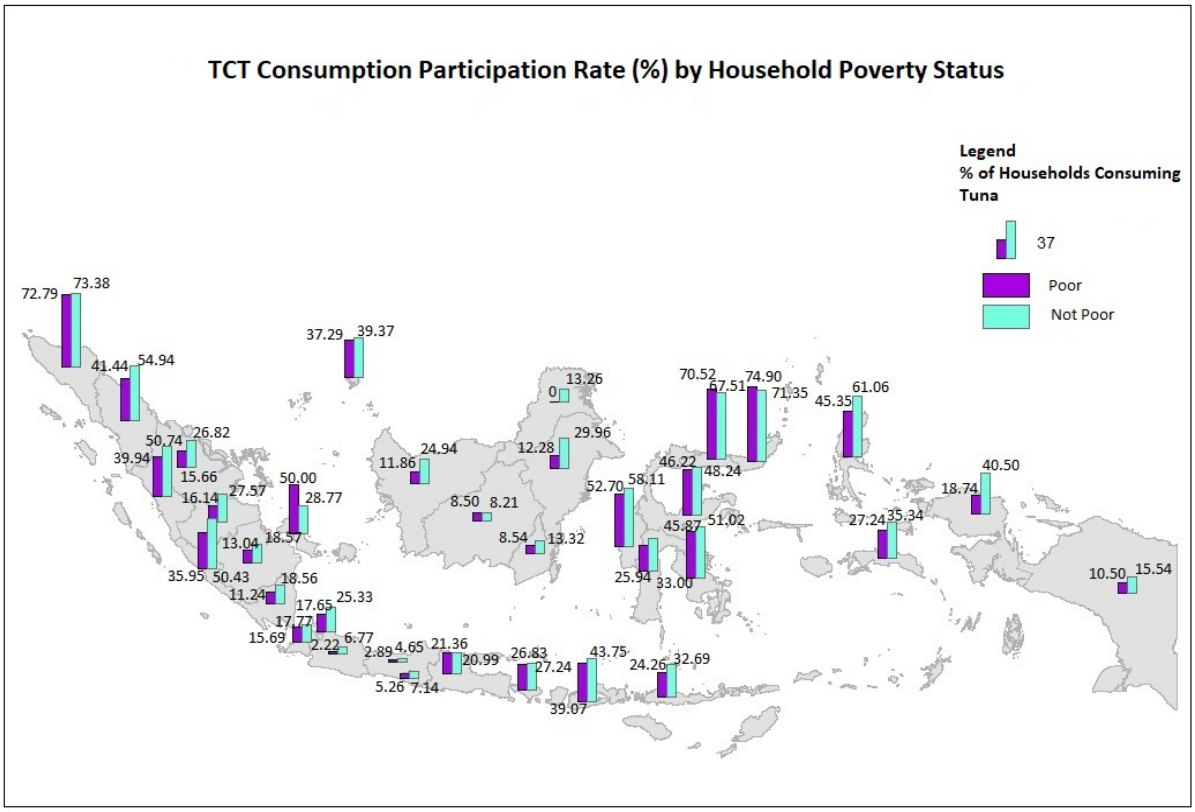

Figure 5. TCT consumption participation rate (%) by household poverty status

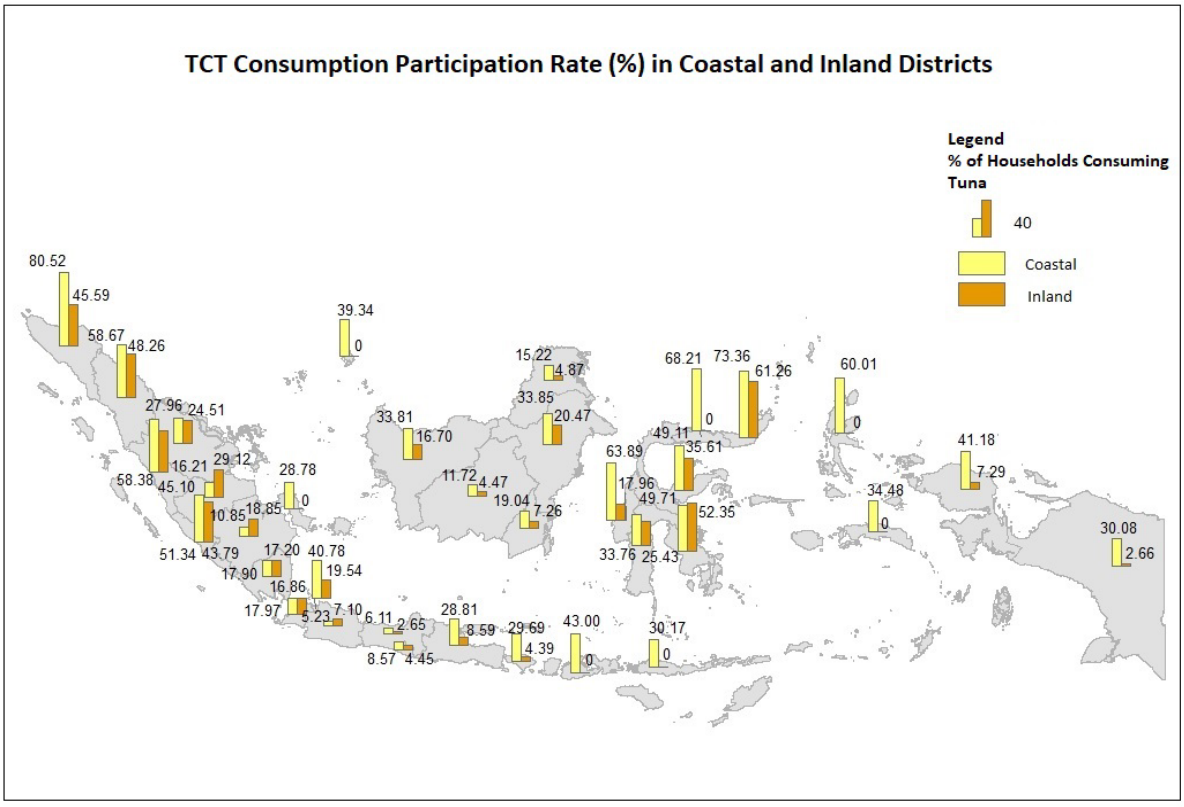

Figure 6. TCT consumption participation rate (%) in coastal and inland districts.

TCT consumption per capita per province

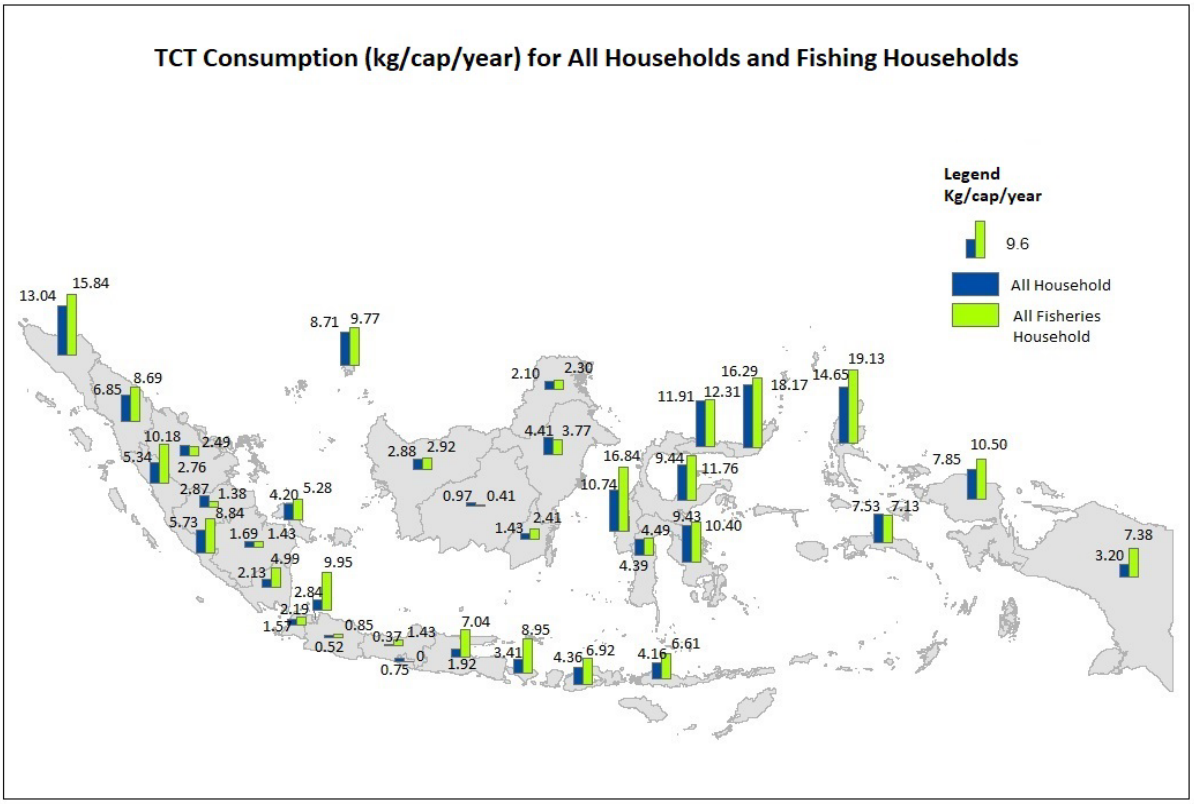

Figure 7. TCT consumption (kg/cap/year) for all households and fishing households

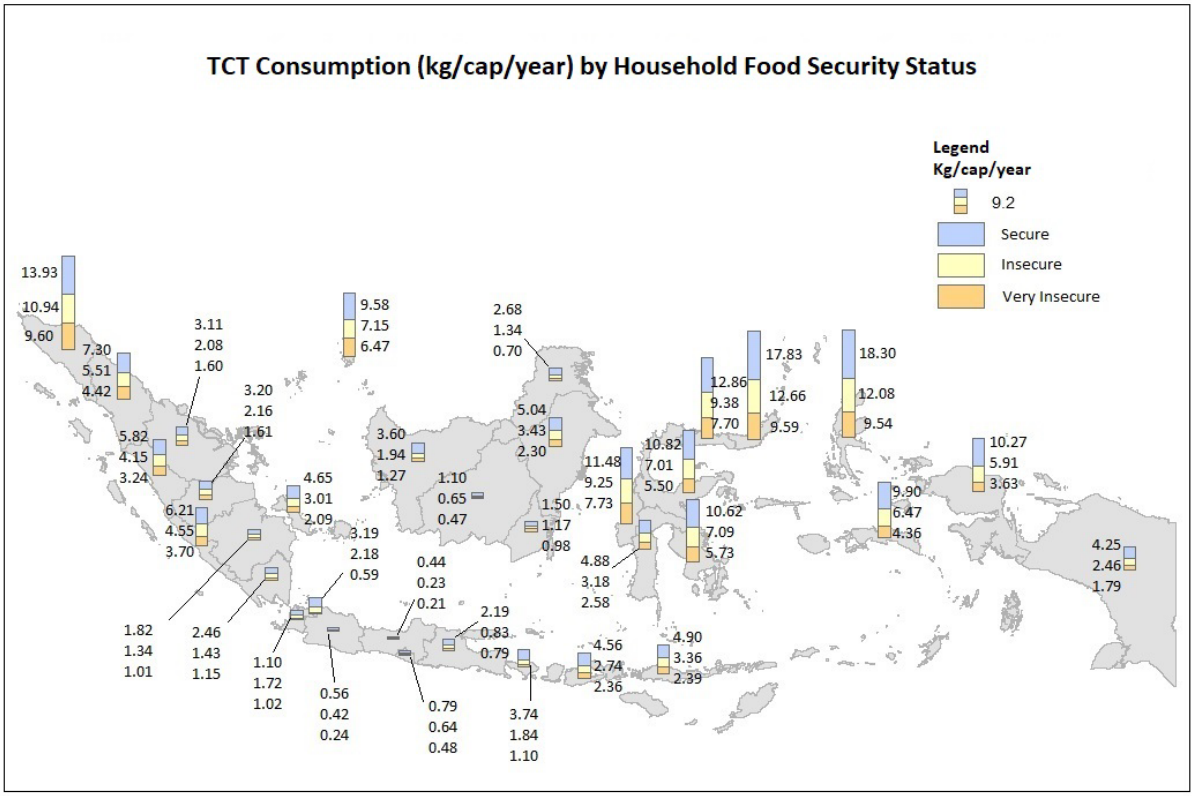

Figure 8. TCT consumption (kg/cap/year) by household food security status

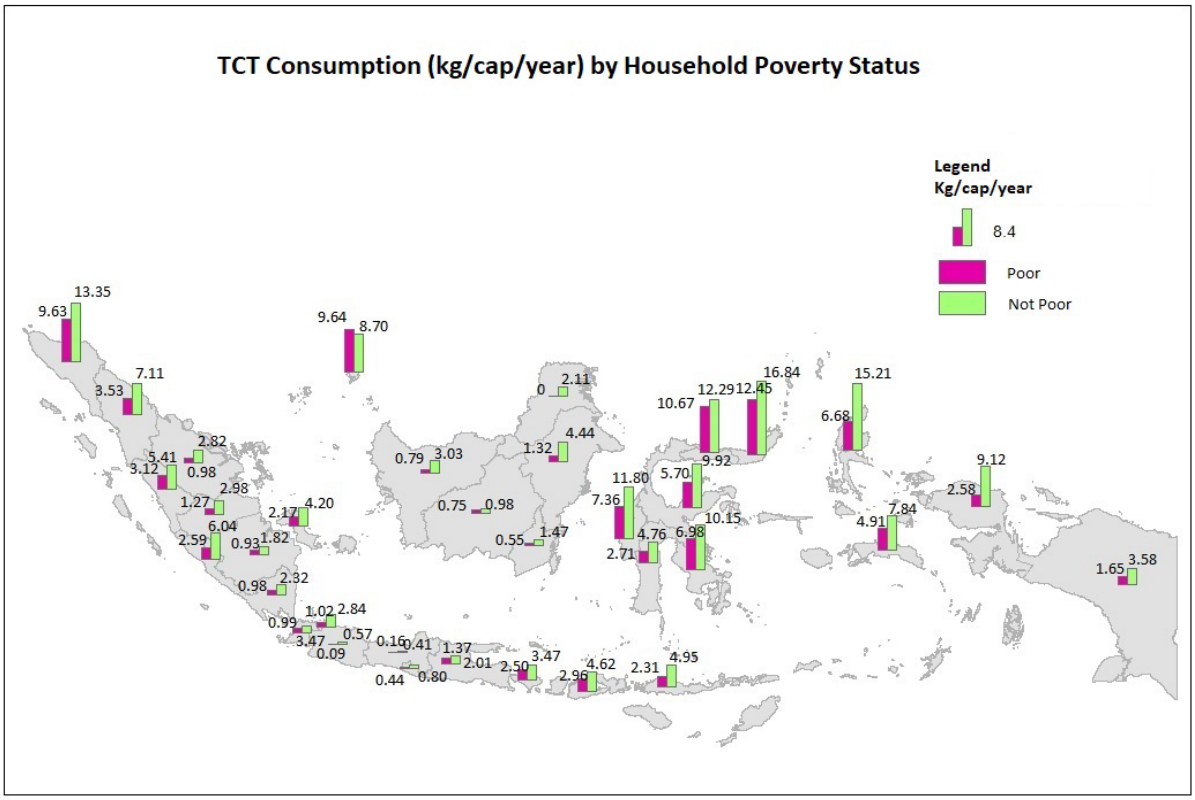

Figure 9. TCT consumption (kg/cap/year) by household poverty status

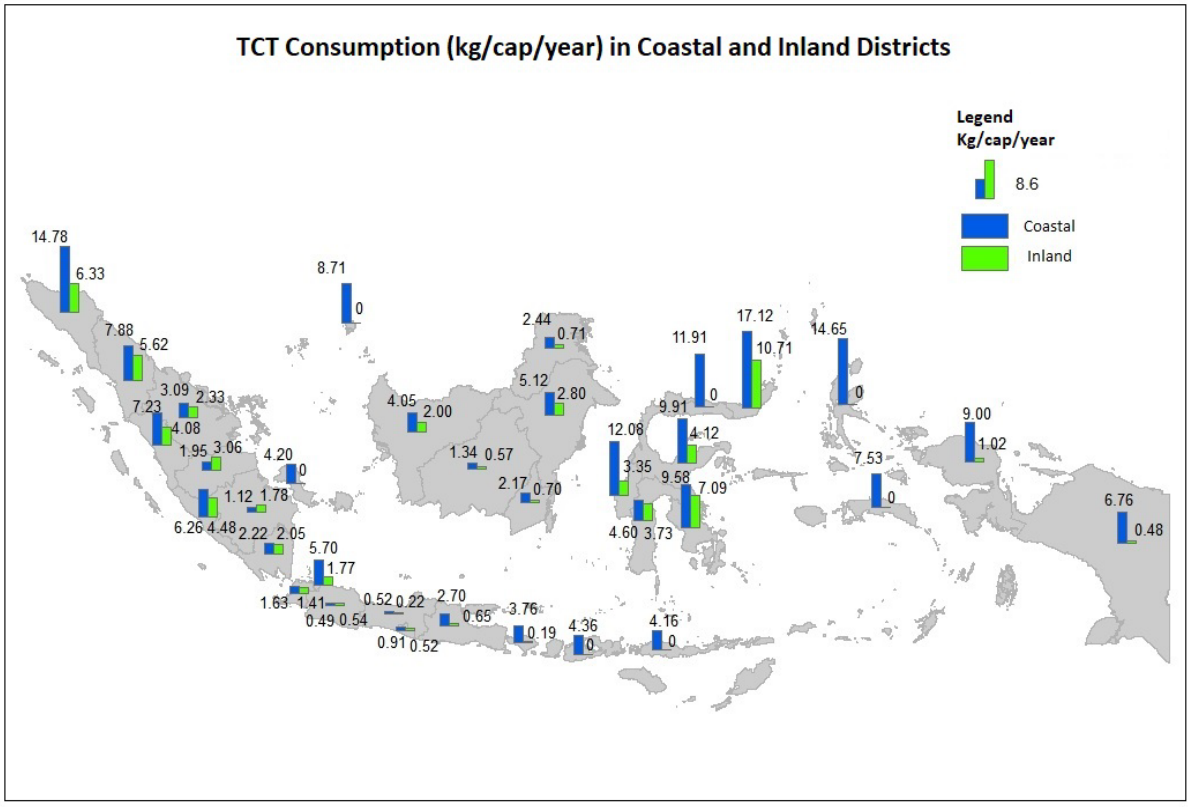

Figure 10. TCT consumption (kg/cap/year) in coastal and inland districts.

TCT consumption as a % of total fish consumption per province

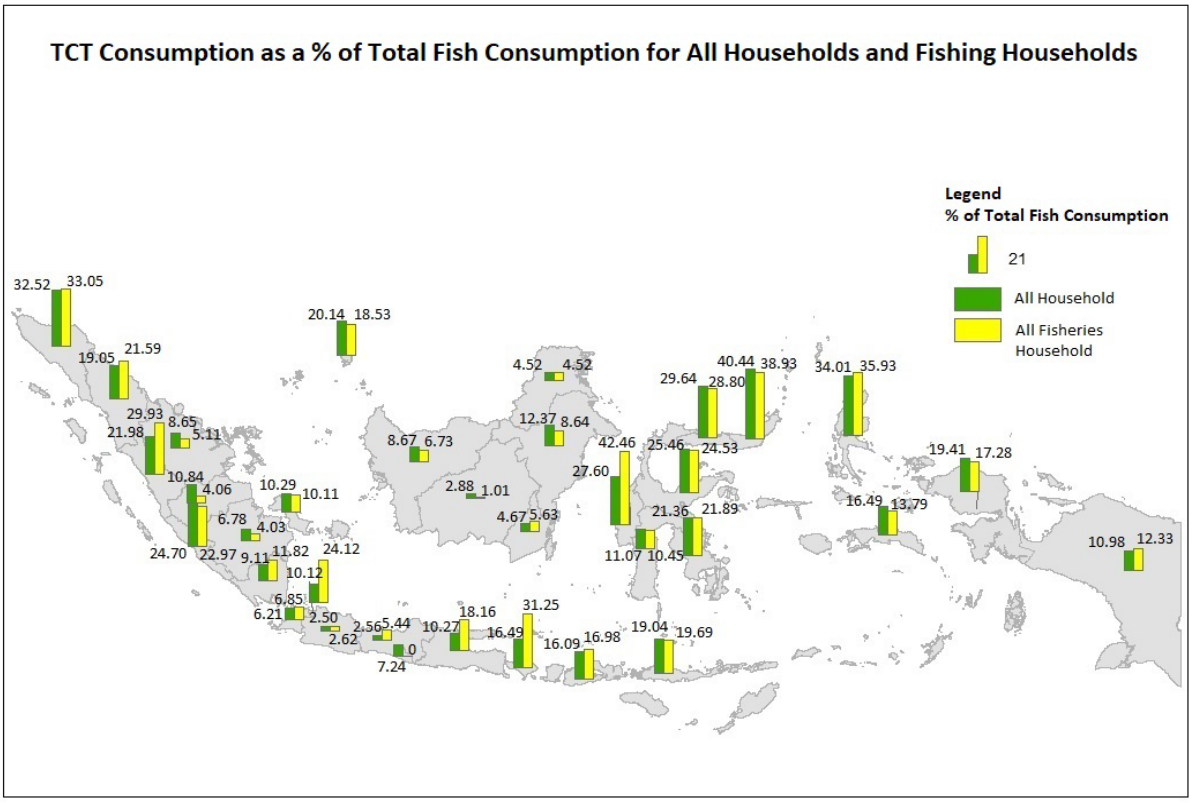

Figure 11. TCT consumption as a % of total fish consumption for all households and fishing households

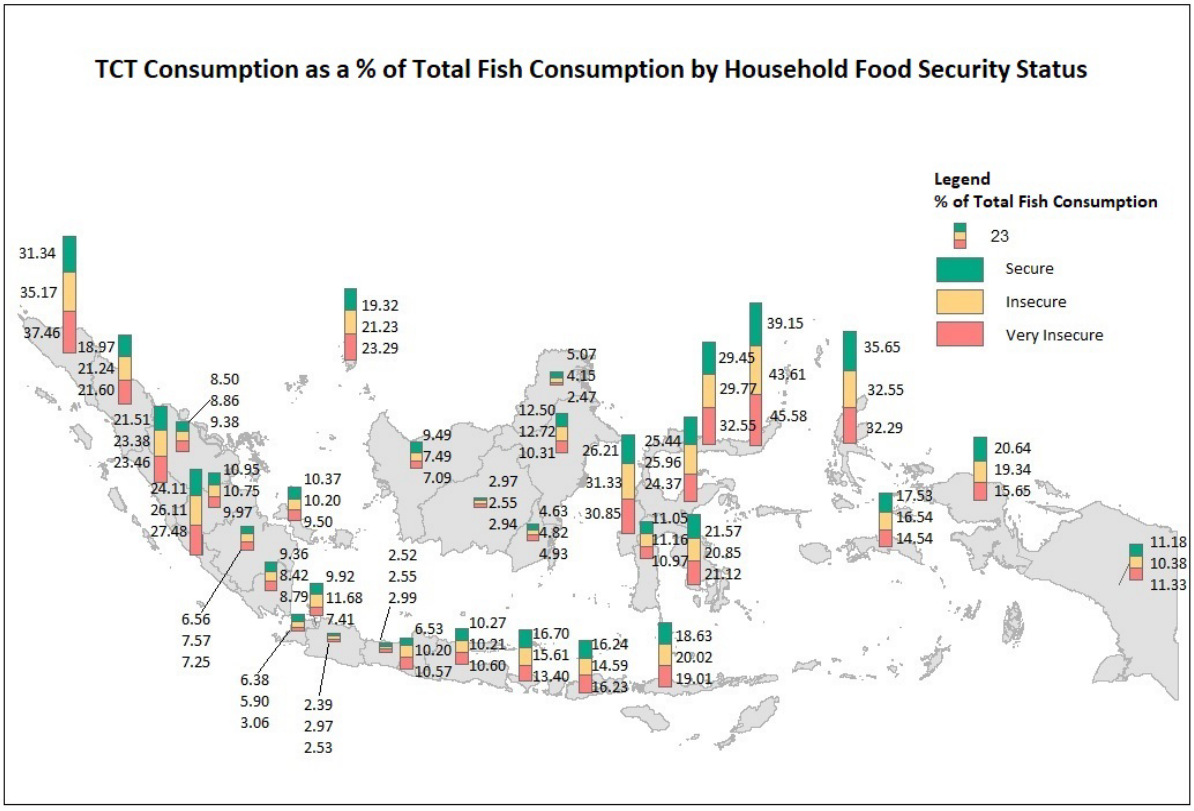

Figure 12. TCT consumption as a % of total fish consumption by household food security status

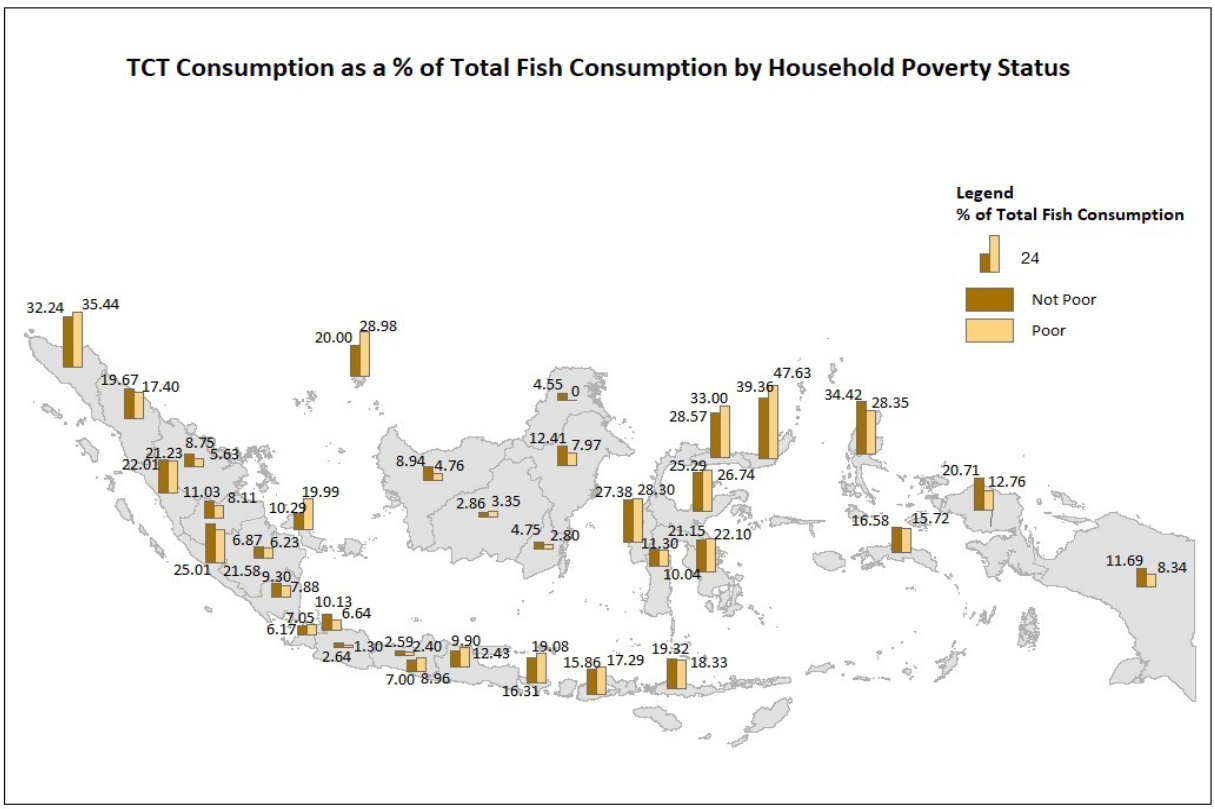

Figure 13. TCT consumption as a % of total fish consumption by household poverty status

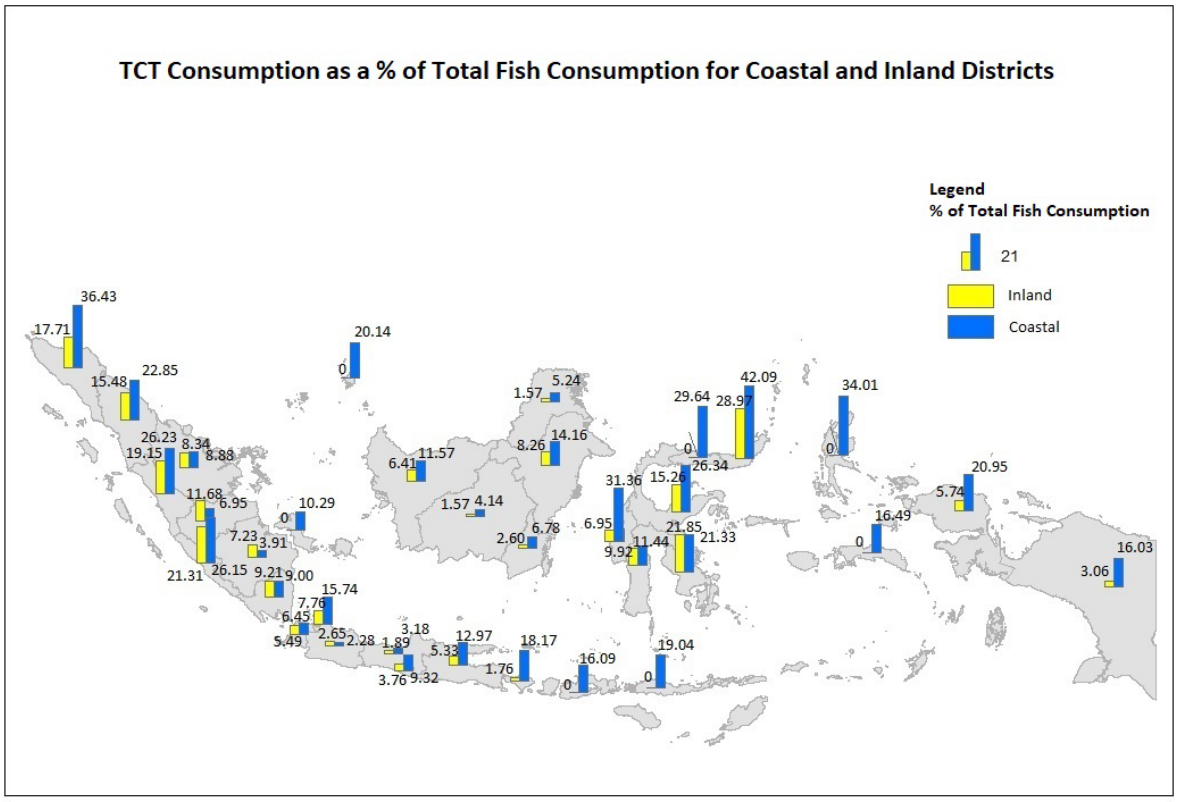

Figure 14. TCT consumption as a % of total fish consumption for coastal and inland districts

TCT consumption as a % of total protein consumption per province

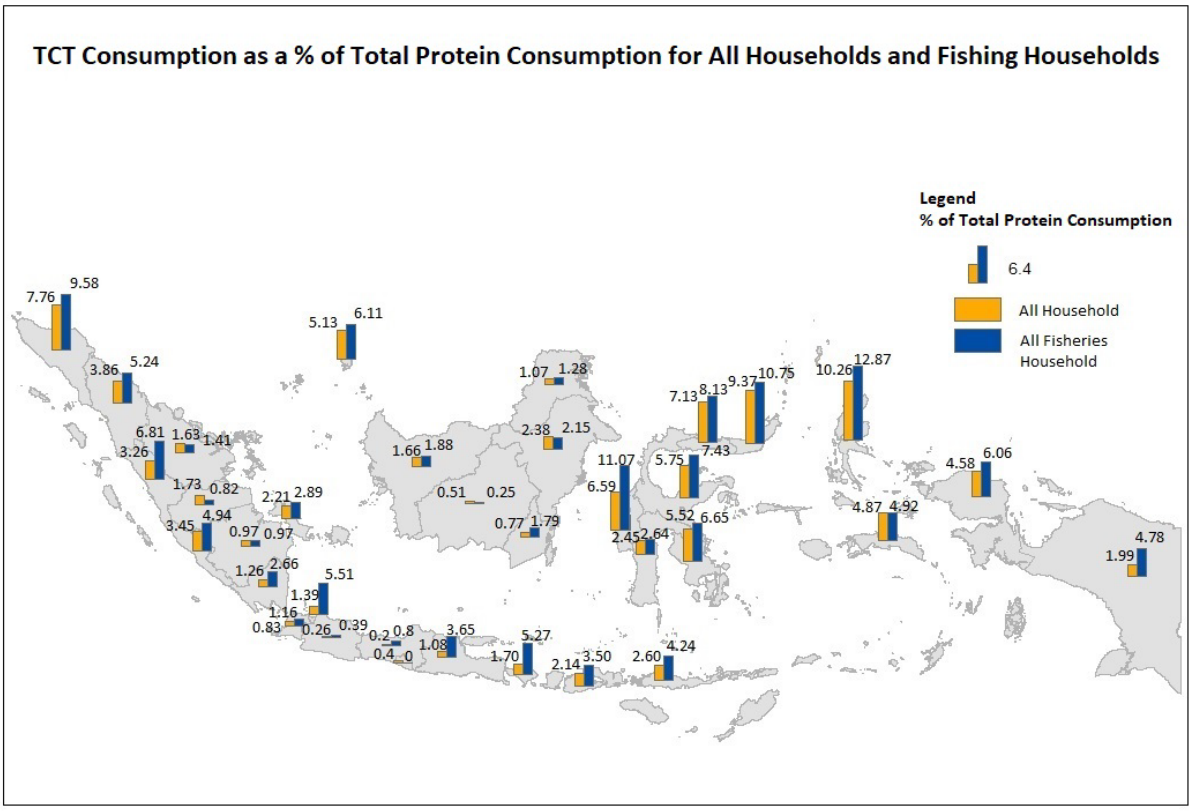

Figure 15. TCT consumption as a % of total protein consumption for all households and fishing households.

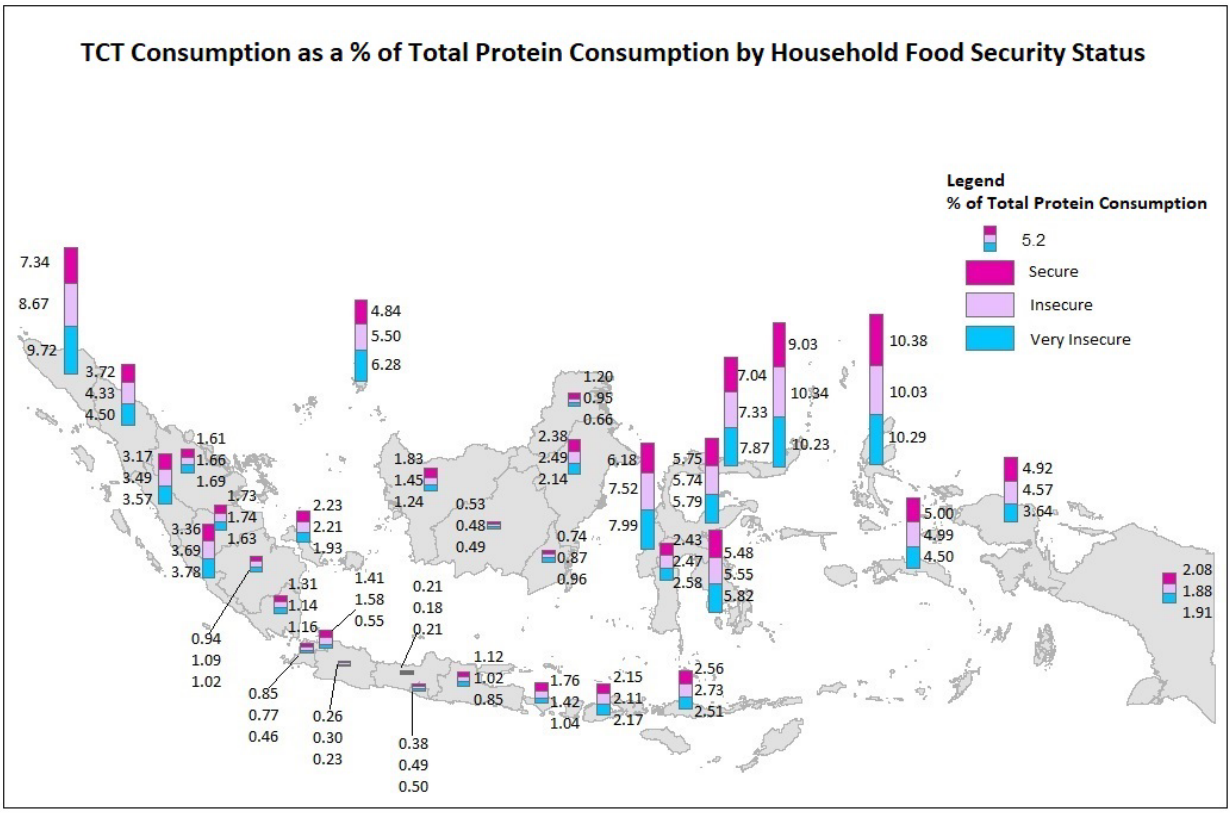

Figure 16. TCT consumption as a % of total protein consumption by household food security status

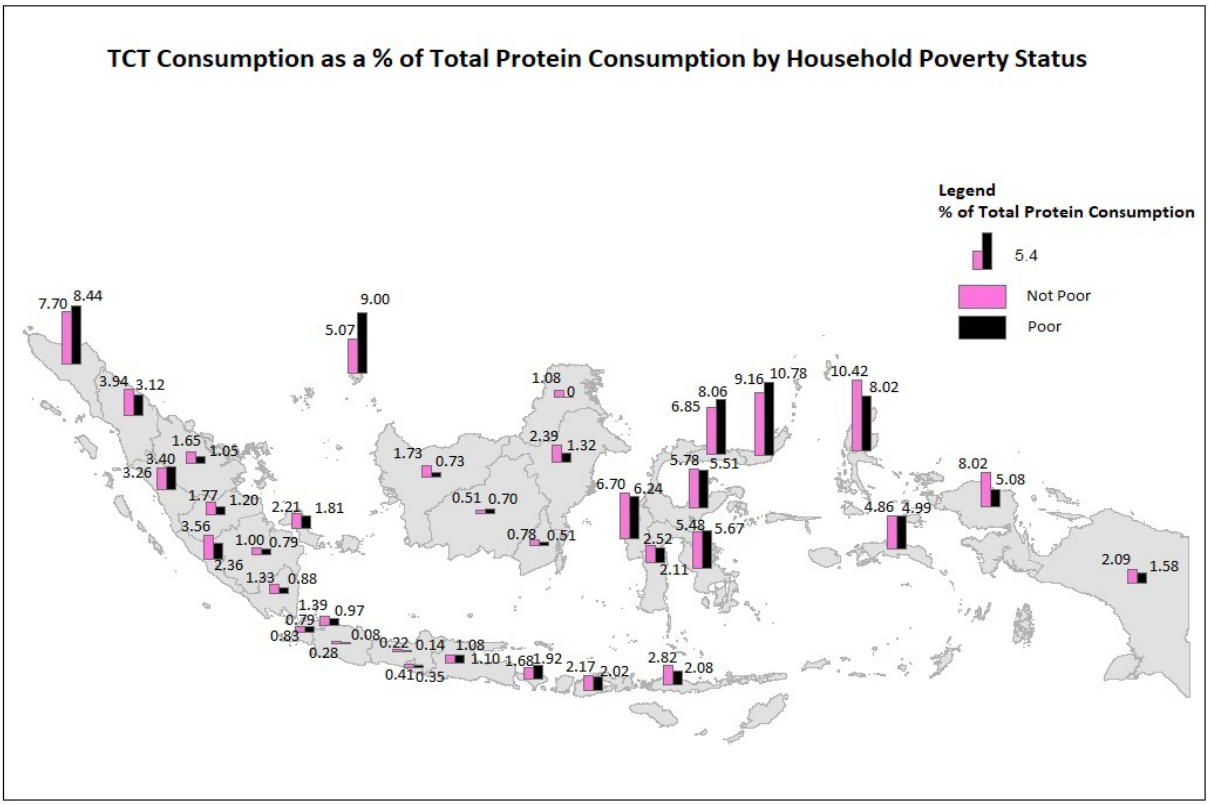

Figure 17. TCT consumption as a % of total protein consumption by household poverty status

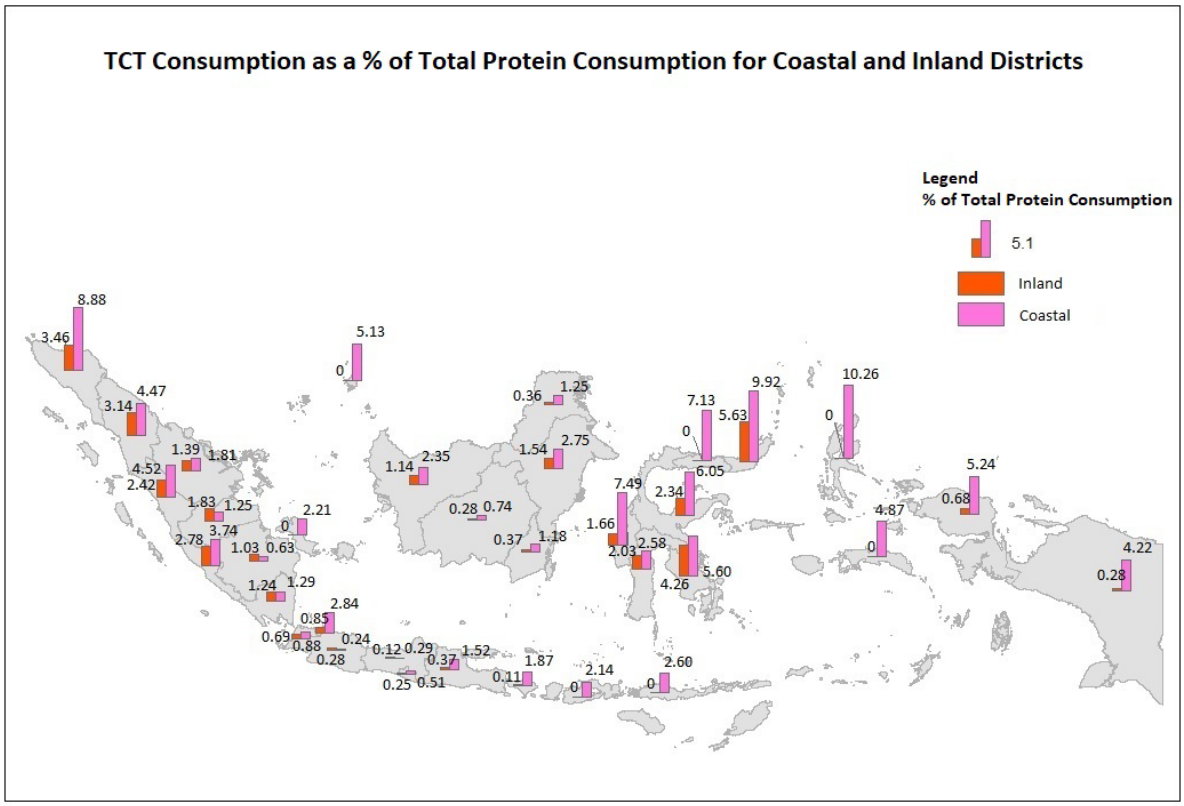

Figure 18. TCT consumption as a % of total protein consumption for coastal and inland districts

Supporting tables – TCT consumption data

Table 3. Contribution of TCT to total fish consumption

No	Province	Fish Protein (calorie/capita/day)	TCT Protein (calorie/capita/day)	TCT Contribution to Fish Protein (%)
1	Aceh	15,4	4,86	31.56%
2	North Sumatra	14,43	2,55	17.67%
3	West Sumatra	9,11	1,99	21.84%
4	Riau	11,99	1,03	8.59%
5	Jambi	9,98	1,07	10.72%
6	South Sumatra	9,11	0,63	6.92%
7	Bengkulu	9,01	2,13	23.64%
8	Lampung	8,25	0,79	9.58%

9	Bangka Belitung Islands	15,6	1,56	10.00%
10	Riau Islands	15,66	3,25	20.75%
11	DKI Jakarta	10,02	1,06	10.58%
12	West Java	6,85	0,19	2.77%
13	Central Java	5,12	0,14	2.73%
14	Yogyakarta	3,31	0,28	8.46%
15	East Java	6,96	0,71	10.20%
16	Banten	10,05	0,59	5.87%
17	Bali	7,19	1,27	17.66%
18	West Nusa Tenggara	11,76	1,62	13.78%
19	East Nusa Tenggara	8,53	1,55	18.17%
20	West Kalimantan	11,56	1,07	9.26%
21	Central Kalimantan	12,06	0,36	2.99%
22	South Kalimantan	11,57	0,53	4.58%
23	East Kalimantan	13,31	1,64	12.32%
24	North Kalimantan	15,68	0,78	4.97%
25	North Sulawesi	15,18	6,07	39.99%
26	Central Sulawesi	13,7	3,52	25.69%
27	South Sulawesi	15,12	1,64	10.85%
28	Southeast Sulawesi	17,53	3,52	20.08%
29	Gorontalo	14,81	4,44	29.98%
30	West Sulawesi	14,42	4,00	27.74%
31	Maluku	15,9	2,8	17.61%
32	North Maluku	16,29	5,46	33.52%
33	West Papua	14,67	2,92	19.90%
34	Papua	9,29	1,19	12.81%
	Indonesia	10,67	1,66	15.09%

Table 4. TCT protein contribution as a % of total fish and total protein consumption for all households and fishing households

No	Province	TCT protein contribution (% of total fish consumption)		TCT protein contribution (% of total protein consumption)	
		All Households	Fishing Households	All Households	Fishing Households
1	Aceh	32,52	33,05	7,76	9,58
2	North Sumatra	19,5	21,59	3,86	5,24
3	West Sumatra	21,98	29,93	3,26	6,81
4	Riau	8,65	5,11	1,63	1,41
5	Jambi	10,84	4,06	1,73	0,82
6	South Sumatra	6,78	4,03	0,97	0,97
7	Bengkulu	24,7	22,97	3,45	4,94
8	Lampung	9,11	11,82	1,26	2,66
9	Bangka Belitung Islands	10,29	10,11	2,21	2,89
10	Riau Islands	20,14	18,53	5,13	6,11
11	DKI Jakarta	10,12	24,12	1,39	5,51
12	West Java	2,50	2,62	0,26	0,39
13	Central Java	2,56	5,44	0,20	0,80
14	Special Region of Yogyakarta	7,24	0,00	0,40	0,00
15	East Java	10,27	18,16	1,08	3,65
16	Banten	6,21	6,85	0,83	1,16
17	Bali	16,49	31,25	1,70	5,27
18	West Nusa Tenggara	16,09	16,98	2,14	3,50
19	East Nusa Tenggara	8,67	6,73	1,66	1,88
20	West Borneo	2,88	1,01	0,51	0,25
21	Central Borneo	12,37	8,64	2,38	2,15

22	South Borneo	4,67	5,63	0,77	1,49
23	East Borneo	12,37	8,64	2,38	2,15
24	North Borneo	4,52	4,52	1,07	1,28
25	North Sulawesi	40,44	38,93	9,37	10,75
26	Central Sulawesi	25,46	24,53	5,75	7,43
27	South Sulawesi	11,07	10,45	2,45	2,64
28	Southeast Sulawesi	21,36	21,89	5,52	6,65
29	Gorontalo	29,64	28,80	7,13	8,13
30	West Sulawesi	27,60	42,46	6,59	11,07
31	Maluku	16,49	13,79	4,87	4,92
32	North Maluku	34,01	35,93	10,26	12,87
33	West Papua	19,41	17,28	4,58	6,06
34	Papua	10,98	12,33	1,99	4,78
	Indonesia	15,23	16,12	3,13	4,30

Source: SUSENAS 2019, processed by BBRSEKP 2021

Table 5. TCT protein contribution as a % of total fish and total protein consumption for inland and coastal districts

No.	**Province**	TCT protein contribution (% of total fish consumption)		TCT protein contribution (% of total protein consumption)	
		Inland	Coastal	Inland	Coastal
1	Aceh	17,71	36,43	3,46	8,88
2	North Sumatra	15,48	22,85	3,14	4,47
3	West Sumatra	19,15	26,23	2,42	4,52
4	Riau	8,34	8,88	1,39	1,81
5	Jambi	11,68	6,95	1,83	1,25
6	South Sumatra	7,23	3,91	1,03	0,63
7	Bengkulu	21,31	26,15	2,78	3,74
8	Lampung	9,21	9,00	1,24	1,29

9	Bangka Belitung Islands	0,00	10,29	0,00	2,21
10	Riau Islands	0,00	20,14	0,00	5,13
11	DKI Jakarta	7,76	15,74	0,85	2,84
12	West Java	2,65	2,28	0,28	0,24
13	Central Java	1,89	3,18	0,12	0,29
14	Special Region of Yogyakarta	3,76	9,32	0,25	0,51
15	East Java	5,33	12,97	0,37	1,52
16	Banten	5,49	6,45	0,69	0,88
17	Bali	1,76	18,17	0,11	1,87
18	West Nusa Tenggara	0,00	16,09	0,00	2,14
19	East Nusa Tenggara	0,00	19,04	0,00	2,60
20	West Borneo	6,41	11,57	1,14	2,35
21	Central Borneo	1,57	4,14	0,28	0,74
22	South Borneo	2,60	6,78	0,37	1,18
23	East Borneo	8,26	14,16	1,54	2,75
24	North Borneo	1,57	5,24	0,36	1,25
25	North Sulawesi	28,97	42,09	5,63	9,92
26	Central Sulawesi	15,26	26,34	2,34	6,05
27	South Sulawesi	9,92	11,44	2,03	2,58
28	Southeast Sulawesi	21,85	21,33	4,26	5,60
29	Gorontalo	0,00	29,64	0,00	7,13
30	West Sulawesi	6,95	31,36	1,66	7,49
31	Maluku	0,00	16,49	0,00	4,87
32	North Maluku	0,00	34,01	0,00	10,26
33	West Papua	5,74	20,95	0,68	5,24

34	Papua	3,06	16,03	0,28	4,22
	Indonesia	7,38	16,64	1,19	3,48

Source: SUSENAS 2019, processed by BBRSEKP 2021

Table 6. TCT protein contribution as a % of total fish and total protein consumption by household poverty status

No.	**Province**	TCT protein contribution (% of total fish consumption)		TCT protein contribution (% of total protein consumption)	
		Not poor	Poor	Not Poor	Poor
1	Aceh	32,24	35,44	7,70	8,44
2	North Sumatra	19,67	17,40	3,92	3,12
3	West Sumatra	22,01	21,23	3,26	3,40
4	Riau	8,75	5,63	1,65	1,05
5	Jambi	11,03	8,11	1,77	1,20
6	South Sumatra	6,87	6,23	1,00	0,79
7	Bengkulu	25,01	21,58	3,56	2,36
8	Lampung	9,30	7,88	1,33	0,88
9	Bangka Belitung Islands	10,29	19,99	2,21	1,81
10	Riau Islands	20,00	28,98	5,07	9,00
11	DKI Jakarta	10,13	6,64	1,39	0,97
12	West Java	2,64	1,30	0,28	0,08
13	Central Java	2,59	2,40	0,22	0,14
14	Special Region of Yogyakarta	7,00	8,96	0,41	0,35
15	East Java	9,90	12,43	1,08	1,10
16	Banten	6,17	7,05	0,83	0,79
17	Bali	16,31	19,08	1,68	1,92
18	West Nusa Tenggara	15,86	17,29	2,17	2,02
19	East Nusa Tenggara	19,32	18,33	2,82	2,08

20	West Borneo	8,94	4,76	1,73	0,73
21	Central Borneo	2,86	3,35	0,51	0,70
22	South Borneo	4,75	2,80	0,78	0,51
23	East Borneo	12,41	7,97	2,39	1,32
24	North Borneo	4,55	0,00	1,08	0,00
25	North Sulawesi	39,36	47,63	9,16	10,78
26	Central Sulawesi	25,29	26,74	5,78	5,51
27	South Sulawesi	11,30	10,04	2,52	2,11
28	Southeast Sulawesi	21,15	22,10	5,48	5,67
29	Gorontalo	28,57	33,00	6,85	8,06
30	West Sulawesi	27,38	28,30	6,70	6,24
31	Maluku	16,58	15,72	4,86	4,99
32	North Maluku	34,42	28,35	10,42	8,02
33	West Papua	20,71	12,76	5,08	2,50
34	Papua	11,69	8,34	2,09	1,58
	Indonesia	15,44	15,23	3,17	2,95

Source: SUSENAS 2019, processed by BBRSEKP 2021

Table 7. TCT protein contribution as a % of total fish and total protein consumption by household food security status

No.	**Province**	TCT protein contribution (% of total fish consumption)			TCT protein contribution (% of total protein consumption)		
		Very Insecure	Insecure	Secure	Very Insecure	Insecure	Secure
1	Aceh	37,46	35,17	31,34	9,72	8,67	7,34
2	North Sumatra	21,60	21,24	18,97	4,50	4,33	3,72
3	West Sumatra	23,46	23,38	21,51	3,57	3,49	3,17
4	Riau	9,38	8,86	8,50	1,69	1,66	1,61
5	Jambi	9,97	10,75	10,95	1,63	1,74	1,73
6	South Sumatra	7,25	7,57	6,56	1,02	1,09	0,94
7	Bengkulu	27,48	26,11	24,11	3,78	3,69	3,36

8	Lampung	8,79	8,42	9,36	1,16	1,14	1,31
9	Bangka Belitung Islands	9,50	10,20	10,37	1,93	2,21	2,23
10	Riau Islands	23,29	21,23	19,32	6,28	5,50	4,84
11	DKI Jakarta	7,41	11,68	9,92	0,55	1,58	1,41
12	West Java	2,53	2,97	2,39	0,23	0,30	0,26
13	Central Java	2,99	2,55	2,52	0,21	0,18	0,21
14	Special Region of Yogyakarta	10,57	10,20	6,53	0,50	0,49	0,38
15	East Java	10,60	10,21	10,27	0,85	1,02	1,12
16	Banten	3,06	5,90	6,38	0,46	0,77	0,85
17	Bali	13,40	15,61	16,70	1,04	1,42	1,76
18	West Nusa Tenggara	16,23	14,59	16,24	2,17	2,11	2,15
19	East Nusa Tenggara	19,01	20,02	18,63	2,51	2,73	2,56
20	West Borneo	7,09	7,49	9,49	1,24	1,45	1,83
21	Central Borneo	2,94	2,55	2,97	0,49	0,48	0,53
22	South Borneo	4,93	4,82	4,63	0,96	0,87	0,74
23	East Borneo	10,31	12,72	12,50	2,14	2,49	2,38
24	North Borneo	2,47	4,15	5,07	0,66	0,95	1,20
25	North Sulawesi	45,58	43,61	39,15	10,23	10,34	9,03
26	Central Sulawesi	24,37	25,96	25,44	5,79	5,74	5,75
27	South Sulawesi	10,97	11,16	11,05	2,58	2,47	2,43
28	Southeast Sulawesi	21,12	20,85	21,57	5,82	5,55	5,48
29	Gorontalo	32,55	29,77	29,45	7,87	7,33	7,04
30	West Sulawesi	30,85	31,33	26,21	7,99	7,52	6,18
31	Maluku	14,54	16,54	17,53	4,50	4,99	5,00
32	North Maluku	32,29	32,55	35,65	10,29	10,03	10,38
33	West Papua	15,65	19,34	20,64	3,64	4,57	4,92

34	Papua	11,33	10,38	11,18	1,91	1,88	2,08
	Indonesia	15,62	15,88	15,39	3,23	3,26	3,12