VCA4D
VALUE CHAIN ANALYSIS FOR DEVELOPMENT

agrinatura for European Commission

Value Chain Analysis of the Coastal Fisheries in Tanzania

Raphaëla Le Gouvello
Richard Lamboll
Arianna Martini
Yahya Mgawe

September 2022

UNIVERSITY of GREENWICH
NRI | Natural Resources Institute

Value Chain Analysis for Development (VCA4D) is a tool funded by the European Commission / INTPA and is implemented in partnership with Agrinatura.

Agrinatura (http://agrinatura-eu.eu) is the European Alliance of Universities and Research Centres involved in agricultural research and capacity building for development.

The information and knowledge produced through the value chain studies are intended to support the Delegations of the European Union and their partners in improving policy dialogue, investing in value chains and better understanding of the changes linked to their actions

VCA4D uses a systematic methodological framework for analysing value chains in agriculture, livestock, fishery, aquaculture and agroforestry. More information including reports and communication material can be found at: https://europa.eu/capacity4dev/value-chain-analysis-for-development-vca4d-

In the framework of collaborations with INTPA / F3 regarding VCA4D, COLEACP has a market analysis available at: https://eservices.coleacp.org/en/e-bibliotheque/market-profile-about-fisheries-in-tanzania. The main results of this note have been used by the experts throughout the report.

Team Composition

Le Gouvello, Raphaëla | Economics expert and team leader

Lamboll, Richard (NRI) | Social expert

Martini, Arianna |Environmental expert

Mgawe, Yahya | National expert

The report was produced through the financial support of the European Union. Its content is the sole responsibility of its authors and does not necessarily reflect the views of the European Union.

The report has been realized within a project financed by the European Union (VCA4D CTR 2017/392-416).

Citation of this report: Le Gouvello, R., Lamboll, R., Martini, A., Mgawe, Y., 2022. Value Chain Analysis of Coastal Fisheries in Tanzania. Report for the European Union, DG-INTPA. Value Chain Analysis for Development Project (VCA4D CTR 2017/392-416), 211 p + annexes.

VCA4D Project Management Unit Support

Marie Hélène Dabat, Frédéric Lançon | Methodology and economic analysis software (AFA)

Giorgia Mei, Olimpia Orlandoni, Sara Baumgart | Project Management and Graphic Design

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF BOXES

ACKNOWLEDGEMENTS

This assessment would not have been possible without the assistance and cooperation of a large number of people who provided valuable information at different levels of the coastal fisheries value chain in Mainland Tanzania (MLT) and in Zanzibar (ZNZ).

The team is highly indebted to all individuals and institutions engaged in the course of conducting this study. In particular, the team is grateful to the following persons who provided their expertise and their support into the study implementation:

In Mainland Tanzania:

Dr Rashid Tamatamah (PS-MLF), Dr Nazael Madalla (Dir. Aquaculture-MLF), Ms. Lilian Ibengwe, Ms. Upendo Hamidu, Ms. Jovice Mkuchu, Mr. O. Ngogo (all from Directorate of Fisheries-MLF), Dr Ismael Kimirei (DG-TAFIRI), Dr Mary Kishe, Dr Baraka Kuguru and other Researchers at TAFIRI, the National Task Team (NTT) for implementation of the SSF Guidelines in Tanzania, Mr H. Bhagat (MD- Bahari Bounty Fishing and Processing Company), Mr Abubakary Kombo (ABAJUKO Fish processing Plant), Mr Habibu Mkali and Mr Ulimboka Ndile (Fisheries Officers - Kilwa District Council), Mr Adam Malima and his team of Fisheries Officers (Mafia District Council), Mr Amin Abdallah (Warden Incharge - Mafia Island Marine Park), Ms. Yunge (Fisheries Officer- Ferry Fish Market), Mr Jason Ruben (Independent fisheries management consultant), Ms. Hélène Gobert and Amanda Crémel and their colleagues at the French Development Agency, the BMU representatives, women groups, communities, fishers, traders, and processors, who attended to our information requests.

In Zanzibar:

Dr Aboud Jumbe, (PS- Ministry of Blue Economy and Fisheries), Dr Captain Hamad B. Hamad (Director – MBEF), Dr Salum Hamed (Director – MBEF), Dr Zakaria Khamis (Director – ZAFIRI), Dr Narriman Jiddawi (Independent Consultant), Dr Wahira Othman (SUZA), Dr Arthur Tuda (Executive Secretary- WIOMSA) and his team, Mr Ali Thani (CEO-MWAMBAO) and his team, Mr Hamad Makame (ZANSEA), TUSIYUMBISHANE fish-based organization, The VFC and beach officer representatives, women groups, community leaders, fishers, traders, processors, who provided assistance during focus groups discussion and key informants interviews, who attended to our information requests.

The team is very grateful to the whole Agrinatura team for their support throughout the study, in particular Giorgia Mei for the coordination and logistics, Heval Yildirim, Marie-Hélène Dabat, Frédéric Lançon, for the economic part, and Conor Walsh for reviewing the environmental analysis.

Special thanks are also provided by the whole team to Lamine Diallo, Andrea Massarelli, and Mathew Mpanda from the EU Delegation in Tanzania, for their very positive guidance, throughout the study, and to Dr Cécile Brugère for her help in the start of the economic analysis.

ACRONYMS

AFA	Agrifood Chain Analysis
AIGA	Alternative Income-Generating Activity
AoP	Area of Protection
APAI	African Protected Areas Initiative
BE	Blue Economy
BMU	Beach Management Unit
BoT	Bank of Tanzania
BP	Bloody Pressure
CBO	Community Based Organization
CCD	Cold Chain Development
CCS	Cold Chain System
CDB	Convention on Biological Diversity
CIF	Cost of Insurance and Freight
CITES	Convention on International Trade in Endangered Species
CPUE	Catch Per Unit Effort
DFD	Department of Fisheries Development
DRC	Domestic Resource Ratio
DSFA	Deep-Sea Fishing Authority
EAME	Eastern African Marine Eco-region
EEZ	Exclusive Economic Zone
EMA	Environmental Management Act
EU	European Union
EUD	European Union Delegation
EVA	Ethylene-Vinyl Acetate
FAO	Food and Agriculture Organization
FBR	Fiberglass
FETA	Fisheries Education and Training Agency
FF	Finfish
FFM	Ferry Fish Market
FGD	Focus Group Discussion
FOB	Free On Board
FTE	Full-Time Equivalent
FU	Functional Unit
FUI	Fuel Use Intensity
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GPS	Global Positioning System
HACCP	Hazard Analysis Critical Control Point
HP	Horse Power
ICM	Integrated Coastal Management
ICRAN	International Coral Reef Action Network
ICRI	International Coral Reef Initiative
ICZM	Integrated Coastal Zone Management
IGS	Intermediate Goods and Services
IPCC	Intergovernmental Panel on Climate Change
IUU	Illegal, unreported, and unregulated
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
LGA	Local Government Authority
LPG	Liquefied Petroleum Gas
LWE	Live Weight Equivalent
MBoEF	Ministry of Blue Economy and Fisheries in Zanzibar
MBREMP	Mnazi Bay and Ruvuma Estuary Marine Park
MCA	Marine Conservation Areas
MCU	Marine Conservation Unit
MDAs	Ministerial Departments and Agencies
MIMP	Mafia Island Marine Park
ML	Mainland
MLT	Mainland Tanzania
MPA	Marine Protected Areas
MPR	Marine Parks and Reserves
MSC	Marine Stewardship Council
MSY	Maximum Sustainalble Yield
MTZS	Million Tanzanian Shilling
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non-Governmental Organization
NICEMS	National Integrated Coastal Environment Management Strategy
NM	Nautical Miles
N_2O	Nitrous oxide
NOP	Net Operating Profit
NPC	Nominal Protection Coefficient
OCGS	Office of the Government Statistician
OHS	Occupational Health and Safety
PE	Polyethylene
PIOT	Physical Input / Output Table
PM2.5	Particulate Matter < 2.5 µm
PS	Prime Secretary
PVC	Polyvinyl chloride
RGoZ	Revolutionary Government of Zanzibar
SACCOS	Savings and Credit Cooperative Societies
SAU	Sea Around Us.org
SSCF	Small Scale Coastal Fisheries
SSF	Small Scale Fisheries
STAN	SubSTance flow ANalysis
SUMATRA	Surface and Marine Transport Regulatory Authority
SWOT	Strength/Weakness/Opportunity/Threat
TACMP	Tanga Coelacanth Marine Park
TAFICO	Tanzania Fisheries Corporation
TAFIRI	Tanzania Fisheries Research Institute
TASAC	Tanzania Shipping Agencies Corporation
TAWFA	Tanzanian Women Fish Workers Association
TIFPA	Tanzania Fish Processors Association
TSEEZ	Territorial Sea and Exclusive Economic Zone
TZ	Tanzania
TZS	Tanzanian Shilling
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
URT	United Republic of Tanzania
URTMLF	United Republic of Tanzania Ministry of Livestock and Fisheries
USD	United States Dollar
VA	Value Added
VC	Value Chain
VCA	Value Chain Analysis
VCA4D	Value Chain Analysis for Development
VFC	Village Fishermen Committee
WB	World Bank

WIO	Western Indian Ocean
WIOMSA	Western Indian Ocean Marine Science Association
WWF	World Wide Fund for nature
ZAFICO	Zanzibar Fishing Corporation
ZATI	Association of Tourism Investors
ZFSS	Zanzibar Fisheries Frame Survey
ZIPA	Zanzibar Investment Promotion Authority
ZZB	Zanzibar
ZNZ	Zanzibar

EXECUTIVE SUMMARY

Context

This report provides an analysis of the coastal fisheries value chains in Tanzania, under the "Value Chain Analysis for Development" (VCA4D) project. The assessment consisted of four analyses: functional, economic, social, and environmental. All components of the analyses draw on multiple information sources, including secondary data and primary data collected in late 2021 and 2022.

The VCA4D analysis is primarily intended to serve the purpose of the EU Delegation (EUD) in Tanzania for determining priorities in supporting Blue Economy initiatives in Tanzania. It follows a scoping study of coastal fisheries in Tanzania that recommended conducting the VCA4D for five identified main sub-chains representing about 80 % of the total estimated volumes of marine fisheries (around 70,000 t) (Linton 2021). Although relatively minor compared to the total fisheries in Tanzania, the contribution of marine coastal fisheries to the Gross Domestic Product (GDP) and livelihoods of the semi-autonomous region of Zanzibar (ZNZ) (more than 4% according to the RGoZ, 2020) and coastal Mainland Tanzania (MLT) is important.

Functional analysis

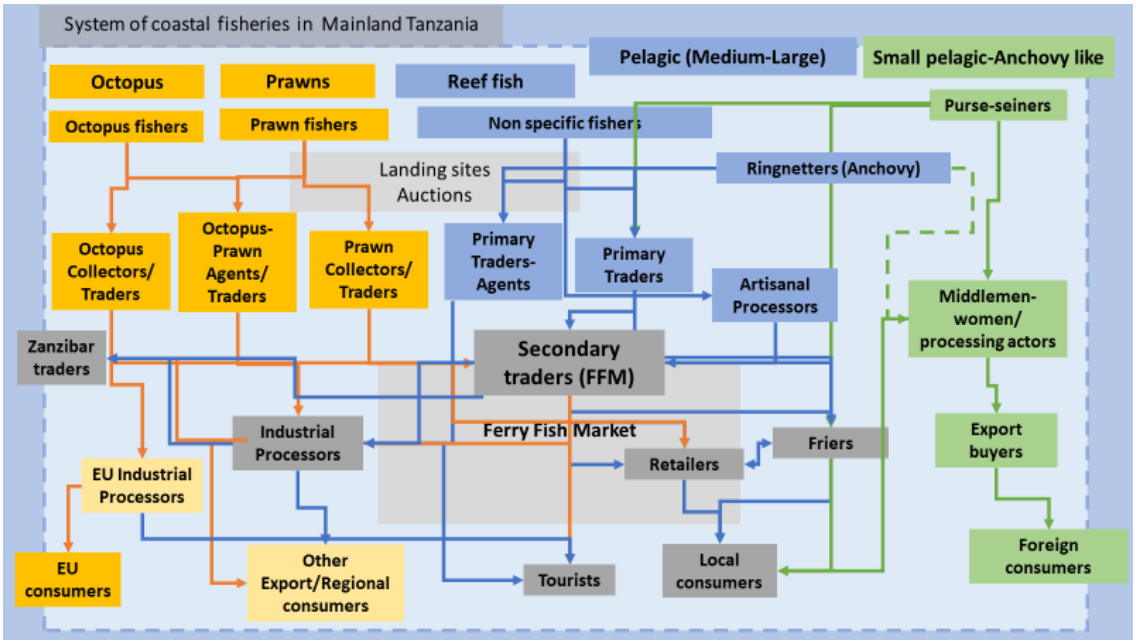
The United Republic of Tanzania (URT) has a coastline of about 2,300 km representing both important ecological and economic resources. URT's coastal marine ecosystems are found in five coastal regions (Tanga, Coast, Dar es Salaam, Lindi, and Mtwara) of the MLT and the semi-autonomous archipelago state ZNZ, comprised of two main islands: Pemba and Unguja. Fishing in the URT is an important source of income and nutrition. A quarter of the Tanzanian population (estimated 60 million people in 2020) depends on coastal resources or inland lakes for their livelihoods (URTMLF, 2019). Annual fish consumption is 7.6 kg/person on average between 2016 and 2019 (MLF, 2020). The sector (freshwater and marine) directly employed nearly 202,000 people in 2019 as fishermen and supported more than 4 million people engaged in fisheries value chains (processing, trade, fish transport, net making and boat building). The fisheries sector contribution to the national GDP was estimated at 1.7% in 2020 (out of the total contribution of 26.9% by agriculture) (URT, 2021).

In Tanzania, the fisheries sector can be divided into inland fishing and freshwater aquaculture, and marine fishing and mariculture. Inland fishing dominates and contributes at least 85% of national fish production volume. Marine fisheries contribute 10–15% of national fish production volume, while marine aquaculture (e.g., algae production) is negligible. The artisanal sector accounts for approximately 95% of all catches (Jiddawi and Ohman, 2002; URTMLF, 2021, Sekadende et al. 2020).

Coastal fisheries are managed separately in Mainland Tanzania (MLT), by the Ministry of Livestock and Fisheries, and in Zanzibar (ZNZ), by the Ministry of Blue Economy and Fisheries of the Revolutionary Government of Zanzibar. Hence, two distinct, but linked, systems are described in the functional analysis (Fig. A): MLT coastal fisheries and ZNZ coastal fisheries. Within each of these two systems were identified and characterised sub-chain systems, which are outlined below:

Sub-chains in Mainland Tanzania (MLT)	Sub-chains in Zanzibar (ZNZ)
➢ Anchovy and anchovy-like small pelagic, ➢ Other small, medium, and large finfish, ➢ Octopus, ➢ Prawn.	➢ Anchovy and anchovy-like small pelagic, ➢ Other small, medium, and large finfish, ➢ Octopus.

1



2

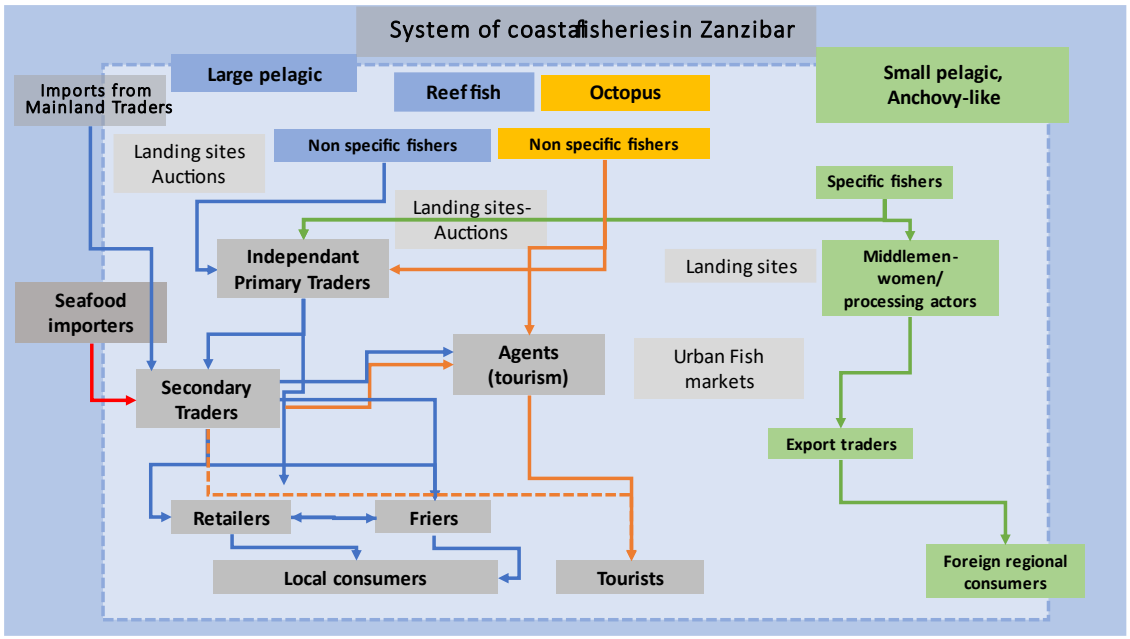


FIG. A FLOW DIAGRAM OF THE SYSTEM OF COASTAL FISHERIES IN 1) MLT AND 2) ZNZ
(Team elaboration)

In both MLT and ZNZ the primary production systems depend on artisanal fisheries, which involve different types of fishing vessels and fishing gears. The boats, of various sizes, are mainly wooden, with sails and/or outboard engines as means of propulsion. The majority of fishers are not confined to one specific sub-chain but may move from one type of fishing to another depending on factors such as season and catch rates. The final seafood products are similar in both MLT and ZNZ: fresh/chilled fish (whole fish or cut), frozen products (fish and octopus, prawns), fried fish for local consumption (mainly small – medium pelagic, and small reef fish), and dried fish (mainly for small pelagic, particularly anchovy and anchovy-like for domestic and export market).

Regarding the production volumes in tonnes, the Food and Agriculture Organisation (FAO) official volumes of catches for each sub-chain were amended using primary and secondary data. In general, we estimate that catch volumes are at least 30% higher than the official catch volume of each sub-chain, suggesting total volumes of the study sub-chains of 66,882 t in MLT and 71,215 t in ZNZ. The total number of fishers is

calculated to be around 18,000-28,000 and 24,000-35,000 for MLT and ZNZ, respectively. This is much lower than the official statistics reported of about 50,000 fishers officially estimated in each of MLT and ZNZ. This difference in numbers may be related to the methodological approach used, as well as the scope of our study, which does not include shellfish, squids, rays, and shark fisheries.

Key differences in the characterization of actors in MLT and ZNZ are less pronounced at the fisher's level, but more significant in terms of primary and secondary traders and include the following:

- Industrial processors operate only in MLT, and they are associated with the octopus, prawn and, to a lesser extent, with high-value finfish sub-chains. Therefore, the suppliers and agents working with the processing plants, and the export opportunities for frozen octopus and prawn are specific to MLT.
- The tourist market is important in both MLT and ZNZ. In ZNZ this has led to the creation of a specific category of actor as agent/buyers, while in MLT, the tourist market is handled by industrial actors, inducing a competition of industrial and small-scale traders at the FFM. In fact, in MLT, the tourism market also includes urban end-users of an emerging higher income class consuming seafood in restaurants.
- Different tax and royalty regimes exist and are generally lower in ZNZ than in MLT. This may have a) favoured the presence of fish importers in ZNZ and b) contributed to the higher volume of exports to regional markets of dried anchovy from ZNZ (6,000-7,000 t) compared to MLT (about 1,000 t).
- The Ferry Fish Market (FFM) in MLT is acting as a central market node, capturing more than 10-15% of the total volumes of marine seafood, and does not have an equivalent in ZNZ.
- Fish are landed at numerous landing sites, 274 in MLT, and 235 in ZNZ. The majority of them have an auction system, where the first trading is conducted.
- In principle, and to varying degrees, Beach Management Units (BMUs) in MLT and Village Fishermen Committees (VFCs) in ZNZ play a major role in the local governance of fisheries.

Given the complexity of the two systems and their peculiar characteristics, the data and the analyses at the sub-chain level were disaggregated for MLT and ZNZ. These findings were later consolidated to provide an overall analysis of the economic, social, and environmental sustainability of coastal fisheries at the level of MLT and ZNZ. Our estimated MLT and ZNZ annual productions are both within the same range of 70,000 t (Live Weight Equivalent). The volume of seafood imports in ZNZ represents a minor share. The local market absorbs 50% and 36% of the volumes in MLT and ZNZ respectively. The tourist and high-income consumers' market captures 23% of the volumes in MLT and 19% in ZNZ. The estimated "losses" from the market place, representing the wasted post-harvest biomass or the auto-consumption (seafood consumed by fishers households etc), are very similar, within 19-20% for both MLT and ZNZ. The main reason for this variation in volume allocation between MLT and ZNZ is linked to the Anchovy sub-chain (for instance 6% of export for MLT, compared to 18% in ZNZ).

From a technical point of view, the coastal fisheries sector in both MLT and ZNZ shows wide room for improvement. This is linked to the challenge in containing consumption fuels used during fishing and artisanal processing activities (such as fossil fuel and firewood) given the low energy efficiency of the engines and the equipment used for processing (braziers). Another weak spot observed is related to the little development of the Cold-Chain System (CCS) and market infrastructures such as landing, auction site, and food fish storage facilities. This weakness could be contributing substantially to high post-harvest losses, especially nutritional and quality losses.

What is the contribution of the value chain to economic growth?

Profitability & Sustainability of the VC activities for key actors

Profit is generally shared between the boat owner, the captain/skipper and the crew. Based on these profit sharing rules we used a specific approach for the estimation of the profitability in fishing. The profitability, expressed by the individual fisher's income varies between 62-756 USD/month in MLT and 42-288 USD/month in ZNZ, depending on the métier, the costs incurred, the fish landing price and the catch volume. Some crew members are potentially vulnerable, with an income below a minimal wage of 80-130 USD/month. The most critical cases are related to the purse seiners, targeting anchovy-like small pelagic in ZNZ and in MLT, with potential estimated monthly incomes around 50 USD/month or less. Cost structures are mainly determined by the fisheries' technologies and particularly whether the fishing vessels are motorized or not. When the boat is motorized, the fuel cost represents 27 % (when a sail is also used with an outboard engine, as for gillnetters) to 94 % (for cases associated with fiberglass boats, ring-netters, or purse seiners) of the total of the Intermediate Goods and Services (IGS) costs. Other significant operational costs include bait, maintenance

(boat and engine), fishing gears, and various fishing accessories. The price of the landed fish coupled with trip catch rates are key factors determining the profitability of ring-netters, fishers using motorized fiberglass boats and purse seiners, although this observation is less obvious in MLT. The profit generated by the boat owners (as expressed by the Return on turnover, NOP/Output in %) varies from 4 % to 36 %. In both MLT and in ZNZ, the Return on turnover for boat owners is better in situations of artisanal fisheries using sails, as investments and operational costs are lower.

The main trading and processing costs (IGS) are related to transport, electricity, firewood, ice, handling, and processing labours in MLT and in ZNZ. Returns on turnover range from 12-39 % for MLT traders and processors, and 2-30% for ZNZ traders and processors. Monthly incomes generated for the MLT traders and processors are within the range of 144-1,564 USD and 332-49,598 USD for traders and processors, respectively, depending on the sub-chains and the sub-categories of actors. Monthly incomes generated for the ZNZ traders and processors are lower, within the range of 102-545 USD and 72-332 USD for traders and processors, respectively, depending on the sub-chains and the sub-categories of actors.
In MLT, the highest profitability rates are found in the sub-chains where industrial processors are operating for the export market in Europe (Octopus sub-chain): 22% for the traders, and 39% for the processors. The profit finding of 13% for prawn industrial processor is probably an under-estimate. Artisanal processors are mainly operating in the anchovy and anchovy-like and finfish sub-chains, especially in drying, boiling, frying activities in MLT and ZNZ. Return on turnover for these actors is about 25 % for the Anchovy-like sub-chain processors, and 17% for the finfish sub-chains in MLT, whereas it ranges from 0 to more than 50% in ZNZ, with an average estimated at 9%.
In ZNZ, two sub-categories of traders emerge from the analysis:

- Small-middle size, primary and secondary traders, operating in coastal areas and in the cities, for an average volume of purchase of 12 t with high variability in their profit (Return on turnover 0%-16%, average at 8%), expressing some vulnerability.
- Large-scale traders, dealing with much higher volumes of purchase (40-3,800 t): some are frozen seafood importers from MLT or from other countries, mainly Asia. The highest volumes and Return rate on turnover (28%) are found in the category of traders-exporters of dried anchovy to the regional foreign market. In the other "big traders", the relative profit is lower 6% for hotel buyers and 10% for importers.

The profitability varies greatly between actors, sub-chains and the two regions of MLT and ZNZ. In Finfish (e.g. Low, Mid and High value finfish), a higher range of prices is observed in the ZNZ value chains and was taken into account. The Return on turnover (% NOP/Output) for traders and processors, is always lower in ZNZ (< 7-8%) than the ones observed in MLT (around 16-17%). In the Anchovy-like sub-chain, the situation is more beneficial to traders and processors in ZNZ than in MLT.

The relative significant contribution of the fisher's category to the Direct VA and Wages differs between MLT and ZNZ. The contribution to the Direct VA is equally distributed in MLT between the three (fishers/traders/processors) categories of actors (around 32-34%) while 60 % of the Direct VA is due to the fishers in ZNZ. The major contribution to wages is related to the fishers in both regions (>66%), but is more important in ZNZ (80%), as the category of industrial processors associated with many employees does not exist in ZNZ.

Total effects within the MLT and ZNZ economies

The Total Value Added (Direct VA + Indirect VA) is estimated at 398,451 MTZS in MLT; 262,058 MTZS in ZNZ; and 660,509 MTZS for the whole country of Tanzania. The importance of Indirect VA (i.e., the VA generated by the supplies of goods and services to the actors of the VC) expressed through the Driving effect ratio (Indirect VA / Direct VA) is very similar for MLT and ZNZ, and estimated at 0.2 for the whole. The rate of integration, on the other hand, indicates the portion of the value of the VC production which eventually remains within the national economy and is quite high in both MLT and in ZNZ. The contribution of coastal fisheries in MLT, and of fisheries in ZNZ, to the GDP (national and agriculture) is higher than the official figures (see Box A), because of the addition of indirect effects and because of the overall methodology of the VCA4D economic analysis.

Box A Contribution of the value chain to the GDP (national and agriculture)

- ✓ **In MLT,** the estimations of the relative contribution of the VC to the **GDP**, and the **agriculture GDP** are **0.29%** and **1.07%, respectively**, slightly higher than the official reported figures. Our estimate of the Total Value Added represents more than 16% of the estimated GDP due to the national fisheries contribution in MLT. If reported to five coastal regions (including Dar-Es-Salaam), our total VA estimate is closed to 1% of the GDP of the coastal regions in MLT that is estimated at 39,686,080 MTZS, e.g., 28.4% of the MLT GDP according to the National accounts in MLT 2014-2020, National Bureau of Statistics, 2021.
- ✓ **In ZNZ**, the direct contribution of the fisheries value chain to the economy (Direct VA of 217,678 MTZS) is in the order of magnitude of the official statistics. The estimation of indirect effects allows a significant addition of added value to the ZNZ economy as compared to the current official estimations of the fisheries value added. As a result, the total contribution of the fisheries VC to the overall ZNZ economy (GDP) is **6.32 %** and to the agriculture GDP is **30%**.
- ✓ For the **URT** (summing MLT and ZNZ findings), the contribution of coastal fisheries VC to the URT GDP is **0.46%** and **1.74%** of the Agriculture URT GDP.

The public fund balance (tax income minus subsidies) is positive for both MLT and ZNZ; no subsidies were identified. Income Tax is estimated at 20,930 MTZS in MLT, 4,566 MTZS in ZNZ, and 25,496 MTZS for the URT. In both MLT, and ZNZ, it is also very likely that the tax collection is not optimized.

Total imports of goods and services by the VC actors are reported to be 55,282 MTZS in MLT and 43,132 MTZS in ZNZ, resulting in the same range of 10-11% of the total production for both. Total exports are reported to be 50,5562 MTZS in MLT and 53,414 MTZS in ZNZ, resulting in a slightly negative balance of trade for MLT, and positive for ZNZ. The overall resulting URT balance of trade is positive in the Tanzanian economy mostly because of the ZNZ dried anchovy exports to the foreign regional market.

In global economy, our calculated Domestic Resource Ratio (DRC) are 0.44, and 1.12, for MLT, and ZNZ respectively. According to the VCA4D methodological guide (Version 2, Feb. 2021), the MLT DRC (*DRC<1; DRC=[Non-tradeable domestic factors at market price (excluding transfers) / (Production at international price – Tradeable intermediate goods and services at international prices*]) indicates that the value chains of coastal fisheries are viable in MLT, in the global economy. This situation is different in ZNZ, where the value of domestic factors which are consumed are higher than the value added they produce.

The Nominal Protection Coefficients (*NPC = [Domestic price of the product/ International parity price of the product])* for all the Value Chains (VCs) were estimated to be around 1, indicating that all the actors of the VCs generate equivalent incomes that they would have on international markets.

Comparison of sub-chains

In MLT, the Finfish sub-chain captures 68% of the Total VA. The Anchovy-like, Octopus and Prawns sub-chains share 11%, 14% and 7% of the Total VA, respectively. The importance of frozen octopus and prawns as exports of high value products is, however, highlighted through the other indicators.

In ZNZ, the finfish sub-chain is also very significant, capturing 71% of the Total VA. The Anchovy-like, and Octopus sub-chains share 25%, and 4% of the Total VA, respectively. However, the Anchovy sub-chain displays a profile with stronger overall economic performances, as expressed by the high Export Rate (63%), the Return on turnover (>40%), Rate of integration into the economy (77%), and DRC <1 (0.4).

From an overall economic growth perspective, all the considered sub-chains in both MLT and ZNZ are playing major and complementary roles. For instance, the octopus and prawn sub-chains in MLT are less significant in terms of Direct VA, but they are contributing to the balance of trade, through the export earnings, and become therefore quite significant from a macroeconomic perspective. In ZNZ, the Anchovy-like sub-chain plays a similar role because of the very significant export trades.

Many interactions are encountered between the two systems, at all levels of their coastal fisheries value chains, which influence the economic outcomes. This strongly suggests a need for more cooperation between MLT and ZNZ with regard to coastal fisheries management.

Is the economic growth inclusive?

Overall, the estimated monthly incomes compared to a reference minimal wage (130 USD/month) and previous studies (Ibengwe et al. 2022; Linton, 2021; Sofreco, 2018; Stanek, 2015) range from 0.5 to 4 times this rate for all the categories of actors. The share of the fisher's landing price in the final end-user price widely varies, among sub-chains and the two regions, ranging from 9 % (anchovy in ZNZ) to 56 % (finfish and octopus

in ZNZ), and between 14% (anchovy ML) to 41 % (high value finfish FF3) in MLT, indicating here again a potential higher inequality on the sub-chains.
Overall, our study shows that the Gini's coefficients, that measure the equality of income distribution between the actors within the sub-chains, are indicating less inequality in MLT, as compared to ZNZ. The "best" (lowest) Gini's coefficients are found in MLT finfish sub-chains (0.5216), particular in the low-value finfish sub-chain mostly covering the fisheries of medium pelagic and reef fish, for local markets. The "worst" Gini coefficients are seen in ZNZ, in the Anchovy-like sub-chain and in the Octopus sub-chain; 0.8566 and 0.8482, respectively. However, all the explored sub-chains are displaying Gini's coefficients much higher than the proposed acceptable value of 0.35 proposed by the FAO in 1980.
Vulnerability in the coastal fisheries value chains may be considered in terms of sensitivity (the intrinsic degree to which people and economies depend on fisheries) and adaptive capacity (the ability of people and socioeconomic systems to anticipate, respond to, and adjust to the impacts of a change, and to minimize, cope with, and recover from the consequences). Guided by the above definition, a very high proportion of the stakeholders in the coastal fisheries sub-chains may be considered vulnerable. According to our estimates, the fishers appear as a vulnerable group in most sub-chains although in some cases, their income can exceed three times or more the minimal wage.
In common with most fisheries value chains, except for Octopus, women are traditionally involved in downstream activities as retailers, artisanal processors (frying, boiling, and drying). But women are now getting more and more involved in the primary traders, buyers at the auction places, emerging as entrepreneurs. However, their positioning is still relatively limited. We estimate the women overall participation in the explored VCs, at 26%, 15%, and 21%, for MLT, ZNZ, and Tanzania, respectively.
Most of the jobs, while they are may or may not be skilled, are unqualified (>90%). Traders and artisanal processors are mostly self-employed. The rate of formal employment is important in the sub-chains where industrial processors play a major role (Octopus and Prawn sub-chains in MLT), around 30%, while it is very low for all the others. Seasonal, temporary, partial jobs are seen in the seasonal fisheries (Octopus, Prawns, Anchovy-like) while in the Finfish sub-chains, the activities could be practiced the whole year long.

Is the coastal fisheries value chain socially sustainable?

Working conditions:
CQ3.1 Are working conditions throughout the VC socially acceptable and sustainable?
MLT and ZNZ have separate, although similar, labour law regimes. There is recognition that gaps exist in the laws, as well as inconsistencies between the laws applying in the MLT and ZNZ. There is weak enforcement of labour rights and standards, lack of occupational safety and health, and weak organization of workers in general in Tanzania. There is no evidence that seafood processing companies (only operating on MLT) are not respecting labour standards, but most workers in coastal fisheries value chains are in the informal sector where enforcement of rights and organization of workers is particularly challenging. Both MLT and ZNZ law prohibits exploitation of children in the workplace, but both MLT and ZNZ have limited capacity to enforce. The overall child labour rate is high in Tanzania. Children work in fisheries (freshwater and marine) but the extent, particularly of child labour, is not clear. Job safety in the fisheries sector remains an important issue, but official data is not readily available. A number of risks associated with fisheries were reported during our field visits including accidents and deaths at sea and the lack of appropriate rescue services and equipment. In spite of the challenges, people, including women and youth, are attracted to fisheries VCs in MLT and ZNZ. Measuring attractiveness of remunerations in fisheries value chains is challenging; it varies with sub-chain, stakeholder, location & over time. Many fishers reported that they are fishing because of a lack of alternatives.

Land and Water rights*: CQ3.2 Are land and water rights socially acceptable and sustainable?*
There are both fisheries/ marine resource and land rights to consider with respect to fishers and coastal communities. Fishers "property rights" appear to be mainly being affected by the creation of protected areas in MLT and ZNZ and coastal developments, particularly in ZNZ. Policy and legislation related to land and natural resources differ between MLT and ZNZ. Tanzania is a leading country in terms of plans to take forward implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF) in the Context of Food Security and Poverty Eradication (the SSF Guidelines). MLT fisheries policy is much more explicit about following SSF Guidelines. There is an active National Task Force and a National Plan of Action (NPoA) to implement the SSF Guidelines. Fishers "property rights" are mainly being affected by the creation of protected areas by state actors. In ZNZ, previous fisheries policy has been criticized for not being sufficiently aligned with SSF Guidelines and the extent to which these concerns are being addressed under the implementation of the new Blue Economy policy is not entirely clear. A NPoA to implement SSF Guidelines has been drafted.

No recent large -scale acquisitions by private sector actors in coastal fisheries VCs were identified. Fishers "property rights" are mainly being affected by the creation of protected areas by state actors and coastal developments not directly linked to fisheries VCs, particularly tourism. In both MLT and ZNZ, early discussions with local communities around Protected Areas (PAs) appear to align with an open, co-management approach but then benefits to local communities fail to materialize. In ZNZ, the level of prior disclosure for tourist and other coastal development investments is not clear, but observers suggest need for more transparency, accountability and public participation. In Tanzania, land policy and law is widely considered to have been designed to protect citizens' rights and enable all citizens to participate in decisions on matters concerned with their occupation of land. However, implementation is often not in accordance with the rules. In ZNZ, the Minister is required by law to obtain consent from the holder of the Right of Occupancy before land is leased. Observers have expressed concerns, however, that rules are not always followed and levels of compensation are not always appropriate. Future interventions should align with, and explore ways, of supporting the implementation of the SSF guidelines.

Gender equality: *CQ3.3 Is gender equality throughout the VC acknowledged, accepted and enhanced?*
There have been significant social and economic improvements, but gender equality remains an important issue in Tanzania. In MLT and ZNZ, women have relatively little involvement in the major coastal fisheries VCs at the production stage (the major exception being octopus) but are highly involved in post-harvest activities. The extent to which they are active varies with VC and, to some extent, geographical location. Risks of exclusion are associated with cultural barriers, economic barriers, access to fisheries resources and policy. However, women are becoming increasingly active in post-harvest activities as both managers/ entrepreneurs and workers, suggesting risks of being excluded are diminishing. Formal legal provisions guarantee women access to, ownership and protection of their rights to land and equal rights to men, but customary tenure can still be discriminatory. Women do have ownership of assets, but for URT, only 7.4 % of Tanzania's house owners are women. In ZNZ 20.9% of house owners are women. There has been considerable improvement over the past 20 years, with 68–70 % of Tanzanian women having access to loans through empowerment funds. However, women remain largely excluded from mainstream financial services structures and female traders, in general, face limited access to business development services.
Traditionally, most direct decisions related to fisheries production in coastal Tanzania would be made by men. However, women would be directly involved in some production decisions in the inter-tidal zone such as foot fishing for octopus, net fishing for shrimp and smaller fish, collecting shellfish. Women working in fisheries VCs can control their own income, but for many the income is used for household needs. Women are more likely to belong to groups such as SACCOSs and CBOs than larger organizations. In MLT, women belong to BMUs and hold leadership positions, while in ZNZ, to a much lesser extent, women belong to VFCs and don't hold leadership positions. Women reported that the division of labour within the households is not equal in their communities. and this was linked to women now having to earn an income as well as doing most of the household activities.
Some women are becoming significantly more economically empowered at least partly through engaging with fisheries VCs and taking up leadership positions. At the same time, other women, and men (younger and older) are earning income from fisheries VCs but with varying degrees of vulnerability. Women's participation in fisheries VCs is multifaceted and shaped not just by their gender, but also by factors such as household assets, education, and skills. Future interventions need an analysis of the current and potential role of both women and men, and other specific social groups (e.g., youth) based on engagement with these different stakeholder groups in differing contexts.

Food and Nutrition Security *CQ3.4 Are food and nutrition conditions acceptable and secure?*
Fisheries (coastal and fresh) make an important contribution to national food and nutrition security. In coastal communities, fisheries make both a direct and indirect (through income) contribution to food and nutrition security. In MLT and ZNZ, local food production is decreasing in coastal fishing communities (diminishing access to land, declining soil fertility, changing climate, pests & diseases). Food supplies are increasing on local markets, and this was at least partly linked to improving infrastructure. In MLT and ZNZ: trends in income from fisheries value chains to be able to purchase food are highly variable for different stakeholders. In MLT and ZNZ, women's Focus Group Discussions suggest that the nutritional quality of available food was improving in markets, but there appears to be a mixed picture regarding nutritional adequacy. Nutritional practices are increasingly dependent on households' ability to buy nutritious food. Non-communicable diseases (high Blood Pressure and diabetes) are increasing in coastal areas. For MLT and ZNZ, risks of high

dependency on income associated with fisheries VCs are high for fishers' households given increasing numbers of fishers and for non-fisher households if fish stocks are not sustained and /or more people are attracted to their communities and incomes decline. Much more analysis is needed to understand the relationship between food and nutrition security and fisheries at the level of fisher's households, coastal fishing communities and more widely. This should be part of a wider dialogue around sustainable and inclusive food systems in Tanzania to inform decision-making processes.

Social Capital: *CQ3.5 Is social capital enhanced and equitably distributed throughout the VC?*
In MLT and ZNZ there is a range of formal and informal organizations participating in fisheries VCs. Goals and performance of these different organizations appears to vary considerably. Many fishers interviewed did not feel well represented. Inclusivity of membership varies according to a number of factors including their purpose, location and governance. Beach Management Units (BMUs-MLT) are much more inclusive than Village Fisheries Committees (VFCs -ZNZ). The recently formed TAWFA provides a network for organizations involving women in fisheries-related activities. BMU and VFC leadership is periodically elected and in that sense is representative and accountable. However, many of the fishers interviewed did not feel well represented.
In general, fishers appear to negotiate on an individual or small group (crew) basis. However, examples of fishery-related organizations who negotiated on behalf of their members were identified. BMUs and VFCs have a role providing information about illegal fishing practices and fisheries policy, but performance varies in practice. There is a complex web of social and economic relations in which SSF market actors are embedded. This includes various informal credit arrangements based on trust. Formal support service capacity to fishers is generally weak.

BMUs, VFCs and Village Liaison Committees (VLCs) (if protected areas) are institutional arrangements which in principle enable communities to participate in marine resource decisions that impact on their livelihoods. In practice, performance is very variable. Traditional knowledge and resources are not well respected in coastal resources management. It is difficult to identify a realistic alternative to such multi-stakeholder initiatives, but future interventions should strive to support such organizations in ways which fairly distribute both costs and benefits. Aligning such organizations with existing institutions to minimize destructive conflict is important. Understanding the factors driving community cohesion in SSF is critical to inform strategies for supporting effective participatory governance approaches and empowering decentralized, localized, and community-based resource management approaches. Supporting initiatives which are facilitating learning amongst coastal communities is important.

Living conditions*. CQ3.6 To which standards are major social infrastructures and services acceptable and do the vanilla value chain operations contribute to improving them?*
Globally, many small-scale fishing communities face significant challenges in terms of health, water & sanitation, and education services, alongside housing. In MLT and ZNZ, women's FGD participants reported that health facilities and services had improved. Women attributed improvement in facilities to the government, although out-of-pocket spending on health accounts for 23 % (MLT) and 30% (ZNZ) of household expenditure. High Blood Pressure and diabetes were reported to be increasing in all communities visited. In terms of housing in MLT and ZNZ, women's FGDs and official survey statistics indicate a major increase and high proportion of houses with "modern" roof (iron sheets) and to a lesser extent modern walls and floors. Women's FGDs reported that fisheries income has contributed. With regards to water and sanitation, on MLT women reported a mixed situation with availability and increasing saltiness of water a problem in some locations. In ZNZ: 94.7% of households (91.8% in rural areas) have access to a protected water source and 98.8% of households (98% in rural areas) are within 1 km of source of drinking water. Improvements in water supply were not linked to income from fisheries. With regards to education and training, on MLT, primary school net enrolment rate is 83.4% (81.3% in rural areas). Fisheries-related income had contributed to educational costs and in Songo Songo exam performance. In ZNZ: primary school net enrolment rate is 81.4% (78% in rural areas). Women in FGDs reported that there was more access to education now and particularly it was now equal for both girls and boys. There was a mixed responses regarding a link with fisheries.

A review of secondary information appears to align with a relatively positive trend reported in the comparatively few coastal communities we visited. However, a more disaggregated analysis of the situation, drivers and trends is needed to inform decision-making aiming to improve sustainable livelihoods within coastal communities. Alongside this, supporting a multi-stakeholder learning process involving local and

national decision makers and other stakeholders should be considered to explore solutions and co-design ways forward to address the complexity of issues around coastal marine livelihoods and systems.

The overall findings on the social sustainability of Tanzania coastal fisheries are summarised in the radar diagram (Figure B). Working conditions are generally challenging in the mainly informal coastal fisheries value chains. There are concerns regarding land rights, coastal resource property rights and small-scale fishers' rights in coastal fishing communities in Tanzania. There have been major improvements in gender equality in Tanzania, but this remains an important issue. Women are participating in and benefiting from coastal fisheries value chains, but further improvements can be made. Coastal fishing communities are becoming increasingly dependent on purchased food which increases their reliance on fisheries-related income and vulnerability to food price changes. Living conditions in terms of education, housing and facilities appear to be improving for many in coastal communities and, particularly in the case of housing, income from fisheries value chains appears to be contributing. However, there are concerns regarding health and negative social outcomes, such as increasing incidence of high blood pressure and diabetes. Social capital varies considerably in the value chains, but in general fishers' report that they are not well represented.

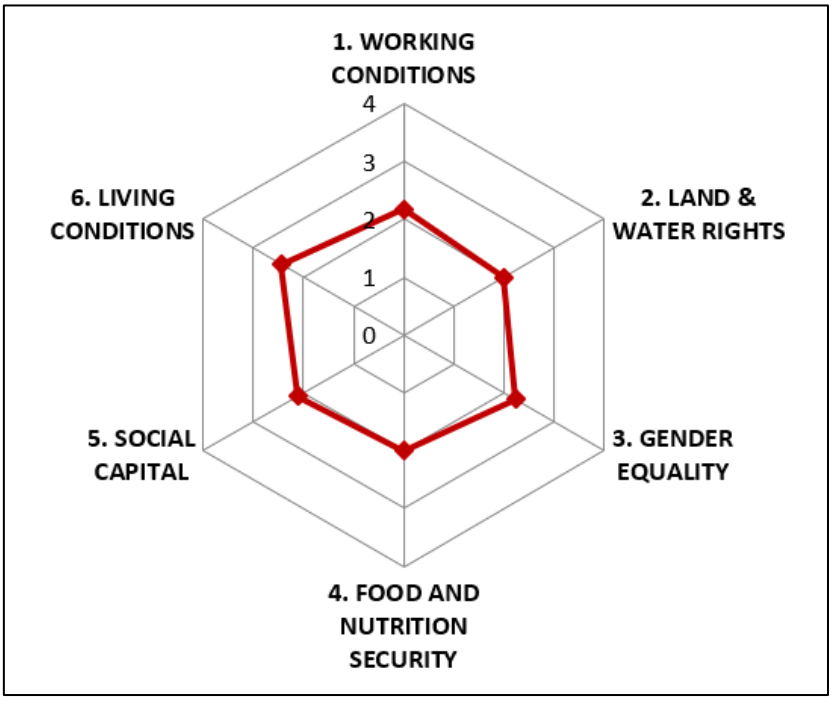


FIGURE B SOCIAL PROFILE OF THE COASTAL TANZANIA FISHERIES VALUE CHAINS

Is the coastal fisheries value chain environmentally sustainable?

Although some differences exist between MLT and ZNZ in terms of environmental sustainability of specific steps of the sub-chains considered, in both geographic entities, the impacts associated with the sub-chains analysed (fishing activities, processing, and export of seafood) affect predominantly the Areas of Protection (AoP) Human Health and Climate Change (Global Warming Potential). This is due to the amount of fossil fuels used for engine operations and other biomasses for processing (i.e., firewood, cooking oil) because of the Greenhouse Gasses (GHG)-related and particulate matter emissions. This general trend is in agreement with other similar VCA4D studies carried out in Mali and Gambia (Andres et al., 2020; Avadì et al., 2020).

Concerning the fishing activities, those having the highest environmental damage/impacts (both on the AoPs and Climate Change/Global Warming Potential) are the ones having high FUI (Fuel Use Intensity, i.e., litres of fuel consumed for 1 t landed seafood): octopus fisheries using motorized vessels in MLT, and finfish longliner in ZNZ.

When considering the processing activities, the ones showing the greatest impacts are those using firewood and cooking oil for frying (MLT and ZNZ) and firewood for boiling (mostly for ZNZ). Indeed, the use of firewood has crucial environmental and health consequences (e.g., particulate matter and GHG emissions, but also deforestation if the wood fuel is cut. However, in the case of ZNZ and MLT, it is likely that a share of the firewood consumed is collected from branches of trees harvested for different reasons). The need for such

types of processing procedures is tightly linked to the need of avoiding high post-harvest losses (physical, quality and nutritional losses). The general sanitary conditions of the landing sites and urban markets, together with the relatively low capacity of the cold chain system and its poor territorial distribution, both in MLT and ZNZ, necessarily results in high rates of post-harvest loss, physical, quality and nutritional losses.
The transport associated with fresh or processed seafood (considered only that within the country) seems to have no major environmental effects, compared to the other activities of the value chains. This appears to be similar to what was reported also for the Gambia fishery sector (Avadì et al., 2020).
Considering the more qualitative aspect of the biodiversity analysis, the fact that there is little information on the state of the exploited stocks appears to be a reason for weakness in the sector. Without stock assessment and not knowing the population size, age structure and size classes of the stocks make it difficult to calculate the Maximum Sustainable Yield (MYS). However, to the best available knowledge (information gathered from the field and the literature), it appears that the stocks exploited by URT's coastal marine fisheries are generally overfished, or close to overfishing, with maybe some exceptions. Supporting these observations are also the testimonies of interviewees who observed decreased CPUE (Catch Per Unit Effort). However, it must be highlighted that the number of people involved in fishing has increased (and this could lead to the fishers' perception of decreased CPUE). With the objective of ecosystems and biodiversity preservation, a range of measures, projects and programmes have been implemented (establishment of marine protection and conservation areas-MPAs and MCAs, ban of destructive fishing gears, research projects for the creation of Alternative Income Generating Activities-AIGA). Although most of them have been positively received by different stakeholders, there is still wide room for improvement.
In short, the environmental issues are overall common between MLT and ZNZ. These include: High FUI for almost all fishing activities using motorised vessels; fuel combustion for processing (firewood) and inefficient processing facilities/equipment; use of cooking oil for processing; weak flow information system that doesn't allow for a good estimation of catches' volumes; in some areas, weak enforcement of input/output measures related to the fishing activities; fish stocks seem to have reached the fully/overexploited status.
Therefore, the value chains analysed, both for MLT and ZNZ, could be improved, in terms of efficiency, at all levels. In addition, there are some issues related to the exploitation status of the stocks, which seem in decline (e.g., overexploitation, habitat degradation, climate change effects). Therefore, the coastal fishery value chain appears weak in terms of environmental sustainability, leaving wide room for improvement within the implementation of a Blue Economy (BE) strategy. Efforts aimed at increasing efficiency should consider the environmental impact per unit and be guided by environmentally sustainable principles.

Conclusions and recommendations

Risk analysis

We conducted a risk analysis, one for MLT and one for ZNZ, and identified the main risk categories, their rationale and their probability. A summary of the risk analysis is presented below: the identified risks are grouped into *risk category* (in italics) and their **probability** is given in brackets (in bold). We kindly ask the reader to refer to the full risk analysis in Appendix 7, Table 1, for a full understanding of the analysis conducted.

Markets (local, regional and international)

- Risk for local consumers and some actors along the value-chain unable to absorb or pass on the increased price, (excessive) increase in prices, particularly for larger fish types (probability = MLT: **moderate**; ZNZ: **high**).
- Decline of exports to the regional market (East and Central Africa markets) (MLT and ZNZ: **moderate**).
- The export industry (EU mainly) drops down (only MLT: **moderate**).
- The tourist industry declines and the prices for seafood drop down in Zanzibar (only ZNZ: **high**).

Logistics and infrastructure and access to supplies

- Higher post-harvest waste and losses (MLT and ZNZ: **high**).

Policies

- Lack of alignment and increase of ongoing conflicts between the relevant sectors with an interest in the Blue Economy and coastal marine resources (only MLT: **high**);
- The Blue Economy high-monetary sectors are prioritized compared to low-monetary sectors, such as small-scale fisheries (only ZNZ: **high**).

Governance and institutions

- Insufficient capacity of formal and informal institutions to cope with the multiple drivers affecting the coastal socio-ecological systems (only MLT: **high**).
- The governance and institutional capacity are not strengthened sufficiently to meet Blue Economy challenges and expectations (only ZNZ: **high**).

Social relations
- Rapid social and economic change affects social relations with uncertain, but potentially negative impacts (MLT and ZNZ: **high**).

Gender, age and alternative livelihood options
- Lack of alternative livelihood options, leading to increasing numbers of people attracted to fisheries VCs and increasing vulnerability (MLT and ZNZ: **high**).

Food safety and sanitary situation
- Degradation of food, safety and sanitary situation (MLT and ZNZ: **high**).

Weather and climate change
- Highly reduced availability of the biotic and abiotic resources on which SSF depends (MLT and ZNZ: **high**).

Fish stock status
- Potential stock depletion (MLT and ZNZ: **high**).

Natural environment
- Destruction of sensitive ecosystems, reduced availability of biotic and abiotic resources, scarce recruitment (MLT and ZNZ: **moderate**).

Investments in fisheries capacity
- Increased overexploitation of fisheries (MLT and ZNZ: **moderate**).
- Perceived or actual unfair distribution of government support (MLT and ZNZ: **moderate**).

Main issues and recommendations

The main issues were identified leading to the following recommendations. On the basis of the VCA4D findings, the main cross-cutting issues between MLT and ZNZ are combined to propose common recommendations for both regions and specific concern when necessary. Specific issues to some sub-chains are also highlighted.

Cross-cutting issues and main resulting recommendations

Data and Information systems

For all the sub-chains included in this study, and for both MLT and ZNZ, there are weak data and information systems, including stock assessment, leading to uncertainties in actual catch figures and existing potential yield. General recommendations are:

- Strengthen capacity (including technical and financial support) to address several crucial issues regarding the overall sustainability of all these value chains.
- Use a holistic approach to develop an integrated data and information flow system (biological information-especially for common stocks between MLT and ZNZ, market data, social and economic aspects, and environmental data).
- Solve the main issue, i.e., lack of information on stock status, in the absence of financial resources and time to perform a stock assessment, it would be necessary to generate knowledge and deepen the existing data on, for example, fishers, catch per unit effort, annual yields per unit areas (e.g., as explored in Kuguru et al., 2022), the average length of fishes caught (and register the fishing of juvenile specimens). In a few words, it is recommended to improve the flow information system.
- Develop an integrated system involving actors collecting and analysing the information and those using the information (and development of guidelines for standard data collection methods, leading to appropriate control measures of fisheries).
- Strengthen collaboration between stakeholders at different levels, e.g., BMU, beach officers, district officers, local authorities, and other stakeholders.

Social issues

The multiple social issues related to coastal fisheries are similar in MLT and ZNZ, although intensified in ZNZ due to, for example, population pressure and tourism. The plans for the implementation of the SSF Guidelines in ZNZ are not as well developed as in MLT.

- Future interventions should align with the principles of the SSF Guidelines and explore ways of supporting the implementations of these guidelines and an informed analysis of the current and potential role of both women and men, and other specific social groups (e.g., youth) based on engagement with these different stakeholder groups in differing contexts.

Limited attention is given to date to fisheries' important contribution to national food and nutrition security. In coastal communities, fisheries make both a direct and indirect (through income) to food and nutrition security. The issue is common to MLT and ZNZ, but even greater in ZNZ where there is a higher dependency on fisheries for the population.

- Much greater attention is needed to understand the relationship between food and nutrition security and fisheries in coastal communities and nationally. For example, trends in the contribution of coastal seafood to nutrition of different social groups in coastal communities and elsewhere; the importance of fisheries income, increasing dependence on purchased food and health outcomes in coastal communities. This should be part of a wider dialogue around sustainable and inclusive food systems in Tanzania to inform decision-making processes.

Emerging fisheries co-management arrangements show some success, but also multiple challenges. There is a range of formal and informal organizations associated with coastal fisheries value chains and resource management. The performance of these organizations appears to vary tremendously. Several multi-stakeholder co-management arrangements have been introduced (e.g., in BMUs in MLT and VFCs in ZNZ). This appears to have had some positive results in some locations, although all those we met reported significant challenges. It is difficult to identify a realistic alternative to such multi-stakeholder co-management initiatives. The VFCs in ZNZ are fishers only, while in the MLT the BMUs are multi-stakeholder. There is a need to consider justice and fairness in both the process and outcomes of these initiatives.

- Multi-stakeholder co-management initiatives are very important, but future interventions should strive to support such organizations in ways that fairly distribute both costs and benefits.

Environmental issues

As explained above, several aspects of the coastal fishery sector could be improved, as follows:

- Co-design ways of reducing the amount of fuel required per trip at sea. For example:
  - upgrade of the engines with those having higher efficiency, as the ones currently in use seem to be obsolete and low efficiency. Evaluation of the use of hybrid or electric engines (provided electricity is obtained from renewable energy sources).
  - improvement of skippers' performance through training courses and by the use of GPS to easily find the best fishing grounds and come back to the landing site straightforwardly.
- Frying using Liquefied Petroleum Gas (LPG) appears to have fewer environmental burdens (GHG- and particulate emissions) than frying using firewood. The initiative to install LPG frying stalls undertaken at the Ferry Fish Market (FFM) could be extended to other urban market nodes throughout the URT. The improvement of the efficiency of the kilns/ovens used for processing should also be considered.
- Improved hygienic conditions and modernized infrastructure (efficient ice machines, cooling, and freezing systems, and modern processing devices) would be desirable in order to decrease or limit product losses, thus increasing the overall efficiency of the coastal fishery value chain. However, the environmental (and economic) impacts associated with a range of different scenarios, including an improved cold-chain system, should be investigated
- Assess waste management. The analysis of waste is outside the scope of this study. However, an important initiative could be to invest in solutions for the recycling and valorisation of used cooking oil, which can have important outcomes on the environmental impact of this sector. Concerning other types of waste (e.g., plastic materials), the observations made during the field missions reveal that this is a further weak spot. A study specifically designed to understand the impact of waste disposal and its fate would be desirable.
- Assess post-harvest losses in terms of both quality and physical loss (analysis of the nutritional quality of fresh and processed seafood).

- Close monitoring of the potential contribution of URT fisheries to stock depletion is highly recommended, especially if the available information on the status of the targeted stocks is scarce. Given the difficulty in the assessment of the stock status and the Maximal Sustainable Yield (MSY), it would be useful to monitor and record the catch at landing sites in more detail to thus understand the Catch Per Unit Effort (CPUE) (but also to record and try to limit the fishing of juvenile individuals).
- Following the precautionary principle and given the available information on the status of the exploited stocks, it would be appropriate to try to decrease fishing efforts and create space for alternative income-generating activities and sources of marine animal protein such as the aquaculture of marine species of low trophic level (e.g., molluscs) or the development of multi-trophic breeding systems such as IMTA (Integrated Multi-Trophic Aquaculture).

Coastal fisheries issues in the context of Blue Economy

Both in MLT and in ZNZ, there are issues related to the institutional environment related to the Blue Economy implementation.

- There is a need to develop an integrated planning framework for all aspects of the blue economy and appropriate institutional arrangements for Blue Economy development

There is a risk of lack of coordination among different donors:

- Donors interested in developing actions in relation to the Blue Economy could join together in an organized group to make interventions more efficient and faster.

There is a risk of inappropriate investment in the Blue Economy.

- There is a need to strengthen arrangements to support responsible investments e.g., through the application of principles of sustainable Blue Economy finance (proposed by the UN and the EU).

Coastal fisheries issues in the context of Agroecology

There is increasing interest in situating small-scale fisheries in research, debate, practice, and movements around agroecology. These are related to the role of fisheries in food sovereignty and transformation of food systems. There are clearly links with the SSF guidelines.

- Explore how agroecology practices and principles can contribute to the economic, environmental, and social sustainability of coastal fisheries systems

For the small pelagic (Anchovy and Anchovy-like) sub-chains in Mainland and in Zanzibar

There are wide similarities and linkages between MLT and ZNZ in the small pelagic value chain. The stock is shared between MLT and ZNZ, as well as the medium and large pelagic stocks.

- There is a strong requirement for more cooperation and collaboration between MLT and ZNZ for its management and governance. This should include a jointly developed and implemented common anchovy and anchovy-like fishery management plan and a small pelagic data and information flow system.

This chain is significant in terms of contribution to local coastal economic growth and providing many local jobs in coastal rural and urban areas. It is well organized in an informal way. The middlemen and women are playing a central role in this chain, which is involving more and more women. The sub-chain appears to be the more efficient in terms of environmental performance, compared to other sub- chains. The mobile nature of small pelagic fisheries may create a challenge for the co-management of resources.

- It is important to support initiatives being taken in addressing challenges faced by actors in this chain including high food fish losses and waste, especially during the rainy season. Researchers, fishers, processors, and other stakeholders should work together to co-design solutions which are economically, environmentally, and socially sustainability.
- Explore the viability of supporting national, regional, and local associations of the main actors of this sub-chain, in particular fishers, middlemen and women (who are central players), as well as traders. Foreign buyers may be given more official recognition for a better organization and performance of the chain, including the marketing environment.
- Much greater attention is needed to understand how small pelagic fisheries contribute to food and nutrition security in coastal communities and nationally to inform decision-making processes.

There are very contrasting results for the exports figures in MLT (8,868 MTZS) and ZNZ (53,414 MTZS). This may be linked to a significant disparity between the two regions in terms of tax and royalty regimes. These very different economic flows may be reflecting unreported exchanges or illegal exports.

- The cooperation between Mainland and Zanzibar related to this sub-chain should carefully encompass all the business environment, including the tax regime, and its traceability.

For the Finfish sub-chains in Mainland and in Zanzibar

Finfish, particularly reef fish, are important for food and nutrition security, for fishers' households, and coastal communities. Moreover, they play a very significant role in the coastal economy. Large pelagic and a few reef fishes are high-value fish and are mostly marketed to the tourist sector in ZNZ as well as in MLT, in the Dar-es-Salaam area.

In MLT, finfish are traded through the auctions system and FFM, where large part of the catch is traded. An important action is to improve the way these nodes are functioning. With regards to auctions, the system is similar in both regions, though coverage is wider in ZNZ with auctioning found in almost all landing sites. Market nodes in ZNZ are smaller and include scattered urban fish markets.

- Improve the process for faster and more precise data collection and processing in these key nodes, to improve the reporting and monitoring of volumes, and price trends.
- With regards to fish landing nodes, there is an urgent need for cost-effectively improving the storage capacities, the ice supplies, provision of sheds for protection from the sun, energy supply, and the general working conditions for all the actors gathered in those key places. This should be done through co-design with key stakeholders (e.g., BMU or VFCs, auctioneers, local authorities, and district officers). Key criteria for success will be positive impacts on sustainability of the sub-chain and the livelihoods of actors.
- The processing facilities should be improved to increase their efficiency and decrease firewood consumption.
- Waste management should be explored, including the collection and valorisation of cooking oil.

Regarding the market trends and social issues:

- Much greater attention is needed to understand the relationship between food and nutrition security and finfish fisheries in coastal communities and nationally to inform decision-making processes. This should include:
- Monitoring fish price trends, and finfish consumption patterns to assess the on-going contribution of the sub-chain to food and nutrition security.

Regarding the primary sector, and the environmental issues:

- An evaluation of costs/benefits for various fishing technologies to enable fishing capacities to be strengthened in a sustainable manner. For example, the expansion of ring-netters may constitute a threat for overexploitation or disbalance in the chain, the expansion of fiberglass motorized vessels, and any initiative to promote the use of Fish Aggregating Devices (FAD).
- Attention should be paid to promoting initiatives aimed at preserving and valuing (or secondarily, restoring) critical ecosystems and biodiversity hotspots, such as reefs and mangroves in fair and just ways.
- Alternative Income-Generating Activity (AIGA) should be jointly explored with fishing community stakeholders and building on lessons from previous initiatives to reduce the pressure on exploited stocks.
- Upgrading the efficiency of the fishing vessels to reduce the FUI.

For the Octopus sub-chains in Mainland and in Zanzibar

This sub-chain provides a significant contribution to the local economic growth in some coastal areas. In MLT, it represents a contribution to foreign currencies as it is an export product. In ZNZ, it is also important, through the tourist market. Women – particularly as foot fishers -play an important role in the primary sector, but there are threats to this role because of the growing number of male diver fishers. The closure periods, promoted by Non-Governmental Organization (NGOs), but being acknowledged to varying degrees by local communities, are very promising initiatives to sustainably manage the resource. In ZNZ, closures take place within MPAs.

- Consider how this closure system could be expanded to other reefs, but with an area-specific approach that ensures that local women are central in decision-making and that inclusiveness is considered throughout the chain. Fishing zones per category of fishers (divers of foot fishers) should be defined and separated.
- Any expansion of the closure system to other reefs should be associated with effective monitoring and evaluation of the catches, the numbers of fishers, and the outcomes in terms of winners and losers.

In MLT, compared to the other sub-chains, the Octopus value chain appears inefficient in terms of environmental performance, due to the high FUI.

- Upgrade the efficiency of the fishing vessels to reduce the FUI.
- Together with a more capillary and efficient cold chain system, these measures could lead also to the improved environmental performance of the fishing activity, allowing the exploitation of reefs that are closer but less served by ancillary services.
- Emphasis should be placed on participatory development and effective implementation of the Octopus fishery Management plan

In MLT, this sub-chain creates employment in the formal sector, mainly through processing factories in urban centres. This is not the case for ZNZ, because of the absence of processing plants.

- Improved sustainability of the products could be further explored and promoted through labels, and an effective traceability system from fisher to end-users, including EU consumers.
- Promotion of investment in Cold Chain Development (CCD) has great potential for transforming this sub-chain.

For the Mainland Prawn sub-chain

This sub-chain looks minor in terms of volumes and contribution to the coastal economic growth. However, the number of artisanal fishers is very significant, and this activity seems to generate quite a significant additional income to fishers for 5-6 months. The natural resource has been threatened, but the Prawn management plan (under discussion, URT 2021) may be a great opportunity if it is implemented correctly. In addition, this chain engages artisanal fishers and industrial players to provide for export markets and tourist markets looking for a high-quality product. This involves a cost-effective cold chain to be assured from the fishers to the end-users.

The Management plan could constitute a great opportunity to have this sub-chain to become emblematic, providing income to local communities for an export market in the future. The vision would be that: all actors of the chain are secured, there would be better management of stocks and the number of fishers, the working conditions for fishers are improved, traceability more detailed, and the management of the logistics towards the end markets improved to maintain quality for export or local tourist markets.

- Ensure the Prawn management plan when fully finalized has adequate means to be implemented.
- Continue to explore and support certification such as Marine Stewardship Council (MSC) or Fair Trade but ensure all the relevant stakeholders are included in the process.

1. INTRODUCTION

1.1. Background and context of the Value Chain Analysis (VCA)

The EU launched an initiative called "Support governance of global food & nutrition security to build resilience" under which it performs value chains (VC) analyses using the Value Chain Analysis for Development (VCA4D) methodological framework. *VCA4D responds to the need for quantitative and qualitative data and specific indicators, with the objective of supporting the VC and policy actors in their decision-making. The VCA4D approach has been mobilized at the request of the EU Delegation (EUD) in Tanzania for the value chain of coastal fisheries, to support the Government of Tanzania, Mainland Tanzania (MLT) and Zanzibar (ZNZ), in their elaboration and implementation of a Blue Economy Strategy, including the fisheries sector.*

In March 2020, ZNZ launched its Vision 2020-2050 on Blue Economy based upon key sectors and prioritization of its economy: fisheries (coastal and deep-sea fisheries), aquaculture, tourism, maritime trade and infrastructure energy, and governance (Captain Hamad, Nov. 8, 2021, oral presentation), while MLT is still in the process of developing its own Blue Economy strategy.

In MLT, the fisheries (ocean and inland waters) sector is reported to contribute 1.71% of the GDP in 2020, employing more than 200,000 full-time people (URTMLF, 2020, Annual Fisheries Statistics Report, Dodoma). Estimated at 85,000 tons/year, the marine coastal fisheries only represent 21% of the total production of fisheries in both MLT and ZNZ (Linton, 2021). Yet, it is identified as a major sector on a regional basis. In ZNZ, it contributes more than 4% of the ZNZ GDP, and in coastal districts of ML, it makes a major contribution to the livelihoods of coastal communities and the local economy. The sector of coastal fisheries is essential for the deployment of the Blue Economy strategy of Tanzania. However, coastal fisheries are very vulnerable if no adequate measures are in place to ensure sustainable management of the marine natural bioresources and anticipate the effects of climate change on fisheries-dependant coastal communities (Barange et al. 2018).

This critical background has prompted the decision for a VCA4D analysis for coastal fisheries VC in Tanzania, to provide the EU delegation in Tanzania and decision-makers in both MLT and ZNZ with a detailed VC analysis, considering the economic, social, and environmental dimensions of sustainable and inclusive development.

A scoping mission was completed in April 2021 by Agrinatura to provide a preliminary understanding of the coastal fisheries' value chains in view of future actions. It pre-identified 5 sub-chains (small pelagic, large pelagic, reef fish, octopus, and prawn) and their potential contribution to growth, inclusiveness, and sustainability. Terms of Reference were defined to conduct a full-fledged VCA4D study to deepen the understanding of the Tanzanian coastal fisheries sector from a multidisciplinary perspective and to have a reference to develop Blue Economy actions to contribute to Tanzania's National Development Plan objectives of creating job opportunities and fostering inclusive and sustainable economic growth.

The future EU supported Blue Economy for Sustainable Transformation (BEST) program will fund support interventions on the coastal marine fisheries VC of Tanzania – both MLT and ZNZ - to cover the topics of: 1) sustainable management of coastal ecosystems and 2) the productive use of the marine and coastal ecosystems and targeted inland waters. It will particularly focus on those activities that can ensure a sustainable transformation of the local economy, targeting women and youth.

The findings, conclusions and recommendations of this VCA4D analysis are intended to be used within the BEST scope of deployment of EU interventions, but will hopefully feed in to the dialogue and deliberations of the BE decision-makers in MLT and in ZNZ.

1.2. General background to the study process

Extensive secondary data compilation and bibliographic review have been implemented since the study started and have been used for the purpose of the VCA4D. A first field trip was conducted from November 4th-20th, 2021 with a follow-up in January 2022 by the environmental expert. A second field trip was conducted by the whole team, in May 2022, to finalize the collection of primary data (mainly in ZNZ) and discuss the preliminary findings with key stakeholders. The agenda and list of people met during the field trips are attached in Appendix 1. Primary data were collected by the experts during these trips. Additional primary data were collected through the support of the VCA4D Tanzania national expert Yahya Mgawe as well as the ZNZ expert Dr Narriman Jiddawi.

IMAGE 1 BOAT BEING BUILT, NUNGWI LANDING SITE, UNGUJA (MAY, 2022. CREDIT: A. MARTINI)

2. FUNCTIONAL ANALYSIS

2.1. General description of the productive systems

2.1.1 Geographic and demographic context

The objective of the study is to analyse the growth, inclusiveness, and social and environmental sustainability of the marine coastal fishery sector in the United Republic of Tanzania (URT), both Mainland Tanzania (MLT) and the Zanzibar archipelago (ZNZ). The country has a coastline of about 2,300 km[1] representing both important ecological and economic resources (Gustavson et al, 2009). The coastline extends approximately 1,424 km from a north-south direction from the border with Kenya in the north to Mozambique in the south. There are also numerous small near-shore islands and one oceanic island, Latham Island (Figure 2.1). About two-thirds of the coastline has fringing reefs often close to the shoreline broken by river outlets. URT´s coastal marine ecosystems are found in five coastal regions (Tanga, Coast, Dar es Salaam, Lindi, and Mtwara) of the MLT and the semi-autonomous archipelago state ZNZ, comprised of two main islands: Pemba (with its coastal administrative regions Pemba North and Pemba South) and Unguja (with its coastal administrative regions Unguja North, Unguja South, and Unguja West). Mafia Island is part of the MLT. In 2012, the population of the 16 MLT coastal districts/ municipalities was 6.6 million, and that of ZNZ amounted to 1.3 million (URT, 2013).

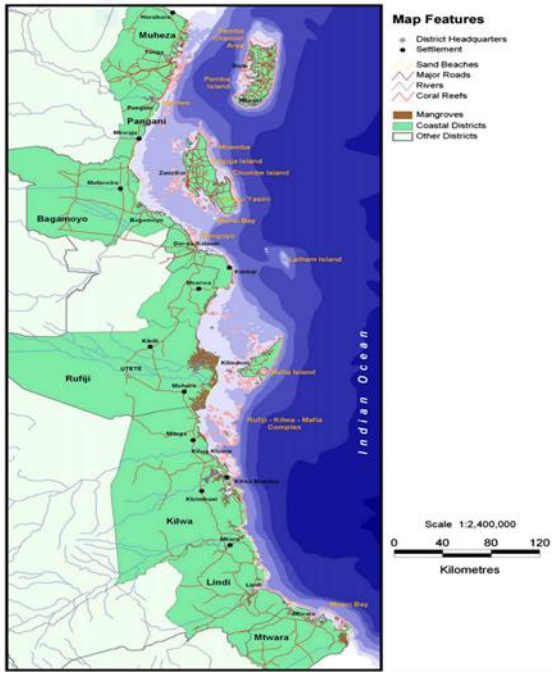


FIGURE 2.1 THE COASTAL ZONE OF TANZANIA (GUSTAVSON ET AL., 2009)

2.1.2 Political and economic context

The URT consists of the MLT and the semi-autonomous ZNZ archipelago. The Union is headed by a President, who is also the head of Government, and its legislative body is the National Assembly (Parliament). ZNZ has the specific status: although part of the Union, exercises considerable autonomy and has its own government with a President, court system, and legislature.

According to the National Bank Tanzania annual report, which consolidates macroeconomic data for MLT and ZNZ (Bank of Tanzania, 2020), the URT economy has continued to be among the fastest-growing economies in sub-Saharan Africa.

In 2019, the economy performed strongly with a real Gross Domestic Product (GDP) growth of 7.0%, the same as in 2018 (Figure 2.2). Agricultural activity accounted for the largest share of GDP at 26.5%. In nominal terms, GDP was TZS 139.9 trillion in 2019, increasing from TZS 129.0 trillion in 2018. Income per capita increased to TZS 2,502,986.6 (1,088 USD) from TZS 2,452,405.8 (1,066 USD) during the same period. Following this good economic performance over the years, the World Bank announced the URT to be a low-medium-income economy in July 2020, a target that was planned to be attained in 2025. Headline inflation remained subdued, below the country medium-term target of 5.0%. This was largely due to the stability of the exchange rate.

[1] The MLT coast is approximately 1,425 km.

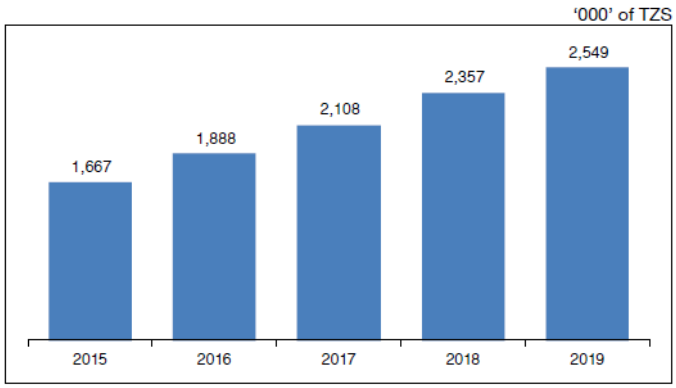


FIGURE 2.2 NOMINAL GDP PER CAPITA IN MLT
(Bank of Tanzania annual report 2019/20, data from the Office of the Chief Government Statistician)

The ZNZ economy has also continued to record strong performance with real GDP growth of 7.0% in 2019, compared with 7.1% in 2018. Nominal GDP increased to TZS 4,132.0 billion in 2019 from TZS 3,663.0 billion in 2018. GDP Per capita increased by 8.2% to TZS 2.5 million in 2019. Inflation averaged 3.8% in 2019-2020, slightly above 3.3% in 2018-2019, driven by food inflation which averaged 5.3%, higher than 2.6% in 2018-2019 following an increase in the prices of major food items.

2.1.3 Coastal fisheries context in Tanzania

Fishing in the URT is an important source of income and nutrition (COLEACP, 2022). A quarter of the Tanzanian population (estimated total population of 60 million people in 2020) depends on coastal resources or inland lakes for their livelihoods[2]. Annual fish consumption is 7.6 kg/person on average between 2016 and 2019 (URTMLF, 2019). The sector (freshwater and marine) directly employed nearly 202,000 people in 2019 as fishermen and supported more than 4 million people engaged in the fisheries value chain (processing, trade, fish transport, net making and boat building). The Tanzanian fisheries sector plays an important role in social development and contributes to the country's economy. It's contribution to the national GDP was estimated at 1.7% in 2020 (out of the total contribution of 26.9% by agriculture) according to the National Sample Census of Agriculture 2019-2020 report[3].

In Tanzania, the fisheries sector can be divided into inland fishing and freshwater aquaculture, and marine fishing and mariculture. The dominant type of fishing is inland fishing with a contribution reaching at least 85% of national fish production volume. Marine fisheries contribute 10–15% to national fish production volume, while marine aquaculture (e.g., algae production) is negligible when compared to the total national production.

Tanzania has a territorial sea of about 64,000 km², an Exclusive Economic Zone (EEZ) extending to 200 Nautical miles (NM) (370.4 km) from the shoreline and covering an area of 223,000 km². The waters of marine fishing also include those of the main islands (ZNZ archipelago, and Mafia) and the offshore waters. Although there is a long coastline, most fishing activities are restricted to several geographically limited areas (approximately 30,000 km²) due to a narrow continental shelf at a depth of less than 200 m (Silas et al., 2020). Important marine resources include coral reef fishes (rabbitfish, groupers, emperors, snappers, goatfish), lagoon, intertidal and sub-tidal species (including octopus, squid, and bivalves), large pelagic species (including tunas and tuna-like species), demersal species (including rays, catfish, and prawns), and the small and medium-sized pelagic species (anchovies, herrings, sardines, and mackerels). The artisanal sector is dominant in Tanzania, accounting for approximately 95% of all catches (Jiddawi and Ohman, 2002; URTMLF, 2021) and although these figures are relatively old, there has not been any significant development of a domestic semi-industrial, or industrial fishery since 2002 (Sekadende et al. 2020).

A key issue is the governance context in which these fisheries are operating. Within the union framework, MLT and ZNZ have the full mandate for the management of their respective marine fisheries located in their territorial waters (12 NM) and internal waters (the waters extending out from their respective territorial waters to the equidistance line between the MLT and ZNZ) (Breuil and Bodiguel, 2015). Fisheries operating in the territorial and internal waters of MLT are monitored by the various divisions under the Permanent Secretary

[2] The United Republic of Tanzania Ministry of Livestock and Fisheries (2019). Livestock and Fisheries Commodity Value Chain Briefs.
[3] The United Republic of Tanzania (2021). National Sample Census of Agriculture 2019/20. National Report. August 2021.

for the Fisheries Sector of the Ministry of Livestock and Fisheries of MLT[4] and those in ZNZ by the Department of Fisheries Development (DFD) in the Ministry of the Blue Economy and Fisheries, ZNZ[5].

Fisheries policy on the MLT is guided by the National Fisheries Policy (URT, 2015) and in ZNZ, by the ZNZ Fisheries policy (RGoZ, 2014), as highlighted in the ZNZ Blue economy Policy of 2020 (RGoZ, 2020). There is currently no institutional mechanism to support collaboration between the authorities that manage shared stocks of coastal fisheries, such as small pelagic, although such a mechanism, the Deep-Sea Fishing Authority (DSFA), exists for the offshore tuna fisheries (Breuil and Bodiguel, 2015).

Coastal fisheries make a far greater relative contribution in terms of GDP, employment, and livelihood in ZNZ than in the MLT. According to the Ministry of the Blue Economy (RGoZ, 2020), in ZNZ the sector contributed 4.8% to GDP in 2019, representing a 0.4% decrease from 2018. Marine fishes provide over 90% of the animal protein requirements in ZNZ. Based on a population of nearly 1.6 million people, the annual per capita consumption of fish is about 22 kg/year (OCGS,2019) compared with per capita red meat consumption of only 3-4 kg/year (Feidi, 2005).

A previous scoping study (Linton, 2021), building on the work of the World Bank Study (Sofreco, 2018) and others, identified five coastal fisheries sub-chains (small pelagic, large pelagic, reef fish, octopus, and prawns). All five of the coastal fisheries sub-chains are found in the MLT and all but prawns in ZNZ. Some of the coastal marine organisms may migrate between the MLT and ZNZ (mostly pelagic fish and to a lesser extent reef fish), while others are specific to a particular geographical location (octopus and prawns). Some fishers also migrate between these sub-systems on a temporary or permanent basis. In some cases, the main markets are the same for both ZNZ and the MLT (e.g., dried anchovies and anchovy-like species to Democratic Republic of the Congo and other regional markets, such as Rwanda, Burundi, Malawi, and Kenya; and it is likely some other species are illegally traded into regional markets). On the other hand, other end-products find their niche in specific markets (e.g., octopus from ZNZ for the touristic sector and that from the MLT for the EU market).

Based on the above, our functional analysis identified two linked coastal marine systems – MLT and ZNZ- each of which has several sub-chains (Table 2.1 and 2.2; Figures 2.3). Some of these sub-chains have strong links between the two systems, while other links are weak or non-existent.

Our main reference year for the value chain analysis is 2019, but it depends on the availability of information and the nature of the analysis. For example, we used data from the University of British Columbia's research initiative "Sea Around Us" to illustrate unreported catches which was updated to 2018. In addition, most of the primary data collected through semi-structured interviews with fishers, processors, and traders/agents is based on their recall, as these actors do not keep records of, for example, catch volumes, or costs for materials and fuels. Therefore, these types of data may not specifically refer to our reference year but represent the average values in recent years.

The sub-value chains analysed in this study are the following:

- Small pelagic (anchovies and anchovy-like species);
- Finfish (medium and large pelagic, reef fish);
- Octopus;
- Prawns (only for the MLT, as in ZNZ prawns' fishery is not conducted systematically, because the environmental conditions, e.g. no major river runoffs as in MLT, do not allow for the establishment of large prawns populations.

2.1.4 Production trends related to the sub-value chains investigated

The availability of data on fishery production for URT coastal fisheries is quite extensive (FAO, National Statistical Reports and Frame Surveys). However, data from different sources appear to be inconsistent (see, for example, data presented in Breuil and Bodiguel, 2015 and FAO stats). This problem is also recognized by the same officers who are responsible for producing the statistical reports for fisheries. The difficulties lie in

[4] District Councils and Municipal Councils are responsible for implementation and enforcement of national policies and legislation.
[5] Regional and district agencies are involved in planning and implementation of government policy.

data collection, which is often based on a few landing sites and is sometimes fragmentary, due to the lack of (human and financial) resources. Illegal, unreported, and unregulated (IUU) fishing activities represent a further challenge to having a clear idea of the state of exploitation of marine resources in the URT. For this section, data on the catch volumes (production trends) for the different sub-value chains analysed in this study, for both MLT and ZNZ, were retrieved from the FAO application FishStat, updated to 2019. FAO data were then corrected by applying a coefficient equal to +30%, according to White et al. (2020) and the University of British Columbia's research initiative "Sea Around Us" (SAU, seaaroundus.org), to account for unreported data (Figure 2.3 A-B). Unreported data consists of the reconstructed domestic catch, which was estimated from non-fisheries sources, including household- and/or nutritional surveys, unofficial documents, national reports, and non-fishery related publications (Jacquet et al., 2010).

For ZNZ, FAO does not provide information on the production of octopus, but this sub-value chain is in fact present. For 2017-2019, FAO data were complemented with octopus catch data from DFD (Department of Fisheries Development), Ministry of Agriculture, Natural resources, Livestock and Fisheries (2019).

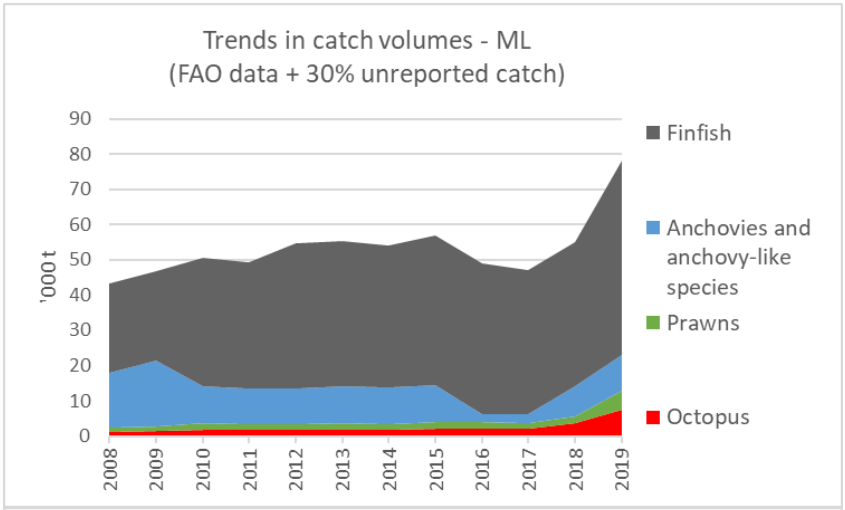
MLT fisheries' production shows an overall increasing trend over the period 2008-2019, with a slight reduction during 2015-2017 (Figure 2.3A). The finfish sub-value chain appears to be the most productive sector in terms of catch quantities. The reduction in catch volumes mainly affects the sub-value chains of finfish and anchovies and anchovy-like species. On the other hand, the catch trend reported for ZNZ (Figure 2.3B) for anchovies and anchovy-like species appears fairly stable, while for the finfish value-chain a marked increasing trend is observed.

Despite the overall increasing production trend of the marine coastal fishery sector of the URT, Silas et al. (2020) noted a long-term trend of reduction of fish landings (~50%) in terms of both catch per vessel and catch per fisher from 1984 to 2016 (Figure 2.3C).

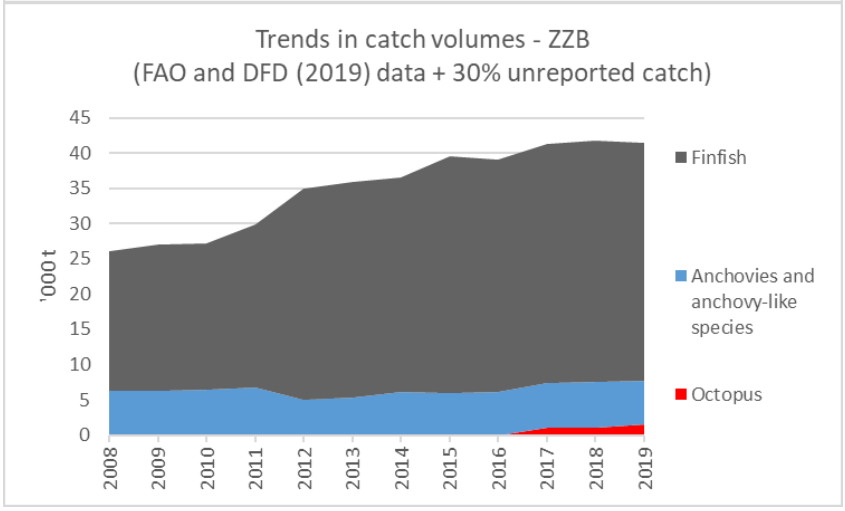
Important note: the production level reported for 2019 in Figures 2.3A-B represents the officially available FAO data (corrected + 30%) and the starting point of our analysis. However, during missions and interviews with officers from the statistics department, interviews with fishers, and based on the quantitative analyses, the authors believe that the official values (gathered from FishStat, FAO) underestimate the actual situation of the production. For this reason, by combining official data, primary and secondary data (e.g., official statistical reports about the fisheries sector in MLT and ZNZ produced by the relevant ministerial departments – which slightly differ from the FAO data), the production values used in this study are shown in Tables 2.1 and 2.2 and are, in our opinion, closer to reality than the official (FAO and URT's) ones.

Image 2 Fishers sailing to the fishing grounds (Nov. 2021, between Kiwinje and Songo Songo, credit: R. le Gouvello)

A



B



C

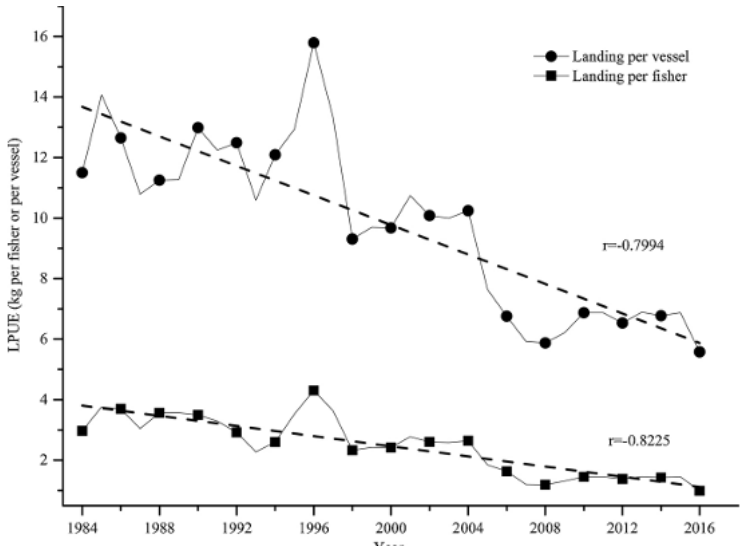


FIGURE 2.3 A-B) PRODUCTION TRENDS OF THE SUB-VALUE-CHAINS IN MLT (A) AND ZNZ (B).
Authors' elaboration from FAO FishStat data corrected using the approach of White et al. 2020. C) Time series of fish LPUE (landings per unit effort) in the artisanal fisheries of Tanzania from 1984 to 2016. From Silas et al. (2020).

The estimates of the production volumes, value and fishers associated with the sub-value chains are given in Table 2.1 and 2.2, for MLT and ZNZ, respectively. These estimates of actual potential volumes in 2019 are those which the economic and environmental analyses rely on unless otherwise stated. As mentioned, these estimates are based upon the cross-checks and comparisons among different sources, formal and informal information, and our computations.

As summarized in Tables 2.1 and 2.2, in 2019, the total production estimated for MLT equals 66,882 t (small pelagic, finfish, octopus and prawns), and the number of fishers amounts to 18,128-28,406, resulting in a Catch Per Unit Effort (CPUE) of about 3-4 t/year/fisher. Regarding ZNZ, the total production seems to reach 69,619 t (small pelagic, finfish and octopus) in the reference year, and the number of fishers equals 24,573-34,925. This results in a CPUE of 2-3 t/year/fisher. Although in agreement with the work of Silas et al. (2020), the calculation of the CPUE based on the total production and the total number of fishers involved in the marine coastal fisheries might not represent the real situation, given that there are profound differences among the sub-value chains analysed in terms of catch volumes and crew members per fishing unit according to the target species. Unfortunately, with the available information it is not possible to estimate the CPUE for the different sub-value chains analyses given the lack of value-chain-specific information on the number of fishers involved, especially for ZNZ.

However, the observation that the CPUE (fisher or fishing unit) is decreasing seems to be consistent among different sources (literature, interviews with the main stakeholders, such as fishers). A closer look at this topic, together with information on the stocks' status, is given in Section 6.4.3.

MLTT– (2018) 2019 data	Official production volumes (t)[a]	Value (MTZS)[a]	Numbers of fishers associated with the VC[b]	VCA4D estimates			
				Estimated actual production volumes (t)[c]	Estimated production value in MTZS[d]	Estimated number of FTE fishers associated with the VC[e]	Estimated number of fishers associated to units in the VC[f]
Small Pelagic (included anchovies)	8,054	**40,269**	11,288	15,000	**53,057**	1,256	2,400
Finfish (except small pelagic)	31,102	**155,505**	24,545	45,332	**352,755**	22,231	7,345
Octopus	3,856	**19,278**	4,541	4,250	**65,606**	3,396	6,586
Prawns	694	**3,472**	3,811	2,300	**31,983**	1,523	1,796
Total	**43,706**	**218,524**	**44,185***	**66,882**	**503,401**	**28,406**	**18,128**

TABLE 2.1 OVERVIEW OF THE MAIN INDICATORS OF THE SUB-VALUE CHAINS INCLUDED IN THE STUDY – MLT
(Team elaboration)

** This is the number of fishers associated to the analysed sub-value chains under study given by the official statistics. The total number of fishers in MLTT, as reported in the same Annual Fisheries Statistic Report 2020, amounts to 53,053.*
[a] Derived from tables 25 and 26 of the Annual Fisheries Statistics Report, URT, Ministry of Livestock and Fisheries, 2020
[b] Marine Fisheries Frame Survey 2018 Report - MLT
[c] Based upon SeaAroundUs (+30% of the FAO reported volumes) and estimated volumes according to exports figures and number of units.
[d] Estimations from the VCAD analysis as final results.
[e] Estimations from the VCA4D analysis – The number of fishers if calculated as a retro-calculation, in Full Time Equivalent (FTE) jobs, mainly based upon total Wages divided by the Annual minimal wage. Please note that in this VCA4D study, each fisher is assigned to one sub-value chain. Seasonal fishers are not accounted through the use of FTE indicator but could be deduced. For instance, the total number of FTE in prawn fisheries could be multiplied by two, as the activity is only on 5-6 months. In addition, the VCA4D study did not include other fisheries, such as shellfish, squids, lobsters, rays, sharks, where significant numbers could be recorded. These facts could explain the gap between the official fishers' number from the Frame surveys and the VCA4D counts. Similar explanations could be given for ZNZ to explain such a gap between official fishers' numbers and the VCA4D counts.
[f] In these estimates, the VCA4D takes into account the number of fishing units (which was adjusted according to the Frame Survey), multiplied by the number of fishers associated to this unit. For instance, a purse seiner unit is associated to an average of 16 crew members. Again, a gap is seen between these numbers and the frame survey records, which may be related to the extreme variability of the number of crew members per unit (sometimes up to 60 people for some ringnetters) or foot fishers, occasional fishers, etc.

ZNZ -2019 data	Official production volumes (t)[a]	Value (MTZS)[a]	Numbers of fishers associated with the VC[a]	VCA4D estimates			
				Estimated actual production volumes (t)[b]	Estimated production value in MTZS[c]	Estimated number of FTE fishers associated with the VC[d]	Estimated number of fishers associated to units in the VC[e]
Small Pelagic - Anchovies	5,445	**24,498**	N/A	36,200	**84,128**	2,613	6,657
Finfish (except small pelagic, anchovy)	24,454	**127,626**	N/A	31,980	**267,269**	31,283	16,569
Octopus (and squid)*	1,107	**7,019**	N/A	1,439	**21,142**	1,029	1,346
Total	**31,006**	**159,143**	**50,218****	**69,619**	**372,539**	**34,925**	**24,572**

TABLE 2.2 OVERVIEW OF THE MAIN INDICATORS OF THE SUB-VALUE CHAINS INCLUDED IN THE STUDY – ZNZ
(Team elaboration)

**Octopus and squid catches are not present in the FAO stats for ZNZ*
*** This value represents the total number of fishers reported in the official statistics. It accounts also for other fisheries not taken into consideration in the current study (e.g., rays, shark, shellfish, squid, lobsters). Unlike the MLT official statistics, ZNZ Frame Surveys do not give details on the number of fishers associated to a specific fishery.*
[a] *Fisheries Data, Ministry of Agriculture, Natural Resources, Livestock and Fisheries (ZNZ)-2019 Fisheries Frame Survey in ZNZ (2020) (MTZS=million TZS)*
[b] *Based upon SeaAroundUs (+30% of the FAO reported volumes) and estimated volumes according to exports figures and number of units.*
[c] *Estimations from the VCAD analysis as final results.*
[d] *Estimations from the VCA4D analysis – The number of fishers if calculated as a retro-calculation, in FTE, mainly based upon total Wages divided by the minimal wage. Please note that in this VCA4D study, each fisher is assigned to one sub-value chain. Seasonal fishers are not accounted through the use of FTE but could be deduced. The VCA4D study did not include other fisheries, such as shellfish, squids, lobsters, rays, sharks, where significant numbers could be recorded (e.g., more than 14,000 foot fishers in ZNZ). These facts could explain the gap between the official fishers' number from the Frame surveys and the VCA4D counts.*
[e] *In these estimates, the VCA4D takes into account the number of fishing units (which was adjusted according to the Frame Survey), multiplied for the number of fishers associated to this unit. For instance, a purse seiner unit is associated to an average of 16 crew members. Again, a gap is seen between these numbers and the frame survey records, which may be related to the extreme variability of the number of crew members per unit (sometimes up to 60 people for some ringnetters) or foot fishers, occasional fishers, etc.*

2.1.5 Infrastructure, logistics and facilities

2.1.5.1. Landing areas and auctions places

The fishing vessels land their catches at the landing sites, 274 in MLT (URTMLF, 2020) and 235 in ZNZ (MBEFZ,2020). These landing sites are supervised by district fisheries officers and local authorities: the Beach Management Unit (BMU) system in MLT, and the Village Fisheries Committee (VFC) in ZNZ.

The primary seafood trading is carried out at the auction places, or directly at the landing areas from the fishing vessels to some categories of buyers. The number of auction places in ZNZ is higher than in the MLT (128, e.g., 54.4% of the landing sites). The MLT Frame Survey states that 174 out of the 274 landing sites have a BMU (which we can suppose it means also an auction, i.e., 63% of the landing sites. Apart from the anchovy sub-chain, and some part of the octopus/prawn sub-chain, most of the landed fish (70%, Mgawe personal communication) will transit through these auction places. In ZNZ, this percentage is likely to be lower, because of the high volumes of small pelagic, directly entering the processing stages, and the short supply chains established with the tourist consumers. Auction places are very active for the finfish sub-chains, based on our observations during fieldwork. Immediate local consumption is organized in those landing areas, particularly with women offering fried or boiled portions of fish, which are consumed by the people working in these landing areas (fishers, traders, providers).

Although most of the auction places are very rudimentary in terms of facilities (no cooling and no freezing capacities, no waste management, poor sanitary conditions), they represent local nodes and play a key role. In fact, the auctions, where they are present, are the first point for data collection of seafood landings, data that are used as the basis for compiling the national frame surveys and annual reports in both MLT and ZNZ.

2.1.5.2. Secondary trading - Urban markets

After the first trading around the landing sites, the seafood is transported (small trucks, bicycles, scooters) to secondary centres, to the surrounding villages, and to urban centres, for a second trading, also involving artisanal processors (freezers) and retail-friers. Here, some seafood is also bought and consumed by local customers. The use of ice at this stage is little.

At the small, secondary urban centres, the seafood is then put in insulated boxes and reaches the large urban markets through the transport by means of trucks, cars, and boats (e.g., dhows), to large urban centres with insulated boxes. The destination urban markets are for example, the Ferry Fish Market (FFM) in Dar-Es-Salaam, and various major urban markets in and around ZNZ City. The transportation is handled as a service by providers, paid on the basis of the volume and distance transported (range of 250 to 1,000 TZS/kg).

In the Octopus and Prawn sub-chains in MLT, the processors may have their own buyers and transporters, strictly working with them, on a formal agreement basis, and operating from the landing areas to their processing facilities, around Dar-es-Salaam, or in Mafia (one) and Tanga (one).

In ZNZ, markets similar to the FFM, in terms of organization and acting as a trading and marketing central node, do not exist. However, various markets in ZNZ City may be playing different roles. For instance, O'Neill and Crona (2017) identified the Darajani market in Stone Town as the main central hub for imports/exports. Because of its location in Stone Town, Malindi may be better placed regarding transactions to hotels and restaurants.

Most of these urban markets in ZNZ lack adequate cooling facilities. They in fact operate as the rural auction places, but on a larger scale. To face these issues, a new Malindi market is being built with support from Japanese aid (JICA), and will be opened by the end of November 2022, following a design quite similar to the FFM. The new Malindi market will be provided with cooling and freezing facilities. However, its capacity seems limited and its location in Stone Town, in the heavily congested ferry area, which may create some inconvenience in the longer term.

BOX 1 THE FERRY FISH MARKET (FFM) IN DAR-ES-SALAAM

The central node of the Ferry Fish Market in Dar es Salaam is a key component of the MLT system, in which more than 12,000 t of frozen, fresh or chilled fish (including freshwater) per year are traded[1]. Many buyers, agents, artisanal processors (frying facilities provided) and retailers are operating here; about 1,000 people every day. Auctions are also taking place in the FFM, allowing data to be recorded on some (60% according to one officer) tonnages and marketing values to be officially transiting through the FFM, by species. Unfortunately, the origin of the seafood batches arriving at the FFM is not recorded.

The FFM was set up in the 1950's and the new structure was built in 2002 (Van Hoof and Kraan, 2017), including 8 zones: Zone 1: Auction Hall, Zone 2: Fish preparation area, Zone 3: Fresh fish retail, Zone 4: Cafeteria, Zone 5: Sea shells, vegetable, fruits and groceries, Zone 6: Fish fry stalls, Zone 7: Mixed product shops, Zone 8: Fish landing site nearby the beach. The Frying area (Zone 6) has been improved in 2015; the installation of frying stalls using LPG replaced the frying areas where frying was usually performed using firewood. This initiative was supported by the local government authorities and friers received, as financial help, one LPG cylinder to start their business, which they have to pay back as a stall rent. Traders have also to pay a stall rent to the FFM and are now paying the friers as a service.

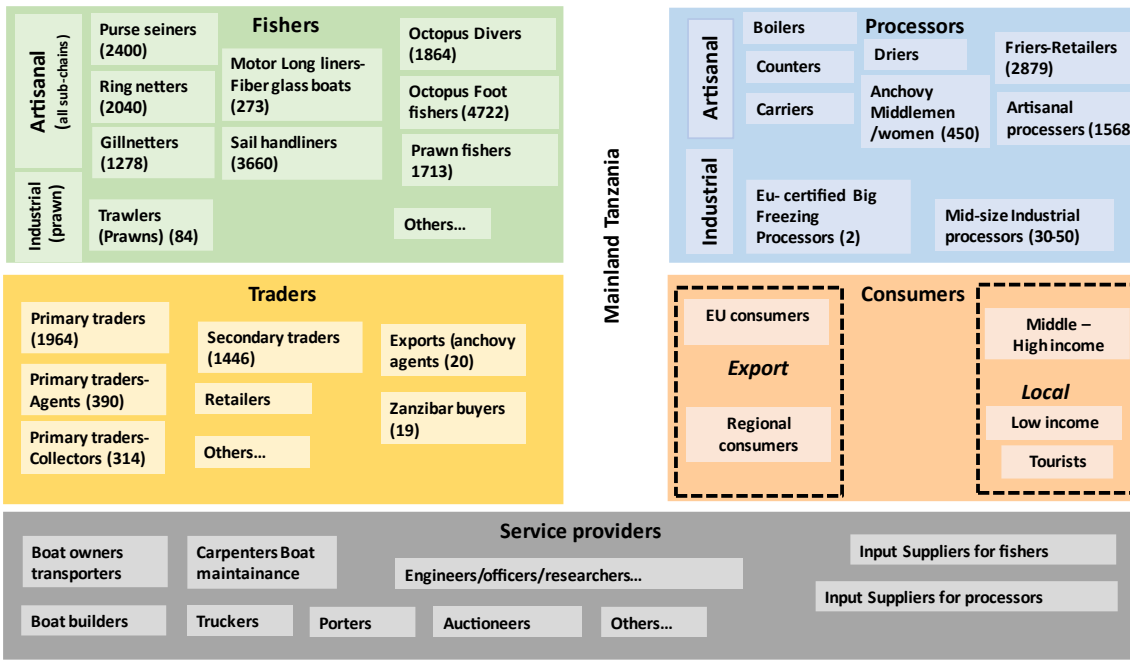
In 2019, more than 60 marine species were traded in the FFM, a total of 9,772 t of fresh marine seafood for a total value (auction price) of 26,188 MTZS, with a price range from less than 1,000 TZS to 11,000 TZS/kg. Among these marine finfish, the small pelagic category (anchovy-like, sardines) is clearly representing the highest volume (5,801 t for a value of 9,488 MTZS, e.g., 59% in weight and 36% in value of the total marine seafood (Figure).

Even though the FFM appears quite "well organized" as reported by Van Hoof and Kraan (2017), major improvements could be made in enhancing the facilities and the operations handled in the FFM, including more capacity building, improvement of the Cold Chain System, more support to the officers in charge.

2.1.6 Common typology of actors

The broad typology of actors used across all the sub-chains and for both the MLT and ZNZ is set out in Figure 2.4 and in Tables 2.3 and 2.4. Some actors vary with sub-chain and with the two regions. Specificities of these sub-chain-related actors are discussed in the following sections and in the appendices. Figure 2.4 is added to the following tables (Tables 2.3 and 2.4), providing detailed description and typology of the actors.

A



B

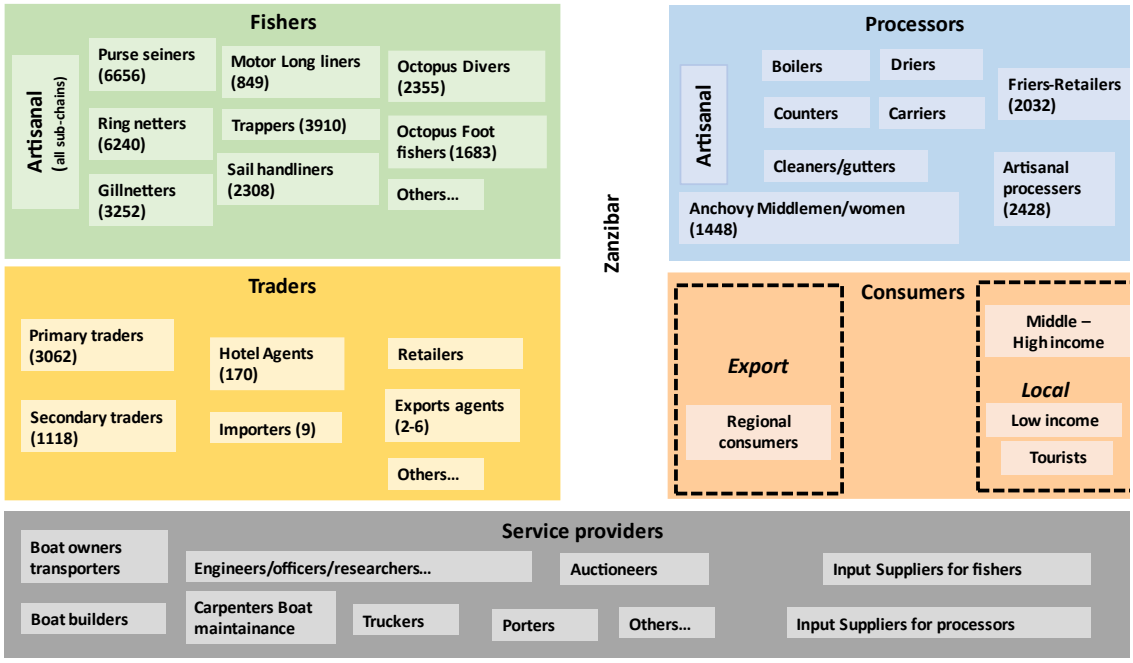


FIGURE 2.4 TYPOLOGY OF ACTORS OF THE VCA OF COASTAL FISHERIES IN A) MLT AND B) ZNZ
(Team elaboration)

Actors	Categories/ sector/number of actors (units*)		Production or processing system	Main species/ /Service	Men	Women
Fishers/ Producers						
Artisanal	MLT	ZNZ				
	68	208	Ringnet	Small and medium pelagics	x	
	1830	1154	Long and hand line (sail)	Large pelagics and reef fish	x	
	91	283	Long line (moto and fibre glass boat)	Large pelagics and reef fish	x	
	150	416	Purse seine	Small and medium pelagics	x	
	213	542	Gillnet	Reef fish, Pelagics,	x	
	1713	..	Small Gillnets	Prawns	x	
	4722	561	Foot fishers	Octopus	x	xx
	1864	785	Divers	Octopus	x	V.few
Industrial	3 units in MLT		Trawler	Prawn	x	
Traders						
Primary traders- Collectors	in MLT; 314		Independent, collecting form fishers, with transportation boats, boxes, provides supports to fishers	Mainly octopus and prawns	x	x
Primary traders	1964	3062	Buyers from local auctions		x	xx
Primary traders- Agents	in MLTT, 390		Buyers from local auctions, linked, commissioned to industrial processors	Medium-large pelagics, reef fish, octopus, prawns		
Secondary traders	1446	1118	Buyers in FFM and urban markets	All species	xx	x
Hotel agents	mainly in ZNZ, 170		Buyers for tourist hotels,			
Exports agents	20	2-6	Deals with regional African buyers, organizes the shipping from the processing areas to the foreign borders	Dried anchovy, octopus, prawns	x	
Importers	Based in ZNZ, 9		buys from Asia mainly	Frozen fish	x	
Traders	MLT to ZNZ (10-72)		Buys from MLT and sells in ZNZ	Mainly octopus and prawns	x	
Processors						
Artisanal						
Retailers- Friers	2879	2032	Frying and Sales to consumers on local markets.	All fish, octopus	x	xx
Middlemen-women	450	1448	Supervising various actions Boilers - Driers – Packers…	Dried Anchovy	xx	xx
Freezers (domestic)	1568	2428		All fish, octopus	x	x
Industrial Large	2	0	Freezing for high value markets EU certified, also sells. Only in MLT.	Large pelagic, Reef fish, Octopus, Prawns	x	
Medium	10-20	0	Non-EU certified, some pending for, also sales, .	Large pelagic, Reef fish, Octopus, Prawns	x	

TABLE 2.3 ACTORS COMMON TO ALL THE SUB-CHAINS AND FOR BOTH THE MLT AND ZNZ (TO BE CONTINUED)

(*unit refers to an operating unit (used in the economic and environmental analysis), for one category of actor. it could therefore be corresponding to one vessel and its crew, or one trader (mostly self-employed). But it also corresponds to one purse seiner (the lead vessel, the others, about 16 crew members), or one company (one industrial processor, the factory with all the employees).

Actors	Categories/ sector		Production or processing system	Main species/ /Service	Men	Women
Consumers						
	Local consumers		Low income	Mostly small and med pelagic, low value reef fish and large pelagic		
			Mid-high income consumers	Income level to be defined, all fish, octopus and prawns		
			Tourists (hotels, restaurants)	Mostly large reef fish, large pelagic, octopus and prawns		
	Export consumers		EU	Octopus and prawns		
			Regional	Octopus and prawns, dried anchovy		
Support Service providers**						
	669	774	Boat builders	Boat building	x	
	1215	1665	Gear repairers	Gear maintenance		
	ND	ND	Carpenters	Boat maintenance	x	
	ND	ND	Engineers	Boat engine maintenance	x	
	ND		Input suppliers	Provision of fishing equipment		
	ND			Provision of processing equipment		
	ND			Provision of processing materials e.g. firewood		
	174	256	Auctioneers	≥2 persons/auction**	x	
	509	1553	Carriers/ Porters		x	x
	2678	488	Transporters		x	
	9515	5007	Boat owners***			
Enabling environment/ Governance						
			District Fisheries Staff		x	
			Scientists, ministry officers		x	x

TABLE 2.4 (CONTINUES) ACTORS COMMON TO ALL THE SUB-CHAINS AND FOR BOTH THE MLT AND ZNZ

(*unit refers to an operating unit (used in the economic and environmental analysis), for one category of actor. it could therefore be corresponding to one vessel and its crew, or one trader (mostly self-employed). But it also corresponds to one purse seiner (the lead vessel, the others, about 16 crew members), or one company (one industrial processor, the factory with all the employees).

** from Frame surveys, 2020 in ZNZ (MBEFZ, 2020 ZNZ) and 2018 for MLT (URTML, 2018)

***deduced from fishing units (VCA4D) 1 fishing unit=1 boat owner at least.

2.1.6.1. Primary sector

Fishing in coastal fisheries is practiced through various fleets, of mostly wooden vessels, motorized or sail-paddle propelled, of various sizes, from 4 up to 20 m. More than 90% of the coastal fisheries are entering the FAO category of small-scale fisheries (URTMLF, 2021). Various fishing gears are used, among them the gillnets, and hand-liners, long-liners and small purse seines dominate. The development of purse seiners and the emergence of ring netters should be noted for their importance in small-medium pelagic (anchovies, sardines, mackerels) captures.

The category of octopus fishers (foot and divers) is rather well defined. More difficult is the exercise to relate fishing gears and vessels to targeted species of medium, large pelagic and reef fish fisheries which include many species. Most coastal fishing activities occur all year long and are mainly organized around the tide cycles, on the frequency of 15-20 trips at sea/month.

Octopus and prawn fisheries are subject to seasonal variations and restrictions. Most fishers are licensed (URTMLF, 2018), but a high variation is observed in the licensing of fishing vessels (71% not licensed in ZNZ, ZNZ Fisheries Frame Survey, 2020) and 42% in MLT, but with huge variations of this registration rate of fishing crafts in coastal areas, where it goes up to more than 90% (Marine Fisheries Frame Survey 2018 Report, Dodoma). There are no fishing harbour facilities in Tanzania.

BOX 2 BRIEF DESCRIPTION OF THE FISHING ACTIVITIES IN THE VARIOUS SUB-CHAINS

- **Small pelagic (anchovy and anchovy-like) fishery**: both in MLT and in ZNZ, the small pelagic fishery targets different species, mainly anchovies, sardines, and Indian mackerel. Small pelagic are fished by means of purse seines and, occasionally, ring nets. Small pelagic fishing is carried out by a small fleet: one main boat (called lead boat) and at least two auxiliary boats (dinghy boats). The lead boat is made of wood, is motorized (HP 40-60 engines) and, on average, are 10-12 metres long (but can be longer, up to 20 m). The dinghy boats are small 2-3 m non-motorized plywood boats. The crew aboard the dinghy is responsible for lighting target areas by using either pressure lamp or electrical bulbs generated by on-board generators. The light is essential in attracting phytoplankton and zooplankton that finally attract shoals of small pelagic. The shoal of small pelagic is then encircled by crew aboard the lead boat. Small pelagic fishing is mostly carried out at night and follows the lunar calendar. Monthly fishing days are about 15 days/month (up to 20 days/month according to some interviews). When landed, small pelagic are sold in buckets. Each bucket contains about 23 kg of fresh small pelagic. One lead boat lands about 21-24 buckets of small pelagic per working night.
- **Finfish fishery** (apart from anchovies and anchovy-like species): both in MLT and in ZNZ, finfish fishing is the most varied type of fishing, both in terms of target species and fishing methods. The species groups targeted are reef fish (e.g. snappers, groupers, rabbitfish, emperors, parrotfish), medium pelagics (e.g. carangids), and large pelagics (e.g., tuna, marlins, albacore, swordfish). The boats used are both wooden and fiberglass, ranging in size from 4 to 10 meters (with some up to 18 meters). Boats may or may not be motorized (engine HP variable, according to the type of vessel used; see Table 6.2 and 6.4, Section 6, for details). The fishing gears used are ring nets, gillnets, handlines and longlines. In ZNZ, the use of wooden traps (known as Dema) is also very common.
- **Octopus fishery**: both in MLT and in ZNZ, octopus fishing is carried out by foot fishers and divers. The main species targeted is *Octopus cyanea*. Fishers are often transported in groups with motorized fiberglass boats or non-motorized wooden boats (see Tables 6.1 and 6.3, Section 6, for details) to the coral reefs identified as fishing grounds. The foot fishers search for octopus along the reefs, generally during low tide, walking on the reef itself. Divers dive and search for octopus at greater depths. Both types of fishers use metal sticks to spear their prey. The use of spearguns is prohibited, although they are still used. The minimum harvestable size of octopus is 500 grams.
- **Prawn fishery**: prawns fishing is only carried out in MLT, mostly in Bagamoyo, Kisiju, and Rufiji (URTMLF, 2021). The fishing activity is performed with small wooden boats (dugout canoes and small planked boats, 4 meters, not motorized). The fishing gear used is the gillnet. Prawns fishing is carried out for about six months/year. The main species fished are *Paneus indicus* and *P. canaliculatus*.

2.1.6.2. Traders

Primary traders operate around the landing sites and in auction places when they exist. The percentage of women in this position seems to be significantly increasing both in MLT and in ZNZ.

Primary traders for octopus and prawns may also be collectors, acting independently or linked to the processors. These collectors may be transport-boat owners, providing a service to the fisher, under an

informal agreement for the octopus caught. They may also supply the fishers with ice, insulated boxes, and gears, accessories.

In the anchovy sub-chain, we identified the middlemen-women in the position of primary traders from the fishers, organizing then the processing of fresh anchovy to dried anchovy sold locally or to traders operating for an export of dried anchovy to the neighbouring countries.

Buyers from auctions are independent or linked to industrial processor by an informal agreement. The processors may supply them with ice, insulated boxes. They may organize the shipping to the Ferry Fish Market (FFM) or major urban markets in ZNZ, using truck and/or boat services. They may also start some processing steps on an artisanal scale, sometimes using domestic freezers, for a frozen sold product.

In MLT, secondary traders in the FFM dispatch their products (fresh, chilled, frozen, whole, or cut) among various buyers, retailers, retailer-friers (mostly women selling in the FFM and in the streets), and direct and indirect customers (tourist hotel, restaurants, supermarkets, local consumers). They may also sell their products to industrial processors, or, alternatively, they may purchase some products from the processors (primary data, May 2022).

In ZNZ, tourist-related traders are present through the whole finfish and octopus sub-chains. A main category is identified as the hotel buyers, secondary traders who operate with primary traders and organize the logistics with them up to the tourist hotels. However, shorter supply chains exist, with fishers or primary traders directly involved with neighbouring hotels (O'Neil and Crona, 2017; primary data May 2022).

2.1.6.3. Processors

There are two main categories of processors:

- the artisanal processors cover the categories of middlemen-women acting in the anchovy sub-chain operating in coastal areas. Other artisanal processors are acting in the finfish sub-chains and presumably in octopus, preparing the products, gutting, tendering (for octopus) and freezing in domestic facilities. Their costs are related to electricity, ice, handling labour and transportation. Other artisanal processors are represented by the friers. Most of them are also trading, buying from auctions, and selling to secondary markets. They may be in the position of competing with the industrial processors for the fish. As a result, when the prices are getting too high, their position becomes difficult.
- the industrial processors: strictly private, the industrial processors are only located in MLT. Two processing plants are based in coastal areas (Mafia, Tanga), and the others in Dar es Salam. Two company sizes are identified, the 2 major ones (more than 300 t) are certified for the exportations of frozen octopus and prawns to the EU. But they also sell to the regional market (Africa) and to the tourist (high quality) market and local market (supermarkets). Other mid-size industrial processors (20-100 t/y) (about 10-20) are not certified for EU export but are competing with the larger ones on all the markets, but EU. These actors have their buyers, sellers, transporters, service paid, commissioned or employees. The Tanzania Fish Processors Association (TIFPA) groups together large private seafood companies, such as Alpha Krust Ltd., Bahari Food Ltd., Tanpesca - Dar and Sea Products Ltd. Alpha Krust Ltd. and Tanpesca belongs to the same international seafood supplier, named 'Sea Food Alpha Group' (COLEACP, 2022). Tanzania Fish Processors Ltd. is located in Mwanza in Tanzania and is part of the Seafood Product Preparation and Packaging Industry.

An important processor and producer of frozen fish in Tanzania is Abajuko Seafood which will be certified for EU export. Two examples of producers/processors of frozen lobsters and crabs in Tanzania are Kasanda Enterprises Limited and the A/A Trading Company Limited. The main processor of seashells recorded for Tanzania is: Aqeel Traders Ltd. All of these establishments that are exporting seafood products are operated to international standards, including HACCP, and are compliant with EU hygiene rules. As well as complying with EU hygiene requirements, many of the establishments are certified to ISO 22000 BRC and other global standards certified on issues of food safety, hygiene standards (Ministry of Agriculture and Fisheries, 2016).

BOX 3 BRIEF DESCRIPTION OF CIRCULATING SEAFOOD PRODUCTS/COMMODITIES

Various kinds of seafood products are circulating in both the ZNZ and MLT systems, as follows:

- **Fresh fish and chilled fish (including cephalopods, prawns):** the products are landed from the fishing vessels, in the landing sites, no processing is occurring on-board. However, some fishing vessels may be equipped with insulated containers, and ice (e.g., longline fishers practicing trips at sea of more than 24 hours, (field data Nov. 2021). Fresh fish is landed on the shore on trays, baskets, and buckets. Carriers (or porters) are paid for doing this task, by traders (middlemen or fish mongers) or by fishers, boat owners, when transporting to the processing or auction place nearby. These fresh fish may be sold in local markets or kept for a few days in containers with ice. After landing, fish is stored in a variety of ways, but the greatest proportion of fish catch is sold directly and not stored at all (58%) (Van Hoof and Kraan, 2017). Local consumers consume them boiled, or fried. Friers and retailers are operating downstream this chain, selling fish whole or cut in pieces.

Part of the landed fish enter processing operations, and lead to final seafood products as follows:

- **Dried fish**: the traditional drying process is applied mainly to anchovies and anchovy-like species. However, all seafood can be dried, as this process compensates for the lack of an efficient Cold Chain System (CCS) for seafood preservation and subsequent domestic consumption. The drying process consists of placing the fish on tarpaulins place on the ground or in trays. Drying takes place under sunlight. Before this operation, fresh seafood (75% in MLT and 100% in ZNZ of the product intended to be dried) is boiled to inactivate enzymes and kill non-spore forming microorganism, and thus delaying spoilage, especially in the case of large catches or during the rainy season. In the MLT, one case of a drying process by means of an experimental device was observed. The drying usually takes place at the landing sites or close-by. Dried anchovy and anchovy-like species represent a clearly identified export regional market, as they are a highly requested export product for the Democratic Republic of the Congo, ("marine dagaa"). Dryers and boilers are in this anchovy case paid for this task by the anchovy fish middlemen (or -women), who trade, supervise the successive steps, and provide the boilers and driers with the required equipment.
- **Frozen fish:** this process applies to finfish (mostly large pelagic), cephalopods (octopus and squids), and prawns. Guts are removed, also the head in some cases for finfish and prawns. Freezing is then occurring followed by the final stages of packaging. The tasks are carried out in small artisanal facilities (using domestic freezers), sometimes at the beach, and in industrial processing plants (mostly in Dar es Salaam). Two of these industrial plants (based in Dar es Salaam) are EU certified, for exports to the EU, others are waiting for this authorization. Filets of finfish may also be prepared for the local tourism market.
- **Fried fish:** the frying process is mostly applied to small and medium pelagic. In the MLT, the central node of the seafood market is the FFM in Dar es Salaam. Here, part of the product is processed through frying. In the past (between the 1990s and 2000s), the fuel used for frying was firewood. Recently, the Local Government Authority (LGA), in agreement with the group of fryers at the FFM, has set up dedicated spaces for this activity (48 stalls). Nowadays, at the FFM, the use of firewood as fuel has been replaced by the use of LPG. In remote areas and other urban markets different from the FFM, the frying activity is still carried out using firewood. In ZNZ, frying using LPG was not observed at the time of the field missions. The cooking oil represents a significant cost for the friers. Friers are usually women (at least the majority) and operate both at the landing sites and around/at the markets and streets. Fried products are very popular, almost considered as a delicacy, sold in small amounts, in portions of 25-100 g, for about 200-1,000 TZS/portion, a price that makes it affordable. However, when translated into price/kg of fried seafood, the price of fried seafood turns out to be quite higher compared to the price range of other processed and fresh seafood (Tables 2.5 and 2.6).

Product/Price/Level	Sub-Chain	Anchovy-like & small pelagic	Finfish (medium-large pelagic, reef)			Octopus	Prawn
			Low value (FF1)	*Med value (FF2)*	*High value (FF3)*		
Landing price	Fresh	880	1,429	2,857	4,500	3,500-4,000	2,500 4,500
Primary trader	Fresh	1,333	1,625 3,000	6,000	5,125 8,000	7,000-7,100	9,000
Processor	Dried	4,700					
	Frozen		4,800 6,000	4,800	8,000 15,000	12,000-12,300 18,400 34,500	23,000 32,000
Secondary trader	Fresh	3,000	6,000	8,000	11,000	8,000	12,800
	Frozen			8,000	12,300	18,400	
Local end-user	Fresh	3,000	6,000	8,000	11,000		12,800
	Frozen		6,000	8,000	8,000		23,000
Retail-frier	Fried	10,000	16,000	17,000 21,500	21,250	18,000	
Tourist end-user	Fresh/Frozen			8,000 12,000	12,000 15,000	12,000 18,400	12,800 23,000
FOB price (export)	Dried	6,900					
	Frozen					18,400 34,500	32,000

Table 2.5 Ranges of selling prices in the coastal fisheries in MLT, among the actors of the sub-chains. sources: primary data; Sofreco, 2018; FFM sales statistics in 2019; Fisheries Annual report of 2020 URTMLF 2020. Prices are indicated in TZS/kg of sold product, in its final presentation (fresh, frozen, dried, fried)

Product/Price/Level	Sub-Chain	Anchovy-like & small pelagic	Finfish (medium-large pelagic, reef)			Octopus
			Low value (FF1)	*Med value (FF2)*	*High value (FF3)*	
Landing price	Fresh	615	2,857	4,500	6,000	5,000
Import price	Frozen		4,400	6,000	7,500	
Primary trader	Fresh	1,333	4,750	6,500	9,000	7,000
	Frozen		6,000		10,500	
Processor	Dried	4,502				
	Frozen		6,000	7,500		
Secondary trader/Hotel agent	Fresh	1,900		8,000	11,000	9,000
	Frozen				10,500	9,000
Local end-user	Fresh	1,900	6,000	7,500	11,000	9,000
	Frozen		6,000	7,500	10,500	9,000
Retail-frier	Fried	9,000	12,000-16,000	16,000-21,500		16,500-21,000
Tourist end-user	Fresh/Frozen			8,000	10,500	9,000-15,000
FOB price (export)	Dried	6,960				

Table 2.6 Ranges of selling prices in the coastal fisheries in ZNZ, among the actors of the sub-chains. sources: primary data; Sofreco, 2018; Fisheries Annual Report, MBEFZ 2020b. Prices are indicated in TZS/kg of sold product, in its final presentation (fresh, frozen, dried, fried)

2.1.6.4. Private support services

Immediate support services are provided in the proximity of landing sites, including auction services, boat construction and repair, the supply of accessories, the maintenance of engines. Most services providers and other suppliers are also based in urban centres.

According to the Ministry of the Blue Economy in ZNZ (RGoZ, 2020), the fisheries sector generates further 13,925 jobs in boat building, processing of marine products, import and export, market of fishing gear and boat building and repair (Feidi, 2005). It is estimated that the entire value chain of the coastal fisheries sector supports about 20% of ZNZ's population (Feidi, 2005), generating USD 50 million in demand from both the tourism and local channels (ZATI, 2010, SWIOFish, 2018).

The Frame Survey (MBEFZ, 2020a) conducted in ZNZ provides useful information and detailed estimates of the numbers of actors involved beside the primary producers (Table 2.7). Some of them are directly linked to the value chains (processors, traders), others represent the category of private support services, namely: Gear repair, Boat builder, Transporters, Porters, Food servers, others (for a total of 63,000 people). The Frame Survey (MBEFZ 2020) estimates that 12,782 people provide direct support to 50,218 fishers in ZNZ.

It is very difficult to compare these estimates to our own VCA4D estimates because the categorization of actors may be different, as well as the boundary of the actor systems (in terms of the degree of involvement). Furthermore, the frame survey is covering all types of fisheries, including those which are not in the scope of our work. However, according to this table, and our VCA4D definition[6], there about 6,497 people involved with the fishers, traders, and processors in ZNZ. This is about 13% of the fishers' number. If we apply this percentage to our own fishers' numbers (Table 2.7), it means that we have an estimate of 3,000-4,500 people of various support services encountered in the VCs that we studied in ZNZ.

Sn	Activities	Total	Male	Female	Female %
1	Processors	**2,312**	1,452	860	37%
2	Trader	**3,973**	3,227	746	19%
3	Gear Repair	**1,685**	1,685	0	0%
4	Boat builders	**774**	774	0	0%
5	Transporters	**488**	488	0	0%
6	Porters	**1,553**	804	749	48%
7	Food servers	**824**	293	531	64%
8	Other severs	**1,173**	249	924	79%
9	Fishers	**50,218**	43,080	7,138	14%
	Total	**63,000**	**52,052**	**10,948**	**17%**

TABLE 2.7 ESTIMATION OF THE NUMBERS AND MALE/FEMALE SHARES PER CATEGORIES OF PEOPLE, DIRECTLY OR AND INDIRECTLY INVOLVED WITH FISHERIES IN ZNZ
(source: MoBEF, 2020)

In MLT, the Frame survey of 2018 (URTMLF, 2018) provides useful information as reported below (Table 2.8). A similar approach as the one adopted for ZNZ suggests that about 1,500 to 2,500 are involved in the support services of the VCs explored in MLT.

[6] According to the VCA4D definition: direct actors involved in the value chain are those who own the product, at the stage where they operate in the value chain. Transporters and porters are independent, paid for their services, not owing the products, and therefore not entering the category of direct VC actors, but indirect actors.

Type of activities	Frame survey 2018 numbers	*Frame survey numbers and VCA4D counting*	VCA4D estimates
Fishers	53,035		18,128-28,406
Fish carriers	509		
Fish processors	5,232		4,820
Fish traders	9,178		6,382
		Direct VC non fisher actors: 14,919	11,202
Net repairers	1,215		
Boat builders	669		
Fish transporters	2,678		
Total Fish related actors	19,481		
		Support services: 4,562=8.6% of fisher number	Estimated 1,500-2500 at least

TABLE 2.8 ESTIMATION OF THE NUMBERS PER CATEGORIES OF PEOPLE, DIRECTLY OR AND INDIRECTLY INVOLVED WITH FISHERIES IN MLT

(MLT Frame survey, URTMLF 2018)

The exact estimates of these indirect jobs related to the coastal value chains should be further explored with specific surveys and estimating the Full Time Equivalent jobs. For instance, the Ministry of Livestock and Fisheries in Tanzania (2016) stated in 2016 that the fisher number of 183,000 could generate employment for up to 4 million people in indirect jobs, which by far exceeds the current estimations of the frame surveys. Boat owners and various suppliers can also be added to these numbers. A multiplier factor of 20 is proposed by the Ministry of Livestock and Fisheries (Mgawe, primary data, 2022) between the number of fishers and all the jobs involved with the fishers, direct and indirect actors.

2.1.7 Flows and volume allocations

The qualitative circulating major pathways, flows of seafood biomass are visualized in Figures 2.5 and 2.6 that illustrate the major sub-chains identified in the study. Figures 2.5 and 2.6 describes the flows of seafood products (produced locally) of coastal fisheries in MLT and in ZNZ. Specific flow diagrams are presented for each sub-chain in the paragraph 2.3 of the Functional analysis (Figures 2.15 and 2.16), and in the sub-chain appendices (Cf Appendix of the Economic Section 3.1 Sub-chains).

2.1.7.1. Flow analysis and sub-chains in MLT

In MLT, the overall flow system is described in the following graph which visualises main pathways, leading to the identification of the sub-chains as follows (Figure 2.5):

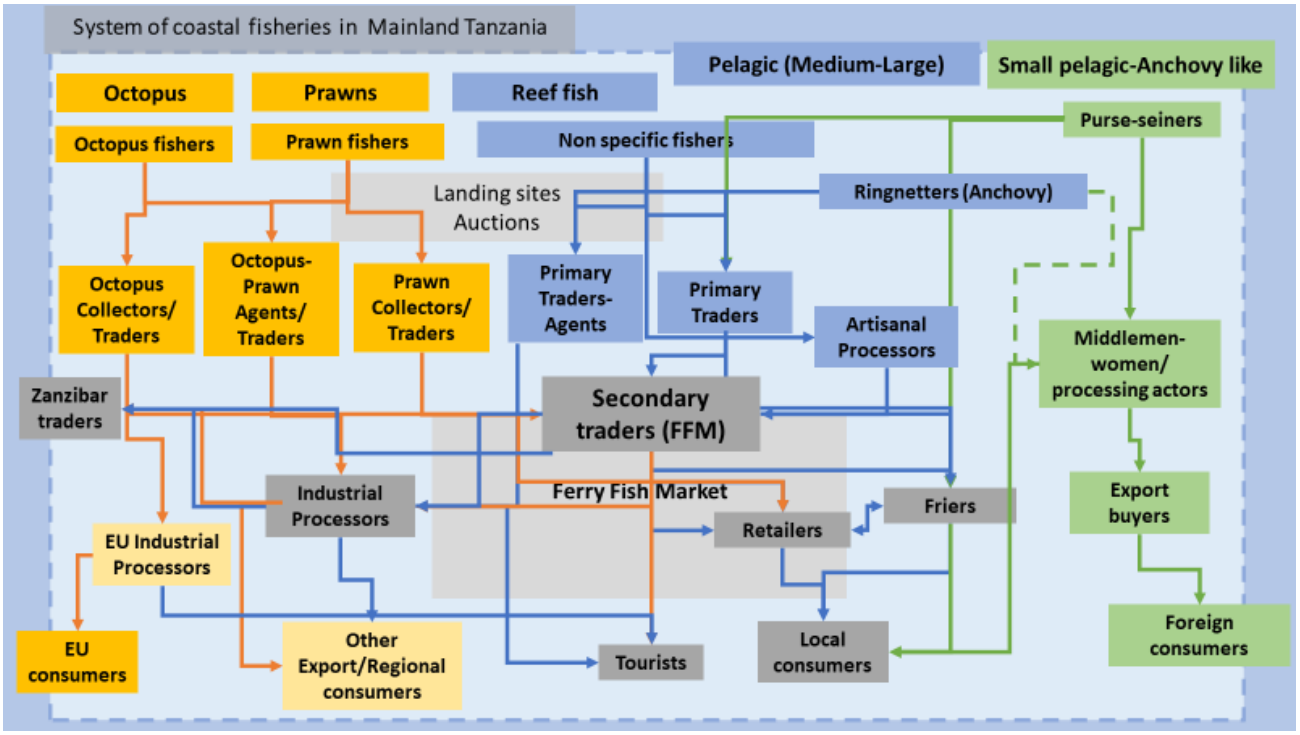


FIGURE 2.5 FLOW DIAGRAM OF THE SYSTEM OF COASTAL FISHERIES IN MLT
(VCA4D team elaboration)

- The Anchovy-like sub-chain (see also Figure 2.15A in the following Section 2.3): the main targeted species are small size small pelagic (<10 cm length). The fishing is mainly by a dedicated fleet (see Box 2 for details). A major part of the landed fish is directly sold to processors, "middlemen and middlewomen" who organize the successive processing operations, namely boiling-drying-packing. Another part of the landing is sold in the auctions and follows the same flow of the other finfish through the FFM. Most of the anchovy-like product at the FFM is consumed fried, in the streets and urban areas.

- The Finfish (medium pelagic – reef fish – large pelagic) (see also Figure 2.15B): finfish fishers target various species using different gears (see Box 2). Most of the landed fishes are sold in auctions. A part is processed (frozen) by artisanal or industrial actors. Another part is sold fresh, chilled, and fried, for local consumption. The last part is sold to restaurants, hotels, mostly touristic places. The respective importance of these pathways depends on the type of fish, its quality, its size, the species, and the level of flesh preservation (linked to cooling facilities or not). This observation informed our economic analysis and the subdivision of the Finfish sub-chain into 3 categories:

    - Low value finfish ("FF1"), sold by fishers at 1,429 TZS/kg, mainly medium pelagic, small size reef fish, and large pelagic, mainly consumed in the local markets.

    - Medium value fish, mainly reef fish and large pelagic fish, sold at 2,857 TZS/kg, consumed on local markets. A more important part is processed, sold frozen, including a tourist market.

    - High value finfish, main large reef fish (as the red snapper), sold at 4,500 TZS/kg, consumed on urban markets, in tourist places, fresh and frozen.

- The Octopus sub-chain (Figure 2.16A in Section 2.3): it involves divers and foot fishers (see Box 2). Collectors, or Industrial processing agents buy directly from the fishers and support them economically, for some costs. A large proportion of the octopus follows a high-quality standard path, meaning that it is frozen in industrial processing plants and then exported to the EU and regional markets.

- The Prawn sub-chain (see Box 2) (Figure 2.16B in Section 2.3) involves seasonal fishers, mostly artisanal, but 3 industrial trawlers are still operating. Collectors, or Industrial processing agents are buying directly from the fishers, and supporting them, for most of the costs. As for Octopus, and involving the same

industrial actors, a large proportion of the landed prawns is following a high-quality standard, frozen by industrial processors, exported to the EU and regional markets.

2.1.7.2. Flow analysis and sub-chains in ZNZ

In ZNZ, the main sub-chains were identified through this graph (Figure 2.6):

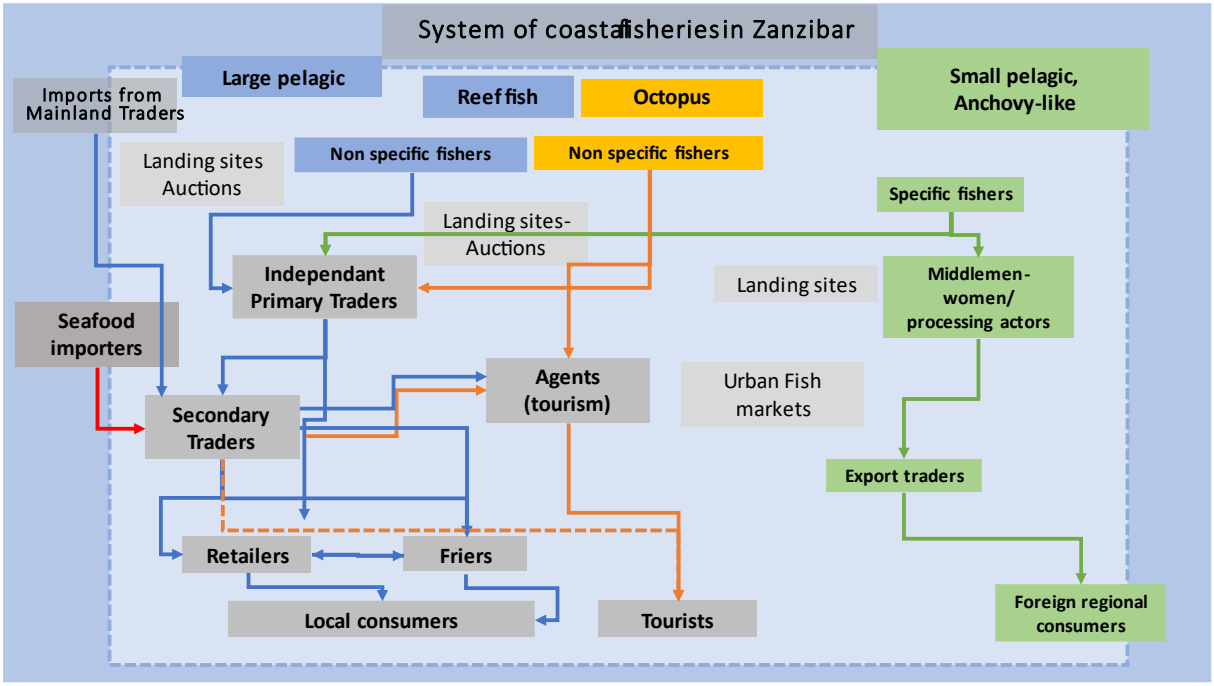


FIGURE 2.6 FLOW DIAGRAM OF THE SYSTEM OF COASTAL FISHERIES IN ZNZ
(VCA4D team elaboration)

- The Anchovy-like sub-chain (Figure 2.17A in Section 2.3), the sub-chain shows a similar structure to MLT, with the same actors. Important differences were however observed, in the numbers of actors, and the volumes. In fact, the official records on exports of dried anchovy issued from the Department of Fisheries reveal much higher volumes of production compared to MLT. One hypothesis to be verified relates to a possible situation in which there is a tendency of small pelagic fishers from MLT to land their catches in ZNZ, probably because of the proximity of small pelagic fishing grounds to ZNZ coastline. The landing price for anchovy in ZNZ does not seem higher than in MLT. The processing production cost of dried anchovy in ZNZ seems slightly lower in ZNZ (see Economic Section 3 for details). For reasons linked to local taxes and royalty levels, it may be more attractive to process the anchovy in ZNZ and export it to regional markets. These findings suggest a need for further collaboration level between ZNZ and MLT regarding this sub-chain, and the common stock management of small pelagic.

- The Finfish (reef fish – large pelagic) (Figure 2.17B in 2.3) sub-chain follows the same pattern than in MLT. The 3 levels of price are different from MLT and may be related to the more important volume share attributed to the tourist market, which fetches higher prices (>8,000-10,000 TZS/kg, associated with short supply chains). Some actors are specific to ZNZ: trappers, hotel agents, and frozen fish importers. The presence of frozen fish importers in ZNZ and not in MLT is likely due to significant differences in the tax/royalty system between the two regions. The 3 categories of finfish identified related to their pricing range in ZNZ are:

    - Low value finfish (“FF1”), sold by fishers at 2,857 TZS/kg, mainly small size reef fish, and large pelagic, mainly consumed in the local markets.

    - Medium value fish (“FF2”), mainly reef fish and large pelagic fish, sold at 4,500 TZS/kg, consumed on local markets. A more important part is processed, sold frozen, including a tourist market.

- High value finfish ("FF3"), main large reef fish (as the red snapper) and large pelagic, sold at 6,000 TZS/kg, in tourist places, fresh and frozen.

➢ The Octopus sub-chain also involves divers and foot fishers (see Box 2) (Figure 2.18 in 2.3). But it is less significant in volumes. Collectors, industrial processing agents, and industrial processors are not existing in ZNZ. In fact, this sub-chain functions on a very similar way (with the same actors) than the one identified for high value finfish in ZNZ ("FF3").

2.1.7.3. Final volume allocations for MLT and ZNZ coastal fisheries

From our estimates, the following final Table 2.9 of volume allocations in MLT and ZNZ could be built and consolidated. We converted the data obtained in net weight in Live Weight Equivalent (LWE in tonnage) for each of the end-use market for the various sub-chains, the two regions and the whole country, to overcome the inherent losses due to drying and freezing processes. Estimated ZNZ and MLT respective productions are within the same range of 70,000 t. The part of imports in ZNZ represents a low volume. Both geographic entities display different profile in volume allocations (Figure 2.7), likely due to the significant volumes taken by the anchovy sub-chain (for instance 6% of export for MLT, compared to 16% in ZNZ). Interestingly, the estimated losses, which actually represent the post-harvest loss biomass OR the auto-consumption, absent from market places, are very similar, within 19-20%.

Region	Total MLT		Total ZNZ		Total URT	
Volume allocations	**Net Weight (t)**	**LWE (t)**	**Net Weight (t)**	**LWE (t)**	**Net Weight (t)**	**LWE (t)**
Annual estimated production	66,882	66,882	69,619	69,619	136,501	136,501
Total import in volume	0	0	1,596	1,596	1,596	1,596
Total inputs	66,882	66,882	71,215	71,215	138,097	138,097
Total export in volume (dried or frozen)	2,624	3,815	7,674	12,790	10,298	16,605
Total tourism market (chilled or frozen)	15,399	15,398	13,816	13,816	29,215	29,214
Total Mainland to Zanzibar (chilled/frozen)	543	543	0	0	543	543
Total local market (fresh, chilled, fried)	22,119	33,792	17,073	25,250	39,192	59,042
Total losses or auto-consumption	25,702	12,509	29,756	14,532	55,458	27,041
Non-food use (feed mills)	495	825	2,896	4,827	3,391	5,652
*Total food supply**	63,763	62,242	60,645	53,598	124,408	115,840

TABLE 2.9 VOLUME FINAL BUDGET FOR COASTAL FISHERIES ESTABLISHED FOR MLT, ZNZ, AND TANZANIA

*Calculated according to COLEACP (2022): Total food supply = Production + Imports + Stock Variations - Exports - Non-food uses. Here, no stock variation was considered in our calculations based on year budget.

Source: VCA4D estimates

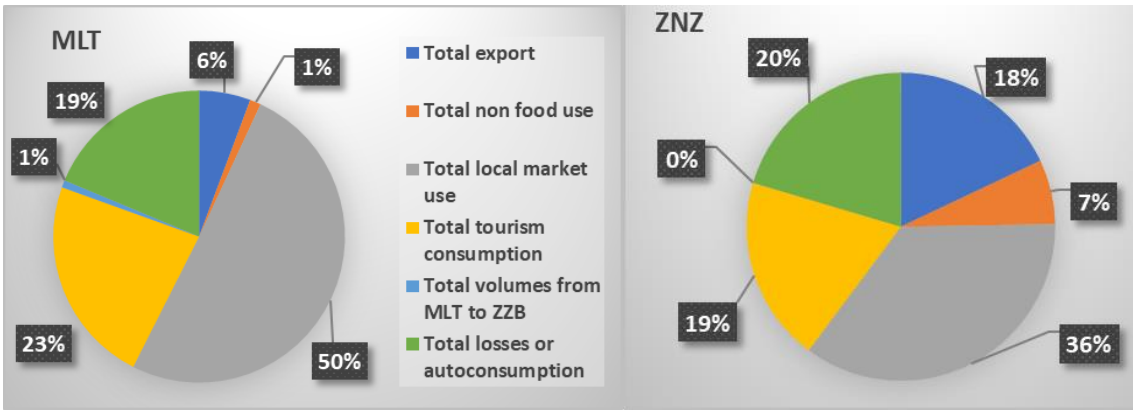


FIGURE 2.7 VOLUME ALLOCATION IN PERCENTAGE OF TOTAL PRODUCTION (+ IMPORTS) OF COASTAL FISHERIES IN MLT (LEFT) AND IN ZNZ (RIGHT), CALCULATED ON THE BASIS OF LIVE WEIGHT EQUIVALENT (LWE IN TONNAGES) (VCA4D FINDINGS)

post-harvest losses, Van Hoof and Kraan (2017) report a higher range of losses (25-50% of catches), mainly due to poor handling on board, poor processing, and poor cooling facilities. But Van Hoof and Kraan also highlight the fact that many people refer to these so-called "losses" while the situation is only reflecting a loss in quality of the seafood product, resulting in lower prices. But most of the time, the fish still available for local consumption. Akande and Diei-Ouadi (2010) as well as Diei-Ouadi and Mgawe (2011) point out that assessed post-harvest fish losses in small-scale fisheries in Tanzania is 5% for physical loss whereas the quality loss is about 27%. This observation is further strengthening the idea that the so-called estimate loss rate, may also reflect an auto-consumption rate for lower value fish. In that sense, large pelagic, and reef fish can also be part of this low value sub-chain, that we considered in our analysis (finfish sub-chain referred as "FF1" in both MLT and in ZNZ). Consequently, the degraded lower nutritional value for these low value fish must be further investigated. Nevertheless, Cold Chain underdevelopment in the midst of changing consumers' preference from cured to fresh / frozen fish is one of major challenges facing costal fisheries in MLT and ZNZ.

2.1.8 The major market trends – end users

2.1.8.1. Local consumption

COLEACP (2022) report that in Tanzania (incl. ZNZ) the total estimated food supply by marine fish and fisheries products[7] increased steadily from 56,600t in 2002 to a total of 78,000 t in 2017 (Figure 2.8). Combined with the population growth figures, this would translate in a decreasing per capita availability of 1.6 kg per year in 2002 to 1.4 kg in 2017. However, the fish food supply that we estimated for Tanzania is almost double than previous reported food supply (about 115,000 t, Table 2.9). The population has increased in Tanzania, which means that the marine seafood food supply could be around 1.1 kg, 33.5 kg, and 1.8 kg per capita in 2019, in MLT, in ZNZ, and in Tanzania, respectively[8]. In coastal areas in MLT, if we consider that most of the seafood is consumed in MLT coastal regions, it may reach 10 kg/capita. This would mean that in coastal areas, in ZNZ, and in MLT, the contribution of coastal fisheries to food security is even more important than expected by official and recent reports[9].

[7] Including FAOSTAT groups: Aquatic animals nei, Cephalopods, Crustaceans, Demersal fish, Marine fish nei, Molluscs excluding cephalopods, Pelagic fish; and excluding FAOSTAT group: Freshwater and diadromous fish.
[8]New Population Census is due in 2022. Calculated with the volumes of food supply (cf Table 2.9, 55 million of the population for MLT, and 1.6 for ZNZ (URT, 2021, BE) and (RGoZ, 2021 BE policy)- Estimation of about 20-25% of the MLT population in costal areas, e.g. 11-13 millions people, cf https://www.citypopulation.de/en/tanzania/admin/
[9] For instance, the RGoZ mentions in its BE policy (2021): 1.6 million people in ZNZ, and 22 kg of seafood consumption per capita.

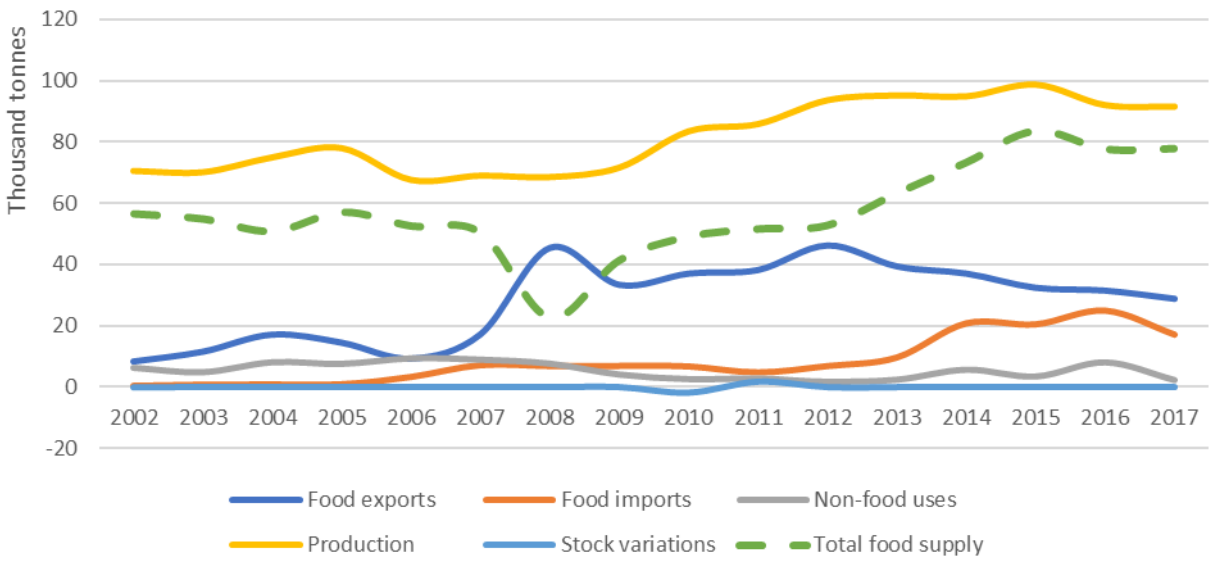


FIGURE 2.8 FOOD BALANCE TREND FOR FISH AND FISHERIES PRODUCTS IN TANZANIA BETWEEN 2002 AND 2017. FRESHWATER AND DIADROMOUS FISH ARE NOT INCLUDED. TOTAL FOOD SUPPLY = PRODUCTION + IMPORTS + STOCK VARIATIONS - EXPORTS - NON-FOOD USES.
Source: COLEACP based on FishStat (COLEACP 2022)

According to the COLEACP study (2022), the main contributing groups to the total national food supply are demersal and pelagic fish species, representing respectively 50% and 39% of the total fisheries food supply in 2017 (excl. freshwater and diadromous fish). Such finding is also confirmed in our VCA4D showing the importance of the finfish sub-chains in both MLT, and ZNZ, including the small-medium and large pelagic, and reef fish.

2.1.8.2. Tourist consumption

Tourism is an important source of income for both MLT and ZNZ (Sofreco, 2018; URTMLF, 2020 and RGoZ, 2021. Tourist activities in MLT are more oriented to the Safari tours, and to a lesser degree to coastal areas. The link between the two touristic geographic regions MLT and ZNZ is well established, as most operating Safari tours in MLT will propose a stay in ZNZ, to benefit from the hotel beaches.

Despite the Covid crisis, the tourism activities in both regions have continued to expand (Figure 2.9), the tourism sector is said to contribute to 33-35% of the GDP, both in MLT and ZNZ. Moreover, the security problems in the Middle East and Kenya have much enhanced ZNZ's attraction for European tourists whilst avoiding excessive flight times.

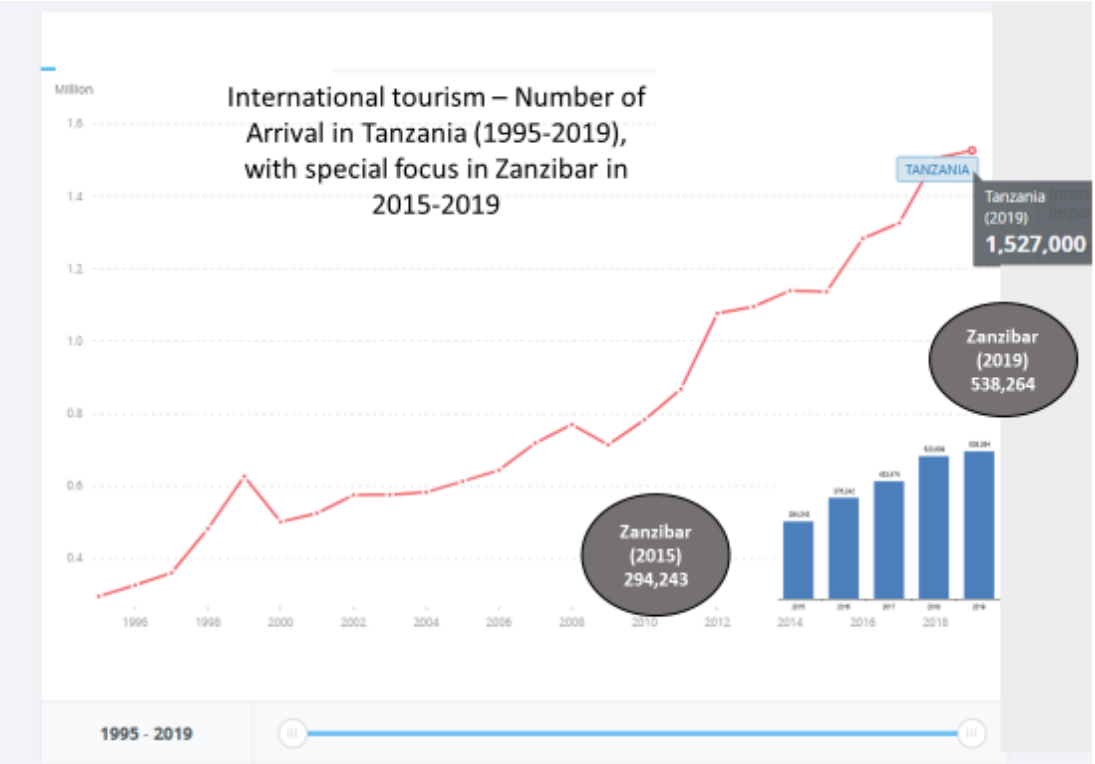


FIGURE 2.9 NUMBER OF TOURIST VISITORS IN TANZANIA FOR THE PERIOD 1995-2019 WITH SPECIAL FOCUS IN ZNZ IN 2015-2019
Source: World Bank[10] ; OCGS, ZATI in ZNZ

Building the Blue Economy Policy, The RGoZ (2021) estimated "the tourism sector has an average annual growth rate of nearly 18.7% between 2011 and 2019, with about 22,000 direct jobs in the tourism sector, of which 76% are employed at one of the 473 hotels in ZNZ (ZCT, 2017; Ministry of Information, Tourism and Heritage, 2017)".

The coastal tourism seafood consumption generates substantial economic benefits, acting almost as an "internal export" trade (i.e., attracting foreign currencies) for high value products (Sofreco, 2018). The most popular seafood products among tourist are king fish, tuna, tuna-like large pelagic, octopus, large reef fish (e.g., red snapper, changu), prawns and lobsters (Sofreco, 2018 and our primary data).

Using the ZNZ Association of Tourism Investors (ZATI) data, and interviews, Sofreco (2018) estimated that in ZNZ, the tourism sector (taking the counts of 300,000 visitors/year) in ZNZ could generate a demand for around 2,000 t of prime whole seafood and contribute at least 40 million USD to the ZNZ economy, and sales of 10 million USD by fishers.

Our findings in ZNZ suggest that the annual consumption of seafood by tourism is much more significant (almost 14,000 t) and have a much greater contribution to the ZNZ economy. Similarly, in MLT, the value generated by the tourist consumption (including restaurants in Dar-es Salaam) will be within the same range as in ZNZ.

But the implications of such a major trend must be questioned: what are the consequences that this creates for the existing fisheries value chains in the country and the livelihoods of the coastal communities? These questions have been already raised by several publications, especially in the case of ZNZ (Benansio et al., 2016; O'Neill et al. 2018; Thyresson et al. 2013). Benansio et al. (2016) reported that at least 57% of the coastal communities of ZNZ Island were actively engaged in fishing and fish trading. The direct links created between the tourists and some local communities may provide significant incomes to some fishers, and some communities, but there are also major social and environmental trade-offs.

[10] World Bank: https://data.worldbank.org/indicator/ST.INT.ARVL?locations=TZ

Regarding natural resources, as pointed out by the EUD[11], coastal tourism may induce additional pressures on marine resources, waste management, coastal lands, and sanitation issues competing with coastal population needs. Competition between tourist and agriculture/aquaculture activities are not only a question of spatial distribution and appropriation of space, but also a question of employment attractiveness, as young people may be more tempted by jobs in the tourism sector rather than continuing primary sector activities. On the other hand, interesting synergies are emerging for the generation of potential income from the tourism industry coupled with the deployment and monitoring of the Marine Protected Areas (MPA), as illustrated in ZNZ (IUCN, 2020). "Zanzibar's tourism sector grew rapidly from 2010 to 2019. With 538,000 international visitors in 2019, tourism represented 28 percent of Zanzibar's GDP and supported an estimated 15,000 direct and 50,000 indirect jobs. However, these gains have been uneven, and because growth has been driven by undiversified resorts with limited linkages to the local economy, the sector has underperformed in terms of inclusive revenue and job creation" (World Bank, 2021).

2.1.8.3. Imports to Tanzania

Fish imports for 2001 to 2019 (both freshwater and marine fish, Figure 2.10) shows that Tanzanian fish products imports increased till 2016 with a cumulative annual growth rate of 36% (COLEACP, 2022). After 2016, presumably because of a significant increase in import taxes, imports decreased significantly from 28 thousand t in 2016 to 3.5 thousand t in 2019. Tilapia was the most important commodity imported followed by mackerel, sardines, tuna, and tuna-like species (Sofreco, 2018).

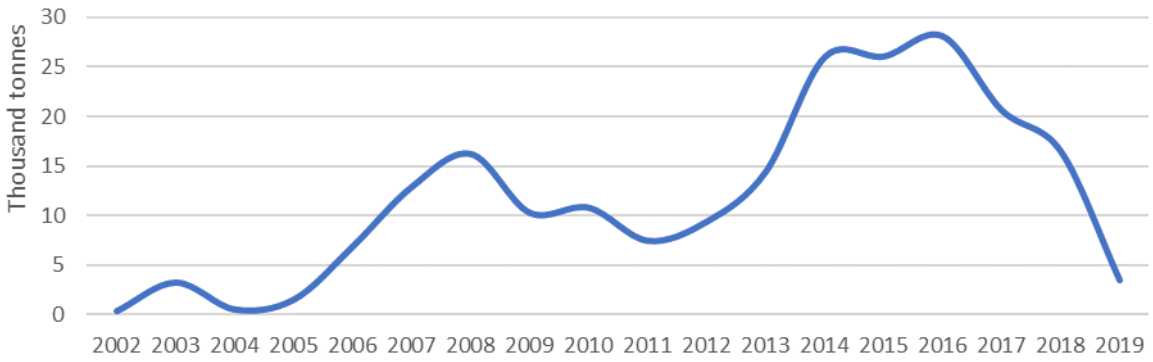


FIGURE 2.10 LONG TERM VOLUME TREND FOR TOTAL FISH BASED PRODUCTS' IMPORTS BY TANZANIA.
Source: COLEACP based on CEPII BACI (2022)

Based on the FAO FishStatJ data, more than half of the 2019 imports (1.9 thousand t) was frozen fish (without further species information). A fifth (696 t) was frozen mackerels (11% without detail on the species and 9% jack and horse mackerel). The top-5 most imported fish types are completed by other undefined frozen fish fillets (148 t), and preserved tuna (134 t). All other fish-based commodities had been imported in amounts below 100 t per year in 2019. Imports originated mainly from China (mackerels and other frozen fish, skipjack tuna, 66% of the imported volume in 2019), South Korea (mainly frozen mackerels, 10%), United Arab Emirates (mainly tuna, 5%), Peru (frozen mackerels, 5%) and Chile (frozen mackerels, 3%) (COLEACP, 2022).

These import figures collected by COLEACP (2022) are following the data that we obtained in ZNZ (May 2022), consolidated at the whole Tanzania country scale, confirming the hypothesis that almost no marine fish are at the moment imported to MLT. The importer settled in ZNZ imports frozen mackerel, yellow tail and king fish, the lowest purchasing price for him is 2760 TZS/kg for mackerel (1.2 USD/kg, CIF price). He explains that he left MLT Tanzania in 2013 (where 22 similar companies were established at the time) to ZNZ because of the tax level. According to him, landing MLT overall costs (including importation taxes) represented 40 MTZS per container, for 11.2 MTZS in ZNZ (1481 TZS/kg fish imported in MLT as compared to 415 TZS/kg). In the regulations from the Tanzanian Government, in 2018 (see Appendix 2.C Functional Analysis Table of Policies), the importation tax royalty is decided the level of 2.5 USD/kg, a level of import tax for fish even higher than

[11] Guido Corno, 2021. Status of marine and coastal ecosystem management in Tanzania *(mainland, Pemba, Zanzibar and Mafia Island)* and options for the EU to build a Blue Economy intervention in Tanzania. Unpublished.

what is reported by this import actor in ZNZ. In addition, un-recorded, un-formal and un-official links of imports of fish from MLT to ZNZ exist, from Tanga, Mafia, and Bagamoyo (O'Neill and Crona, 2017).

Such an import tax level in MLT has been driven by the intention to protect the local market, but this tax policy had immediate consequences for some actors, such as industrial seafood importers, accentuating differences between ZNZ and MLT.

2.1.8.4. Exports of seafood from Tanzania

2.1.8.4.1. Overall situation

According to COLEACP (2022), 2002-2019 seafood exports to the world from Tanzania mainly include freshwater fish, (from MLT, dried fish, smoked, meat), and seaweeds (dried, from ZNZ). Marine exported seafood are marine dried anchovy, frozen octopus, prawns, lobsters and crabs. Other commodities, such as fresh pilchards (*Sardinops* spp.) and fresh sardinellas, were exported in the beginning of the same period, but not anymore, or in very little amounts. This is probably due to the level of export taxes, royalties.

In the top 20 of exports volume, certain products show a significant increase in exports between 2002 and 2019: frozen octopus (+445%, 1.8 thousand t in 2019, for a value of USD 7.7 million), fishmeal (+512%, 1.7 thousand t in 2019) and smoked fish (close to zero exports in 2002 to 930 t in 2019) (Figure 2.11). Interestingly, the Octopus export figure of 1800 t in 2019 reported by COLEACP is not in accordance with the Annual Fisheries report of the 2019, which states exportation of 1,048 t of frozen octopus for the same year (for a value of USD 14.1 million, at FOB) (URTMLF, 2019 and 2020).

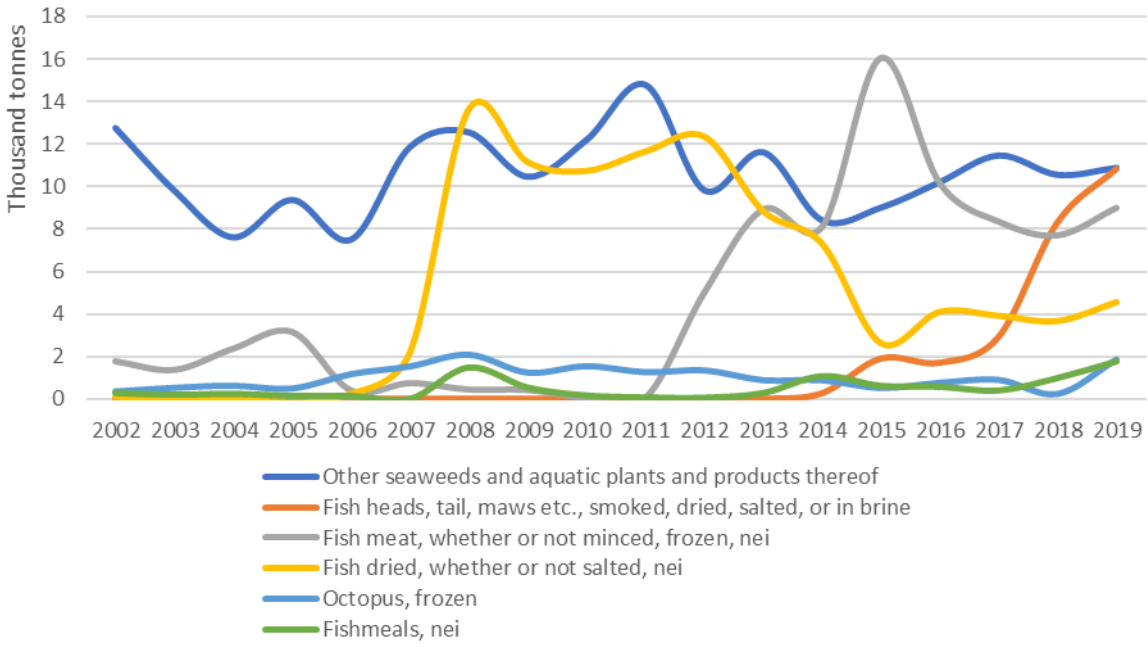


FIGURE 2.11 SIX MAIN EXPORTED SEA PRODUCTS AND SEA FISHES FROM TANZANIA TO THE REST OF THE WORLD IN TERMS OF VOLUME, 2002-2019.
Source: COLEACP based on FishStatJ (COLEACP, 2022)

Regarding dried fish (freshwater and salt water) from Tanzania, the main importer in 2019 is Rwanda (73% of the exports), a destination that increased in importance since 2009, followed by Burundi, Malawi, and the Democratic Republic of the Congo. These countries represent the "Regional market" (which also includes Kenya for octopus and prawns). Presumably, dried fish exported to Rwanda mainly consists of "Dagaa", freshwater anchovies, captured in Lake Victoria, and not of marine dagaa. Marine Dagaa exports to Congo would rather happen through Zambia via the border town of Tunduma. COLEACP (2022) insists upon the fact that "No quantitative evidence could be found for the latter and **no separation between marine or freshwater dried fish could be made** either based on the available data for COLEACP". The interviews that we could conducted in the field (in MLT and in ZNZ) are confirming this hypothesis and suggesting that a significant amount of dried anchovy is transacted in regional market through illegal cross-border trade. This could be due to unfavourable marketing environment including hurdles such as higher taxation regime.

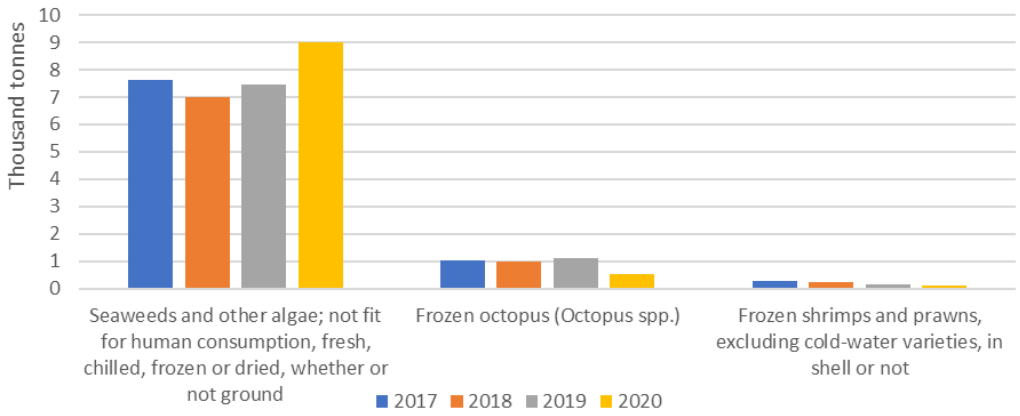
BOX 4 THE DRIED ANCHOVY SUB-CHAINS IN MLT AND IN ZNZ, UNCLEAR ROYALTY LEVEL OR UNREPORTED EXPORTS

To illustrate this issue, the anchovy sub-chains, both in MLT and in ZNZ, provide examples. The royalty level for dried anchovy in ZNZ is said to be 1% of the declared value leaving ZNZ (4,500 TZS/kg Dried anchovy) (information from the Department of Fisheries, May 2022). Export statistics collected by an officer of the Department of Fisheries in MLT, in Kilwa district, show that the tax level for the exported dried anchovy is between 4 to 7 % of the declared value and tonnage. The official Regulation amendment in 2018 (Appendix functional analysis table 2C policies.) does not state the specific case of marine dried anchovy ("Dagaa)" but the Annual report of Fisheries in 2019 (Table 45 of the Annual report for 2019) indicates a royalty level of 10%, while the Annual report of 2020 reports a royalty level of more than 8% of the FOB value (in Table 44 of the Annual report for 2020) (URTMLF 2019&2020). The combined dried anchovy productions of MLT and ZNZ represents at least 8,000 t, for an estimated export value of 62,282 MTZS (VCA4D, findings), that is about 27 million USD.

2.1.8.4.2. Exports to the EU

The main products exported to the EU in volume are seaweeds (7,000-9,000 t in 2019-2020). Frozen octopus (main destination is Portugal, 84% of the exports in 2019), with only 500 t in 2020, and frozen shrimps and prawns, 110 t in 2020, complete the top exported products (Figure 2.12).

A



B

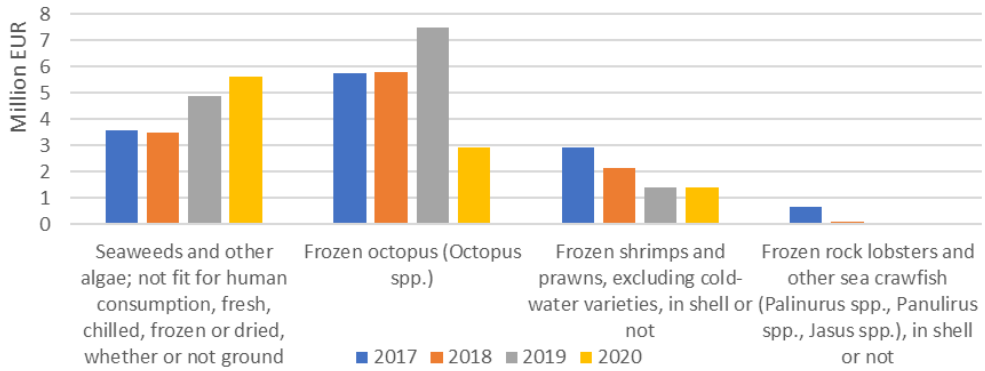


FIGURE 2.12 MAIN EXPORTS TO EU27 FROM TANZANIA FOR SEA FISHES AND SEA PRODUCTS, 2017-2020, IN VOLUME (A) AND VALUE (B).
Source: COLEACP based on Eurostat (2022)

- Octopus market trends

European import prices for Tanzanian frozen octopus have been rising in recent years. Indeed, apart from a significant drop in 2013 and 2014 (a period in which the octopus production in Portugal, being one of the key destination markets, was higher than average), prices have risen slightly and continuously until reaching their highest level in 2019 (almost 6.9€/kg CIF). However, prices have fallen in 2020 and are now around 5.45€/kg (Figure 2.13). This year coincides with a significant drop in European demand (probably due to the COVID-19 pandemic). The downward octopus production trend on the long term (2008-2018) for the main European octopus producers (Italy, Spain and Portugal) could result in less competition and again steadily increasing prices for Tanzanian octopus on the EU market in the future.

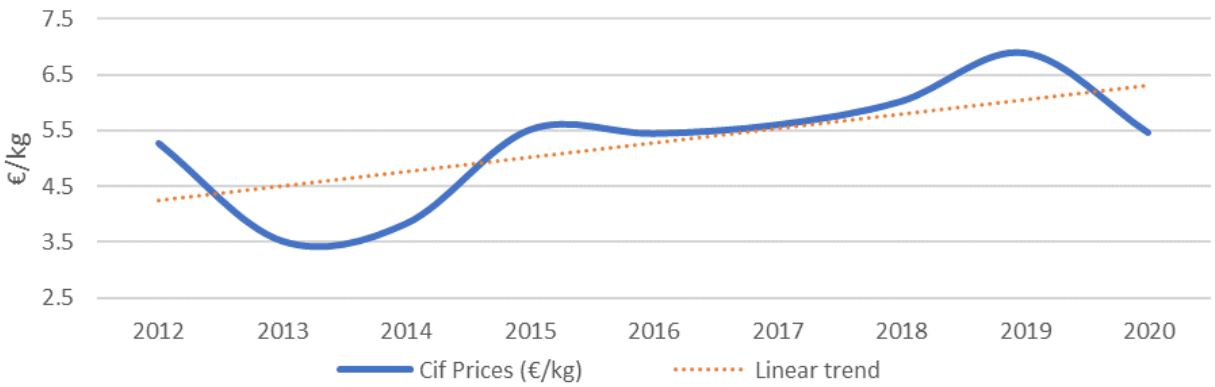


FIGURE 2.13 AVERAGE CIF PRICE FOR TANZANIAN FROZEN OCTOPUS IMPORTED IN THE EU27, 2012-2020.
Source: COLEACP based on Eurostat.

At the Rungis International Market in France, frozen octopus from imports sells for an average price of 11€/kg throughout the year. "European" octopus is sold cheaper than imported octopus. At the retail level, frozen octopus is available at varying prices depending on the degree of processing of the product (washed, cut, cooked). The Continente shop chain in Portugal, which is one of the sellers of Tanzanian frozen octopus on Europe, offers frozen octopus at 12-14€/kg, with prices rising to 17€/kg for tentacles only and up to 45€/kg for cooked and frozen tentacles (reference year 2021).

- Frozen shrimps and prawns

The European import price for Tanzanian shrimps has been rising in recent years, although it did experience a period of decline between 2015 and 2018. In 2020, the price for one kilo of shrimps was around 12.8€ CIF (Figure 2.14).

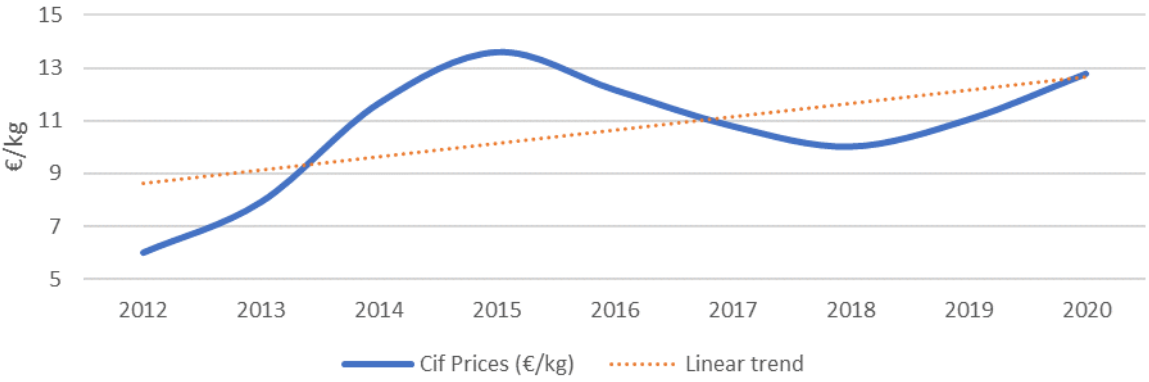


FIGURE 2.14 AVERAGE CIF PRICE FOR TANZANIAN FROZEN SHRIMPS AND PRAWNS IMPORTED IN THE EU27, 2012-2020.
Source: COLEACP based on Eurostat.

At the Rungis International Market in France, cooked prawns are sold for between 15.5 and 16.5€/kg, and 18.5€/kg when peeled. The price can go up to 26€/kg for organic shrimp of a similar origin (Madagascar). Retail prices for these products vary greatly depending on the degree of preparation of the shrimps ('plain', peeled, cooked). Cooked, unshelled shrimps from imports are sold for 12.5€/kg at Carrefour in France, one of the main destinations for shrimps from Tanzania. The price doubles to 27.5€/kg when peeled (reference year 2021).

- Access to the international market / EU market

The regulations to export fish or seafood to Europe are the following[12]:

[12] CBI (2021). What requirements must fish and seafood comply with to be allowed on the European market? https://www.cbi.eu/market-information/fish-seafood/what-requirements-should-your-product-comply

- The country of origin needs to be accredited by the European authorities, meet European food safety requirements and pose no threat to European consumers. The European export accreditation induces that the applicant company invests in a traceability system and a whole HACCP certification, with a control and surveillance system. Therefore, only a few industrial processors are actually certified in Tanzania for exports to the EU (two big companies and a mid-size pending).
- The maximum residue levels for fish and seafood must not be exceeded. They depend on the species and the source. Regulations: Regulation (EC) No 470/2009 (pharmacologically active substances), Regulation (EC) No 396/2005 (pesticides) and Regulation (EC) No 1881/2006 (environmental contaminants).
- Labelling regulations.
- Prove the legal sources of the fish and seafood.

In addition to these mandatory requirements to access the EU market, buyers might request additional certifications, such as, the British Retail Consortium or the International Featured Standards for food safety; Social Accountability International SA8000 Standards and the Business Social Compliance Initiative for social compliance; and MSC, or GLOBAL G.A.P for sustainability (COLEACP, 2022).

So far, only the octopus fisheries has been under an evaluation phase for a MSC certification, this initiative supported by both the industrial processors, and the Ministry of Agriculture and Livestock, Department of fisheries. The octopus certification is associated to the closure system in octopus fishing reefs, as well as the use of jars, a new technique for trapping octopus and maintaining them alive. When MSC certified, the MSC actors should be able to export octopus of a higher quality to the Japanese market, for a price exceeding 35 USD/kg.

2.2. The governance and policy system

The UN Development Programme defines governance as the system of values, policies and institutions by which a society manages its economic, political and social affairs through interaction within and among the state, civil society and private sector. It is the way a society organizes itself to make and implement decisions —achieving mutual understanding agreements and action. Elements of good governance include participation, the rule of law, transparency, responsiveness, consensus orientation, equity, effectiveness, efficiency, accountability and strategic vision in (January and Ngowi, 2010).

2.2.1 Institutional and policy context

2.2.1.1. Institutional actors

The institutional framework for management of coastal resources in Tanzania comprises many actors and institutions, leading to conflicting interesting and unnecessary overlap (Gustavson et al., 2009, Katikiro et al, 2017).

Central and local governments

In both MLT and ZNZ there are both centralized and decentralized aspects of governance system involved in coastal fisheries management. Different line ministries have applied their powers towards coastal resources (Katikiro et al, 2017). Currently, at the national level, two ministries are responsible for overall management and coordination of coastal fisheries.

For MLT, the Ministry of Livestock and Fisheries (MLF) primarily through the Department of Fisheries Development is concerned with the management of inland and marine fisheries within the territorial waters of Mainland Tanzania.

For ZNZ, the recently created Ministry of Blue Economy and Fisheries in ZNZ primarily through the Department of Fisheries Development is concerned with the management of marine fisheries within the territorial waters of Zanzibar.

The main central and local government actors in MLT, in ZNZ, and in URT are presented in Table 2A and 2B in Appendix 2 for the Functional analysis.

In both MLT and ZNZ the state creates laws and policies defining decentralization, legitimation of rights and sharing of benefits, including institutional and capacity building. The state supports local communities and non-state actors by providing them with rights to access and use resources, takes part in decision making, and draws different benefits. Through decentralization processes, the expectation is that the central state plays a minimal role, leaving more room to local government and non-state actors, including local communities. However, central government still holds power and can exercise it in relation to 'resources of national interest', e.g. large ecosystems with multiple resources (Kweka et al, 2017).

Both MLT and ZNZ governments are using co-management approaches to managing coastal fisheries. In both cases, but to varying degrees, central government is the main policy maker and collects revenue. Local government is an implementer. Local government is supposed to ensure the sustainability of coastal resources but may prioritize harvesting and revenue collection instead of conservation. Central governments may prioritize 'national development' rather than conservation, and allow large-scale investment in coastal areas, such as for tourism, oil and gas extraction.

- ✓ MLT: The District Councils and Municipal Councils are responsible for implementation and enforcement of national policies and legislation that address natural resource management. Implementation is operational through the District Fisheries Offices, which have personnel dedicated to fisheries forestry and beekeeping, and wildlife. It is at this level that the effective implementation of national policies and programs is dependent on the available technical and management expertise.
- ✓ ZNZ: Regional and district agencies are involved in planning and the implementation of government policy, as well as the mobilisation of communities.

<u>Local communities</u>

Community may be defined as a group of coastal resource users (and those affected by such use), who are found in the vicinity of the resource and has the right to use and conserve it. Under 'traditional' systems of governance communities were the sole managers of natural resources. However, state interest in controlling resources over time has led to the dismantling of many community-based management systems, paving the way for state ownership. To some degree, with the subsequent move towards decentralization, resource use and ownership has moved to local governments and communities through different legal and policy instruments.

- ✓ MLT: Village-level government operates through a Village Council, under which there are five committees to address issues at the community level. The committees include: security; environment; community development; health; and finance and planning. The Village Council has the direct local-level responsibility for the planning and implementation of projects, and for making decisions regarding such matters as land allocation and community resource use. In practice, however, their activities tend to be more narrowly focused on revenue collection and enforcement.
- ✓ ZNZ: Below the district level, there are Shehias, which are administrative units under the responsibility of a Sheha, who is appointed by the Regional Commissioner. A Sheha often encompasses several villages. The Sheha is the Chief Government Officer and reports directly to the District Commissioner. Each Sheha has an advisory committee of not less than 12 members. In addition, committees at the local level may be established to address specific issues (e.g. for managing the use of natural resources), but the number and specific function of committees varies considerably across Zanzibar.

There are a number of community level institutional arrangements which are relevant to coastal fisheries management which have been set up by the state. The most specific ones are Beach Management Units in TML and Village (Shehia) Fisheries Committees in Zanzibar. In the case of Marine Protected Areas, Village Liaison Committees were established to provide a link between communities and the state authorities (see Section 5 Social Analysis).

In these state-led co-management arrangements, communities are often assumed to be lacking the capacity to manage natural resources, leading to the execution of capacity building programmes. The literature supports the case that local communities are important holders of useful indigenous and local knowledge

which should be integrated in to these arrangements, but there appears to be little evidence that this has happened. In both MLT and ZNZ there has been a number of programmes supporting communities, mostly channelled through NGOs.

NGOs

The failure of the state in achieving conservation has led to the increasing involvement of NGOs in coastal resource governance, especially as donors often prefer working with NGOs rather than governments. Yet, NGOs are often viewed as competitors for scarce resources by the state, hence their participation in partnerships can create internal tensions. In some cases, NGOs create structures that are not in line with existing systems and this may hinder the process of continuity after an intervention has ended. There is a range of international NGOs working with coastal fishing communities including those with primarily a conservation aim, such as WWF Tanzania and Seascape and those with primarily a development aim such as Action Aid. The NGO Mwambao in MLT and ZNZ is an evolving network of coastal communities in Tanzania that is working to build capacity of communities and bring them together while also linking with scientists, government institutions, practitioners, and experts to facilitate cross-learning, information sharing and joint action.

International organizations and bilateral donors

The UN has been one of the main early supporters of ecosystem-based approaches to natural resource management and a main provider of the science behind it. Aid agencies such as the World Bank, USAID and other international donors have been involved in co-management of coastal resources through funding governments and NGOs as implementers. Collectively, UN agencies and donors have driven the co-management agenda, and also further broadened it from a focus on ecosystem conservation to also consider livelihoods and other socio-economic outcomes.

Private sector

Coastal areas are a target for investments ranging from tourism to oil and gas exploration. The involvement of business adds to the challenges of sustainability partnerships. Partnerships with business need to ensure not only social and ecological sustainability, but also the economic viability of business operations. The main question then becomes to what extent these partnerships in coastal resources are able to balance the needs of the state, of communities and profit for business. The recent involvement of the oil and gas exploration industry in coastal areas of Tanzania has brought with it a number of other investments in infrastructure. The extent of which these new investments strengthen or weaken the livelihood and conservation needs of local communities remains to be assessed. The private sector are key players in coastal fisheries value chains.

2.2.1.2. Policy system

Both systems of fishery management in MLT and ZNZ are based on a complex set of informal rules and as Sekadende et al, (2020) explain "Tanzanian fisheries are technically open access but there are arguably some de facto user rights in the artisanal fishery…". A range of policies and regulations have been introduced creating what might be considered a plural system affecting coastal fisheries management systems.

Under the Constitution of the URT (1977) the management of issues related to the environment, natural resources (including fisheries) and tourism are considered non-union and are dealt with separately by MLT and ZNZ governments. As a result, marine and coastal resources are governed by two distinct sets of laws and regulations. However, there is some overlap related to coastal zone management. The Territorial Sea and Exclusive Economic Zone Act (1989) provides for the implementation of the Law of the Sea Convention and establishes the Territorial Sea and EEZ for activities off the coast of mainland Tanzania and Zanzibar. The Deep Sea Fishing Authority Act (1998) provides for the establishment of the Deep Sea Fishing Authority to regulate uses in the EEZ for both jurisdictions as well (J a n u a r y a n d N g o w i, 2010).

Some of the key relevant coastal and marine resource management policies and legislation developed by MLT and ZNZ are listed in Tables 2.10 and 2.11 below and in more detail in Appendix 2 Table 2.C. In both MLT and ZNZ, there is legislation related to general environmental issues, marine resource use, tourism and general land use activities. The legislation demonstrates both the conservation needs and attempts to manage coastal

resources (i.e. protect mangrove forest, fisheries) within a complex socio-economic context. (J a n u a r y a n d N g o w i, 2010).

MLT	ZNZ
National sectoral policies and strategies	
• National Environmental Policy (URT, 1997) • National Fisheries Sector Policy and Strategy Statement (1997) • National Biodiversity Strategy and Action Plan (NBSAP) (1998) • Forest Policy (URT, 1998) • National Integrated Coastal Environment Management Strategy (NICEMS) (2003) • Wildlife Policy, 2007 • Fisheries Policy (URT, 2015 – revising the 1997 Policy)	• Zanzibar National Forest Policy, 1995 • Zanzibar Tourism Policy, 2004 • Zanzibar Vision 2020 (2011) • Zanzibar Environmental Policy, 2013 • Fisheries Policy, 2014 and draft 2016 • Zanzibar strategy for growth and reduction of poverty ZSGRP III, (MKUZA III), 2017 • Fisheries Master Plan (2019-2033) • Zanzibar Blue Economy Policy, 2020 • Zanzibar Vision 2050 (2020) • Fisheries Master Plan
Legislation	
• Territorial Sea and Exclusive Economic Zone (TSEEZ) Act, No. 3 of 1989 • Marine Parks and Reserves (MPR) Act 29, 1994 • Investment Act, 1997 • Deep-Sea Fishing Authority (DSFA) Act, 1998, updated in 2007 • Land Act, 1999 • Village Land Act (1999) • Forest Act, 2002 • Fisheries Act, No 22 of 2003 • Environmental Management Act (EMA), No. 20 of 2004 • Employment and Labour Relations Act, 2004 • Water Resource Management Act, 2009 • Fisheries Regulation, 2009 (amended in 2018, 2020) • Deep-Sea Fishing Authority Regulations, 2009 • The deep sea fisheries management and development Act (2021)	• Land Tenure Act 1992 • Forest Resources Management and Conservation Act, 1996 • Zanzibar Nature Conservation Areas Management Unit Act, 1999 and regulations • Zanzibar Fisheries Act, 2010 • Marine Conservation Unit Regulations, 2014 • Zanzibar Environmental Management for Sustainable Development Act, 2015 (revising the 1996 Act)

TABLE 2.10 COASTAL AND MARINE RESOURCE -RELATED POLICIES, STRATEGIES AND LEGISLATION
Source: EcoAfrica, 2012a and 2012b; Yahya, 2021, and others

Legally binding convention/Treaty/Programme
Convention on Biological Diversity 1992 [ratified 1996]
The Ramsar Convention on Wetlands, 1971 [ratified 2000]
Convention Concerning the Protection of the World's Cultural and Natural Heritage (World Heritage Convention) (1977)
Convention on the Conservation of Migratory Species of Wild Animals (1979)
United Nations Convention on the Law of the Sea (UNCLOS), 1982 [ratified 1985]
Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (Nairobi Convention)
Convention on International Trade in Endangered Species (CITES), 1975 [ratified 1979]
Cartagena Protocol on Biosafety (2000)
Non-legally binding convention/Treaty/Programme
World Summit on Sustainable Development
UNESCO Man and the Biosphere Programme (MAB)
FAO Code of Conduct for Responsible Fisheries
International Coral Reef Initiative (ICRI)
International Coral Reef Action Network (ICRAN)
African Protected Areas Initiative (APAI)
WWF Eastern African Marine Ecoregion (EAME) Programme

TABLE 2.11 COASTAL AND MARINE RESOURCE -LEGALLY AND NON-LEGALLY BINDING CONVENTIONS, TREATIES AND PROGRAMMES
Source: EcoAfrica, 2012a and 2012b; Yahya, 2021, and others

Unlike terrestrial resources, coastal resources in Tanzania began to receive significant attention only in the past three decades. Numerous efforts began in the early 1990s, when the government with assistance from donors started to tackle coastal and marine resources problems using the Integrated Coastal Zone

Management (ICZM) approach, coupled with its National Integrated Coastal Management Policy of 2003. In tandem with ICZM, various government initiatives were undertaken by the National Environment Management Council (NEMC) under a programme known as Tanzania Coastal Management Partnership (TCMP) (Katikiro et al, 2017).

MLT

The National Fisheries Policy (2015). The legal and regulatory framework that governs the fisheries sector consists of a number of laws and regulations. An important one is the National Fisheries Policy of 2015, which sets out to transform fisheries into a sector contributing significantly to socio-economic development. As stated in its vision, *'the overall objective of the National Policy is to develop a robust, competitive and efficient fisheries sector that contributes to food security and nutrition, growth of the national economy, and improvement of the wellbeing of fisheries stakeholders while conserving the environment'.* This policy is relevant because it places emphasis on the adoption of management practices to ensure the environmentally sustainable use of natural resources. Another important piece of legislation that supports the implementation of NEP (1997) is the Environment Management Act (EMA, 2004), which 'provides a legal and institutional framework for the sustainable management of the environment' (Kuboja, 2013). This Act, which repealed and replaced the Fisheries Act of 1970, applies to Mainland Tanzania. Besides providing general provisions, the Act imposes sovereignty over biological resources belonging to the Government as follows: '*all biological resources and their intangible products whether naturally occurring or naturalized within fisheries including genetic resources belonging to the Government in accordance with Article 27 of the Constitution, shall be conserved and utilized for the people of this country in accordance with the provisions of this Act and any other written law on biological resources*.. The Act also makes provisions for sustainable development, protection, conservation, aquaculture development, regulation and control of fish, fish products, aquatic flora and its products. The Marine Parks and Reserve Act (No. 29 of 1994) and the Marine Parks Reserves (Declaration) Regulations of 1999 are the main legal instruments that provide guidelines on the operation of Marine Parks (MPAs) in Mainland Tanzania. Furthermore, they outline roles and responsibilities of stakeholders and community members involved in the fisheries sector. Although the Tanzanian government has maintained the protected status of mangroves as territorial reserves, evidence shows that it has failed to manage them as well as it has managed terrestrial forest reserves. Placing the management of mangroves under forestry makes it difficult to handle coastal resources holistically. Unlike mangroves, coral reefs which support diverse marine ecosystems in Tanzanian waters, including over 500 species of commercially important fish and invertebrates, are regulated through fisheries regulations, and especially the Fisheries Act of 2003 and the Marine Parks and Reserves Act of 1994. The Tanzania Fisheries Research Institute (Act. No. 11, 2016) Another key institution is the Tanzania Fisheries Research Institute (TAFIRI). TAFIRI is a parastatal organization established in 1980 by the Tanzania Fisheries Institute Act Cap. 280. Headquartered in Dar es Salaam, and with offices in Mwanza, Kigoma and Kyela, the institute undertakes research in various areas of interest to the sector.

ZNZ

Fisheries policy in Zanzibar is now under the overall umbrella of the Ministry of the Blue Economy and Fisheries (MBEFZ). In Zanzibar's context, the Blue Economy (BE) covers the sustainable use of the sea, coasts and other water bodies as well as related resources, including underground and undersea waters, for socio-economic development while preserving the environment. In the implementation of this policy, five priority areas are defined, namely (i) fisheries and aquaculture; (ii) maritime trade and infrastructure; (iii) energy; (iv) tourism; and (v) marine and maritime governance (RGoZ , 2020). Although the Ministry of the BE is responsible for coordinating these five priority areas, it does not have directly responsibility for all of them and particularly the most economically important sector -tourism.

The Zanzibar Blue Economy Policy Objective (RGoZ, 2020) is aimed at promoting sustainable economic growth, environmental stewardship and improved livelihoods through the sustainable utilisation of the sea and other blue resources. Specifically, the policy seeks to:

- promote and improve sustainable economic inclusion within the BE priority areas and communities;
- strengthen coordination between multiple economic sectors within the BE framework;
- improve food and nutritional security through the sustainable management of blue resources;
- empower local communities, especially women and youth involved in BE activities;

- ensure the safety and security of Tanzania's maritime domain in coordination with the national maritime security agencies; and
- enhance financing and revenue collection through sustainable BE activities.

The BE Policy has been informed by sector-specific national policies and acts, including the Fisheries Policy (2014[13]). Fisheries and Aquaculture is one of the sector-specific strategic interventions. The key policy issue identified is limited commercialization of deep-sea fishing and aquaculture. The key policy statement is that the government shall optimise the commercialization of deep-sea fishing sector and the development of aquaculture while maintaining support for artisanal fishing. With regard to artisanal fishing the policy strategies are:

- *Promoting and modernising artisanal fishing practices* through identification and education as well as exploiting relevant technological developments;
- *Supporting relevant agri-businesses through diversified financing mechanisms and collective fishermen's organisations*; and
- *Improving nutritional security through better access to marine and fishery products*.

We were informed that a draft National Plan of Action to implement the SSF guidelines in Zanzibar has been prepared, and that a new fisheries policy is in the process of being drafted and, for example, gender issues will be considered.

2.2.2 Challenges and responses

Linkages and coordination between and among the various institutions are rather weak with no clear guidelines on how to operate jointly. Fishers' representation on MLT is placed mainly on Beach Management Units (BMUs). Nevertheless, the structure of these BMUs doesn't provide for wider fishers' proportional representation and participation in planning and implementation of resource management plans. Also, the number of registered BMUs is very low (75) compared to a total number of 275 landing sites (URT, 2015). Also, it seems there is disconnect between LGAs plans and what fishers on the ground want. This has been affecting performance of actors in all coastal fisheries Value Chains. On the other hand, WWF (2010) reported that BMU are weak particularly in terms of administrative system, technical capacity, leadership and management, accountability and transparency, capacity to engage and communicate with external bodies, as well as ability to function strategically as resilient and autonomous entity.

Weaknesses in organization and governance has propelled overcapacity, overfishing, illegal fishing and environmental degradation, jeopardising resource sustainability. The government acknowledges that, "*the current coastal marine fisheries are fully, if not over-exploited. For the capture fisheries, whether in marine or inland waters, the over-riding imperative is to ensure that controls are placed on fishing effort, to stem the increase in numbers of vessels and fishers which is leading to the inevitable "tragedy of the commons".*

Salient organizational and governance issues and outcomes in coastal fisheries in the country have been summarised by Mairi and Mgawe (2021) as follows:

i) Overcapacity, Overfishing, illegal fishing practices and environmental degradation have become endemic threatening resource sustainability and sustainable livelihoods in fishing communities.
ii) Trade-off between the zeal for increased income, food-fish supply, employment and export revenue from SSF on one hand, and resource sustainability on the other hand.
iii) Inadequate institutional capacity to meet the challenge of introducing effective fisheries co-management regime, taking note of existing complexities in SSF, multitude of fish species, large number of fishers, dispersed fishing grounds, and numerous landing sites. Likewise, most of Beach Management Units (BMUs) established across the country do not have capacity to exercise effective management of fishery resources in their jurisdictional areas.
iv) Inadequate financial resources for building institutional capacity and linkages of key institutions to meet resource management challenges, including development and implementation of Fisheries management plans.

[13] Although a new fisheries policy appears to be in the process of being drafted.

v) High cost of financing fisheries resource management in the absence of an effective mechanism for ploughing back part of the resource rent to cover the cost.
vi) Small number of government-employed fisheries extension workers to meet the demand, while the use of community-based change agents or social carrier of innovation is yet to gain roots.
vii) Low level (number) of users' participation and representation in policy making processes and setting of fisheries regulations reduces legitimacy of resource management tools including a few management plans in place.
viii) Fisheries Monitoring, Control and Surveillance (MCS) function consumes large amount of fund for resource management, but the system itself is not sustainable partly because of high enforcement cost in the midst of limited fund and low level of users' participation in resource management activities.
ix) Inadequate scientific data and information flow system to inform decision-making process for rational resource management and sustainable livelihood regime; and
x) The low involvement of NGOs and CBOs in advocacy and constituencies building for effective resource management planning and implementation.

Currently, the government is trying to mitigate the challenges by using different approaches such as development and implementation of Fisheries Management Plans (FMPs) for improved responsible fisheries and sustainable development as being advocated by the SSF Guidelines (FAO, 2015). Some of the Fisheries Management Plans that have been developed are:

1. Artisanal Small and Medium Pelagic Management Plan;
2. Octopus Fishery Management Plan;
3. Prawn Fishery Management Plan; and
4. Tanzania Tuna Management Strategy.
5. General Management Plan for Mafia Island Marine Park (MIMP);
6. General Management Plan for Tanga Coelacanth Marine Park (TCMP);
7. General Management Plan for Mnazi-Bay and Ruvuma Estuary Marine Park (MBREMP);
8. General Management Plan for Dar es Salaam Marine Reserves System (DMRS);
9. General Management Plan for Menai Bay Conservation Area (MBCA);
10. General Management Plan for Tumbatu Marine Conservation Area (TUMCA);
11. General Management Plan for Pemba Channel Conservation Area (PECCA);
12. General Management Plan for Changuu – Bawe Marine Conservation Area (CHABAMCA);
13. General Management Plan for Mnemba Island Marine Conservation Area (MIMCA).

2.2.3 Issues related to organization and governance at all levels

2.2.3.1. Input supply

The private sector is the one supplying fishing inputs such as fishing gears, canoes and fish handling facilities. However, respondents observed that lack of capital associated with inadequate credit facilities is a major issue affecting their performance. In the meanwhile, there is an increasing trend towards establishment of community-based microcredit schemes, especially the Village Community Banks (VICOBA). Fishers are being coached on how to establish and manage the VICOBA mostly by the Non-Governmental Organizations such as the WWF. In some fishing communities such as Somanga and Songo Songo, the microcredit scheme has empowered a large number of women, and thus providing a light on what could be the way forward in addressing capital accessibility challenge.

2.2.3.2. Harvesting

The majority of actors at this node are primary fishers, especially owners of fishing canoes, skippers and crew on board fishing canoes and suppliers of inputs together resource management agents. With regards to organizational and governance, these primary fishers do not have their own organizations or representation framework. The only exception in this generalization is the prawn fishers in Pangani district who decided to form their own organization, which works in collaboration with BMU (URT 2022 Prawn fisheries management

plan). The weaknesses in terms of organizational and governance at this node have led to persistence of overcapacity, overfishing and illegal fishing.

The majority of respondents in fishing communities were explicit over declining Catch Per Unit Effort (CPUE) as well as Landing Per Unit Effort (LPUE). Similarly, they experience reduced size of individual fish and disappearance of certain species from fish catches. The moratorium imposed on shrimp trawling between 2007 and 2017, and the one on sea cucumber fishing in MLT, which is still in place are testimony of gaps in fisheries co-management system in place.

In view of the situation, it is important to build institutional capacities of the various key institutions. Efforts have to be made in helping fishers to form working groups based on their common interest and areas of specialization within their respective value chains. The profiling of such working groups would allow for proportional representation towards improved fisheries co-management, and thus reducing resource management challenges. This does not preclude the need for building capacity of BMU and VFCs as an urgent intervention measure.

2.2.3.3. Landing

The level of interaction between fishers in communities, fisheries extension officers, and local leaders is at least visible at this node. for obvious reasons. It is at the landing site where transaction between primary fishers and traders is made resource rent is being collected and shared. Weak organizational and governance structure coupled with lack of Standard Operating Procedures tend to delay transactional processes, and thus impairing safety and quality of perishable fishery products. Also, there is no practical evidence that part of resource rent is being ploughed back to improving the landing sites.

2.2.3.4. Processing

Consumer preference in domestic market is shifting from cured to fresh fish consumption (Mgawe, 2017). The economics of selling fish in its fresh condition becomes apparent when production cost and output doing traditional processing are taken into consideration. The changed landscape is challenging the country to catalyse technical improvements particularly the Cold Chain Development (CCD).

With regards to organization and governance, fishers at this node of VC mostly operate on individual basis. Expanding the reach and scope of the BMUs to beyond landing site management, could perhaps help in organizing them though provision of processing infrastructure for joint use and management could trigger interest for working together in order to secure greater benefits from their products. The government suggest that introduction and devolution of effort management to community level would seem to offer potential for more sustainable fisheries, although until now there has been little effort to develop and test different approaches or models (URT 2016).

2.2.3.5. Distribution

Consumer preference in domestic market is shifting from cured to fresh fish consumption (Mgawe, 2017). The economics of selling fish in its fresh condition becomes apparent when production cost and output doing traditional processing are taken into consideration. The changed landscape is challenging the country to catalyse technical improvements particularly the Cold Chain Development (CCD).

With regards to organization and governance, fishers at this node of VC mostly operate on individual basis. Expanding the reach and scope of the BMUs to beyond landing site management, could perhaps help in organizing them though provision of processing infrastructure for joint use and management could trigger interest for working together in order to secure greater benefits from their products. The government suggest that introduction and devolution of effort management to community level would seem to offer potential for more sustainable fisheries, although until now there has been little effort to develop and test different approaches or models (URT 2016).

2.2.3.6. Marketing

The market for coastal fisheries products is basically segmented into local, regional and international markets. Almost all reef, medium and large pelagic from coastal fisheries are sold and consumed in local market including tourist hotels. On the other hand, high value products such as prawns / shrimp and Octopus are traded in international markets whereas large percentage of dried anchovy and anchovy-like is sold in regional markets. This contrasted situation reveals significant issues that are outlined in the SWOT/C matrix presented below regarding the market environment (Table 2.12).

Actors	Strengths	Weaknesses
Suppliers	Predictable supply pattern enabling fishers to supply fish consistently.	Dispersed production & Disorganized
Intermediaries	Increasing number of traders	Less organized, lack adequate capital and thus rely heavily on few available sponsors or purchasing on credit (*mali kauli*)
Customers	Expanding market size due to population growth and export trade	Majority feels that eating fish such as anchovy is a sign of being a loafer.
Competitors	Cheap source of animal protein, especially the anchovy and sardine like species.	Lack of coordinated promotion campaign
Macro-Forces	**Opportunities**	**Threats/Challenges**
Political/Legal	Expanding regional market due to improved political climate and security, as well as easing of transport	Numerous regulators with overlapping functions including multiplicity of levy
Economic	Increasing demand for fish in local and international markets would enable fishers secure greater benefits	• Lack of capital/ credit facilities is curtailing fishers from securing greater benefits from coastal fisheries • Lack / dilapidation of market infrastructure
Social-cultural	Urbanization changing consumers' preference say from cured to fresh fish	Failure to diversify and rebrand some products such as marine anchovy could result into high food fish losses
Technological	Technology such as Mobile phone technology will continue easing transaction among different actors	Cold Chain underdevelopment curtails development of coastal fisheries, and thus rural transformation
Ecological	Strengthening of management regime would improve fisheries resource sustainability	Increasing demand for quality and safe fish could lead introduction of capital-intensive processing facilities displacing SS fishers.

TABLE 2.12 SWOT ANALYSIS REGARDING THE MARKET ENVIRONMENT OF COASTAL FISHERIES IN THE URT
(source: team elaboration)

2.2.3.7. Consumption

The organization and governance at this node is rather complex because it occurs mostly at household level. However, low level of consuming anchovy and marine sardine-like fish is associated with high food fish loss and waste due to bulk production on one hand and constrained consumption on the other hand. This is taking place amidst high level of malnutrition among large segment of the population. In this regard, the importance of promoting anchovy consumption cannot be overemphasised.

2.3. A VCA4D multi-scale approach for a system divided in two sub-systems

All the preceding sections indicate the degree of complexity encountered in the analysis of coastal fisheries in Tanzania. Two systems are acknowledged, MLT and ZNZ, both systems divided into sub-systems, related to several sub-chains.

For macro-economic reasons, it is of interest to consolidate our findings for MLT and ZNZ, as well as for the whole country, URT. Similarly, for each region, it is meaningful to work at a macro-scale when a Blue Economy strategy must be elaborated and implemented associated to a set of policies.

On the other hand, it is also quite relevant to disaggregate these macro-systems on a sub-region lower scale (for instance only coastal regions/districts in MLT) or per sub-chain, to better explore each of the sub-chain-case study, and propose specific recommendations, introduced with a specific SWOT analysis for each sub-chain.

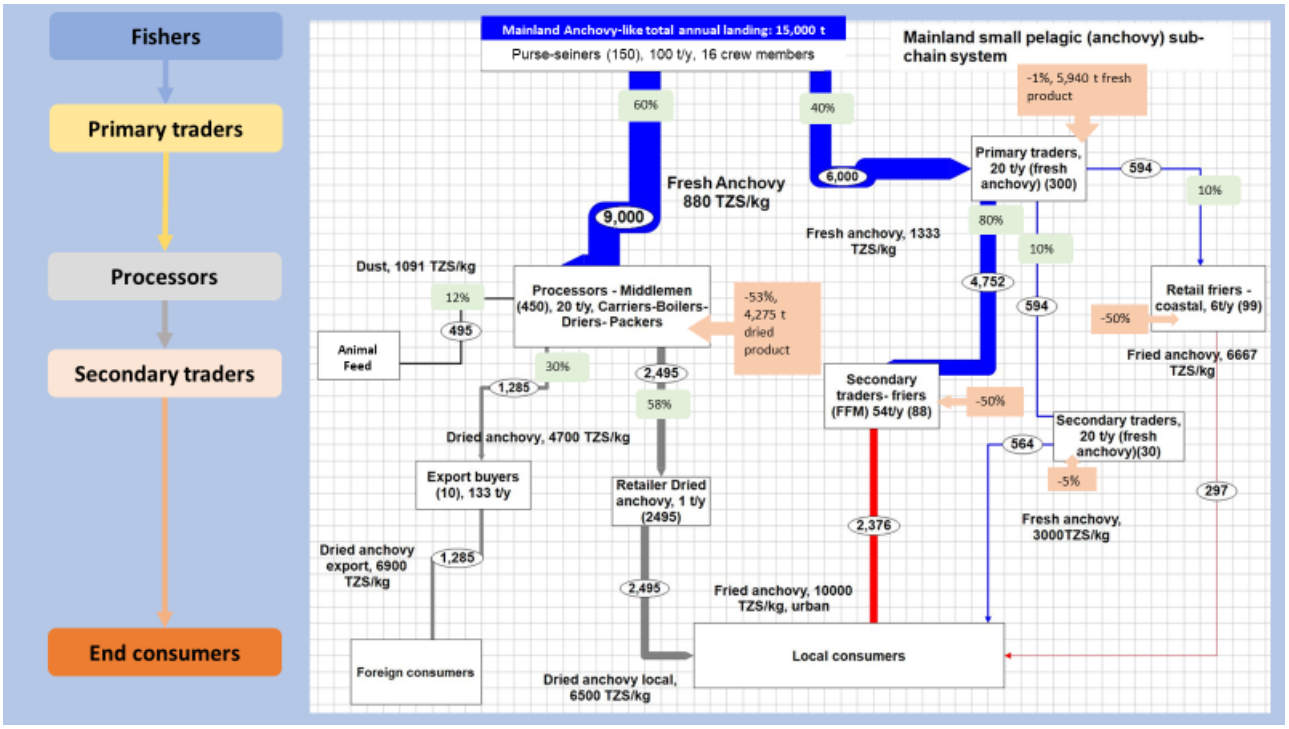
To address these multi-scale issues, we have carried out very specific analytical work on each sub-chain, to understand how each is functioning, a similar approach than the one used by Sofreco (2018) and as recommended by Linton (2021). We have also considered the two regions of ZNZ and MLT separately.

Therefore, the functional analysis of each of the sub-chain is hereunder presented under a graph format (derived from the STAN software used for Substance and Material Flow Analysis[14]), highlighting the direct actors of the VC, the relative mass flows between them (the arrow is proportional to the flow size), price flows, and process yields (Figures 2.15 - 2.18). Each actor type is characterized by the number of units encountered (using the software AFA), the annual volume of product per year. A subsequent functional analysis for each sub-chain has been used for the environmental and economic analyses. A consolidation at the higher macro-scale was conducted after the sub-chain successive analyses to address the economic framing questions.

As a result, SWOT analysis were conducted, specific to each sub-chain, and allowing to identify the trends, and the major players. These SWOT are also resulting from the work conducted in the following sections of the report, this is the reason why they are presented in the last part of the report and its associated appendix (Section 7).

[14] STAN Software: https://www.stan2web.net/

A)



B)

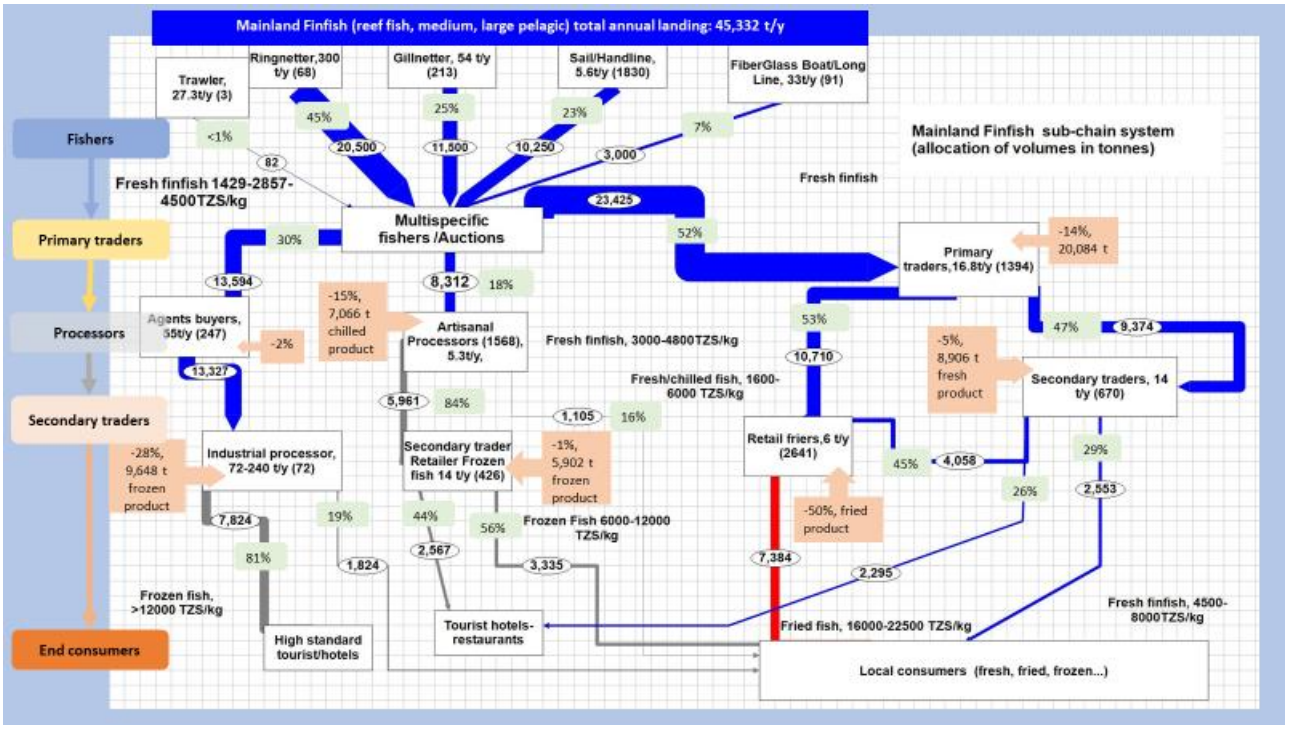
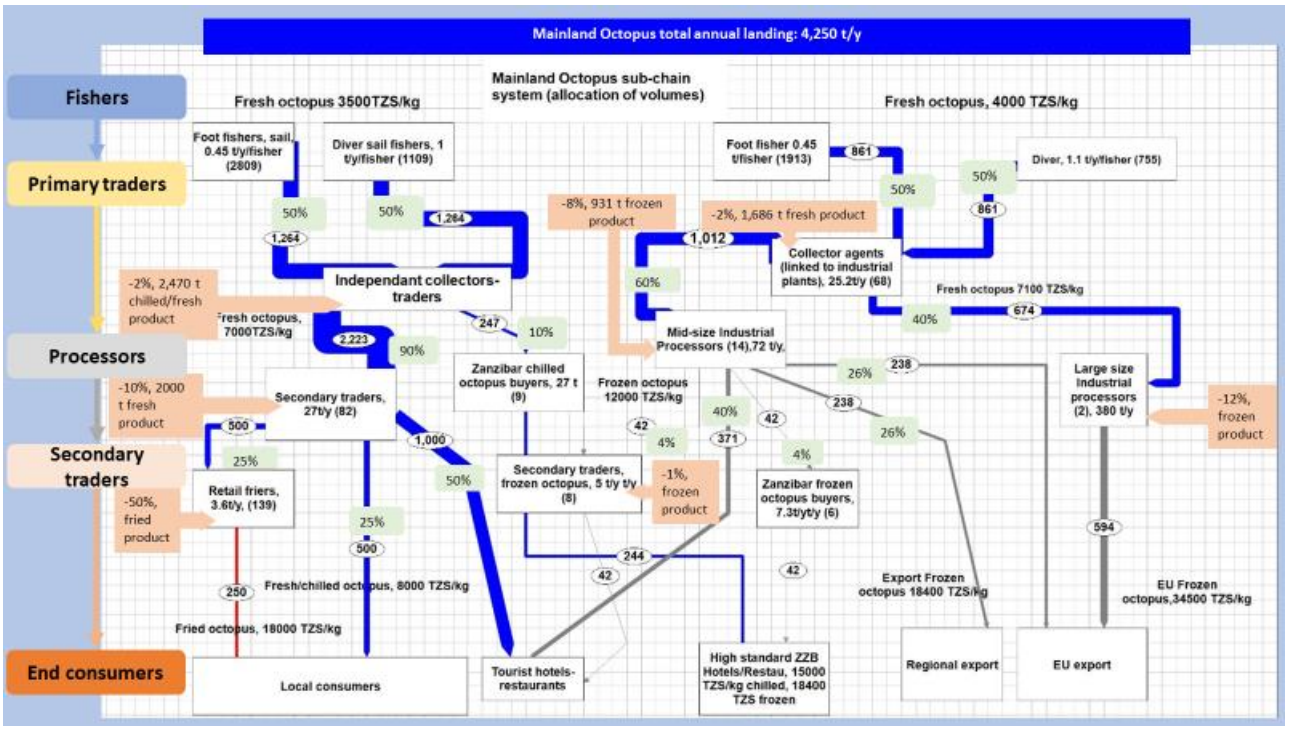


FIGURE 2.15 FLOW SPECIFIC SYSTEMS AND FUNCTIONAL ANALYSIS IN THE MLT COASTAL FISHERIES VALUE SUB-CHAINS A) SMALL PELAGIC (ANCHOVY-LIKE; B) FINFISH (CONTINUES)

Legend: Arrow are proportional to mass flows (tonnages indicated in t). Colours are indicating the type of products: blue=fresh (or chilled), grey=frozen; red=fried. Each actor category is described by its name, its annual volume of biomass input, and the estimated numbers of units for the actor category. Yields (%) for the main operations and prices (in TZS/net weight kg) are specified through out the chain, from the primary producers (fishers) to the end-users.

A)



B)

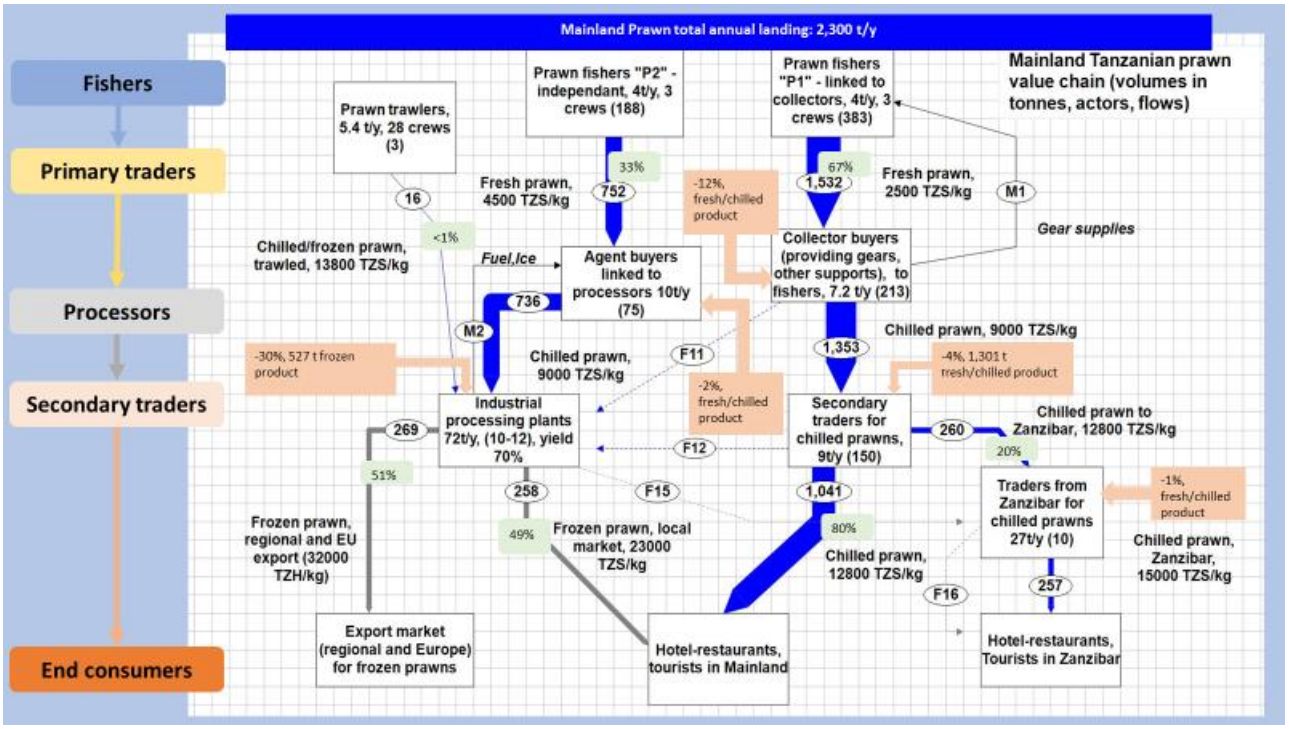
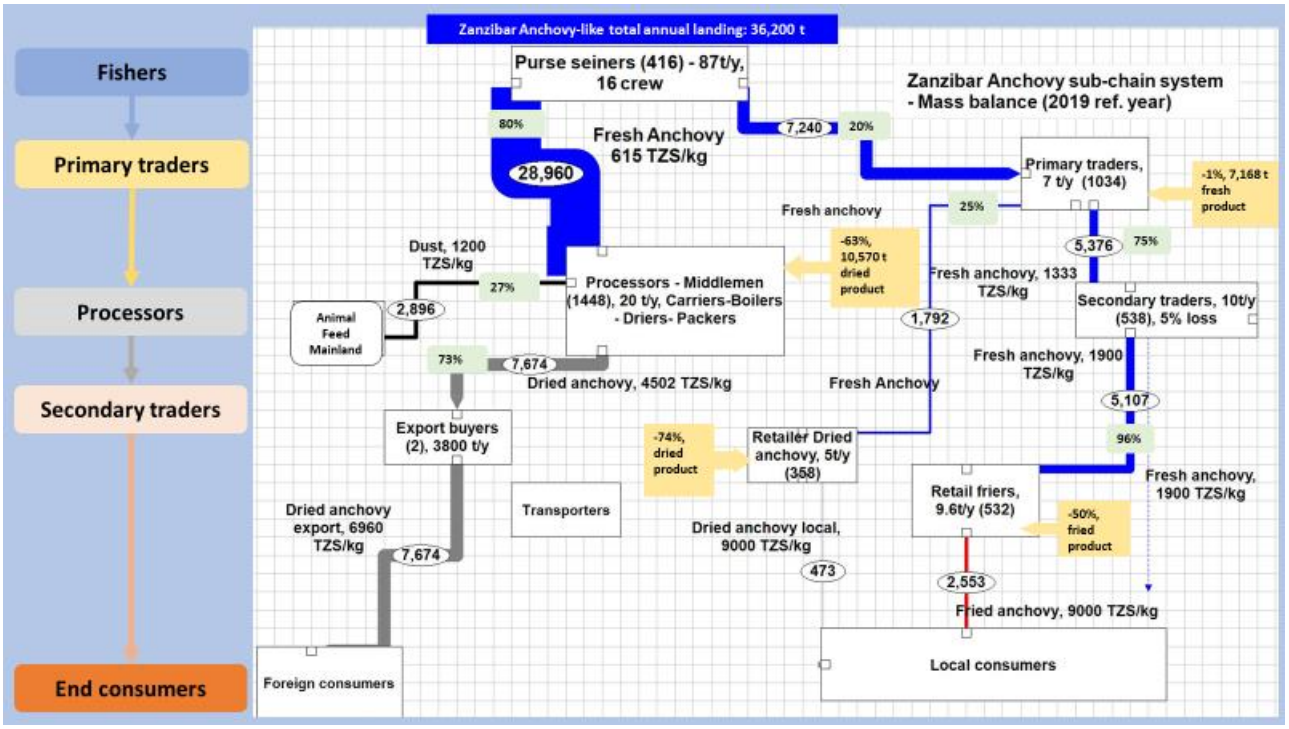


FIGURE 2.16 (CONTINUES) FLOW SPECIFIC SYSTEMS AND FUNCTIONAL ANALYSIS IN THE MLT COASTAL FISHERIES VALUE SUB-CHAINS A) OCTOPUS; B) PRAWN (CONTINUED)

Legend: Arrow are proportional to mass flows (tonnages indicated in t). Colours are indicating the type of products: blue=fresh (or chilled), grey=frozen; red=fried. Each actor category is described by its name, its annual volume of biomass input, and the estimated numbers of units for the actor category. Yields (%) for the main operations and prices (in TZS/net weight kg) are specified throughout the chain, from the primary producers (fishers) to the end-users.

A)



B)

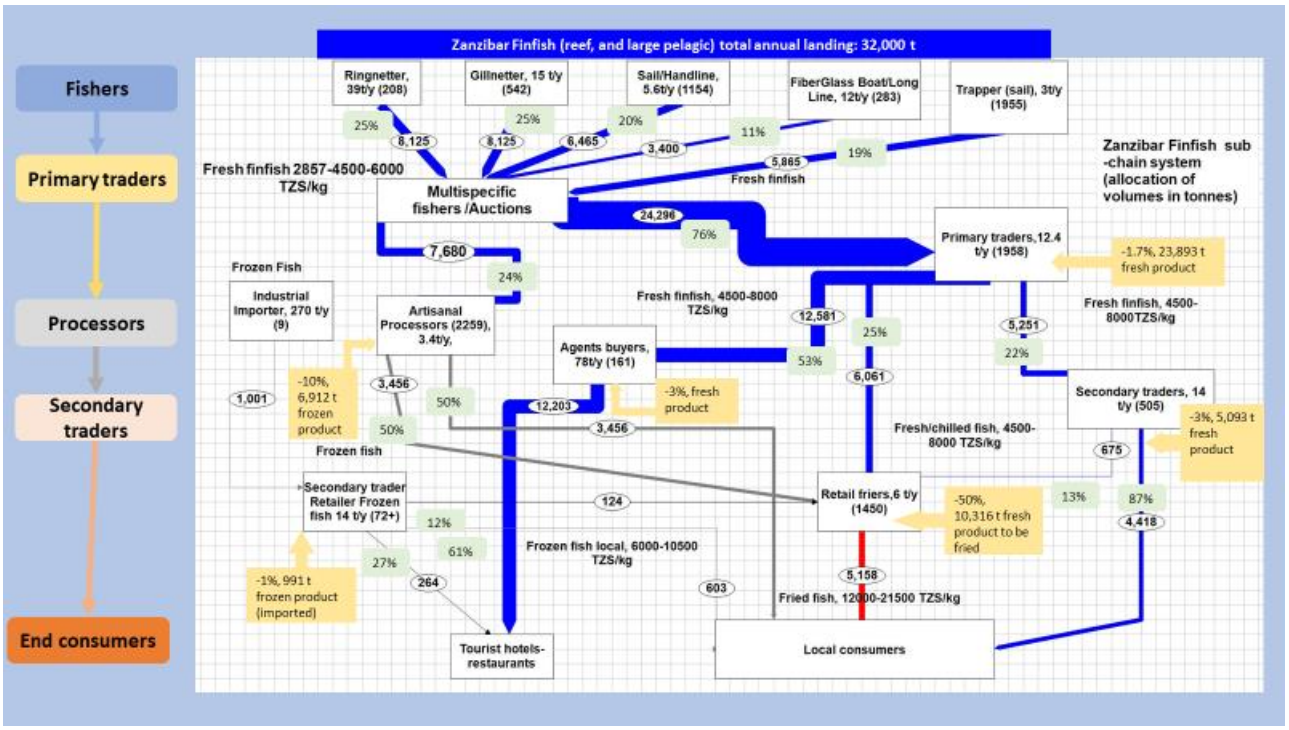


FIGURE 2.17 FLOW SPECIFIC SYSTEMS AND FUNCTIONAL ANALYSIS IN THE ZNZ COASTAL FISHERIES VALUE SUB-CHAINS A) SMALL PELAGIC (ANCHOVY-LIKE; (CONTINUES)

Legend: Arrow are proportional to mass flows (tonnages indicated in t). Colours are indicating the type of products: blue=fresh (or chilled), grey=frozen; red=fried. Each actor category is described by its name, its annual volume of biomass input, and the estimated numbers of units for the actor category. Yields (%) for the main operations and prices (in TZS/net weight kg) are specified through out the chain, from the primary producers (fishers) to the end-users.

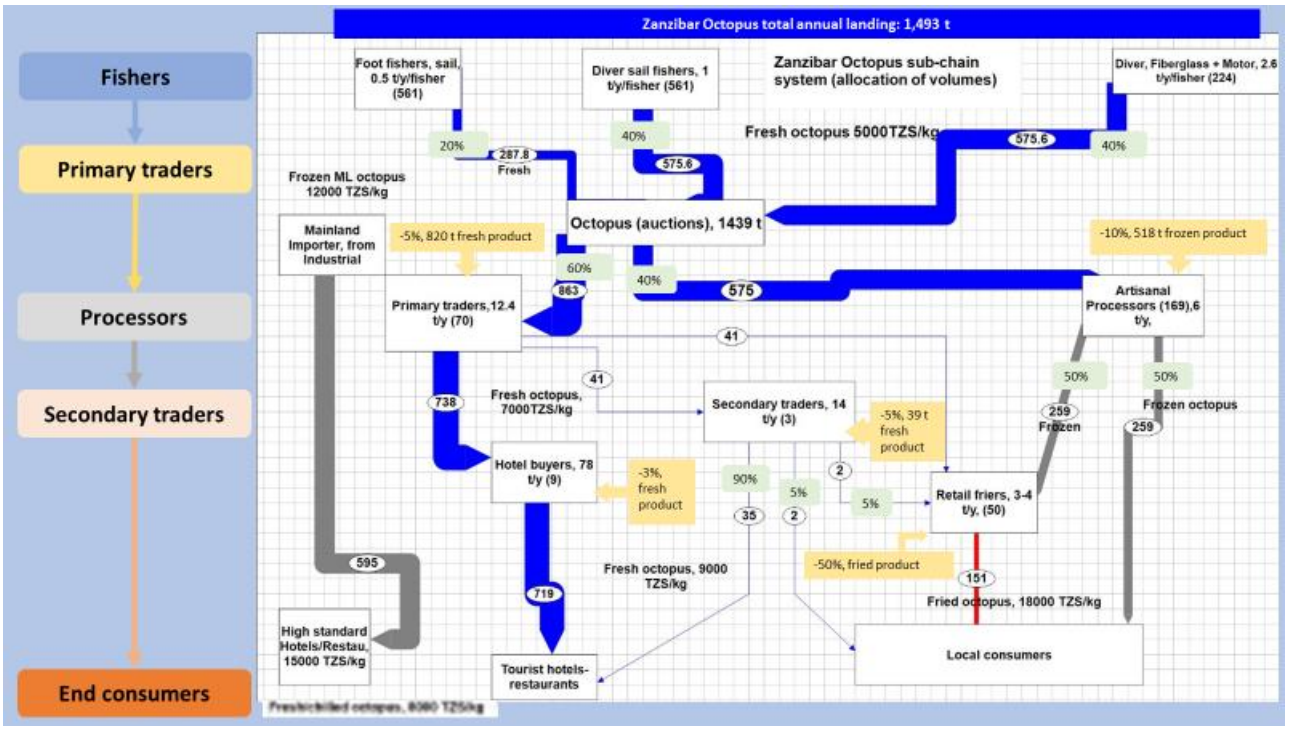


FIGURE 2.18 FLOW SPECIFIC SYSTEMS AND FUNCTIONAL ANALYSIS IN THE ZNZ COASTAL FISHERIES VALUE SUB-CHAINS A) OCTOPUS (CONTINUED)

Legend: Arrow are proportional to mass flows (tonnages indicated in t). Colours are indicating the type of products: blue=fresh (or chilled), grey=frozen; red=fried. Each actor category is described by its name, its annual volume of biomass input, and the estimated numbers of units for the actor category. Yields (%) for the main operations and prices (in TZS/net weight kg) are specified through out the chain, from the primary producers (fishers) to the end-users.

3. WHAT IS THE CONTRIBUTION OF THE VALUE CHAIN TO THE ECONOMIC GROWTH?

3.1. Methodology

3.1.1 Description of the overall methodology

The software AFA is used for the economic analysis, to address the questions related to the Framing Question FQ1, What is the contribution of the value chain to the economic growth? The Framing Question FQ2 related to the Inclusiveness is addressed using AFA results combined with specific calculations and qualitative information, derived from primary and secondary data.

- A booklet of appendices attached to the economic analysis (Sections 3 and 4, respectively Economic growth and Inclusiveness) was created. To facilitate the access to the numerous appendices, the information (including tables and figures) attached to the appendices) are numbered with the section numbers of these sections 3 and 4. There are referred in the main as Appendix Section 3 or Section 4. It is recommended to use the navigation tool in the contents of the appendices to find the right place for any particular information.

Primary data (see Appendices Section 3.1.1 on sub-chains) were obtained by field work from field missions performed by the team (November 2021, January 2022, May 2022) and additional visits and interviews (semi-structured) conducted by national experts both in MLT and ZNZ based on checklist / questionnaires (see Appendix Section 3.1.1 Questionnaires).

Secondary data were also used, from the official sources (Fisheries Frame surveys, Annual fisheries reports), from the scientific literature, and from some key reports directly related to value chain assessments of seafood in Tanzania.

Macro-economic national data for MLT were obtained from the Bank of Tanzania (BoT), the National Bureau of Statistics (NBS), Ministry of Finance and Planning in Dodoma, and from other sources. With regards to ZNZ, macroeconomic data used were obtained from the Office of the Government Statistician (OCGS)[15], Sector Ministries, Departments and Agencies (MDAs), and from key informants interviewed especially in May 2022.

The approach has been systemic and successive, starting from the functional analysis (see Section 2) adapted at each sub-chain, and computation of operational counts for each actor and each operation. Actors are identified as economic units, which means that in some cases, it could be more than one person, in people numbers. For instance, for fishers of small pelagic purse seiners, the fishing unit could represent a lead vessel, and associated small boats, dinghy, lamp holders. On average, at least 16 people are involved including crew, skipper, and the boat owner. In processing activities, the unit is the level of an enterprise, formally registered or not, therefore the unit could be an industrial plant with up to 50 people employed, or a self-employed lady, frying fish and selling fish in the streets.

Data for operational accounts for each category of actors are computed in the identified sub-chains, sub-categories of actors are created, specific to each sub-chain and allowing the use of the AFA software, with distinct operations. For instance, in MLT, the octopus fishers are not only divided in the two categories, divers, and foot fishers. Two different situations are considered as two sub-categories, the octopus fishers (foot and divers) using a transportation boat (and therefore selling the octopus at 3,500 TZS/kg (to cover transportation service), and the case of fishers independent having to cover their own boat cost, this resulting in the process of 4 sub-categories (Appendix Section 3.1 Octopus MLT).

The approach of the "typical case", the average case, representing a majority has been adopted for each sub-category of actors and operations, as many different situations, practices are observed. It is impossible to compute all of them reflecting their diversity. Therefore, for each "typical case", a brief specific description is given in the tables in the appendices (Appendix Section 3.1 Sub-chains). An annual volume of commodity has been defined per actor, leading to an estimation of the number of actors for each category. The estimates are compared to annual official statistics when these data exist and adjusted accordingly, to reflect the potential

[15] Office of the Government Statistician in ZNZ:
http://www.ocgs.go.tz/php/ReportOCGS/ZNZ%20In%20Figures%202020.pdf

"true" macro-situation. Consequently, the initial national volumes of production (by the fishers) are corrected to reflect the reality and the other statistics. For instance, in ZNZ, the reported official volumes of small pelagic (anchovy-like) is around 2,000-3,000 t/y (MoBEFZ, 2020b), whereas the reported volume of export of dried anchovy for the same years, is 6,000-7,000 t of dried fish, which means at least 3 times more of fresh anchovy captured and landed in ZNZ. After discussion with the representants of the department of fisheries in both MLT and in ZNZ, it was generally recognized that the fisheries frame surveys recording the numbers of gears, vessels constitute one of the most reliable sources of information. Our calculations are therefore considering these official figures more than the reported official volumes of production, considered as under evaluated. The numbers of actors (units, including fishing units) are resulting from the calculations, how much of the volumes (input) is actually operated by each actor. The numbers of fishers are the result of a simple multiplication, the number of fishing units multiplied by the number of on-board crew fishers.

Therefore, each sub-chain led to its own table of actors, and operations, using acronyms (cf. Appendices Section 3.1.1 Sub-chains). The cascade of prices along each value chain had been adjusted according to the primary and secondary data, and to be consistent, from the fishers down to end-users, seafood consumers.

The construction of sub-chains in AFA software was first made and consolidated for MLT. It served as a basis for the construction of the coastal fisheries sub-chains in ZNZ, then it was adjusted with specific ZNZ findings (May 2022) primary data. Specific actors had to be created in ZNZ as well as the description and consideration of the specificities for the operating systems and resulting costs. For instance, specific ZNZ actors related to the tourism market had to be created and described for their operating system. Sometimes, potential similar actors such as purse seiners, had to be adjusted in ZNZ, as some parameters are varying, between MLT and ZNZ: volume of catch per day, number of sea trips/year, fuel costs, etc. Similarly, some MLT actors are not present in ZNZ, such as the industrial processors.

3.1.2 Specificities of the economic analysis at the macro-economic level

Due to the numerous sub-chains that are considered in the economic analysis, a consolidation process is done for ZNZ, for MLT and at the URT level, using a data base on Excel (see Appendix 3.2 section 3.2.2 Data base).

The total effects, international competitiveness and viability are estimated for the sub-chains in MLT using Tanzanian National official data for Mainland, namely the Input/Output table (2015)[16] and computations for the evaluation of the indicators for the allocation of the effects due to Intermediate Goods and Services (IGS) on the national economy (Appendix 3.1 Sub-chains in MLT). In ZNZ, no Input/Output table is available[17]. A consolidated one with MLT authority is under discussion (May 2022, field trip). A Supply/Use table could be obtained from the OCGS. Interestingly, this table shows the very significant rate of importations of goods (more than 30%) from MLT to ZNZ. The evaluation of indirect and total effects has never been reported for fisheries in ZNZ. Consequently, in the absence of a ZNZ-specific Input/Output table that allows these calculations, the decision was taken to calculate the indirect value added of the fisheries sub-chains in ZNZ using the MLT Input/Output table as a first estimation.

For the future, it is recommended to produce such a table for ZNZ, or/and to refine the rules for estimating those indirect effects between MLT and ZNZ economies.

Distribution of incomes, jobs, wages were assessed in each sub-chain by using the AFA results, as a basis. These were compared to the "current practiced" minimal wage[18], to calculate the number of Full Time Equivalent employment (FTE) per each category of actors, through the total numbers of wages, boat ownerships (for the boat owner and Net Operating Profit (NOP)(for the self-employment). The average income

[16] Tanzania National bureau of Statistics: https://www.nbs.go.tz/index.php/en/census-surveys/national-accounts-statistics/na-statistics-by-subject

[17] Input/Output Table (PIOT) should be part of an ongoing consolidation process between MLT and ZNZ for the national accounts (oral comm. May 2022 from OCGS officer). The two bureau of statistics are involved in this process, together with the Tanzanian Revenue Authority who consolidates the counts for the whole URT (https://www.tra.go.tz/).

[18] It should be noted that there is no real official minimal wage as referred in the website https://africapay.org/tanzania/salary/minimum-wages. Currently, the authorities are using the figure we took of 300,000 TZS/ month in calculations related to employments. It was also confirmed by respondents in our interviews. But, this wage cannot be truly referred as the official minimal wage for Tanzania, neither can the minimal wage proposed by the Africapay website. This situation is similar in Zanzibar.

(monthly income in USD) was also estimated for each category of actor, and compared to published data on this aspect, and the official wage rate.

The specific results of the economic analyses are presented in detail for each sub-chain in the Appendices (of Section 3.1.1 Sub-chains). This Section 3 presents the main findings in these sub-chains, the consolidated ones for MLT and for ZNZ. Each VCA4D frame questions is successively addressed for MLT, ZNZ and the URT.

In view of the extended scope of the study (multiple sub-chains, actors and two systems), most of the results presented in the main text are using aggregated and relative indicators of the VCA4D frame to allow comparisons and draw conclusions. Results in absolute numbers are available in the appendices, under tabulated formats , including additional figures (Appendices attached to the Section 3.2 and 4).

3.2. What is the contribution of the value chain to economic growth?

3.2.1 Profitability & Sustainability of key actors

Please note that the monthly income per category of actors are also presented and discussed in Section 4 (Inclusiveness), Table 4.2.

3.2.1.1. Profitability & Sustainability of fishers

Specificities of fishers operational accounts

Both in MLT and in ZNZ, the fisheries are almost 99 % artisanal small-scale fisheries, corresponding to the FAO criteria of Small-Scale Fisheries (SSF) (URTMLF, 2021). The number of motorized vessels is still limited, with outboard engines, imported, of 15 to 40 HP. Most fishing vessels are wooden boats, built in Tanzania, of a variable length, operating with sails, and paddles for the smallest (canoe type). Some fiberglass boats are also operating, their number will increase in ZNZ, linked to the initiative of Ministry of the Blue Economy and Fisheries (MoBEF) under a World Bank Covid recovery fund (RGoZ, 2020; Cpt Hamad, oral presentation, 2021, 2022).

The gears used are very diversified, from one category of fishers to another, the degree of specialization is limited for the fishers. Using different gears (for example gillnets, handlines or longlines), fishers may target different species, categories of fish (reef, pelagic, demersal), according to the season, the market trends, and their own needs, as recently indicated by Taylor et al. (2022).

We had to differentiate the fishers through the main target species for the analysis of the sub-chains. But it is very likely that one fisher in MLT or in ZNZ identified for instance as “small pelagic anchovy fisher” may occasionally or on a regular basis be operating as a reef or large pelagic fisher, or octopus/prawn fisher when it is the season.

The estimation of fisher’s profitability and income follows the same rules that are established in fisheries, costs are divided into variable and fixed costs, and following the sharing system for the incomes generated for the fishers (Le Floc’h et al. 2008, Le Floc'h 2009, Daurès et al. 2013, García-de-la-Fuente et al. 2013, Meunier et al. 2014) (Figure 3.1).

For each fisher category, the first key variables are related to the average catch per trip at sea, the number of trips at sea per year, the number of crew members and their status (ordinary crew member, skipper, assistant skipper, boat owner…) (Figure 3.1). We tried to reflect an average situation, not the one mentioned by fishers as the “good catch”, which in this latter case, would lead to huge volumes of catches per year and for the whole fleet, by far beyond the annual figures we considered.

The landing costs are mainly related to the auction fees (about 1 to 3 %), when the fisher market their fish through the auction, and the local taxes, for instance 1 % for the BMU in MLT, this tax does not seem to be so well established in ZNZ. The cost and revenue sharing system rules vary a lot between fishers. The common fees deduced from the Gross profit include the fuel, the bait costs and sometimes small accessories that need to be replaced for the gears. The maintenance fees (services provided) for the engine, boat and gears are sometimes covered in part by a percentage of the “Gross profit to be shared”, or only covered by the boat

owner after the gross profit is shared between crew members and the boat owner. In general, the part of "Gross profit to be shared" attributed to the crew could be varying between 50 to 75 % of the total share. The boat owner ship covers the costs of depreciation (engine, boat, gears) and licensing of the vessel, when it is done.

The average monthly income for fishers is calculated out of the wages (from the share system) and the average number of crew members onboard.

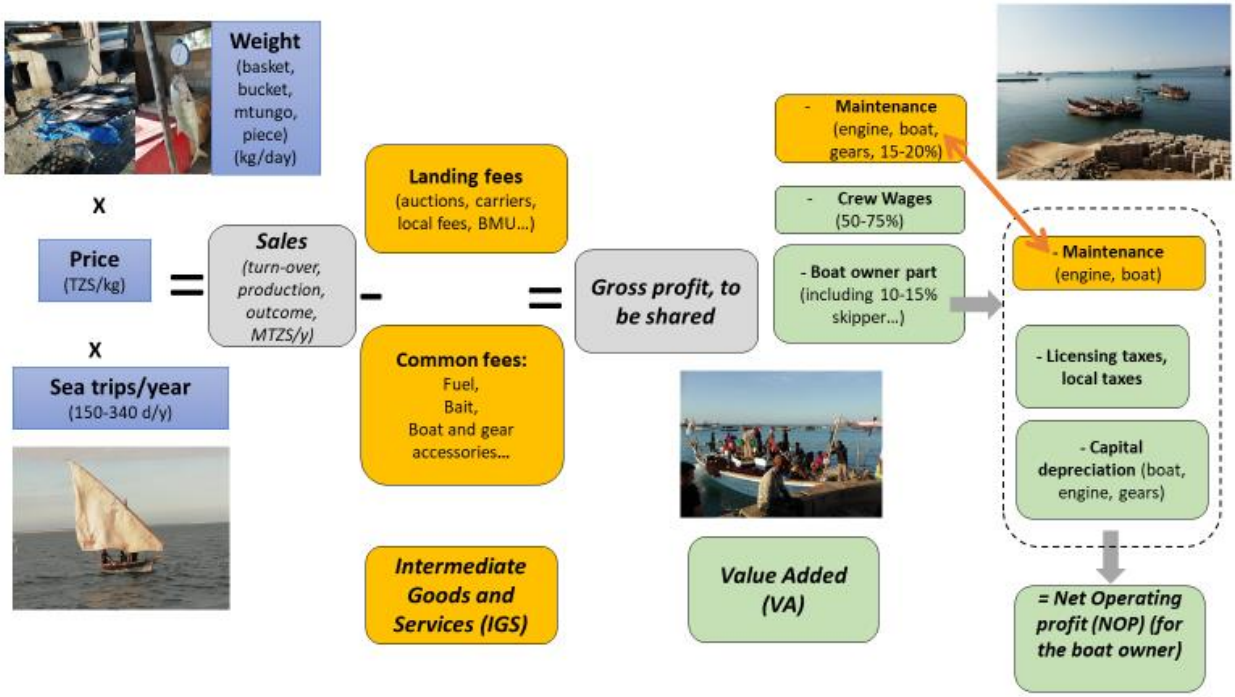


FIGURE 3.1 FISHING ACCOUNTING APPROACH (ADAPTED FROM LE FLOC'H 2009, LE GOUVELLO 2019).
LEGEND: ORANGE BOXES: FEES ACCOUNTED IN THE INTERMEDIATE GOODS AND SERVICES – GREEN BOXES: ACCOUNTED IN THE ESTIMATION OF THE VALUE ADDED. MAINTENANCE COSTS CAN BE FIXED OR VARIABLE, SHARED WITH THE CREW AND BOAT OWNER, OR CAN BE JUST COVERED BY THE BOAT OWNER.

The Net Operating Profit (NOP) is calculated as a final result, and is corresponding to the boat owner part, deduced with all the preceding costs. The economic return expressed as the Return on turnover (NOP/Output in percentage) is therefore calculated for the boat owner. But on small size fishing vessels using sails, the resulting profit is often reduced to a minimal percentage, as the profit has been previously shared between the crew members. Sometimes the vessel ownership (canoe type) can be shared by the 2-3 onboard fishers. In some cases, fishers could be considered almost as service providers or employees[19] to primary trader actors, as in the Octopus and Prawn sub-chains in MLT. The fishers pay the service for transportation, the transportation boat belongs to the collectors. Therefore, they have only to cover the costs of the accessories for fishing as foot fishers or divers. Sometimes, like in the Prawn fisheries, all the gear costs are also covered.

This is the reason why we considered that the comparison of the final incomes generated for each fisher is the most reliable indicator to reflect the reality of the profitability of fishery sectors.

In terms of capital, fiberglass boats are estimated at 14 MTZS for a life span of 20 years, equipped with 15 HP Outboard engines purchased at 4.5 MTZS for 4-5 years. Large (more than 9 m length) wooden boats (for instance dhows for gillnetters) are purchased at 9 MTZS for 10 years, equipped with 40 HP engine, purchased at 9 MTZS lasting 10 years. Smaller non-motorized boats, duggout canoe type are purchased between 0.3 to 1 MTZS, depending on the boat size, and lasting up to 10 years. But a high degree of variability was expressed by fishers, depending on the maintenance intensity (paid as a service) that was devoted to the boat, engine,

[19] In this case of Octopus or Prawn fishery in MLT, fishers have entered into an informal reciprocal arrangement where they agree to sell their catch to the collector and the collector provides the service of a boat at a cost (further details in Appendix of Section 3.1 Sub-chains Octopus and Prawn MLT)

and the gears. If good maintenance, the life span is expanded, and a second-hand market is practiced. The gears and various fishing accessories represent a significant part of the investments, their life span is limited, usually less than 4 years. Most of the time, we included them in the IGS, for a life span of one year.

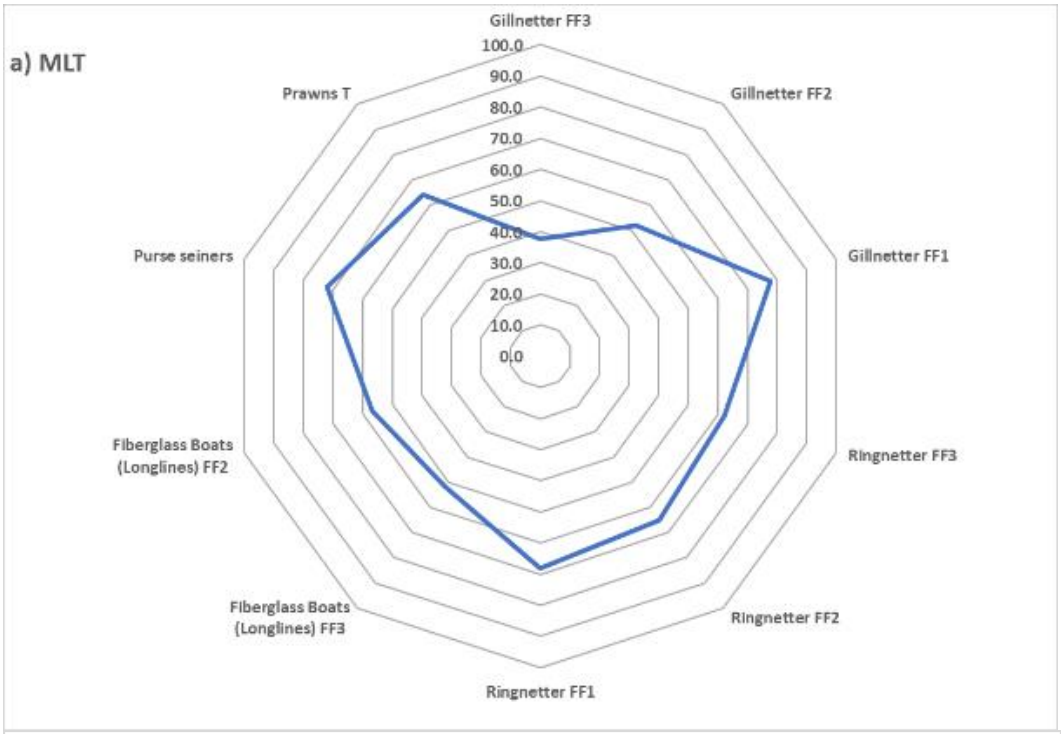
We considered 19 and 18 cases corresponding to various situations for fishers in MLT and in ZNZ, respectively. We therefore acknowledged a high degree of variability in all these variables and the subsequent calculations for fisher's profitability (Tables in Appendix of the Section 3.2.1.1).

Profitability results for fishers

The profit for the boat owners varies from 4 % to 36 % in the situations we studied (Appendix of Section 3.2.1.1). But in some cases, as reported by fishers, it can be down to negative figures, if the prices are down, or the trip catch less. In both MLT and in ZNZ, the Return on turnover is better in situations of artisanal fisheries using sails, as investments are lower. In fiberglass motorized boats, using longlines, the boat owner part is lower than the income generated for each crew member. But in this case, most of the time, the boat owner is also on board, and will therefore double his revenue. In the other cases, the boat owner's monthly revenue is comparable to that of the crew member, and ranges 1 to 3 times the minimal wage that we used. Monthly profit generated for the boat owners (expressed in USD/month) can be very significant for ring net boat owners (1,800 USD/month) and could explain the auto-financing capacity as reported by fishers in the field, even though the catch volumes considered for ring netters in ZNZ is much lower than the ones observed in MLT (Nov. 2021, field data).

When the boat is motorized, similar profiles were found between MLT and ZNZ, the fuel cost represents 27% (when a sail is also used, as for Gillnetters) to 94% of the IGS costs for cases associated with fiberglass boats, ring netters or purse seiners (Figure 3.2). This last finding emphasizes fact that good pricing of the landed fish coupled with high trip catch rates are key factors for the profitability of Ringnetters, fishers using motorized fiberglass boats and purse seiners, although this observation is not as clear in MLT.

A

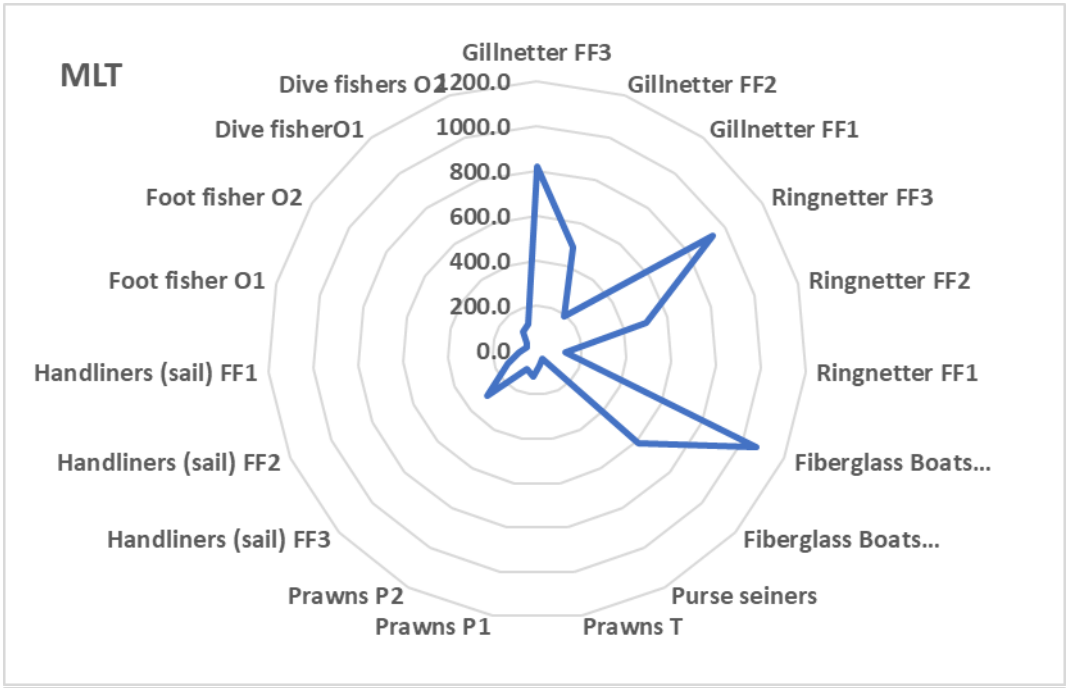


B

FIGURE 3.2 FUEL COSTS (EXPRESSED IN PERCENTAGE OF TOTAL IGS COSTS) OF MOTORIZED FISHING FLEETS IN A) MLT AND IN B) ZNZ.
(VCA4D findings, primary data, AFA computations)

The monthly income generated for each fisher represent average situations showing a certain degree of vulnerability for some fishers' métiers (Marchal et al. 2006), below the threshold of 100-130 USD/month, as observed in the purse seiners (targeting Anchovy-like), Octopus and Prawn fishers in MLT (Figures 3.3). But, in these two last cases, the fishing activity is seasonal, occasional, and is often complementing another activity, whereas in the purse seiners, the activity could almost be considered as a year-long job. In ZNZ, the critical métiers are among the purse seiners again, as well as others if the fish is sold at a low value. The range of fisher's income is slightly higher in MLT (50 to 1,000 USD/month) as compared to ZNZ (from 40 to 800 USD/month in ZNZ).

A



B

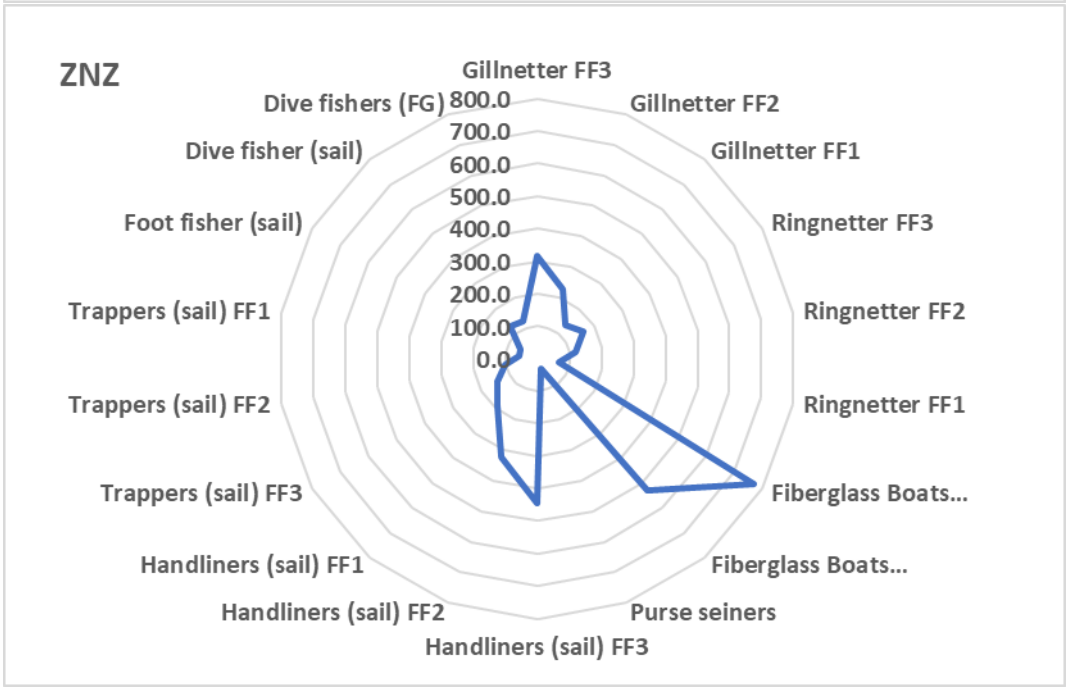


FIGURE 3.3 MONTHLY INDIVIDUAL FISHER INCOME (IN USD/MONTH) GENERATED BY VCA4D EXAMPLES OF FISHERIES IN A) MLT AND IN B) ZNZ.
LEGEND: O1 AND O2= OCTOPUS FISHERS (CF APPENDIX SECTION 3.1 SUB-CHAIN OCTOPUS MLT), P1 AND P2 FOR PRAWN FISHERS (CF APPENDIX SECTION 3.1 SUB-CHAIN PRAWN MLT) FF1-FF2-FF2: FINFISH TARGETED MEDIUM-LARGE PELAGIC AND REEF FISH, MARKETED AT LOW VALUE, MEDIUM VALUE, AND HIGH VALUE), T= TRAWLER (ONLY IN PRAWN FISHERY)
(VCA4D findings, primary data)

According to our calculations, the critical cases are related to the purse seiners, targeting anchovy in ZNZ and in MLT. In this case, the profitability seems very critical for the crew members (and also the boat owner) if the catch volume is maintained at the level we considered, much lower than the published estimates in the literature and preceding studies (Sofreco, 2018) but in accordance to published work integrating seasonal variations (Ibengwe et al. 2022; Stanek, 2015). As a result, the reported estimated number of FTE in this métier is very low when compared to the published numbers of the Frame surveys in MLT and in ZNZ (see Functional analysis, Tables 2.1 and 2.2). The main explanation is related to the low landing price we took into account

(considering the variability described in the various reports on anchovy like fish price fluctuations as well as daily catch volumes encountered according to the season (Ibengwe et al., 2022; Zafico, 2021). We had many controversial figures in these anchovy-like sub-chains. Most fishers were mentioning much higher catches, which would make this fishery very profitable for the boat owners and lead to an acceptable income for the crew (see Section 4.2.1.2 Inclusiveness).

3.2.1.2. Profitability & Sustainability of traders and processors in MLT

Two categories of processors are clearly distinguished:

- Artisanal processors mainly operating in the Anchovy-like and finfish sub-chains) for the activities of drying, boiling, frying: Operating costs are related to firewood, electricity, consumables, and handling labours. Return on turnover is about 25 % for the Anchovy-like sub-chain processors, and 17% for the finfish sub-chains.
- Industrial processors mainly operating on the Prawn, Octopus sub-chains to produce frozen products, to export markets and local markets (tourism): Two categories of these operators are found, depending on the volumes they handle. Calculated Return on turnover (%NOP/output) for Octopus industrial processors is almost 39%.

Main trading costs (IGS) are related to transports, ice purchasing costs, and handling labours in MLT with an average Return on turnover of 16-19% (Table 3.1).

The Operational accounts (Appendix of Section 3.1 Sub-chain Octopus MLF/actors) for the mid-size operators are derived from the WWF study on the Octopus sub-chain in MLT (WWF, 2020) and seems to reflect quite close to the reality for these actors (data crossed with primary data). The situation is not as clear in the Prawn sub-chain where the same industrial processors are operating. Our primary data obtained in May 2022 are leading to contradictory results when crossed with other data, on volumes, exports figures. The Return on turnover of those actors 12.78 % of industrial processors for prawns is probably reflecting a low conservative hypothesis of profit. The highest profitability rates are found in the sub-chains where industrial processors are operating for the export market in Europe (Octopus sub-chain): 22% for the traders, and 39% for the processors.

Monthly incomes generated for the MLT traders and processors are within the range of 144-1,564 USD and 332-49,598 USD for traders and processors, respectively, depending on the sub-chains and the sub-categories of actors (Table 3.1).

MLT	Sub-chain	Total Output (MTZS)	IGS (MTZS)	VA (MTZS)	Wage (MTZS)	Tax (MTZS)	Depre-ciation (MTZS)	NOP (MTZS)	Return on turnover NOP/ Output (%)	Monthly income in USD	Number of units
Traders	MLT anchovy-like	20.01	11.29	8.72	4.46	0.28	0.00	3.97	19.86	144	2,972
	MLT finfish	97.86	75.71	22.15	3.61	1.96	0.05	16.53	16.89	364-850	2,737
	MLT octopus	198.02	140.75	57.28	7.30	6.11	0.70	43.17	21.80	1,564	275
	MLT prawns	87.75	58.68	29.07	1.53	1.86	0.00	25.68	29.26	931	448
	MLT traders	**65.82**	**47.82**	**18.00**	**4.01**	**1.36**	**0.05**	**12.57**	**19.10**	**455**	**6,382**
Processors	MLT anchovy-like	36.95	18.35	18.60	9.08	0.12	0.25	9.15	24.77	332	549
	MLT finfish	72.50	58.48	19.02	1.94	0.91	3.97	12.20	16.83	298-673	4,106
	MLT octopus	293.04	150.34	142.69	5.76	14.63	8.43	113.87	38.86	49,598	155
	MLT prawns	1,453.04	1,020.53	432.51	37.61	117.29	91.94	185.67	12.78	6,441	10
	MLT processors	**78.41**	**54.60**	**23.81**	**2.95**	**1.50**	**3.87**	**15.48**	**19.74**	**561**	**4,820**

TABLE 3.1 INDIVIDUAL OPERATIONAL COUNTS AND PROFITABILITY FOR TRADERS AND PROCESSORS IN MLT
(VCA4D findings – AFA[20])

3.2.1.3. Profitability & Sustainability of traders and processors in ZNZ

The main costs in trading are related to transport, ice, some labour (carrier, gutter), landing/tax costs for the importers from Asia, local/export taxes for the Dried anchovy exporters. The detail accounts of traders in ZNZ are presented in the Appendix (of Section 3.2.1.3), according to the sub-chains (Appendix Section 3.1 Sub-chains) and in the Table 3.2 below.

Two categories of traders emerge from the analysis:

- The traders of a small-middle size, primary and secondary traders, operating in coastal areas and in the cities, for an average volume of purchase of 12 t with high variability in their profit (Return on turnover %NOP/Output, almost zero to 16%, average at 8%.
- Large-scale traders, dealing with much higher volumes of purchase (40-3,800 t): some are frozen seafood importers from MLT or from other countries, mainly Korea. The highest volumes and return rate on turnover (28%) are found in the category of traders-exporters of Dried anchovy to the regional foreign market. In the other "big traders", the relative profit is lower 6% for hotel buyers and 10% for importers (Figures in the Appendices Section 3.2.1.3).

Return on turnover rates for traders in ZNZ are lower than the values observed in MLT, with the exception of the exporter of Dried anchovy to the regional market (Return on turnover estimated at 27%).

The detailed accounts of artisanal processors in ZNZ are presented in Appendix (of Section 3.2.1.3). They are mainly represented by freezers using domestic facilities, retailer-friers, frying and selling fried finfish and octopus, driers (mainly for small pelagic). The degree of variability in the Return on Turnover indicator in this category is high, ranging from zero to up to 50% with an average level of 9.25%. The highest relative profit remains in retail friers of small pelagic (>50%) (Appendix of Section 3.2.1.3). However, the estimation of the retail final price of fried seafood is very difficult to obtain in the streets and villages, and in landing areas. It is very likely that most of these retailers-friers are making acceptable profits out of this activity. The fact that the

[20] The individual counts are resulting from successive computations made on AFA and Excel, reflecting "average" counts, and therefore not exactly corresponding to the individual accounts that were processed at the first stage of the analysis. For instance, the processor account in the Anchovy-like sub-chain in MLT mostly reflects the accounts of the middlemen-women taking care of the production of Dried anchovy, but is also includes the case of processors, friers of fresh anchovy in the streets or in the FFM.

final fried product is sold in very limited volumes (50-100g) allows them to increase the price (more than 9,000 TZS/kg, net weight), while the local consumer still purchases it.

Monthly incomes generated for the ZNZ traders and processors are within the range of 102-545 USD and 72-332 USD for traders and processors, respectively, depending on the sub-chains and the sub-categories of actors (Table 3.1).

ZNZ	Sub-chain	Total Output (MTZS)	IGS (MTZS)	VA (MTZS)	Wage (MTZS)	Tax (MTZS)	Depreciation (MTZS)	NOP (MTZS)	Return on turnover NOP/Output (%)	Monthly income in USD	Number of units
Traders	ZNZ anchovy	39.82	30.29	9.53	0.53	0.31	0.00	8.70	21.84	315	1,932
	ZNZ finfish	134.78	125.84	8.94	4.87	0.97	0.05	3.05	2.26	102-116	2,575
	ZNZ octopus	202.75	182.88	19.87	2.45	2.38	0.05	14.99	7.39	545	106
	ZNZ traders	**96.57**	**87.13**	**9.44**	**3.00**	**0.72**	**0.03**	**5.69**	**5.89**	**206**	**4,613**
Proces-sors	ZNZ anchovy	30.81	15.98	14.83	5.34	0.10	0.22	9.17	29.77	332	1,980
	ZNZ finfish	33.69	30.45	3.25	0.80	0.04	0.25	2.16	6.42	72-100	3,978
	ZNZ octopus	35.35	31.09	4.25	1.08	0.04	0.34	2.79	7.90	101	219
	ZNZ processors	**32.83**	**25.83**	**6.99**	**2.26**	**0.06**	**0.24**	**4.43**	**13.50**	**161**	**6,177**

TABLE 3.2 INDIVIDUAL OPERATIONAL COUNTS AND PROFITABILITY FOR TRADERS AND PROCESSORS IN ZNZ
(VCA4D findings – AFA)

3.2.1.4. Comparative profitability between regions, actors, and sub-chains

The comparative profitability between actors, sub-chains and the two regions of MLT and ZNZ shows a high degree of variability.

In Finfish (FF1; FF2; FF3), e.g. Low, Mid and High value finfish), a higher range of prices is observed in the ZNZ value chains and was taken into account. The Return on turnover (% NOP/Output) for traders and processors, is always lower in ZNZ (< 7-8%) than the ones observed in MLT (around 16-17%). A possible explanation of this finding may be related to the influence of the tourism market in ZNZ which would tend to increase the prices, this situation benefiting the fishers, but not to small-scale traders and artisanal processors.

On the contrary, for the Anchovy sub-chain, the situation is more beneficial to traders and processors in ZNZ when compared to MLT. A slightly lower production cost[21] of Dried anchovy, combined with a much higher volumes of products may explain this finding.

3.2.1.5. Cost structures

The multiplicity of cases leads to contrasting results in the cost structures of the sub-chains. The direct fuel costs (as the percentage of total IGS costs) calculated for each sub-chain and region varies between 4.8% (Prawns in MLT) to 48.9% (Anchovy-like in MLT) with an average at 23%; from 10% (Finfish) to 39% (Anchovy sub-chain) in ZNZ. It is mainly associated to the fisheries technologies, whether the fish vessels are motorized or not.

Other significant IGS costs are related to the fishing gears, various fishing accessories, transportation, electricity, ice, firewood for processing activities. To illustrate these ranges of costs related to various situations, a comparison is made between the anchovy sub-chains in MLT and ZNZ, and for the finfish "FF2", medium price in MLT and in ZNZ (Figure 3.4). In the anchovy sub-chain comparison, Fuel (combining fuel for the vessels and gas for the friers) cost is higher in MLT but this fact is mainly due to the use of gas in the frying

[21] See Appendix Section 3.1 Sub-chains Anchovy MLT and ZNZ. For instance, from primary data, calculated productions cost is for a processor 1,831 TZS/kg as compared to 1,777 TZS/kg.

space in the FFM, that is processing a significant volume of small pelagic (estimation at 2,376 t, cf Appendix 3.1 Sub-chain Anchovy MLT/Functional analysis). The other IGS costs are within the same range.

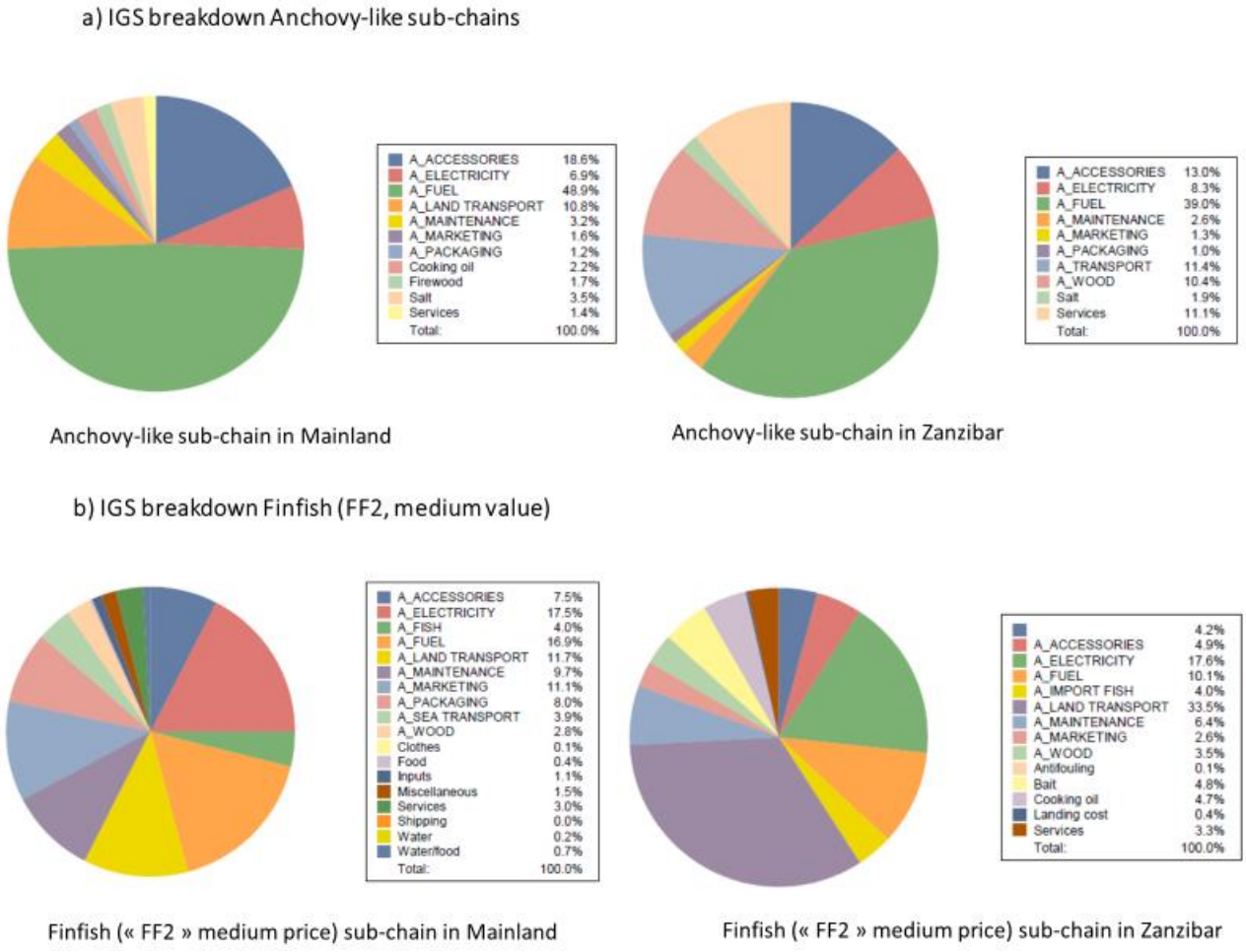


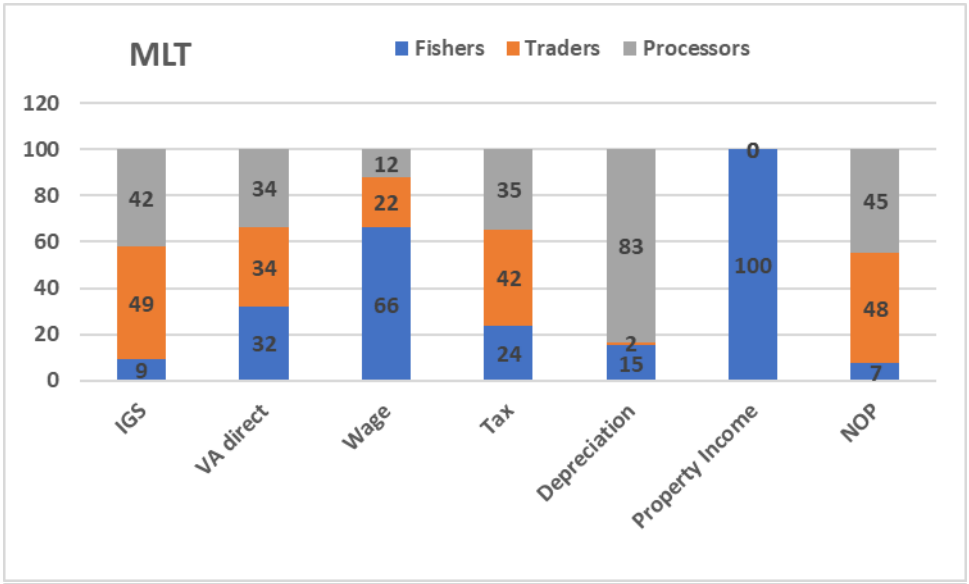
FIGURE 3.4 COMPARISON OF COST STRUCTURES (IGS BREAKDOWN) FOR A) ANCHOVY-LIKE SUB-CHAINS IN MLT AND IN ZNZ, FOR B) FINFISH (MEDIUM VALUE) SUB-CHAINS IN MLT AND ZNZ
(VCA4D findings – AFA)

In the finfish sub-chains, fuel costs are higher in MLT as compared to ZNZ, this could be explained by the higher number of sail fishers in ZNZ, using handlines, and traps. On the other hand, the transport costs are significant higher in ZNZ (33.5 %) compared to 11.7% in MLT. From our primary data, it appears that traders in ZNZ (May 2022) are mentioning higher transportation costs compared to our primary data from MLT (Nov. 2021) and secondary data of the Sofreco's report (2018). A higher transportation cost in ZNZ may also be due to a multitude of small-scale-volume transports, with no centralized fish market, such as the FFM in MLT. This finding should be further explored, in relation to fuel price. To our knowledge, there is no mechanism of maintaining a fuel price lower or higher in ZNZ, although surprisingly, a reduction of almost 1,000 TZS per litre was noticed at the gas station in ZNZ compared to MLT (May 2022).

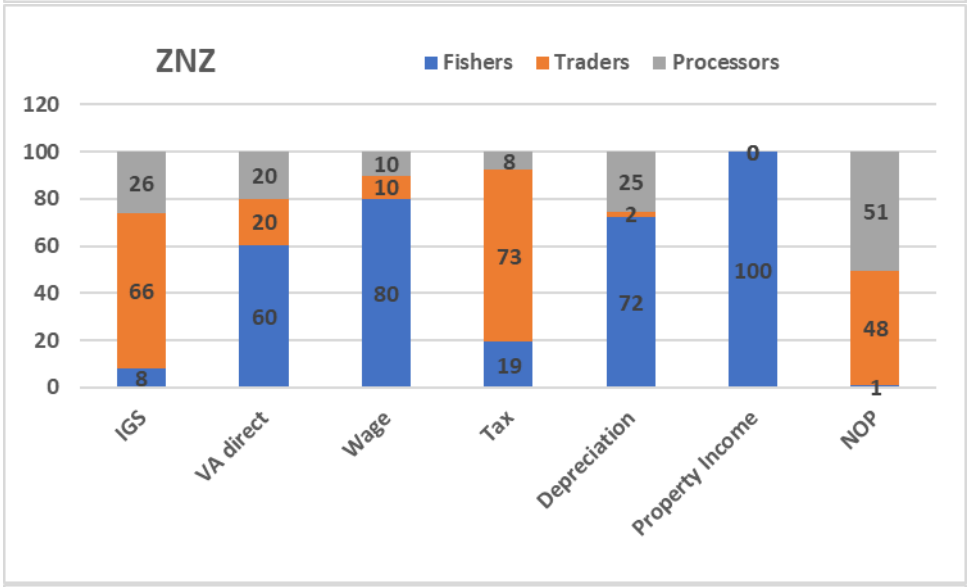
3.2.2 Respective contribution of key actors to the components of the direct value added

The respective contribution of each category of actors to the components of the Value Added Direct are presented in the following Figure 3.5.

A



B



C

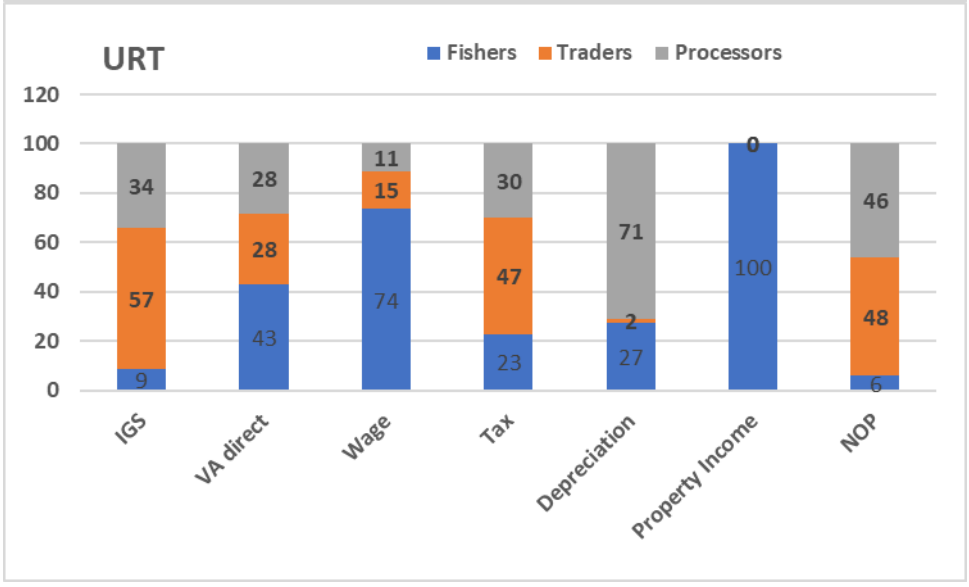


Figure 3.5 Distribution (in % of the total) among actors of the Total Output, Intermediate Goods and Services (IGS), Direct VA, Wage, Tax, Depreciation, Property income (boat ownership), Net Operating Profit (NOP) in the coastal fisheries of a) MLT, b) ZNZ, and c) URT

Source: VCA4D findings

Fishers are contributing to 32%, 60% and 43% of the Total Direct VA in value (MTZS) to coastal fisheries in MLT, ZNZ and the URT, respectively.

Traders in MLT are contributing to 34%, 22%, and 48% to the Direct VA, Wages, and NOP, respectively (Figure 3.5A). Processors in MLT are contributing to 34%, 12%, and 45% to the total Direct VA, Wages, and NOP, respectively (Figure 3.5A).

Traders in ZNZ are contributing to 20%, 10%, and 48% to the total Direct VA, Wages, and NOP, respectively (Figure 3.5B). Processors in ZNZ are contributing to 20%, 10%, and 51% to the total Direct VA, Wages, and NOP, respectively.

Traders in URT are contributing to 28%, 15%, and 48% to the total Direct VA, Wages, and NOP, respectively (Figures 3.5C). Processors in URT are contributing to 28%, 11%, and 46% to the total Direct VA, Wages, and NOP, respectively. In both regions, the relative significant contribution of the fisher's category to the Direct VA and Wages is highlighted by these indicators (43% and 74%, respectively). However, the Total NOP is mostly captured by the traders and processors (94%).

In both regions MLT and ZNZ, the relative significant contribution of the fisher's category to the Direct VA and Wages is different. The contribution to the Direct VA is equally distributed in MLT between the 3 categories of actors (around 32-34%) while 60 % of the Direct VA is due to the fisher's in ZNZ. The major contribution to Wages is related to the fishers' in both regions (>66%), more important in ZNZ (80%), as the category of industrial processors with a high number of employees) does not exist in ZNZ.

3.2.3 Total effects within the MLT and ZNZ economies

Economic Growth VCA4D Framing questions/Results	Total MLT	Total ZNZ	Total URT
C.Q.1.1 How profitable and sustainable are the VC activities for the actors involved?			
Actor number (units)	20,717	15,797	36,514
Annual volume of production in t	66,882	69,619	136,501
Total VC production in MTZS	503,401	372,539	875,940
IGS in MTZS	164,606	154,861	319,467
Total Direct VA in MTZS	338,795	217,678	556,473
Wages in MTZS	117,547	137,921	255,468
Depreciation in MTZS	22,391	5,943	28,334
Property income (Boat owner fees) in MTZS	10,604	15,130	25,734
Taxes in MTZS	20,930	4,566	25,496
Net operating profit (NOP) in MTZS	167,323	54,118	221,441
Return on turnover (%) (NOP/VC production)	**33.24**	**14.53**	**25.28**
C.Q.1.2 What is the contribution of the VC to the GDP?	**Total MLT**	**Total ZNZ**	**Total URT**
Total Indirect VA in MTZS	59,656	44,380	104,036
Total VA in MTZS	398,451	262,058	660,509
Driving Effect Ratio: Indirect VA/Direct VA	**0.18**	**0.20**	**0.19**
Rate of Integration into the Economy: Total VA/Production of the VC	**79.15**	**70.34**	**75.41**
GDP in MTZS	139,641,854	4,147,000	143,788,854
Total Value Added in percentage of the GDP	**0.29**	**6.32**	**0.46**
C.Q.1.3 What is the contribution of the VC to the agriculture sector GDP?	**Total MLT**	**Total ZNZ**	**Total URT**
Agriculture and fisheries GDP in MTZS	37,192,537	875,200	38,067,737
Direct Value Added (fishers) in percentage of the agriculture sector GDP	**0.29**	**14.96**	**0.63**
Direct Value Added in percentage of the agriculture sector GDP	**1.07**	**29.94**	**1.74**
C.Q.1.4 What is the contribution of the VC to the public finances?	**Total MLT**	**Total ZNZ**	**Total URT**
Public Funds Balance (benefits-costs) in MTZS[22]	20,930	4,566	25,496
C.Q.1.5 What is the contribution of the VC to the balance of trade?	**Total MLT**	**Total ZNZ**	**Total URT**
VC Exports in MTZS	50,556	53,414	103,970
VC Total Imports in MTZS	55,282	43,132	98,414
Impact of Balance of trade of the VC: VC exports - Total imports[23] in MTZS	**-4726**	**10,282**	**5,556**
Total Imports/VC Production	**0.11**	**0.12**	**0.11**
C.Q. 1.6 Is the VC viable in the international economy?	**Total MLT**	**Total ZNZ**	**Total URT**
Capital at market price in MTZS	56,013	62,290	118,303
Domestic non tradeable factors at market price (e.g. labour, capital, land, environmental goods) in MTZS	164,367	260,489	424,856
International parity price of the product in MTZS	503,401	372,539	875,940
Labour at market price in MTZS	129,283	202,765	332,048
Tradeable intermediate goods and services at int. Prices in MTZS	129,246	139,204	268,450
Transfer in MTZS	20,929	4,566	25,495
Domestic Resource Ratio (DRC)	**0.44**	**1.12**	**0.70**
Nominal Protection Coefficient (NPC)	**1**	**1**	**1**

TABLE 3.3 MAIN RESULTS OF THE VCA4D ECONOMIC GROWTH ANALYSIS FOR COASTAL FISHERIES VALUE CHAINS IN MLT, IN ZNZ, AND IN URT.

Source: primary data, various sources of secondary data, including MLT and ZNZ National statistics, and AFA software.

[22] The public funds balance is positive for the three systems, MLT, ZNZ and URT as no subsidies are encountered in our calculations.

[23] The total imports value includes the estimation of the most significant import costs of IGS that are related to the value chain functioning (for production, transportation, marketing, porocessing): costs of imported fuel, gears, other occessories, packaging materials, electricity…

3.2.2.1. Indirect effects

To calculate indirect effects, in most cases (at the exception of Finfish and Octopus in ZNZ[24]), more than 70-75 % of the IGS could be allocated with coefficients, based mostly upon the grouped costs of Accessories (fishing gears, boxes), Packaging, Fuel, Electricity (grouped with ice cost), Transportation, and Marketing (including auctions fees) (See Appendices of Section 3.2.2).

The Total Value Added (Direct VA + Indirect VA) is estimated at 398,451 MTZS in MLT; 262,058 MTZS in ZNZ; and 660,509 MTZS for the whole country Tanzania.

The importance of Indirect VA expressed through the driving effect ratio is very similar between the two regions, and estimated at 0.2 for the whole, indicating a high rate of integration in the local economy in MLT, and in ZNZ (Table 3.3 before and Figure 3.6).

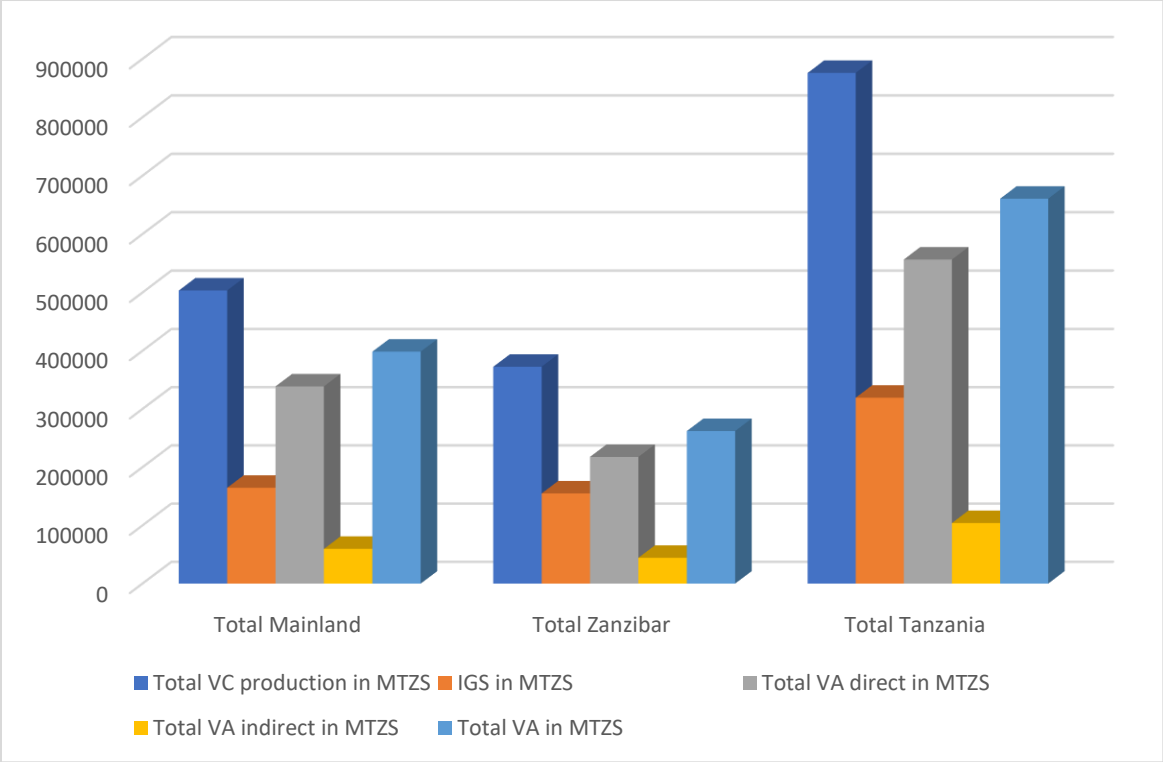


FIGURE 3.6 DISTRIBUTION OF COASTAL FISHERIES VC TOTAL PRODUCTION (MTZS), IGS (MTZS), DIRECT VA (MTZS), INDIRECT VA (MTZS), TOTAL VA (MTZS), IN MLT, IN ZNZ, AND IN URT
(VCA4 findings, AFA)

3.2.2.2. Contribution of the value chain to the GDP (national and agriculture)

In MLT, the estimations of the **relative contribution to the GDP**, and the agriculture GDP are within the range of official reports[25], **0.29 %** slightly higher than the official reported figures of 0.25% of the Total GDP for the marine fisheries in MLT (URTMLF, 2020). Total GDP fisheries (1.7% in 2019) reported in Tanzania (including the major production of the lakes), is 2,379,172 MTZS in 2019, this means that our estimate of the Total Value Added would represent more than 16% of the estimate of national fisheries contribution to GDP in MLT.

If reported to five coastal regions (including Dar-Es-Salaam), the regional GDP is 39,686,080 MTZS, our total VA estimate is closed to 1% of this regional coastal GDP in MLT.

[24] The degree of disaggregation of the IGS was inferior in these sub-chains because of a lack of data. Therefore, in these cases, the calculation of indirect effects can be taken as a minimal value.
[25] See URT, 2021: National accounts of Tanzania MLT, 2014-2020. National Bureau of Statistics Ministry of Finance and Planning https://www.nbs.go.tz/nbs/takwimu/na/National_Accounts_of_MLT_Tanzania_2020.pdf

This observation advocates for a specific macro-economic accounting approach to the marine fisheries sector in the coastal regions of MLT, particularly relevant for a marine Blue Economy Strategic planning.

In ZNZ, the direct contribution of the fisheries value chain to the economy (Direct VA of 217,678 MTZS) is very much in the order of magnitude of the official statistics of the OCGS which reports a fisheries-related GDP of 198,000 MTZS in 2019 and 206,400 MTZS in 2020 at current prices 2016-2020 (RGOZ, 2021, ZNZ figures in 2020)[26].

The estimation of indirect effects allows a significant addition of added value to the economy. **As a result, the direct contribution of the fisheries sector to the overall ZNZ economy (GDP) of 6.32%** is higher than the figure of 4.8% published by the OCGS and reported in the ZNZ BE strategy (RGoZ, 2020, Blue Economy Policy[27]). **When compared to the agricultural ZNZ GDP, the fisheries sector represents 30% of the agricultural GDP**, meaning that the ZNZ economy is highly dependent on fisheries.

For the URT (summing MLT and ZNZ findings), the contribution of coastal fisheries to the URT GDP is 0.46% and to the Agricultural URT GDP is 1.74%.

3.2.2.3. Contribution of the value chain to public finances

The public funds balance is positive for the three systems, MLT, ZNZ and URT as no subsidies are encountered in our calculations.

Tax income is estimated at 20,930 MTZS in MLT, 4,566 MTZS in ZNZ, and 25,496 MTZS for the URT. In both regions, MLT, and ZNZ, it is also very likely that the collection of taxes is not optimized, as reflected by the poor rate of licensing in the respective Frame surveys of both MLT and ZNZ. However, Kakama (2019) reports that if the BMU are collected by the local government officers, and represent a significant public revenue, very little or almost none of this income is actually re-invested back in fisheries management. We noticed that people interviewed in MLT were reporting spontaneously their level of taxes, e.g., local, district, marketing, levies, while this was not the case in ZNZ. We took this into account in the data computation and it might explain the much lower value of taxes reported for ZNZ.

Interestingly, as reported by COLEACP in MLT, the high level of royalties and levies in the imports and exports of seafood products was identified as a specific and perennial source for funding the deployment of marine protection areas (primary data from COLEACP). if the future policies imply subsidies through the facilitated access to various pieces of equipment, boats, to fishers, these facts should be taken into consideration and will mitigate a positive contribution on public finances.

3.2.2.4. Contribution of the value chain to the balance of trade

Total imports of intermediate consumptions (goods and services) are reported to be 55,282 MTZS in MLT and 43,132 MTZS in ZNZ, resulting in the same range of 10-11% of the total production (VC Output) for both. However, as already mentioned, the specific case of ZNZ allows some uncertainties in the evaluation of the exact imports, as the OCGS considers that products coming from MLT in to ZNZ are also imports in its Supply and Use table.

Total exports are reported to be 50,5562 MTZS in MLT and 53,414 MTZS in ZNZ, resulting in the balance of trade being negative for MLT, and positive for ZNZ. The overall URT balance of trade is positive in the Tanzanian economy because of the ZNZ fish exports.

However, in ZNZ, except the for Dried anchovy made from Anchovy-like small pelagic, no finfish are exported on a significant basis. This finding is quite surprising if we compare it to the official ZNZ statistics, reporting almost no exportation of fish products but seaweeds.

[26] See Table 3.1.4 p24: http://www.ocgs.go.tz/php/ReportOCGS/ZNZ%20In%20Figures%202020.pdf
[27] See ZNZ Blue economy policy, http://planningznz.go.tz/doc/new/BE%20Policy-2020.pdf

Obviously, these official OCGS reports did not take into account in their estimates for exports the exportation of Dried anchovy which is quite high, as reported by the Department of Fisheries. We used the Department of Fisheries data in our calculations of exports (cf Appendix 3.1 Anchovy-like sub-chain) (Figure 3.7)[28].

In MLT, exports are related to the 3 sub-chains: anchovy-like, octopus and prawns, the two latter's playing an important role with regard to this indicator (cf Appendices 3.1 for MLT sub-chains, Anchovy-like, Octopus and Prawns).

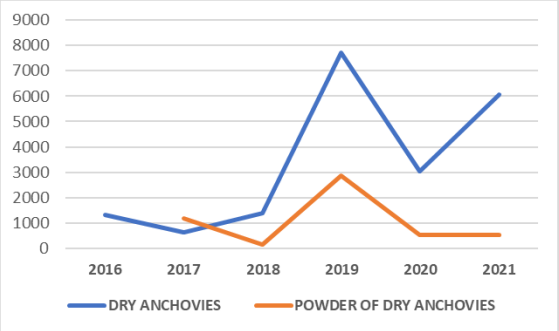


FIGURE 3.7 EXPORTS IN TONS (T) OF DRIED ANCHOVIES AND POWDER IN TONS FROM ZNZ BETWEEN 2016 AND 2020
Source: Dpt of Fisheries, Ministry of Blue Economy and Fisheries, RGoZ; (Powder = Dust for feed mills)

3.2.4 Competitiveness and viability within the international economy

No subsidy or tax reduction are reported in the various activities related to the VCs in coastal fisheries in MLT, and in ZNZ. These VCs are basically functioning according to market rules, although some non formal unwritten agreements may exist between actors, for instance between fishers and primary traders, or between traders and industrial processors or hotels. However, the importation of various goods for the coastal fisheries is subjected to importation taxes, that may impair the competitiveness and viability of the VCs within the international economy.

Our calculated Domestic Resource Ratio (DRC) values for MLT, and ZNZ are 0.44, and 1.12, respectively, indicating that the VCs of coastal fisheries are viable in MLT, in the global economy, while this situation is different in ZNZ, where the value added is lower than the value of the domestic factors production. Such a finding is probably more frequent in island economies depending on a high rate of imported products from mainlands.

The Nominal Protection Coefficients (NPC) for all the VCs were estimated to be around 1, indicating that all the actors of the VCs generate equivalent incomes, that they would have on international markets.

3.2.5 Comparison of sub-chains

3.2.4.1. In MLT

Detailed VCA4D economic analyses were conducted for each of those sub-chains and are available in the appendices (Cf Appendices of Section 3.1 Sub-chains, and also Appendices of Sections 3.2.2/Data base ; 3.2.4.1 Table MLT; 3.2.4.2 Table ZNZ). Multiple comparisons could be run among the various indicators estimated for the VCA4D economic analysis. In this section, we compare how each of the VCs of coastal fisheries in MLT addresses the main VCA4 framing questions. For visual purposes of the main findings, we transformed the most important economic key indicators into percentage variables and computed them on radial diagrams.

[28] Declared at the unit price of 4,500 TZS/kg for the calculation of Royalties, it means that in 2019, ZNZ exported for a value more than 31,500 MTZS, an export figure much higher than the seaweed exports reported for this year (10,382 MTZS in RGoZ, 2020, BE Policy, p.9).The OCGS reports a total of 48,573 MTZS for the same year 2019, this indicating that obviously the dried anchovy products were not included in these export figures.

Indicators	Anchovy MLT	Finfish MLT	Octopus MLT	Prawn MLT	Total MLT
Total VC production (MTZS)	53,057	352,755	65,606	31,983	503,401
IGS (MTZS)	12,345	131,050	13,176	8,035	164,606
Total Direct VA (MTZS)	40,712	221,705	52,430	23,948	338,795
Total Indirect VA (MTZS)	2,305	49,434	4,660	3,257	59,656
Total VA (MTZS)	43,017	271,139	57,090	27,205	398,451
Wages (MTZS)	22,142	85,983	3,220	6,202	117,547
Depreciation (MTZS)	550	19,286	1,499	1,056	22,391
Land fees (MTZS)	390	10,214	0	0	10,604
Taxes (MTZS)	981	10,678	6,284	2,987	20,930
Net operating profit (MTZS)	16,649	95,545	41,426	13,703	167,323
VC Product Exports (MTZS)	8,868	0	33,084	8,604	50,556
VC Goods and Services Total Imports (MTZS)	7,460	40,405	4,999	2,418	55,282
Return on turnover in %	31.38	27.09	63.14	42.85	33.24
Driving Effect Ratio: Indirect VA/Direct VA*100	5.66	22.30	8.89	13.60	17.61
Rate of Integration into the Economy: Total VA/Production of the VC in %	81.08	76.86	87.02	85.06	79.15
Total Value Added in percentage of the GDP	0.03	0.19	0.04	0.02	0.29
Direct Value Added (fishers) in percentage of the agriculture sector GDP	0.01	0.22	0.04	0.02	0.29
Direct Value Added in percentage of the agriculture sector GDP	0.12	0.73	0.15	0.07	1.07
Total exports/VC production in %	16.71	0.00	50.43	26.90	10.04
Total Imports/VC Production*100	14.06	11.45	7.62	7.56	10.98
Domestic Resource Ratio (DRC)*100	55.95	53.09	2.74	23.98	43.93
Share % of the export price (FOB) in the final consumer price in the importing country	83.04	0.00	94.78	96.15	
Total Imports/VC Production	0.14	0.11	0.08	0.08	0.11
Nominal Protection Coefficient (NPC)	1.00	1.00	1.00	1.00	1.00
Driving Effect Ratio: Indirect VA/Direct VA	0.06	0.22	0.09	0.14	0.18
Domestic Resource Ratio (DRC)	0.56	0.53	0.03	0.24	0.44

Table 3.4 Summary table of the main economic indicators for the calculation of Total effects in MLT sub-chains
(VCA4D findings – AFA)

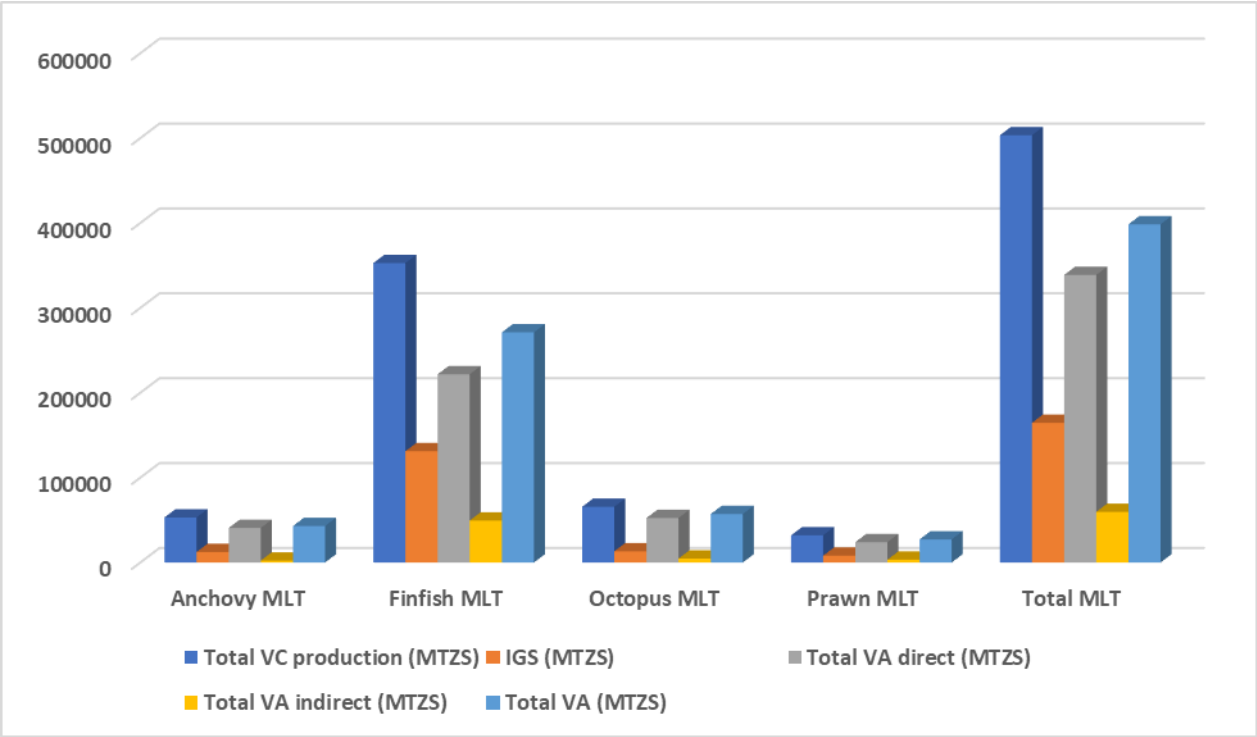


FIGURE 3.8 COMPARISON BETWEEN SUB-CHAINS OF TOTAL VC PRODUCTION, IGS, DIRECT VA, INDIRECT VA, AND TOTAL VA IN MTZS, IN MLT COASTAL FISHERIES
(VCA4D findings – AFA)

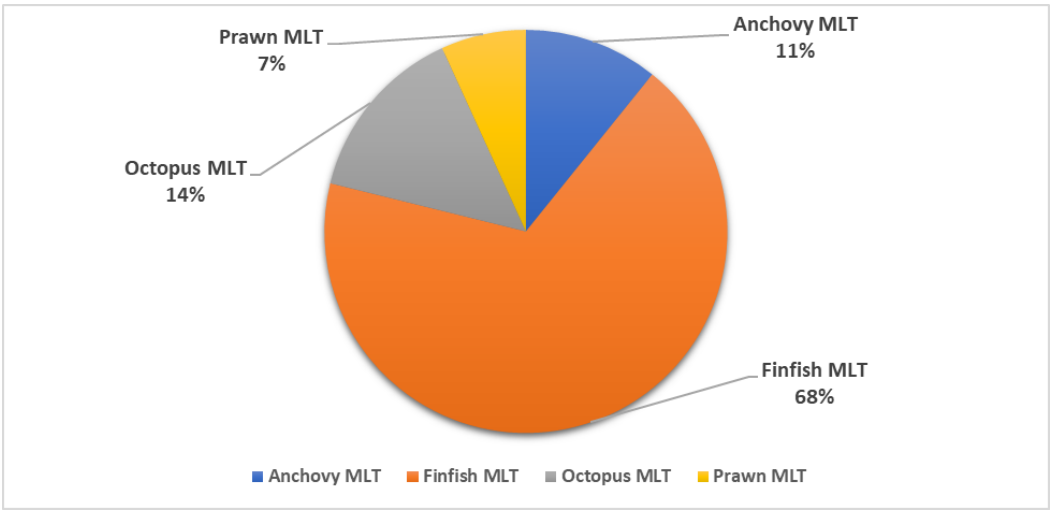


FIGURE 3.9 SHARE (IN %) OF THE TOTAL VA FOR COASTAL FISHERIES VALUE CHAINS IN MLT
(VCA4D findings)

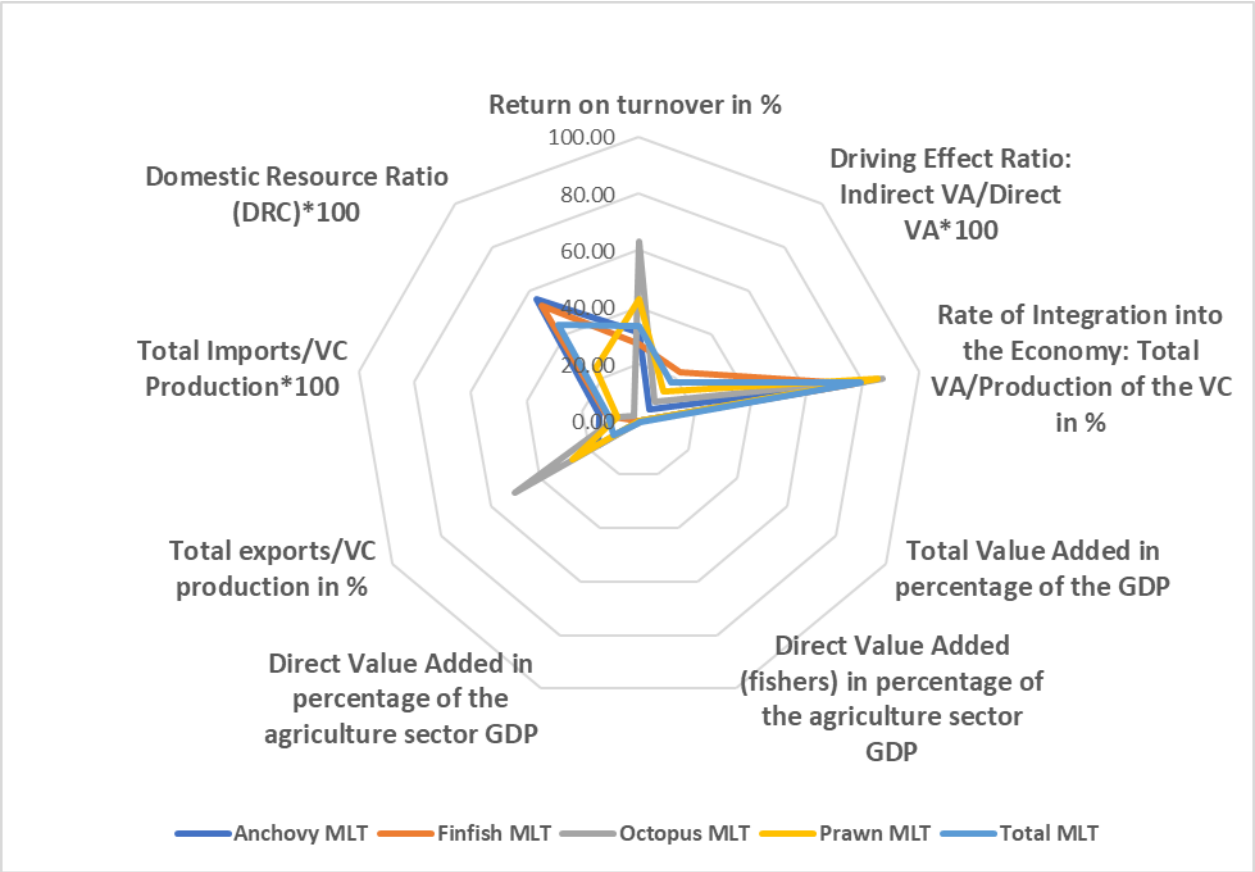


FIGURE 3.10 COMPARISON OF SUB-CHAINS IN COASTAL FISHERIES IN MLT USING MAIN RELATIVE VCA4D ECONOMIC INDICATORS (EXPRESSED IN %)
(VCA4D findings – AFA)

The rate of integration into the national economy is high in all sub-chains (>75%) but to a higher degree for the Octopus and Prawn sub-chains. Clearly, in terms of VA, the Finfish sub-chain plays the most significant role (Figures 3.8 and 3.9, and Table 3.4), capturing 68% of the total VA, although it remains very minor when compared to agriculture and overall MLT GDP (0.22% and 0.19%, respectively). However, the Figure 3.10 highlights the importance of the two sub-chains leading to exports of high-value products (frozen octopus and prawns). The economic performance (as expressed by the Overall Return on turnover) of these sub-chains is higher than the two, related to finfish. The Anchovy sub-chain in MLT performs in between these two contrasted sets of results (Finfish vs Octopus-Prawns), reflecting the overall MLT situation, and balancing the import/export trades. However, its relative weigh as compared to the others remains minor (11% of total MLT VA).

3.2.4.2. In ZNZ

A similar approach implemented in the case of ZNZ shows very contrasted results between the Anchovy and finfish sub-chains (Table 3.5, Figures 3.11-3.13). If the Finfish value chain represents the major contribution (71%) to the total VA of fisheries in ZNZ, the Anchovy sub-chain (25% of the Total VA) displays economically strong assets, expressed by the high Export Rate (63%), Return on turnover rate (42%), Rate of integration into the economy (77%), and DRC <1 (0.4).

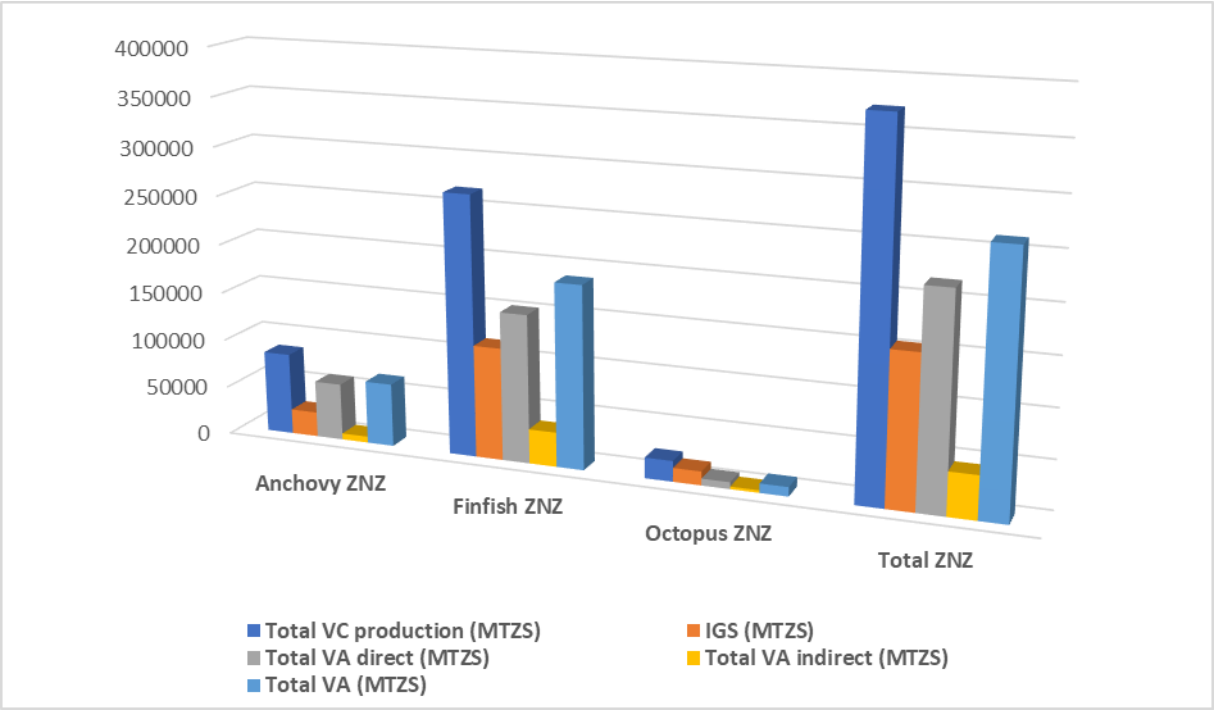


Figure 3.11 Comparison between sub-chains in ZNZ of Total VC Production, IGS, Direct VA, Indirect VA, and Total VA in MTZS
(VCA4D findings- AFA)

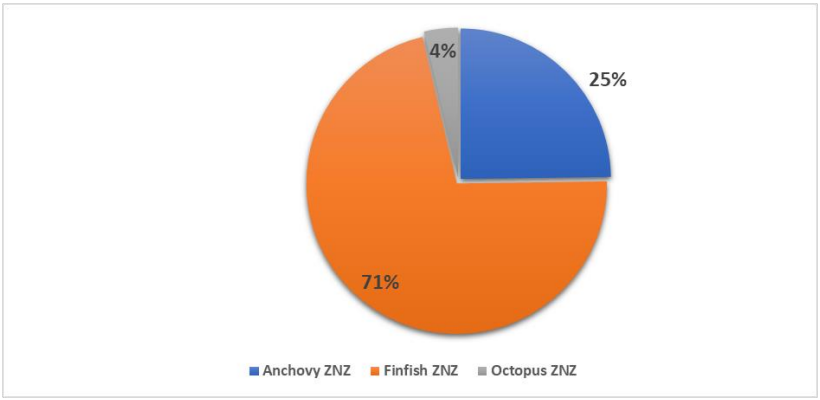


Figure 3.12 Share (%) of the Total VA for fisheries value chains in ZNZ
(VCA4D findings- AFA)

Indicator	Anchovy ZNZ	Finfish ZNZ	Octopus ZNZ	Total ZNZ
Total VC production (MTZS)	84,128	267,269	21,142	372,539
IGS (MTZS)	25,532	115,158	14,171	154,861
Total Direct VA (MTZS)	58,596	152,111	6,971	217,678
Total Indirect VA (MTZS)	6,349	35,421	2,610	44,380
Total VA (MTZS)	64,945	187,532	9,581	262,058
Wages (MTZS)	20,005	113,740	4,176	137,921
Depreciation (MTZS)	1,585	4,102	256	5,943
Land fees (MTZS)	957	14,161	12	15,130
Taxes (MTZS)	1,051	3,215	300	4,566
Net operating profit (MTZS)	34,998	16,893	2,227	54,118
VC Exports (MTZS)	53,414	0	0	53,414
VC Total Imports (MTZS)	11,407	28,867	2,858	43,132
Return on turnover in %	41.60	6.32	10.53	14.53
Driving Effect Ratio: Indirect VA/Direct VA*100	10.84	23.29	37.44	20.39
Rate of Integration into the Economy: Total VA/Production of the VC in %	77.20	70.17	45.32	70.34
Total Value Added in percentage of the GDP	1.57	4.52	0.23	6.32
Direct Value Added (fishers) in percentage of the agriculture sector GDP	1.24	13.27	0.45	14.96
Direct Value Added in percentage of the agriculture sector GDP	7.42	21.43	1.09	29.94
Total exports/VC production in %	63.49	0.00	0.00	14.34
Total Imports/VC Production*100	13.56	10.80	13.52	11.58
Domestic Resource Ratio (DRC)*100	39.59	141.62	68.42	111.64
Share % of the export price (FOB) in the final consumer price in the importing country	64.68			
Total Imports/VC Production	0.14	0.11	0.14	0.12
Nominal Protection Coefficient (NPC)	1.00	1.00	1.00	1.00
Driving Effect Ratio: Indirect VA/Direct VA	0.11	0.23	0.37	0.20
Domestic Resource Ratio (DRC)	0.40	1.42	0.68	1.12

Table 3.5 Summary table of the main economic indicators for the calculation of Total effects in ZNZ sub-chains
(VCA4D findings – AFA)

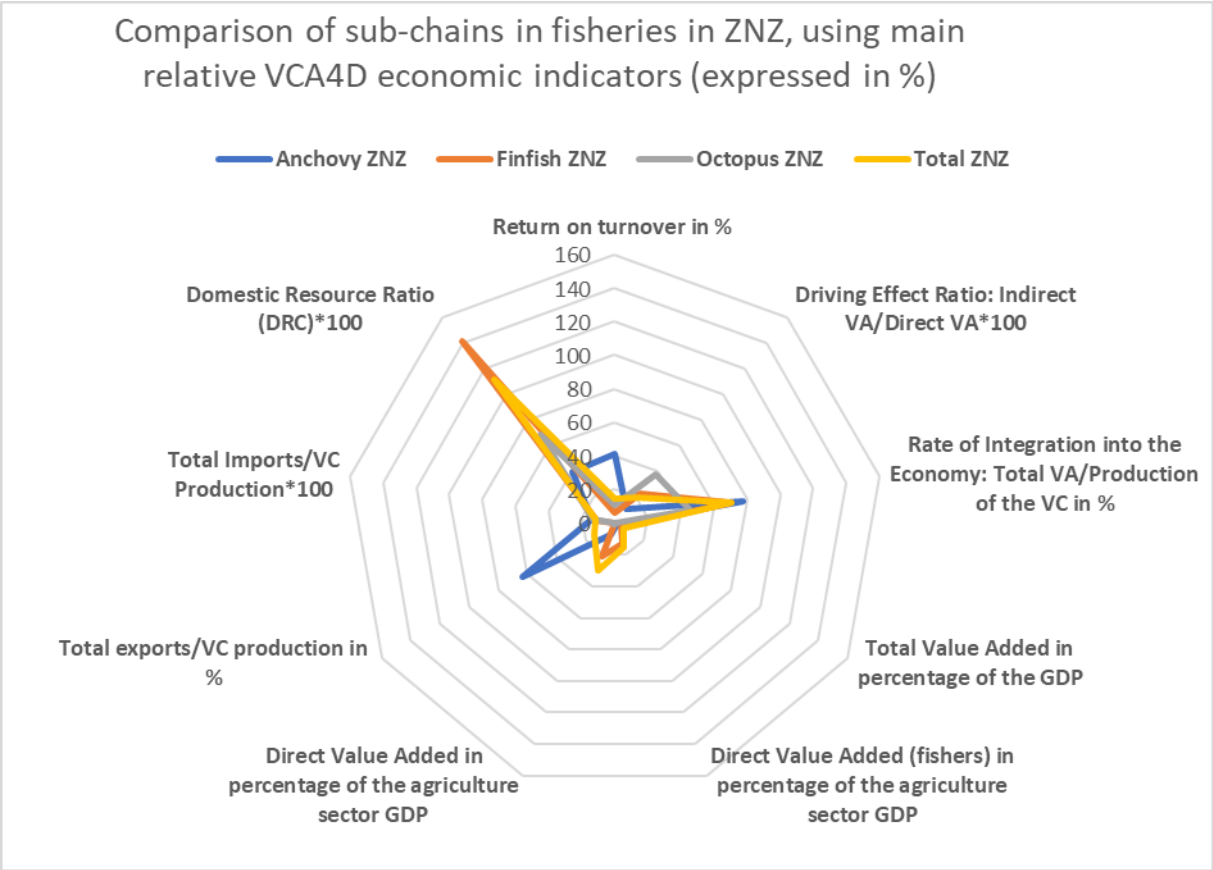


FIGURE 3.13 COMPARISON OF SUB-CHAINS IN COASTAL FISHERIES IN ZNZ USING MAIN RELATIVE VCA4D ECONOMIC INDICATORS (EXPRESSED IN %)
(VCA4D findings – AFA)

The low Return on turnover rate (6%) observed in Finfish sub-chain in ZNZ as compared to the Anchovy sub-chain in ZNZ (42%) or as compared to the Finfish sub-chain in MLT (27%) could be explained by the preceding findings related to actors' profitability (Section 3.2.1). This indicator in MLT is clearly "boosted" by the role played by small artisanal processors (as retail friers) in low value finfish (cf Appendix of Section 3.1 Sub-chain Finfihs/FF1 MLT), while in the ZNZ Anchovy sub-chain it is mainly explained by the export traders.

Of interest is the DRC calculation for the Finfish sub-chain in ZNZ, DRC of 1.4, which further indicates, in ZNZ, that the value of domestic factors which are consumed is lower than that of the value of the domestic factor production. The Rate of integration of the Octopus sub-chain (45%) is much lower than the others (>70%), this finding is related to the level of imports of frozen octopus from MLT that we introduced into the Octopus sub-chain in ZNZ.

3.2.4.3. Comparison of the Anchovy-like sub-chains of MLT and of ZNZ

An additional comparison was made between the anchovy sub-chains in MLT and in ZNZ, showing that the two chains are exhibiting rather similar profiles, with the exception of findings related to volumes (tonnages and production in MTZS) and exports (Figure 3.14 and 3.15). The absolute numbers for MLT are inferior to those obtained in ZNZ, because of the significant difference introduced in our computations related to the initial captured volumes. However, this comparison added with our observations throughout this VCA4 study strongly advocates the idea of considering this sub-chain as one chain for the whole country of Tanzania, consolidating the findings at this level.

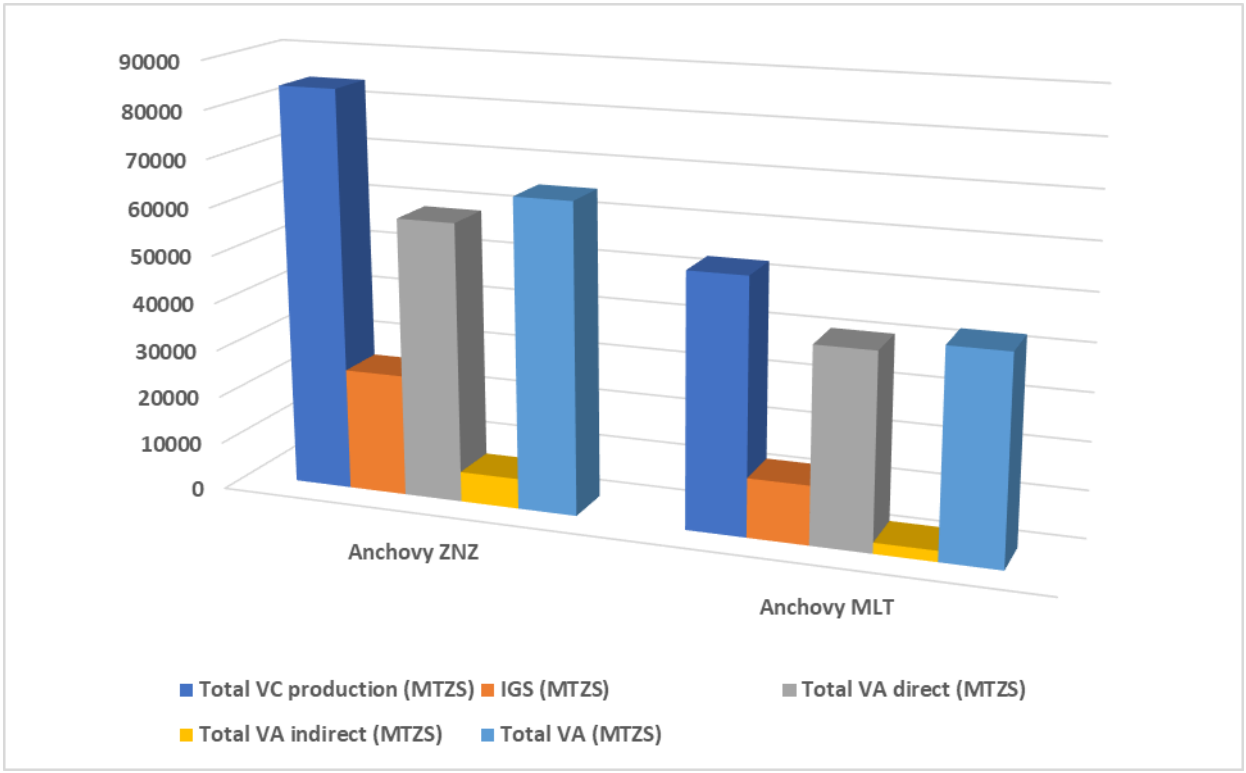


FIGURE 3.14 COMPARISON OF ANCHOVY-LIKE SUB-CHAINS IN MLT, AND IN ZNZ, REGARDING VC TOTAL PRODUCTION, IGS, DIRECT VA, INDIRECT VA AND TOTAL VA IN MTZS
(VCA4D findings – AFA)

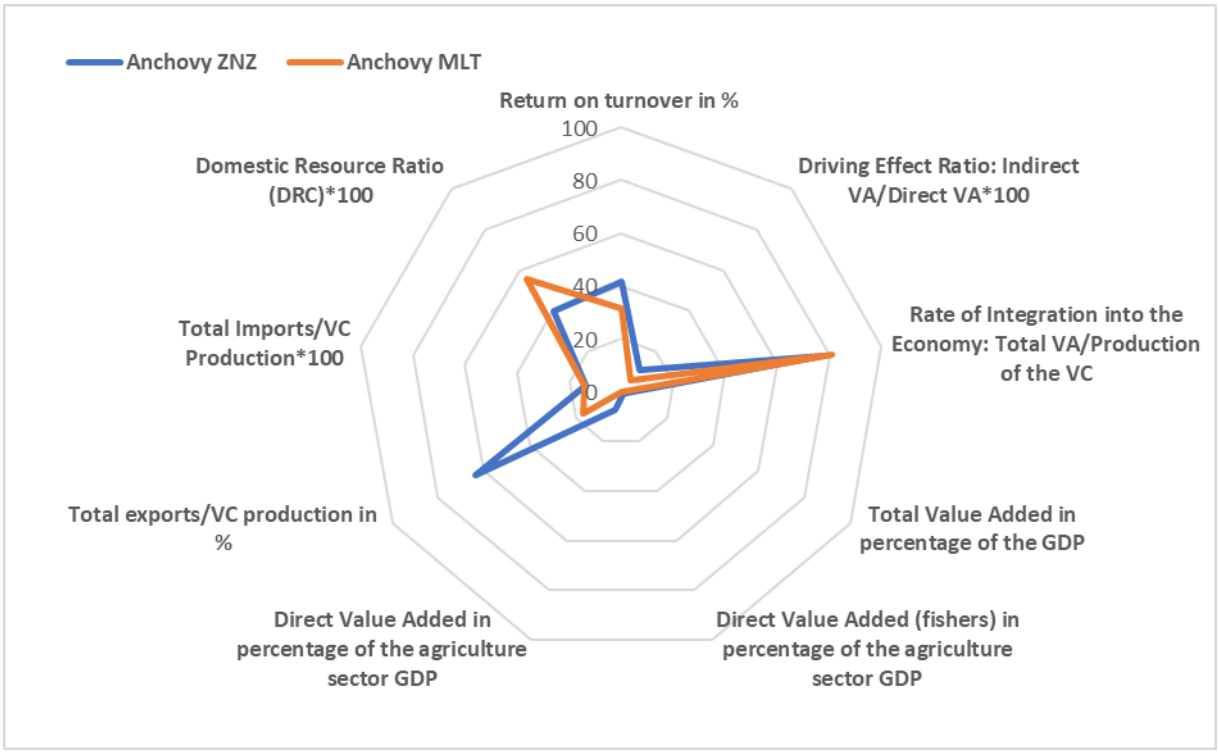


FIGURE 3.15 COMPARISON OF ANCHOVY-LIKE SUB-CHAINS IN COASTAL FISHERIES IN MLT AND IN ZNZ USING MAIN RELATIVE VCA4D ECONOMIC INDICATORS (EXPRESSED IN %)
(VCA4D findings – AFA)

The Figure 3.15 allows a rapid visualisation of the major difference between the two Anchovy sub-chains, which is in the total export percentage of the total VC production, >60% for ZNZ for less than 20% for MLT, this gap further questioning the real export figures of Dried anchovy that occur in MLT as raised in the Box 4.

3.2.4.4. Comparison of MLT, ZNZ and URT

Using the same approach, the respective profiles of MLT, ZNZ and URT are compared with the main relative VCA4D economic indicators expressed in percentage (Figure 3.16). Contrasted findings between the two regions are evidenced in the DRC and the percentage of the VA to the Agriculture GDP.

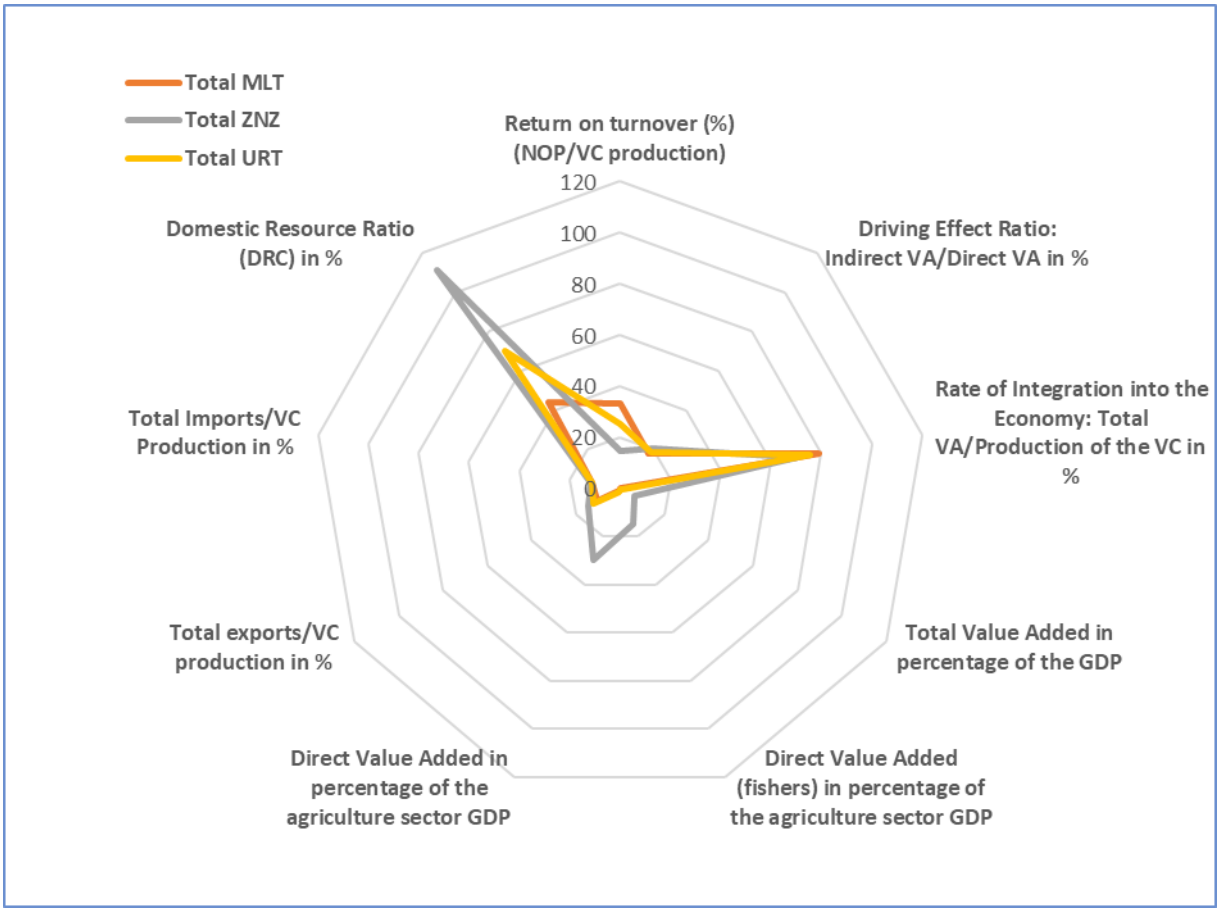


FIGURE 3.16 COMPARISON OF COASTAL FISHERIES CONSOLIDATED VALUE CHAIN IN MLT, IN ZNZ, AND IN URT, USING MAIN RELATIVE VCA4D ECONOMIC INDICATORS (EXPRESSED IN %)
(VCA4D findings – AFA)

3.2.6 Summary table of economic indicators for FQ 1.

3.2.5.1. Summary table of indicators for framing question 1 – MLT TANZANIA

Framing Question 1: What is the contribution of the VC to economic growth?		**INDICATORS**	**RESULTS**
CQ1.1	How profitable and sustainable are the VC activities for the entities involved?	**Operating Accounts of every type of actor**	See Table 3.1 Fishers: Tables in Appendices 3.1 Sub-chains and Appendix of section 3.2.1.1
		Net operating profit by type of actor (MTZS) – Monthly income in USD	Table 3.1 Monthly income range: Fishers: 62-576 USD/m Traders: 144-1,564 USD/m Processors: 233-49,598 USD/m
		Return on turnover (operating profit/production) (%)	Fishers:13% Processors: 20% Traders: 22%
		Benchmarks for fisher's net income (minimum wage, livelihood needs, job opportunities…)	Minimal wage of 130 USD/month. Fishers' wages highly variable, according to métiers, and landing volume and price. Some fishers (on-board crew) below minimal wage (like purse seiners). Attractiveness: still high

Framing Question 1: What is the contribution of the VC to economic growth?		INDICATORS	RESULTS
CQ1.2	What is the contribution of the VC to the GDP?	**Value of final VC production (MTZS)**	503,401 MTZS
		Direct VA (MTZS)	338,795 MTZS
		Total VA	398,451 MTZS
		Total Direct VA creation per stage (MTZS):	Fishers: 109,173 MTZS/32% Processors: 114,754 MTZS/34% Traders: 114,869 MTZS/34%
		Total VA and components (MTZS):	Wages/salaries: 117,547 MTZS Land fee (boat ownership): 10,604 MTZS Taxes: 20,930 MTZS Depreciation: 22,391 MTZS NOP overall: 167,323 MTZS NOP fishers: 124,485 MTZS/7% NOP processors: 74,620 MTZS/45% NOP traders: 80,217 MTZS/48%
		Total VA in percentage of the GDP	0.29%
		Rate of integration into the Economy (total VA/VC production)	79.15%
CQ1.3	What is the contribution of the VC to the agriculture sector GDP?	**VC agricultural actors' Value Added in percentage of the agriculture sector GDP**	1.07%
CQ1.4	What is the contribution of the VC to the public finances?	**Receipts of the government (taxes, etc.)**	20,930 MTZS
		Outlays of the government (subsidies, etc.)	0
		Public Funds Balance	20,930 MTZS
CQ1.5	What is the contribution of the VC to the balance of trade?	**VC exports**	50,556 MTZS
		VC total imports (goods and services)	55,282 MTZS
		Balance of trade of the VC (VC exports - VC total imports)	-4,726 MTZS

Framing Question 1: What is the contribution of the VC to economic growth?		INDICATORS	RESULTS
CQ1.6	Is the VC viable in the international economy?	**Nominal Protection Coefficient (NPC)**	1
		Domestic Resource Cost Ratio (DRC)	0.44

3.2.5.2. Summary table of indicators for framing question 1 -ZNZ

Framing Question 1: What is the contribution of the VC to economic growth?		**INDICATORS**	**RESULTS**
CQ1.1	How profitable and sustainable are the VC activities for the entities involved?	**Operating Accounts of every type of actor**	Table 3.2 Fishers: Tables in Appendices 3.1 Sub-chains and Appendix of section 3.2.1.1
		Net operating profit by type of actor (MTZS) – Monthly income in USD	Table 3.2 Monthly income range: Fishers: 46-288USD/m Traders: 102-545 USD/m Processors: 72-332USD/m
		Return on turnover (operating profit/production)	Fishers: 0.27% Processors: 13.5% Traders: 5.89%
		Benchmarks for fishers' net income (minimum wage, livelihood needs, job opportunities…)	Minimal wage of 130 USD/month. Fishers' wages highly variable, according to métiers, and landing volume and price. Some fishers (on-board crew) below minimal wage (like purse seiners). Attractiveness: still high

Framing Question 1: What is the contribution of the VC to economic growth?		INDICATORS	RESULTS
CQ1.2	What is the contribution of the VC to the GDP?	**Value of final VC production (MTZS)**	372,539 MTZS
		Direct VA (MTZS)	217,678 MTZS
		Total VA	262,058 MTZS
		Total VA creation per stage (MTZS)	Fishers: 130,933 MTZS/60% Processors: 43,203 MTZS/20% Traders: 43,542 MTZS/20%
		Total VA and components (MTZS)	Wages/salaries:139,921 MTZS Land fee (boat ownership): 15,130 MTZS Taxes: 4,566 MTZS Depreciation: 5,943 MTZS NOP overall: 54,118 MTZS NOP fishers: 490 MTZS/1% NOP processors: 27,381 MTZS/51% NOP traders: 26,246 MTZS/48%
		Total VA in percentage of the GDP	6.32%
		Rate of integration into the Economy (total VA/VC production)	70.34%
CQ1.3	What is the contribution of the VC to the agriculture sector GDP?	**VC agricultural actors' Value Added in percentage of the agriculture sector GDP**	29.94%
CQ1.4	What is the contribution of the VC to the public finances?	**Receipts of the government (taxes, etc.)**	4,566 MTZS
		Outlays of the government (subsidies, etc.)	0
		Public Funds Balance	Receipts – Outlays = 4,566 MTZS
CQ1.5	What is the contribution of the VC to the balance of trade?	**VC exports**	53,414 MTZS
		VC total imports (goods and services)	43,132 MTZS
		Balance of trade of the VC (VC exports- VC total imports)	10, 282 MTZS

Framing Question 1: What is the contribution of the VC to economic growth?		INDICATORS	RESULTS
CQ1.6	Is the VC viable in the international economy?	**Nominal Protection Coefficient (NPC)**	1
		Domestic Resource Cost Ratio (DRC)	1.12

3.2.5.3. Summary table of indicators for framing question 1 – TANZANIA

Framing Question 1: What is the contribution of the VC to economic growth?		**INDICATORS**	**RESULTS**
CQ1.1	How profitable and sustainable are the VC activities for the entities involved?	**Operating Accounts of every type of actor**	Varying. Tables 3.1 and 3.2 Fishers: Tables in Appendices 3.1 Sub-chains and Appendix of section 3.2.1.1
		Net operating profit by type of actor – Monthly income	Tables 3.1 and 3.2 Monthly income range: Fishers: 46-576 USD/m Traders: 102-1,564 USD/m Processors: 72-49,598 USD/m
		Return on turnover (operating profit/production)	Fishers: 3.7% Processors: 12.3% Traders: 17.5%
		Benchmarks for fishers' net income (minimum wage, livelihood needs, job opportunities…)	Minimal wage of 130 USD/month. Fishers' wages highly variable, according to métiers, and landing volume and price. Some fishers (on-board crew) below minimal wage (like purse seiners). Attractiveness: still high

Framing Question 1: What is the contribution of the VC to economic growth?		INDICATORS	RESULTS
CQ1.2	What is the contribution of the VC to the GDP?	**Value of final VC production**	875,940 MTZS
		Direct VA	556,473 MTZS
		Total VA	660,509 MTZS
		Total VA creation per stage	Fishers: 240,106 MTZS/43% Processors: 157,957 MTZS/28% Traders: 158,411 MTZS/28%
		Total VA and components:	Wages/salaries: 255,468 MTZS Land fee (boat ownership): 25,735 MTZS Taxes: 25,495 MTZS Depreciation: 28,336 MTZS Overall NOP: 221,439 MTZS NOP fishers: 12,975 MTZS/6% NOP processors: 102,001 MTZS/46% NOP traders: 106,463 MTZS/48%
		Total VA in percentage of the GDP	0.46%
		Rate of integration into the Economy (total VA/VC production)	75.4%
CQ1.3	What is the contribution of the VC to the agriculture sector GDP?	**VC agricultural actors' Value Added in percentage of the agriculture sector GDP**	1.7%
CQ1.4	What is the contribution of the VC to the public finances?	**Receipts of the government (taxes, etc.)**	25,495 MTZS
		Outlays of the government (subsidies, etc.)	0
		Public Funds Balance	Receipts – Outlays=25,495 MTZS
CQ1.5	What is the contribution of the VC to the balance of trade?	**VC exports**	103,970 MTZS
		VC total imports (goods and services)	98,414 MTZS
		Balance of trade of the VC (VC exports - VC total imports)	5, 556 MTZS

Framing Question 1: What is the contribution of the VC to economic growth?		INDICATORS	RESULTS
CQ1.6	Is the VC viable in the international economy?	**Nominal Protection Coefficient (NPC)**	1
		Domestic Resource Cost Ratio (DRC)	0.70

4. IS THIS ECONOMIC GROWTH INCLUSIVE?

4.1. Income distribution along the value chains

4.1.1 Disaggregated Value Added, Wage, NOP, FTE

The disaggregation of the direct VA among actors is indicated by the figures (see Section 3.2.1, Figures 3.1) for MLT, ZNZ, and URT by the estimate of the percentage distribution for the Direct VA, the Wages, the NOP. In this section, we included the estimation of FTEs[29] (cf Appendix for details, Section 4.1 Tables) and in the following figure (Figure 4.1).

These estimates show very contrasted results between MLT and ZNZ. The NOP share is not the appropriate indicator as the share system for fishers leads to an NOP close to zero with an exception of octopus fishers in MLT. The relative contribution of the primary sector (fishers) in ZNZ to the total of Direct VA, Wages and number of FTE is higher in ZNZ compared to MLT. This is probably due to the presence of industrial processors in MLT, providing a high number of jobs (28% of the FTE processing jobs).

In addition, the total estimated number of fishers is higher in ZNZ, as compared to MLT (24,000 as compared to 18,000, respectively), for about 65,000-70,000 t of production volume for each region.

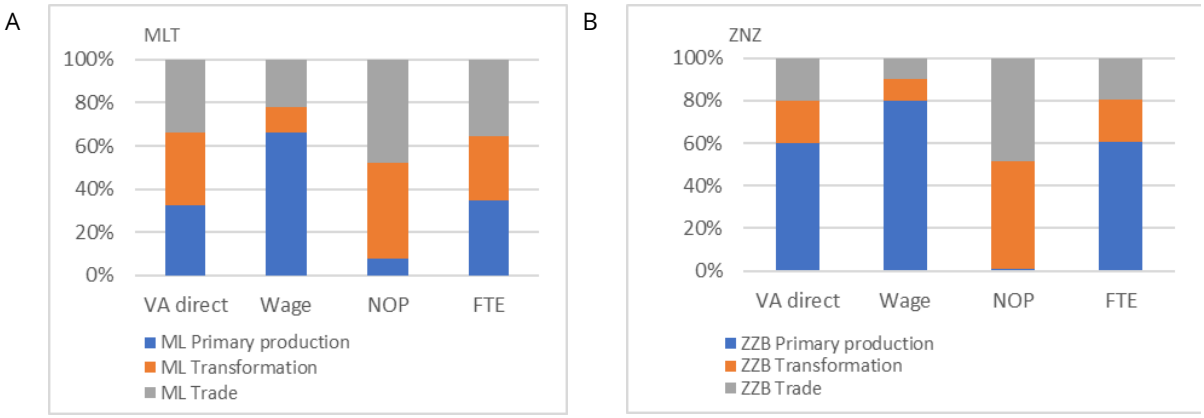


FIGURE 4.1 BREAKDOWN IN % OF DIRECT VA, WAGES, NOP, AND FTE BETWEEN CATEGORIES OF ACTORS IN A) MLT, AND IN B) ZNZ
(VCA4D findings – AFA)

4.1.2 Monthly income per category of actor

The relative contribution of each category of actors to the Total Output, Value Added, Wages, NOP was presented in Section Cf 3.2.1. regarding the assessment of Profitability for each actor.

4.1.2.1. Fisher's income

The range of monthly incomes was quite high as estimated in our calculations, depending on the type of métiers and the landing price, for the various fishers in MLT and in ZNZ (Section 3.2.1.1; Figure 3.4.). These incomes were calculated on a year basis. However, in some métiers such as prawns and octopus fisheries, low incomes are around or inferior to our considered minimal wage (130 USD/m) and the minimal wage of the Fisheries and Marine services sector minimal monthly wage of 86 USD proposed in the Africapay.org ref site. These activities are practiced on a seasonal basis, and are often complementing another activity, in fisheries or others (e.g. agriculture) (Table 4.1). If we calculate the revenues for the fishers on a daily basis for these fisheries, the hereunder indicated incomes can be multiplied by a factor or 2 or 3, around and higher than 250 USD/month.

[29] The numbers of FTE are computed by dividing the total of NOP+Wage and Boat Ownership divided by the minimal wage (estimated at 300,000 TZS/month in MLT and in Tanzania).

Participant	Comments on sources of income and livelihoods
Mainland	
Dagaa fishing crew, FGD, Kilwa Kivinje	All the household income for these three fishers come from fishing. In future all three are expecting income from the tree crops they have planted.
Songo Songo women/ octopus fisher FGD	• Partipant1Lives by herself in her own house. Has 6 grandchildren. Seaweed farming is her main source of income • Participant 2 Lives with 4 grandsons. Seaweed farming is more important source of income than octopus. Last time she eats octopus was 5 months ago. When young she eats octopus every day. • Participants 3 Single mother with one child. Renting a house. Used to eat octopus year round. Previously 100% of income was from octopus, now 50:50 with earnings from transporting dagaa fish. • Participant 4 Lives alone in a house she built herself. One son staying with her mother. Sells clothes and fishes for octopus during *Bamvua.*
Ringnet fisher key informant interview, Kilindoni, Mafia	• He is aged 42 years and has been fishing for more than 20 years. He went to madrasa for his education. He started fishing when he was young, fishing for octopus, crab. Life was difficult. He was brought up by his mother only and so decided to start working. • He is originally from Pemba. But has been a fisher in various places such as Mombasa and Shimoni (Kenya), before reaching Mafia in 1998. At that time Mzee Omari Msomanga owned (??) this part of the coastline. Mzee Msomanga let them to live free (freely?) in that area and from 2004 up to now he has decided to stay. Many fishers from Pemba stay in Mafia – more than 1,000. • He is doing ring net fishing as a crew member. Life is not good, but there is no alternative.
Prawn fishers from Rufiji seeking employment in Mafia FGD.	• The three fishers came from 3 different communities in the Rufiji delta area. They are in Mafia looking for any kind of fishing to do during the close season in the Rufiji area. The open season for prawns lasts for 6 months, during which they fish for 15-20 days/ month. • In their communities, prawn fishing is mainly done from dug out canoes (2 persons per boat). The canoe usually belongs to the fishers, but sometimes they hire. A dugout costs Tsh 600,000 and lasts for 2-3 years. The fishing gear (net, ropes, buoys, spools) lasts for about one month. • They usually fish from 7.00 am to 2.00 pm. No bait is used. Most fishers use a gill net. After catching the prawns (maximum catch would be 150 kg of prawns) they go to the middlemen who have financed this investment. Usually they are paid cash, but if the middlemen don't have cash it is recorded in a record book. • If middlemen have financed the trip then they agree to sell at Tsh 2,500 – 3,000/ kg. If fishers finance the trip they can sell for Tsh 4,000-5,000 / kg. All three of these fishers rely on middlemen for finance. There are about 40 middlemen in the Rufiji area. • There is no cooperative specific to prawn fishers.
Zanzibar	
Chwaka Bay fishers FGD	• Participant 1 (23 years) Madema (basket) fisher; keeps cattle. • Participants 2. (32) Mshipi (hook and line) fisher. No farming. • Participants 3 (59) Net fishing. Cattle farming, poultry (ducks) • Participant 4(42) Net fisher. Seasonal farming. Keeps goats (free grazing). • Participant 5 (30) Ring net fishing. Goat keeping. • Participant 6 (46) Net fisher. Lime/ citrus farming, inter-cropped with coconuts
Nungwi Fishers FGD	• Participant 1 (40 years) Net fisher, especially at night. Farming cassava only, inside this village • Participant 2 (37) Mshipi (line and hook) Farming banana. Lives in Pemba. Comes to fish during the fishing season. • Participant 3 (39) Madema (basket net) fishing. Farming banana and cassava. Lives in Pemba (Kangani village, Mkoani Southern district) • Participant 4 (56) Deep sea nylon net fisher. Mason. No farming. • Participant 5 (45) Nyavo small net fisher in shallow water. Repairing and making new nets. • Participant 6 (20) Chokozi octopus diver. No other livelihood activities.

TABLE 4.1 COASTAL COMMUNITIES FISHERS LIVELIHOOD ACTIVITIES (PRIMARY DATA)

Both in MLT and in ZNZ, the average income generated for the crew in Anchovy-like fisheries is critical, less than half the minimal wage, a critical situation like the one observed by Ibengwe et al. (2022) in MLT, by Stanek (2015), our results are even lower.

A similar critical situation is observed on fishing métiers associated with low value fish (e.g., Ringnetter FF1), even in situation of non-motorized fishing fleets.

However, in the particular of purse seiners, if the daily catch increases, the income generated is significantly augmented. But according to our data (Nov. 2021) and the rules of income shares, the crew members are taking a lesser advantage of this situation compared to the boat owner, the skipper or lamp holders (Figure 4.2). However, as reported by some fishers respondents, the crew seems quite satisfied with the sharing arrangement that was decided with the boat owners Nov. 2021, Social interviews).

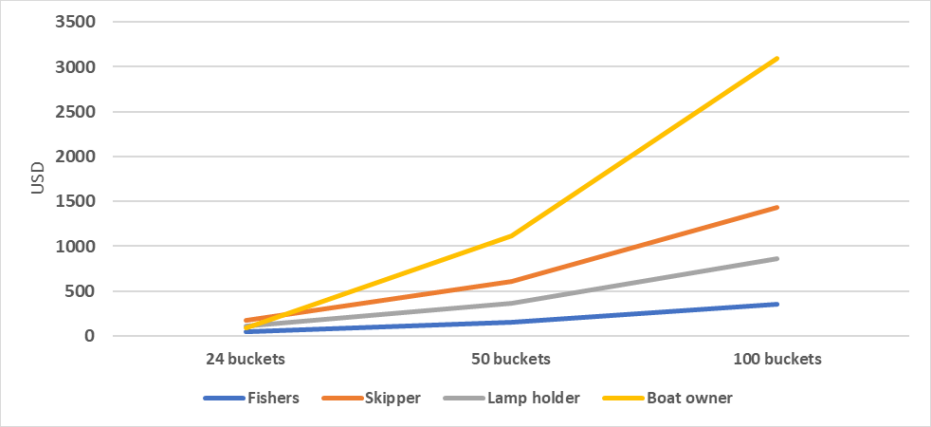


FIGURE 4.2 ESTIMATED FISHER MONTHLY INCOME IN USD AS A FUNCTION OF THE DAILY CATCH IN NUMBER OF BUCKETS FOR A PURSE SEINE UNIT TARGETING SMALL PELAGIC, ANCHOVY-LIKE IN MLT

Source: primary data, November 2021. Based on: 16 crew on-board, one skipper, one boat owner, a bucket= 23 kg of fresh anchovy, landing price at 880 TZS/kg fresh anchovy

These observations support the recognition that fishers (as on-board crew members) can be considered as a vulnerable category for most of them, as often recognized in artisanal small-scale fisheries (URTMLF, 2021). Among fishers' categories, if the landing price is reaching higher values, as it is in the case for fishers selling into the tourism market in ZNZ, the incomes generated can become quite significant, as seen with the example of the fishers we interviewed (May 2022). These fishers using longlines, fiberglass boats, mainly targeting high value fish (large pelagic or large reef fish), marketed at 6,000 TZS/kg and more, in auctions places or directly to hotels could obtain monthly incomes around 750-800 USD/month.

Handliners, trappers, ringnetters and gillnetters would be in the position to reach high incomes if they can target high value fish (cases FF3 in our study). However, very likely, these fishers are within the categories targeting medium value finfish ("FF2"), operating on on-shore fishing grounds, for a monthly income ranging from 100 to 350 USD/month in ZNZ, and a wider range of 150-500 USD/month in MLT.

4.1.2.2. Income distribution in the VCs among actors

Monthly incomes are deduced from VCA4D computations, the total Wages+NOPs+Property income divided by the estimated numbers of actors (unit) and the number of people per actor (Table 4.2).

MLT	Actors	Anchovy	Finfish 1	Finfish 2	Finfish 3	Finfish	Octopus	Prawn	MLT
Average monthly income/fisher in USD	Fisher MLT	62	113	321	576	336	67	111	155
Average monthly income (NOP)/processor in USD	Processor MLT	332	673	233	298	442	49,598	6,441	561
Average monthly income (NOP)/trader in USD	Trader MLT	144	364	694	850	599	1,564	931	455
ZNZ		**Anchovy**	**Finfish 1**	**Finfish 2**	**Finfish 3**	**Finfish**	**Octopus**		**ZNZ**
Average monthly income/fisher in USD	Fisher ZNZ	46	110	207	288	214	99		162
Average monthly income (NOP)/processor in USD	Processor ZNZ	332	83	72	100	78	101		161
Average monthly income (NOP)/trader in USD	Trader ZNZ	315	116	119	102	111	545		206

TABLE 4.2 RANGE OF MONTHLY INCOMES (IN USD/MONTH) AMONG ACTORS IN THE SUB-CHAINS IN THE COASTAL FISHERIES IN MLT AND ZNZ
(VCA4 findings)

Overall, these estimated monthly incomes compared to the minimal wage (130 USD/month) and previous studies (Ibengwe et al. 2022; Linton, 2021; Sofreco, 2018; Stanek, 2015) are within the described ranges. The various methodologies to approach these estimates, as well as the consideration of full-time job, or temporarily/ seasonal income, make any further comparison difficult.

The lowest monthly incomes are observed in ZNZ, the fishers (purse seiners) or artisanal processors of finfish. The highest income is seen in the industrial processors in MLT. But this last finding must be refined by the exact total number of employees in those factories.

The share of the fisher's landing price in the final end-user price, widely varies, among sub-chains and the two regions, ranging from 9 % (Anchovy in ZNZ) to 56 % (Finfish and Octopus in ZNZ), and between 14% (Anchovy MLT) to 41 % (Finfish FF3) in MLT, indicating here again a potential higher inequality on the sub-chains.

4.2. Participation in the value chain governance

4.2.1 Gini coefficients

The use of Gini coefficients associated to Lorenz curves provides an assessment of income distribution among groups of actors in value chains and economic systems. The Gini coefficient ranges from 0 to 1, with 0 denoting that income is perfectly equally distributed, in which case the Lorenz curve would follow the line of perfect equality. According to the FAO (1980), a Gini coefficient of 0.35 and over is high and indicates a high degree of inequality (O'Neill et al. 2018).

Overall, our study shows that the Gini 's coefficients are indicating less inequality in MLT, as compared to ZNZ (Figure 4.3). The best Gini's coefficients are found in MLT finfish sub-chains (0.5216), particular in the low value

finfish sub-chain ("FF1") mostly covering the fisheries of medium pelagic and reef fish, for local markets. The "worst" Gini coefficients are seen in ZNZ, in the Anchovy-like sub-chain and in the Octopus sub-chain; 0.8566 and 0.8482, respectively. However, all the explored sub-chains are displaying Gini's coefficients much higher than the proposed acceptable value of 0.35 proposed by the FAO in 1980.

O'Neill et al. (2018), report Gini's coefficients in ZNZ of 0.68 for the overall chain they studied (octopus-reef fish), while our own estimates are around 0.6882-0.8482. However, as their study included a panel of fishers and traders dealing with the tourism market, the situation we studied in our case of Finfish "FF3" (high value fish), is in their range.

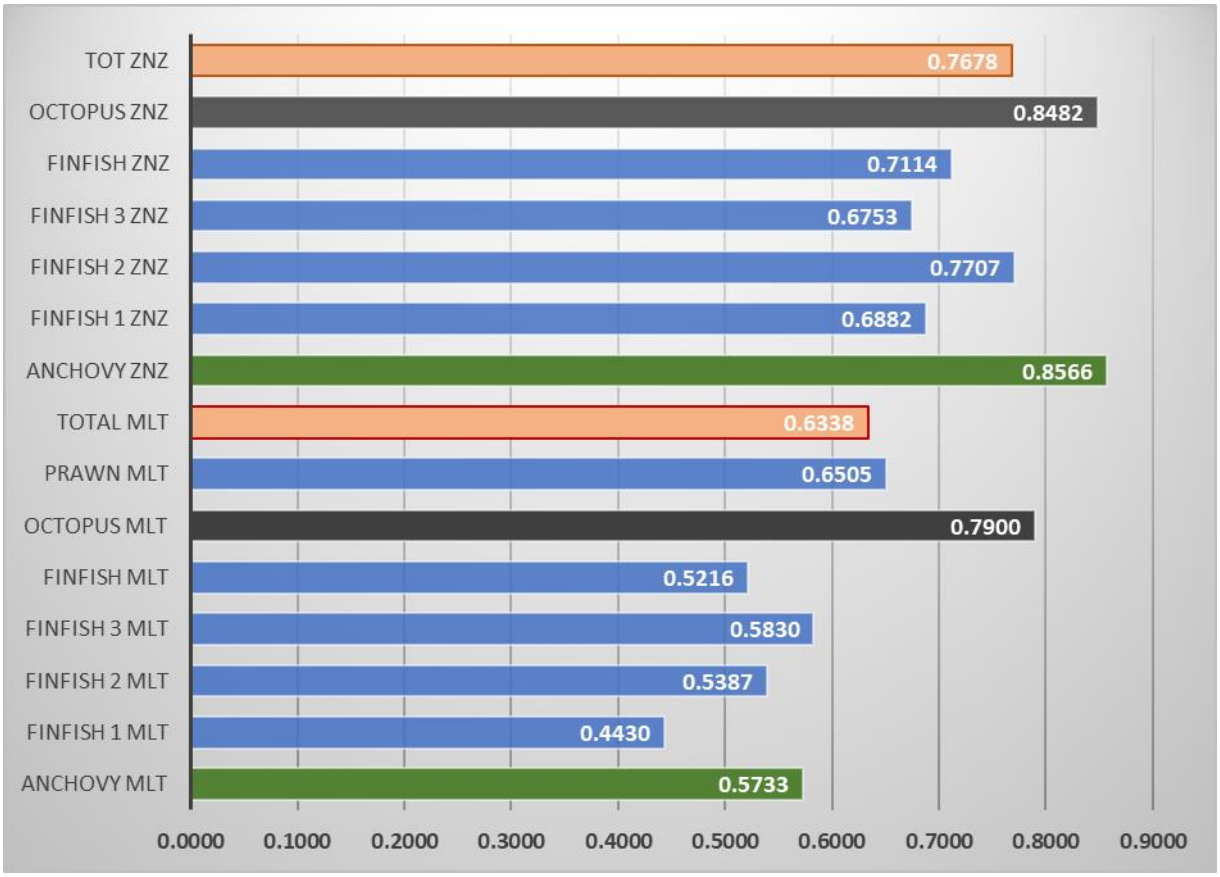


FIGURE 4.3 GINI COEFFICIENTS FOR THE COASTAL FISHERIES VALUE SUB-CHAINS IN THE MLT AND IN ZNZ
(VCA4D findings – AFA)

The Anchovy sub-chain displays a much higher degree of inequality in ZNZ as compared to MLT, probably because of the dominant position of the export traders in ZNZ and the evidenced vulnerable position of fishers. The Anchovy sub-chain Gini coefficient in MLT of 0.5733 (and the Lorenz curve profile) should be compared to the work of Ibengwe et al. (2022) indicating a Gini of 0.79 for the whole chain (Figure 4.4). Interestingly, after discussion, with the author (May 2022), such discrepancy may be related to the panel of actors included in the evaluation of Gini's coefficient in their work compared to our work. In our sub-chain, we included a significant volume (40%) of Anchovy-like fish being, as fresh and fried fish, sold to the local market. In Ibengwe et al. (2022), they strictly focused on the Anchovy sub-chain intended to be processed as Dried anchovy and exported.

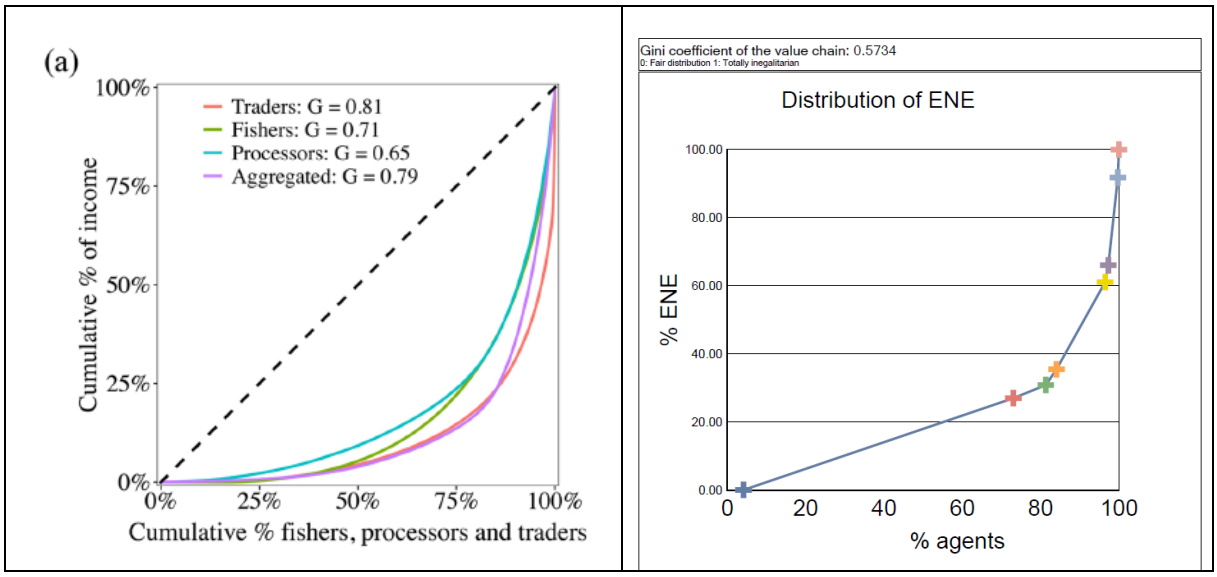


FIGURE 4.4 LEFT: LORENZ CURVE ON AVERAGE SEASONAL INCOME FOR MARINE DAGAA FISHERS, PROCESSORS AND TRADERS, REPORTED WITH GINI COEFFICIENTS (G) IN IBENGWE ET AL. (2022). RIGHT: LORENZ CURVE AND GINI COEFFICIENT ON ANNUAL INCOME IN THE SUB-CHAIN OF ANCHOVY-LIKE FISH IN MLT TANZANIA
(Right: AFA - VCA4D estimate, ENE="Excédent Net d'Exploitation" in French, e.g. Net Operating Profit)

4.2.2 Marginalized and vulnerable groups

Vulnerability in the coastal fisheries value chains may be considered in terms of sensitivity (the intrinsic degree to which people and economies depend on fisheries) and adaptive capacity (the ability of people and socioeconomic systems to anticipate, respond to, and adjust to the impacts of a change, and to minimize, cope with, and recover from the consequences). Vulnerability is largely determined by socioeconomic processes, including policies, governance, norms, and practices, many of which interact with ecological change. Fisheries and their communities are particularly exposed to climate-related hazards due to their living and working at sea and on coastlines (Bladon et al, 2022).

Guided by the above definition, a very high proportion of the stakeholders in the coastal fisheries value chains may be considered vulnerable. Most of the individuals in the fishers, processor and trader groups, together with associated workers and service providers are highly dependent on fisheries and communities such as Kilwa Kivinje have become increasingly dependent on fisheries. Informal employment arrangements and inadequate mobilization have made many of the fishers encounter low rates of remuneration, low job security and inadequate access to social-security and social-protection systems (Mwaipopo, 2017).

According to our estimates, the fishers appear as a vulnerable group in most sub-chains although in some cases, their income can exceed 3 times or more the minimal wage.

Other actors may become even more vulnerable in some sub-chains, such as artisanal processors in finfish sub-chains. Many of these SSF communities are also experiencing a high level of structural constraints and inequities that heighten their sensitivity and restrict their adaptive capacity, thus increasing their vulnerability. For example, insecure property rights, conservation policies which bring significant costs and insufficient benefits to community members and coastal developments which are restricting access to marine resources in what has been described as unjust or unfair way.

One particular group that may be marginalized are migrant fisher who are an important feature of East African fisheries. It may be the case that migrant fishers seek permission to temporarily reside from host community representatives, who may allocate areas where the migrants can camp. Migrant fishers are also expected to register with district fisheries officers but, overall, these fishing rights are not clearly defined. (Sekadende et al, 2020). The retired Beach recorder at one community in Zanzibar recounted the temporary camp (daga) of one group of migrant fishers had been burnt down by local community members to deter them from fishing in their locality. A crew member from Pemba explained how he finally decided to stay in Mafia because a local person of some prominence enabled him to feel free to stay on the island, alongside many other migrants from Pemba.

4.2.3 Women's contribution

The degree of participation of women in the fisheries value chains, in both MLT and ZNZ has been drastically changing in recent years (further details in Section 5 Social analysis). The new and ongoing census will allow better estimates on women participation. In the primary sector, the number of women in the major value chains is very low, with the exception of octopus foot fishers. The Frame Survey conducted in ZNZ provides estimates of women participation (cf Table 2.7 in the functional analysis, section 2.1.6.4, gender, and support services) (MoBEFZ, 2020).

In most fisheries value chains, women who were in the past strictly involved in downstream activities, retailers, and artisanal processors (frying, boiling, drying) are now getting more and more involved in the primary traders, buyers at the auction places. But they are also emerging as entrepreneurs, positioned as middle women for the Anchovy-like sub-chain, having the responsibility of handling all the operations from purchase of fresh anchovy up to the sale of dried anchovy to export traders. In large-scale trading, secondary traders in urban areas, and industrial processing activities, the percentage of women is still reduced, but this situation is changing (O'Neill et al. 2018).

Consequently, the percentage of women included in the various sub-chains was estimated by combining literature data and information obtained in our primary data. In the absence of real recent estimates of the women numbers in these value chains, we adopted the following approach:

- We evaluated the number of FTEs, for each category of actors, and sub-chain (tables in Appendices of Section 3.2 Data base, and Appendix (table) of Section 4.1).
- We considered that all the activities retail-activities were done by a majority of women, which might be an optimistic assumption.
- When a new category of actors was perceived as an activity where women were taking more and more responsibility, we took an arbitrary share of 50/50 between men and women which might be again optimistic.

Such approach gives as a rough estimate of the situation as it could be, based on rather optimistic assumptions of women participation in coastal fisheries, to explore the major trends and contrasts between sub-chains.

With this approach, in the coastal value chains, the estimate of women employment rate for MLT, ZNZ, and Tanzania, 26%, 15%, and 21%, respectively. The estimated rate of 15% in ZNZ can be compared to the rate of 17% provided by the last frame Survey in ZNZ (MoBEFZ, 2020). The higher overall rate in MLT may be due to factors such as the encountered women foot octopus fishers and women working in seafood processing factories.

Clear differences may exist between the sub-chains. For instance, this analysis of the sub-chain of Finfish in MLT leads to an estimate of 12 to 76%, whereas in ZNZ this estimate ranges between 7 to 20%. The importance of retail-friers (an activity that we attributed to women) may explain these differences. However, in terms of income, the average income calculated for those women in the streets could be quite significant. For instance, it is estimated at more than 800 USD/month in the case of women frying and selling small size fish (anchovy-like, sardines, small reef fish) in ZNZ (see Section 3.2.1.3 and Appendix for Section 3.2.1.3).

4.2.4 Employment types

Using a similar approach as for the women job rate, we estimated the rate of temporary vs full-time jobs, unqualified vs qualified jobs, as well the self-employment rate, and the rate of formal (under written contracts) jobs.

The actors may or may not be skilled, but majority of the jobs are unqualified (>90%). The self-employment rate varies according to the sub-chain and the category of actors. Traders and artisanal processors are mostly self-employed, but this situation is different for fishers, as most of them are effectively involved in profit sharing arrangements. The rate of formal employment is important in the sub-chains where industrial processors play a major role (Octopus and Prawn sub-chains in MLT), around 30%, while it is very low for all the others. Seasonal, temporary, partial jobs are seen in the seasonal fisheries (Octopus, Prawns, Anchovy-like) while in the finfish sub-chains, the activities could be considered the whole year long.

4.2.5 Summary table of indicators for framing question 2

Framing Question 2: Is this economic growth inclusive? *(To be completed with Social Analysis results)*		**INDICATORS**	**RESULTS**
CQ2.1	How is income distributed across actors of the VC?	**Disaggregated Value Added**	See section 3.2.2 and Fig. 3.5 Contribution to the Direct VA: Fishers: 32%, 60% and 43%, for MLT, ZNZ, and URT. MLT: Traders in MLT 34%, Processors 34%, ZNZ: Traders 20%, Processors 20% URT: 28 % for traders and 28 % processors.
		Total fisher income	See section 4.1.1.1, monthly income for fishers 62-756 USD/month in MLT and 42-288 USD/month in ZNZ. Critical cases: purse seiners, targeting anchovy in ZNZ and in MLT, monthly incomes around 50 USD/month and less.
		Wages and salaries (at every stage, all activities)	See section 4.1.1.2 Table 4.2
		Total income accruing to marginalized and vulnerable groups	See section 4.2.2 Almost all categories of actors are considered as vulnerable, particularly fishers.
CQ2.2	What is the impact of the governance systems on income distribution?	**Income distribution among actors**	See Section 3. Share of Operating profits (net or gross) per actor + Operating profits distribution chart (in %) in the text.
		Share of fisher price in the final price (%)	Ranging from 9 % (Anchovy in ZNZ) to 56 % (Finfish and Octopus in ZNZ), and between 14% (Anchovy MLT) to 41 % (Finfish FF3) in MLT.
CQ2.3	How is employment distributed across the VC?	**Number of jobs (family, self- and formal employment) at different VC stages (permanent/ temporary, skilled/unskilled…)**	Fig. 4.1 Most jobs unqualified (>90%). Self-employment rate varies: Traders and artisanal processors are mostly self-employed, rate of formal employment is important in the sub-chains where industrial processors play a major role (Octopus and Prawn sub-chains in MLT), around 30%, while it is very low for all the others. Seasonal, temporary, partial jobs are seen in the seasonal fisheries (Octopus, Prawns, Anchovy-like) while in the finfish sub-chains, the activities could be considered the whole year long.
		Employment of women	Section 4.2.3: In all value chains, the estimate of women employment rate for MLT, ZNZ, and Tanzania, 26%, 15%, and 21%, respectively.

5. IS THE VALUE CHAIN SOCIALLY SUSTAINABLE?

5.1. Introduction

This section explores the social sustainability of the coastal fisheries value chains. It includes an outline of the social context and an assessment of social impacts related to the activities of the coastal fisheries value chains. The main framework used to guide the analysis is based on six basic domains: i) Working conditions; ii) Land & water rights; iii) Gender equality; iv) Food and nutrition security; v) Social capital and; vi) Living conditions.

The analysis is mainly based on existing literature (peer reviewed and grey), official household survey data, interviews with key informants and Focus Group Discussions. Key informant interviews were held at local and national levels. Focus Group Discussions were held with key actors in the fisheries sub-chains, together with women and community leaders in fishing communities (See Appendix 1 for details).

5.2. Results

5.2.1 Working Conditions

5.2.1.1. Summary of findings

1. WORKING CONDITIONS		
1.1 Respect of labour rights	MLT and ZNZ governments have separate, although similar, labour law regimes. There is recognition that gaps exist in the laws, as well as inconsistencies between the laws applying in the MLT and ZNZ. There is weak enforcement of labour rights and standards, lack of occupational safety and health, and weak organization of workers. No evidence that seafood processing companies (only operating on MLT) are not respecting labour standards, but most workers in coastal fisheries value chains are in the informal sector where enforcement of rights and organization of workers is particularly challenging.	Moderate/ Low
1.2 Child Labour	Both MLT and ZNZ law prohibits exploitation of children in the workplace, but both MLT and ZNZ have limited capacity to enforce. Older children may be employed to do non-hazardous work. MLT: The overall child labour rate for children aged 5-17 years was 28.8 % in 2014. An estimated 29,285 children aged 5–17 years were working in fisheries (fresh & marine), but how many of these were working as child labour was not stated. ZNZ: Children work in fisheries, but the extent is not clear. In some fishing villages children's work at fish markets prevents them from attending school.	Moderate/ Low
1.3 Job safety	Job safety in the fisheries sector remains an important issue, but official data is not readily available. A number of risks associated with fisheries were reported during our field visits including accidents and deaths at sea and the lack of appropriate rescue services and equipment.	Moderate/ Low
1.4 Attractiveness	In spite of the challenges, people, including women and youth, are attracted to fisheries VCs in MLT and ZNZ. Measuring attractiveness of remunerations in fisheries VCs is challenging; it varies with sub-chain, stakeholder, location & over time. Many fishers reported that they are fishing because of a lack of alternatives.	Substantial

Rating Scale used:	
Meaning	***Scale***
High likelihoods of this happening, no or little risks in the VC	**High**
Substantial likelihoods of this happening, low risks in the VC	**Substantial**
Moderate to low likelihoods of this happening, medium risks in the VC	**Moderate/Low**
Unlikely of this happening, high risks in the VC	**Not at all**
The parameter is not applicable for the VC	**n/a**

5.2.1.2. Respect of labour rights

The United Republic of Tanzania (URT) has expressed its consent to the International Covenant on Economic, Social and Cultural Rights (ICESCR) and the International Covenant on Civil and Political Rights (ICCPR) and the treaties have entered into force since 1976[30]. The eight (out of 8) fundamental ILO international labour conventions are "in force" in URT[31]. Mainland Tanzania and Zanzibar have separate, although similar, labour law regimes. Despite the adoption of new labour law regimes for Mainland Tanzania in 2004 [32] and for Zanzibar in 2005, there is a recognition that some gaps exist in the laws, as well as inconsistencies or conflicts between the laws applying in the Mainland and Zanzibar, or between the labour laws and other laws. There is weak enforcement of labour rights and standards, lack of occupational safety and health, and weak organization of workers (ILO, 2013).

Most of those working in the fisheries sector are in the informal sector where enforcement of rights and organization of workers is particularly challenging (HLPE, 2014). Informal employment arrangements and inadequate mobilization have made many of the fishers encounter low rates of remuneration, low job security and inadequate access to social security and social protection systems (Mwaipopo, 2017). Key issues relating to conditions of labour in the small-scale fisheries of Tanzania identified by Mwaipopo (2017) include:

- Employment conditions are based on oral, informal agreements which, although binding according to traditional sanctions, do not permit formal recognition by current legislation unless they are sanctioned by the government. Such situations allow for avoidance of the law and fishers' rights.
- Small-scale fishing is a precarious occupation, sometimes subjecting fishers to natural disasters. Opportunities to subscribe to insurance schemes exist, but they are still minimal and not widely advocated.
- Employment agreements do not entail binding insurance benefits, including accident or offseason benefits; and there is still inadequate mobilization of social security schemes and benefits among fishers and fishing communities to cater for the needs of the occupation.
- There are limitations in small-scale fishers' organizations to mobilize for favourable employment conditions.
- The working environment remains precarious for fishers because of poor technologies, especially for local vessels to maintain seaworthy safety standards.
- Informality limits effective monitoring of small-scale operators, despite sound regulations. This has had implications for fishers' abilities to engage in gainful employment from the fisheries.

Medium to large seafood companies with a strong focus on octopus and prawn fisheries, but also finfish, are in the formal sector and workers are under greater effective protection of employment law. Seafood companies targeting the EU market are required to meet minimum standards and receive regular inspections, but this is mainly concerned with issues such as food safety and quality, labelling and legality of fishing rather than labour rights (CBI, 2020). However, MSC (Marine Stewardship Council) certification for octopus is being pursued by some companies in collaboration with the Ministry of Livestock and Fisheries and WWF. This could mean companies having to meet minimum social, as well as environmental standards.

5.2.1.3. Child Labour

In Mainland Tanzania, in 2014, 25% of children aged 5–13 years (almost 2.8 million) were considered to be in child labour[33]. Nearly 95% of children in child labour were in the agricultural sector and nearly 93% in

[30] http://indicators.ohchr.org/

[31] https://www.ilo.org/dyn/normlex/en/f?p=1000:11200:0::NO:11200:P11200_COUNTRY_ID:103476

[32] The 2004 Employment and Labour Relations Act (ELRA), in particular, lays out the broad, fundamental rights and regulations at work, and also covers foreign and migrant workers. The 2017 reform added further protections around employment standards and trade union matters, as well as child labour prohibitions (DTDA 2021 in Lambin and Nyyssola 2022).

[33] Following national legislation and global measurement standards, children are classified as being in child labour on the basis of the following criteria: a) For children aged 5–11 years: those in employment; b) For children aged 12–13 years: those in employment except those in light work; c) For children aged 14–17 years: those in work posing a danger to health, safety or morals and in "night work".
Children in employment are those engaged in any economic activity for at least one hour during the reference period. Economic activity covers all market production and certain types of non-market production (principally the production of goods and services for own use, excluding water and firewood collection). It includes forms of work in both the formal

unremunerated family work. One of the coastal regions (Mtwara, 35%) was significantly above the national average, two were slightly below (Pwani, 24.2% and Tanga, 22%) and two significantly below (Lindi,14.4% and Dar es Salaam,0.9%). Of children aged 5-13 years, 55.6% were in school exclusively, 19.7% were in school and working and 24.7% were completely out of school. About 8% (1,450,000) of children in the compulsory schooling age group of 7–13 years were out of school[34]. The overall child labour rate for those aged 5-17 years for Mainland Tanzania was 28.8 % (4.2 million children). An estimated 29,285 children of age 5–17 years were working in the fisheries sector in Mainland Tanzania, but it is not stated how many of these were working as child labour (NBS/ ILO 2016; ILO/FUNDAMENTALS, 2018). It is important to note that older children could be involved in apprenticeship training.

The law prohibits the exploitation of children in the workplace. By law the minimum age on the Mainland for employment is 14; in Zanzibar the minimum age is 15. Children older than 14 but younger than 18 may be employed only to do non-hazardous work that is not likely to be harmful to the child's health and development or attendance at school. The government has published regulations to define hazardous work for children in several sectors, including in fishery[35]. The law limits working hours for children to six hours a day. Although legal penalties for violations of minimum age laws are likely sufficient to deter violations, there are few reported instances of law enforcement officials imposing penalties. The labour inspectorates for both Mainland Tanzania and Zanzibar lack human and financial resources to adequately enforce minimum age laws, and labour inspectors lack authority to assess penalties for violations. Inadequate enforcement leaves children vulnerable to exploitation (US Department of State, 2021).

On Mainland Tanzania children worked as domestic workers, street vendors, and shopkeepers as well as in fishing and other sectors. In Zanzibar children worked primarily in fishing, clove picking, domestic labour, small businesses, and gravel making. In fishing villages such as Matemwe, children's work at fish markets prevents them from attending school (US Department of State, 2021). On our field visit in November 2021, a small number of children were observed cleaning fish in the afternoon at one landing site in Zanzibar. A poster raising awareness about children working was attached to the auction market wall.

5.2.1.4. Job safety

Occupational health and safety in the country is reflected in the occupational safety and health law. The Occupational Health and Safety (OHS) Act 2003 recognizes roles played by public and private institutions and is the main legislation governing occupational health and safety practice in Tanzania, but it still leaves out the self-employed and informal sectors. Occupational health services are accessed by less than 5% of the working population in Tanzania (Mrema et al., 2015). The main group of workers in the fisheries sector covered by OHS law would be those working in seafood processing factories.

At the national level, the Tanzania Shipping Agencies Corporation (TASAC) (formerly Surface and Marine Transport Regulatory Authority - SUMATRA) under the Ministry of Transport is responsible for safety at sea. TASAC carries out inspections of fishing vessels, to assure seaworthiness at a fee set by the Authority. However, Haule (in Breuil and Bodiguel, 2015) suggested that inspections are more geared towards revenue collection than ensuring vessels are seaworthy. Collaboration between TASAC and the Fisheries Development Division was almost non-existent, and the Fisheries Development Division has no data on fisher casualties at sea[36]. Efforts are being championed by the Fisheries Education and Training Centre (FETA) to provide TASAC with validated Safety at Sea short course training for fishers (Mgawe, pers com July 2022).

---

and informal economies; inside and outside family settings; work for pay or profit, or as a domestic worker outside the child's own household for an employer (with or without pay).

[34] The main reasons stated by children who have never attended school or have dropped out are the school is too far away (21%), too expensive (17 %), refusal/ lack of interest to go to school (22 %), consider themselves too young to go to school (17%), but only 2% are not attending school in order to work or look for work.

[35] The Child Development Policy of 2008 strongly prohibits every form of child labour particularly children employed as domestic workers, those employed in bars, mines, plantations, fishery, prostitution; and those employed as business hawkers in the streets.

[36] The Royal National Lifeboat Institution (RNLI) is implementing a project with the London School of Hygiene and Tropical Medicine and Ifakara Health Institute to determine how feasible it is to use secondary data to understand the epidemiology of drowning in Tanzania. https://rnli.org/-/media/rnli/downloads/tanzania-research-factsheet.pdf?rev=516209e5cc1544f8abf71934358ae70b&hash=93F3DF65598EA180A5565190DBE727C9

Fishers supplying the Ferry Fish market in Dar es Salaam are exposed to low levels of safety, especially when traveling to deep sea for fishing activities. Fishermen lack protective equipment, strong fishing boats and communication equipment that would support their safety at the fishing grounds. Fishermen also pointed out that there were no rescue teams that conducted regular sea patrols to find out those in need of rescue including the fishermen (Kachule 2021). A study in Zanzibar found that less than half of boats had safety equipment, such as life-jackets and phones (RNLI, 2019). A number of risks associated with fisheries were reported during our field visits including accidents at sea and the lack of appropriate rescue services and equipment (Table 5.1). Some Beach Management Unit (BMU) committee and Village Fisheries Committee (VFC) members reported that it was their responsibility to provide rescue services, but that they didn't have adequate resources. During our consultations, examples of deaths at sea in the past 12 months were reported.

Respondents	Comments on risk
MLT	
Crew members (three) on dagaa fishing vessels, Kilwa Kivinje, Kilwa.	• One challenge is breakdown of engines – an example of this happening with a big catch in rough seas and the boat sinking. Fortunately, they got assistance from a nearby boat. • What are the benefits of BMU membership? –"Hakuna" There are none. For example, when their boat broke down, they called the BMU, but there was no response.
Somanga BMU committee	• The fish market minimised accidents caused by buying directly from boats. • BMU rescues fishers at sea.
Women fishers / Women focus group Songo Songo	• When sea is rough it is difficult to get to the reef. Two women died in a sailing boat last year due to rough seas.
Kilindoni fish landing site crew member, Mafia	• He belongs to the BMU. A benefit is that the BMU can save you if you are in the ocean.
Female fish boilers (two), Kilwa Kivinje, Kilwa.	• With reference to boiling fish, there were no cases of accidents because they take precautions
Fish carriers (two female), Kilwa Kivinje, Kilwa.	• Both have been transporting for many years. Their energy is starting to go down. It is difficult to walk on the beach. They have some problems with their legs because of the nature of the work.
ZNZ	
Reefs fishers (two) using a wooden boar with sail, Chabauka MPA	• Risk has changed because mobile phone allows them to call and a fibreglass boat would come. *Sisi kwa Sisi*. • They also avert risk by not going to sea when conditions are not good. • Accidents happen once or twice a year due to bad luck. 'Ocean doesn't have insurance'. • In the past (20 years ago) people were not going far, so there was less risk.
Retired beach recorder, Kaipwani, Unguja Ukuu.	• In September and October 2021, there were two incidents involving fishers from here: -One man went to dive for octopus and never came up- he disappeared -In another case, 4 men went fishing and their engine failed; 1 man fell in the water and died.
Zanzibar Director of Department of Fisheries Development (FGD)	Accidents at sea for Unguja May -November 2021: June – 3 fishers; August – 2 fishers • Weather information comes from: the radio; Apps are linked to the Tanzania Meteorological Office • Fishers are normally reluctant to follow information because they need to fish to eat. • Fishers are trusting their indigenous knowledge
Matemwe fishermen FGD	• • Mshipi (hook and line) fishers: Strong seas and small vessels are a problem. During calm weather they can get more. The whole activity is very risky • Octopus diver: very easy for the vessel to sink.
Matemwe Village Fisheries Committee (VFC)	• One of their aims is to rescue fishers involved in accidents. They use money from their own resources to do rescuing.
Nungwi fishermen FGD	• Octopus diver: Muscle cramps when swimming.
Nungwi VFC	• Carry out rescues using their own vessel • Train people to swim and rescue people (PANJE project http://thepanjeproject.or.tz/index.html)) • Challenge: They have a boat but don't have good rescue facilities e.g. life jackets.

TABLE 5.1 FISHERY STAKEHOLDERS' COMMENTS ON RISK ASSOCIATED WITH FISHERIES

5.2.1.5. Attractiveness

Measuring attractiveness of remunerations in fisheries value chains is challenging because it varies with sub-chain, stakeholder, location and over time.

Fujimoto (2018) reported that the fish catch in a dagaa processing village in Zanzibar fluctuates across seasons: May-September is a good fishing period, December-April is a poor fishing period, and October-November is a moderate fishing period. As such, wage work and cash income from this industry may decline during the poor and moderate fishing periods. At Ngalawa landing site Zanzibar, Tusiyumbishane Cooperative reported that the number of bags of dried dagaa they sold varied between 100 and 400/ 500 bags per season. Dagaa fish export data from Kilwa Kivinje shows the monthly exports for 2021 varied from 5,625 kg (FOB TSH 53,906,249) in February to Kg 71,980 (FOB TSH 689,808,333) in November.

A study carried out in three fishing communities and one border post in Mainland Tanzania assessed income inequalities among actors in marine small pelagic fishery (*dagaa*) value chains. The study identified 12 marine dagaa actors involved in value chain activities. An examination of income distribution within individual actors' categories showed differences across the four seasons. For instance, in the fishers' category, the highest average daily income was in the Kusi season (March – April) with boat owners earning the highest average income of USD 60.96 ± 1.62, followed by master fishers USD 21.0 ± 0.55, light boat crews USD 14.81 ± 0.44 and crews USD 6.08 ± 0.17. The study reported that fishers operate on an average of about 17.9, 15.6, 16.9 and 18.1 days in a month during Kaskazi (November -February), Kusi, Matlai ya kaskazi (May-August) and Matlai ya kusi (September-October) seasons, respectively. The authors' analysis shows the monthly income for boat owners ranges from USD 316.9 - USD 956.4, master fishers USD 111.2 - USD 329.5, light boat crews USD 81.5 - USD 127.1, and crews USD 31.7 - USD 95.4[37]. Kilindoni (Mafia island) fishers earned the most, followed by Kipumbwi (Pangani district, adjacent to the Pemba channel that separates Zanzibar Island from the Mainland) and lastly Jasini (the informal route of most marine dagaa consignments crossing to Kenya) (Ibengwe et al, 2022).

Facility owners had the highest average seasonal income for the processor's category compared to casual laborers and porters. Overall, during Matlai ya kusi, actors received the highest average income, about USD 102.02 ± 2.56 for facility owners, USD 9.99 ± 0.25 for casual laborers and USD 10.86 ± 0.30 for porters. The study reported that processors work on average for 11, 10.5, 12 and 11 days in a month, throughout Kaskazi, Kusi, Matlai ya kaskazi and Matlai ya kusi seasons, respectively. The authors' analysis shows the monthly income earned for facility owners ranges from USD 562.1 - USD 1,122.2, porters USD 100.3 - USD 119.8 and casual laborers USD 97.3 - USD 109.9[38]. It was noted that Kipumbwi processors earned the highest income, followed by Kilindoni and Jasini.

Primary traders earned relatively more income, followed by middlemen, loaders/ packers and porters in all seasons. Contrary to the fishers and processors categories, the trader's category revealed different income peaks for various actors in the four seasons. For example, primary traders reported the highest average seasonal daily income of USD1290.82 ± 105.12 during Kusi season, while middlemen, porters and loaders/packers, received the highest seasonal income during Kaskazi season of USD 139.29 ± 4.78, USD 16.01 ± 0.62 and USD 21.62 ± 1.12 and respectively (Ibengwe et al, 2022).

Ibengwe et al (2022) concluded that fishers earned the lowest average seasonal income, and taking into account the USD 86.7 Tanzanian minimum wage per month for fishing and marine activities, the monthly income of crews USD 31.7 - USD 95.4 appears to be below the national minimum wage in most months. However, processors and traders earned above the Tanzanian minimum wage per month for fishing and marine activities.

As commented by fishers during our field work:
"*There are a lot of challenges in fishing and can't compare with other sectors. Would shift to a job with fewer challenges if it was an option*." Crew members on *dagaa* fishing vessels, Kilwa Kivinje
"*Life is not good, but there is no alternative*." Kilindoni fish landing site crew member, Mafia.

[37] These figures appear to be slightly inconsistent with the data provided in tables in the Ibengwe at al paper which suggests that boat owners monthly income ranges from USD 272.84 - USD 1030.22, master fishers USD 95.78 - USD 354.90, light boat crews USD 70.20 - USD 250.29, and crews USD 27.30 - USD 102.75. But the broad pattern remains the same.

[38] These figures again appear to slightly inconstant with the data provided by Ibengwe et al in their paper which suggests that facility owners range from USD 516.92 - USD 1122.22, porters USD 94.19 - USD 119.46 and casual laborers USD 91.98 - USD 109.89. But the broad pattern remains the same.

Colbert-Sangree (2012) in a study in two fishing villages in southern Unguja also found many respondents in both villages voiced "no other job" as their reason for fishing. The second most common response was my town is a "fishing village". A small percentage in each village responded that they "enjoy fishing", 3% and 9% for Kizimkazi and Jambiani respectively.

Despite the challenges, fisheries are still attracting people. In the context of an approximate 50% reduction in terms of both catch per vessel and catch per fisher from 1984-2016, Silas et al. (2020) surveyed 319 fishers from eight landing sites[39]. The majority (75%) of the respondents had changed fishing grounds from nearshore to offshore areas because of a general perception that nearshore areas have suffered major reductions in fish stocks. In spite of a generally negative trend, most fishers responded that they would continue fishing. Silas et al. suggest several factors might explain why. Firstly, alternative livelihoods such as crop farming, which employs over 65 % of the population, have suffered similar impacts as the fishing sector, thus preventing fishers from switching to that sector. Secondly, specialization of fishers to a certain fishery activity, such as offshore fishing in this case, may have eroded fishers' adaptive decisions to switch to alternative livelihoods. Thirdly, the adaptive capabilities among coastal communities across the different regions in Tanzania are perhaps not enough to enable fishers to change. Fourthly, fishers perhaps opt to continue fishing because the decline in fish landings is turning seafood products into a superior commodity, and together with demand increasing with the growing population this perhaps causes increased fish prices that are enough to sustain fish operations in the face of declining fisheries.

In terms of post-production activities, two women who carry dagaa from the boat to processing centres in Kilwa Kivinje explained during our fieldwork that the day before we spoke, each had made one trip carrying two buckets each. Previously, payment had been TSH 2,000- 2,500 per bucket, depending on the distance carried, but currently, it is TSH 1,500 per bucket no matter the distance from the boat to the processing site. The price appears to have gone down because people are being attracted to Kilwa Kivinje and so there is a plentiful supply of carriers. Many carriers come from rural areas of Mtwara, often from the same village, and so they hire a room together. Most are women. In Maruhubi, Zanzibar many people from not only within Unguja Island, but also Pemba Island and the Mainland, especially Tanga, had joined the dagaa processing business (Fujimoto, 2018).

Are conditions of activities attractive for youth? In the Silas et al. (2020) survey the interviewed fishers were all men and among them, 87 % were local fishermen, whereas 13 % were migrant fishers. Seventy-six per cent of the fishers were between 21 and 40 years old, 21 % above 40 years old and only 3% below the age of 20. A majority of the fishers had primary education (65 %), while only a few had secondary education (4%), and almost a third (31 %) had no formal education. During our fieldwork In Kilwa Kivinje crew members of fishing boats commented on the attraction to youth: "*Half of the youth in the community are crew. 70% of the crew are youth*".

[39]Deepsea, Tanga district; Bagamoyo, Bagamoyo district; Kunduchi, Kilindoni district; Nyamisati, Rufiji district; Somanga, Kilwa district; Shangani, Mtwara district; Kilindoni, Mafia district; and Chwaka Unguja kati, Zanzibar.

5.2.2 Land & Water Rights

5.2.2.1. Summary of findings

2. LAND & WATER RIGHTS		
2.1 Adherence to VGGT	MLT: Active National Task Force and a National Plan of Action (NPoA) to implement the Small Scale Fisheries (SSF) Guidelines. No recent large-scale land acquisitions by private sector actors in the coastal fisheries value chains were identified (there was an example from the early 2000s of a Prawn farm in Mafia). Fishers "property rights" are mainly being affected by the creation of protected areas by state actors. ZNZ: NPoA to implement SSF Guidelines has been drafted. Some observers have been critical of previous ZNZ Fisheries Policy not being aligned with SSF guidelines. No large -acquisitions by private sector actors in coastal fisheries VCs identified. Fishers "property rights" are mainly being affected by the creation of protected areas by state actors and coastal developments not directly linked to fisheries VC, particularly tourism.	Moderate/Low
2.2 Transparency, participation and consultation	MLT: Early stages of discussions with local communities around protected areas appear to align with an open, co-management approach but then benefits to local communities fail to materialize. ZNZ: Early stages of discussions with local communities around protected areas appear to align with an open, co-management approach but then benefits to local communities fail to materialize. Level of prior disclosure for tourist and other coastal development investments is not clear, but observers suggest there needs to be more transparency, accountability and public participation.	Moderate/ low
2.3 Equity, compensation and justice	MLT: Land policy and law is widely considered to have been designed to protect citizens' rights and enable all citizens to participate in decisions on matters concerned with their occupation of land. However, the implementation is often not in accordance with the rules. ZNZ: Minister is required by law to obtain consent from the holder of the Right of Occupancy before land is leased. Observers concerned that rules are not always followed and levels of compensation are not appropriate.	Moderate/ low

There are both fisheries/ marine resource and land rights to consider with respect to fishers and coastal communities. Policy and legislation related to land and natural resources differ between the Mainland and Zanzibar (Kironde, 2009).

Sekadende et al, (2020) explain that "*Tanzanian fisheries are technically open access but there are arguably some de facto user rights in the artisanal fishery…*". Raycraft (2020) reports that residents of Msimbati village in Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP), Mtwara "*feel that they have customary rights to fish, based on the historical precedent of ancestors utilizing the inshore fishery in the area for approximately 200 years. Access to marine resources in Msimbati was historically based on common property mechanisms, determined by informal institutions at the family and community level. However, access to the fishery in Msimbati has also been governed by the formal institutions of the post-independence state, through the Fisheries Acts of 1970 and 2003. Thus, prior to the park, access to the inshore fishery was characterized by legal pluralism. Customary marine tenure practices, however, have broken down in recent years, which several scholars have attributed to macro-level political and economic pressures throughout the socialist and neoliberal periods*".

Migrant fishers are an important feature of East African fisheries (for example the Kojani fishers from north-east Pemba Island). It may be the case that migrant fishers seek permission to temporarily reside from host community representatives, who may allocate areas where the migrants can camp (known as dago in East Africa) (Jiddawi and Ohman, 2002; Wanyonyi et al., 2016 in Sekadende et al, 2020). Migrant fishers are also expected to register with district fisheries officers but, overall, these fishing rights are not clearly defined.

Although fishing licenses are issued, they have never been intended to be used to control entry into the fishery but are purely administrative in purpose (Sekadende et al, 2020).

Fishers "property rights" appear to be mainly being affected by the creation of protected areas by state and non-state actors in the Mainland and Zanzibar and coastal developments, particularly in Zanzibar. Slade et al. (2016) report on challenges facing coastal communities in Tanzania to include: Conversion of land areas to other uses such as tourist hotels which is limiting the right of access of fishers to fishing grounds; Lack of participation of small-scale fishers in coastal land-use planning processes which is affecting small-scale fishers' rights; Fisheries laws and policies are not commensurate with small-scale fisheries situations, and hence need to be reviewed. Kuboja (2013) reports that "*the Marine Parks and Reserves Act in Tanzania mainland do not make provisions for recognition of customary laws and practices. Traditional or customary usage rights practiced by coastal communities that for example exclude outsiders are critical considerations that need to be reflected in the legislation to encourage better management, and voluntary enforcement of the laws*".

Land rights are important to the livelihoods of a high proportion of fishers and communities in coastal mainland Tanzania and Zanzibar. Tanzania has a dual land tenure system where customary tenure operates alongside statutory tenure (Myenzi, 2009).

On the Mainland, according to Oates et al (2020), during the early years of independence pre-existing land tenure rights were reformed in order to give greater control to the newly formed nation state. By the 1990s, under the influence of Structural Adjustment Programmes, the government introduced the first National Land Policy. This policy sought to attract investment and mobilise the accompanying Land Acquisition Act, but it was also designed to protect citizens' rights and enable all citizens to participate in decisions on matters connected with their occupation of land. It promised to ensure payment of full and fair compensation to any person whose land was acquired under the Land Acquisition Act. Although the compensation procedures were improved under these laws, in practice land expropriation is still often not conducted in accordance with legal requirements. Kironde (2009) concludes that Tanzania is suffering from a number of problems due to poor land governance. He suggests that Tanzania is doing well in areas of recognition of rights (with the exception of communal rights in rural and urban areas), recognition of the rights for women and stakeholder involvement in developing land policies and laws. Tanzania however, has a long way to go in terms of registering land and improving land information systems, urban land management and the management of public land, as well as expropriation and dispute resolution.

In Zanzibar, there is diminishing access to land in coastal areas due to rapid population growth and coastal developments. Lange (2015) reports that only 26% of a total coastline of 412 km consists of sandy beaches that are most suitable for economic activities: tourism, fishing, seaweed farming. While it is possible to combine these activities, the expansion of tourism in some areas has led to exclusion of livelihood activities by local communities. This often happens when hotels are designed and operated to separate tourists from local communities. Lange concludes "*The macroeconomic importance of tourism and the income it generates far surpass the value of other activities in the coastal ecosystem. But much of the tourism industry has excluded local communities[40], even as it claims more and more of coastal and marine resources. Local communities do not have much economic stake in tourism activities—as a whole, they obtain more income from fishing and seaweed than from tourism. Unless there are shared incentives for sustainable management, the future of Zanzibar's coastal environment is not promising*".

5.2.2.2. Adherence to VGGT (Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security)

With the growing recognition of the significance of small-scale fisheries, the FAO working member states developed the Voluntary Guidelines on Securing Sustainable Small-Scale Fisheries in the Context of Food

[40] Based on 2007 figures, Lange (2015) calculated that 53% of Zanzibar's tourist income was distributed to non-Zanzibaris; 47% to Zanzibaris as a whole, but only 20% to local communities. In terms of economic incentives, non-Zanzibari investors and the Zanzibar government receives a greater share of its income from all inclusive club and up market tourism, whereas local communities receive a very high proportion of their income from budget travellers.

Security and Poverty Eradication (SSF Guidelines). The SSF Guidelines are rooted in the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGT); the Code of Conduct for Responsible Fisheries, the recommendations of the Voluntary Guidelines on the Progressive Realization of the Right to Adequate Food in the Context of National Food Security, and the Principles for Responsible Investment in Agriculture and Food Systems (Courtenay et al., 2019).

Tanzania has a National Plan of Action (NPoA) to implement the SSF Guidelines (URTMLF, 2021). The main objective of the NPoA is to provide a framework that will enhance the contribution of small-scale fisheries to incomes, food security and nutrition, and to support the progressive realization of the right to adequate food for all. The purpose is to enable the Ministry of Livestock and Fisheries, Small-scale fishers and other collaborators to achieve the objectives of the SSF Guidelines in Tanzania. The NPoA is directed to both State and non-State actors involved in SSF. The content of the plan of action suggests that at this stage it is mainly orientated towards SSF in marine and fresh waters in Mainland Tanzania.

Through a consultation process involving key stakeholders, a detailed NPoA implementation plan has been developed. This identified actions and strategies in the following areas:

i. Guiding principles based on human rights that should be observed to have involvement of small-scale fishers and fish workers in decision-making processes, and implementation of fisheries management measures.
ii. Governance of Tenure: SSFs should be responsibly and sustainably governed in a manner that allocates rights, provides fisheries information, embraces collaborative research, participation in the management process and living with the outcome, complying with regulations, and developing training to instil responsible fishing ethics.
iii. Social development, employment, and Decent work: Fisheries provides employment. However, small scale fishers continue to lack security, decent pay, and social protection. Thus, SSFs must be conducted in an environment that guarantees small scale fishers the opportunity to realize the dream of working in a good environment with access to health services, better pay and social protection.
iv. Value chains, Postharvest and Trade: Physical and quality loss have nutritional and financial impacts not only on fishers but also on the people depending on the SSFs resources. Therefore, the situation must be reversed through stakeholders' cooperation and implementation of related policies and practices.
v. Gender equality and vulnerable groups: Gender in fisheries continues to be an issue, as many inequalities and women's role remain undocumented and undervalued. Research indicates that gender equality can be addressed by providing adequate funding and recognising women's critical role in fisheries. Also, mechanisms that promote and protect women's rights to participate in all aspects of marine, coastal, and inland water fisheries governance and management improve access of women to fish and fish markets, mainly through provision of credit at affordable rates. Youth and people with disabilities also need specific attention.
vi. Disaster Risks and Climate Change: Small Scale fishers are among the most vulnerable groups to climate change and disaster impacts experiencing social, economic, and environmental costs. Declining catches have affected their incomes, food security and livelihoods. Strengthening their resilience and adaptive capacity is a priority.
vii. Enabling environment and supporting implementation: Effective implementation of the SSF Guidelines requires all relevant stakeholders and agencies' participation. Thus, the Guidelines call for policy coherence, institutional coordination and collaboration, sharing of information and capacity development.

A very active National Task Force Team was formed in 2017 and includes: researchers, academics, local government (District Fishery Officers), communities, private sector, BMUs and fishers. In our meeting with the National Task Force in May 2022, the members outlined their achievements including: the NPoA; the launch of the Tanzanian Women Fish Workers Association (TAWFA); Establishment of a Gender desk in the Department of Fisheries and Development; Mapping of women's organizations relevant to fisheries. Challenges mentioned by the members included: Tanzania being a large country with many water bodies (which they have divided into five categories of the three great lakes, the Indian Ocean and Other); limited financial resources and limited technical support. The Task Force members appear to have energy, a strong

sense of purpose and commitment. The action plan has been costed at MTZS 7,324 (USD 3,171,937). According to the NPoA, the funding will be through the Government appropriation budget. However, this does not preclude willingness to receive technical and financial support from development partners.

In Zanzibar some observers have expressed concern that fisheries policies are not so explicitly aligned with the SSF guidelines. Lindström and de la Torre-Castro (2017) reported that interviews with representatives of civil society organizations and individual fishers in Zanzibar in July-August 2016 showed a complete unawareness of even the existence of the SSF Guidelines. Lindström and de la Torre-Castro also refer to a main objective in the second draft of the then new Fisheries Policy to *'promote responsible and sustainable development of artisanal fisheries further offshore in deeper waters with an aim to increase the contribution of the fishery sector to economic growth and food security. Meanwhile to facilitate the removal of fishing capacity in shallow waters for improved fisheries management in coastal zone*s' (RGZ 2016: 21). They point out that this goal depends upon the replacement of simple wooden inshore vessels with large fiberglass ones equipped with engines which would enable fishers to go offshore. Through the MACEMP[41] programme, a few vessels like these, along with sizeable gill nets, were distributed freely among the villages to be controlled by the Village Fisheries Committees. However, Lindström and de la Torre-Castro suggest that this introduction of technology contributed to distributional injustices, as only a few fishers were granted access to these vessels, predominantly the upper ranks of the Committees (Gustafson et al 2014). They express concerns that fishers are expected to acquire fiberglass boats, engines, and fishing nets and the policy will likely contribute to a segregation of the fishery into a few 'haves' and the many 'have nots'. Those that cannot afford the technical upgrading will be forced to remain inshore and in intertidal areas, where they most probably will be squeezed by the extension and establishment of various forms of protected areas.

Lindström and de la Torre-Castro (2017) argued that the proposed new Fisheries Policy does not convincingly provide for a secure situation for small-scale fishers in Zanzibar. On the contrary, their livelihoods, lifestyle, and way of fishing will be jeopardized and face the threat of either disappearing or experiencing radical change. Due to these implications, they conclude that the proposed new Fisheries Policy is not consistent with the SSF Guidelines. Livelihood security including economic security, gender equity, minimum rights to design one's own management regimes and long-term sustainability, and tenure rights over the fishing resources and ecosystems are all weak. This includes low gender equity and key actors such as women fish traders are not addressed in the Fisheries policy.

Fisheries policy in Zanzibar is now under the overall umbrella of the Ministry of the Blue Economy and Fisheries (MBEFZ). In Zanzibar's context, the Blue Economy (BE) covers the sustainable use of the sea, coasts and other water bodies as well as related resources, including underground and undersea waters, for socio-economic development while preserving the environment. In the implementation of this policy, five priority areas are defined, namely (i) fisheries and aquaculture; (ii) maritime trade and infrastructure; (iii) energy; (iv) tourism; and (v) marine and maritime governance (RGoZ , 2020). Although the Ministry of the BE is responsible for coordinating these five priority areas, it does not have directly responsibility for all of them and particularly the most economically important sector -tourism.

The Zanzibar Blue Economy Policy Objective (RGoZ, 2020) is aimed at promoting sustainable economic growth, environmental stewardship and improved livelihoods through the sustainable utilisation of the sea and other blue resources. Specifically, the policy seeks to:

- promote and improve sustainable economic inclusion within the BE priority areas and communities;
- strengthen coordination between multiple economic sectors within the BE framework;
- improve food and nutritional security through the sustainable management of blue resources;
- empower local communities, especially women and youth involved in BE activities;
- ensure the safety and security of Tanzania's maritime domain in coordination with the national maritime security agencies; and
- enhance financing and revenue collection through sustainable BE activities.

The BE Policy has been informed by sector-specific national policies and acts, including the Fisheries Policy (2014[42]). Fisheries and Aquaculture is one of the sector-specific strategic interventions. The key policy issue identified is limited commercialization of deep-sea fishing and aquaculture. The key policy statement is that

[41] The World Bank-financed Marine and Coastal Environmental Management Plan (MACEMP)
[42] Although a new fisheries policy appears to be in the process of being drafted.

the government shall optimise the commercialization of deep-sea fishing sector and the development of aquaculture while maintaining support for artisanal fishing. With regard to artisanal fishing the policy strategies are:

- *Promoting and modernising artisanal fishing practices* through identification and education as well as exploiting relevant technological developments;
- *Supporting relevant agri-businesses through diversified financing mechanisms and collective fishermen's organisations*; and
- *Improving nutritional security through better access to marine and fishery products*.

The Ministry responsible for fisheries and aquaculture has responsibility for "*Safeguarding the rights of fishers and their respective fish landing sites from the potentially adverse impacts of integrated economic activities."* (RGoZ, 2020) UN Women (2021[43]) highlight the importance of advocating for more macro-economic opportunities for women in the BE.

We were informed that a draft National Plan of Action to implement the SSF guidelines in Zanzibar has been prepared. Also, that a new fisheries policy is in the process of being drafted and, for example, gender issues will be considered. Assuming the new fisheries policy is well aligned with the SSF NPoA, how the policy is implemented in the light of the broader BE policy and strategy context will be an important determinant of SSF outcomes.

Are large scale investments for land acquisition at stake?

The Coastal area is one of the two main areas[44], where large-scale investors are investing in large areas of land in Mainland Tanzania (Randon, 2020). Many investors have tried to establish such projects but with limited success and frequent failures. Development impacts are heavily disputed (Brüntrup, 2016). The largest number of deals concern food crops, followed by biofuel crops, livestock and non-food agricultural commodities. Forestry deals by far cover the largest average size and the largest size under contract (Randon, 2020).

Recent large-scale land acquisitions by private sector actors in the coastal fisheries value chains were not identified. An example from the early 2000s of a Prawn farm in Mafia is outlined in section 2.2 below. Fishers "property rights" are mainly being affected by the creation of protected areas by state (and non-state) actors and coastal developments which are not directly linked to fisheries value chains, particularly tourism in Zanzibar.

One of the latest initiatives is Zanzibar's small island investment programme. The programme opened up 10 smaller islands for high-end development and investment opportunities in 2021 and a further nine islands have been added to the programme in 2022. The programme, which is being implemented by the Zanzibar Investment Promotion Authority (ZIPA), builds on the Zanzibar government's strategy to attract foreign investment to increase the diversification of their blue-economy policy by attracting high-end investment. Investors are being asked to submit proposals to develop, operate and manage the small islands or plots of land thereon under a long-term lease. Zanzibar's government recognises that the islets on offer possess sensitive ecosystems and are already home to fishing and agricultural communities. The ZIPA Executive Director stated: "*They [the investors] should also demonstrate financial capacity, and skills in conserving environments, biodiversity, cultural heritage, and community development. Interested Investors should specify the intended small island/islands for investment and provide detailed information on the kind of high-end investment intended and state the amount to be paid as Lease Acquisition Cost in respect of the intended island.*" ARCHITECT AFRICA (2022). There is potential for displacing fishers from their traditional camps and, as indicated by Lange (2015), high end investments tend to benefit the state rather than local communities. There are also some further tourist developments on islands off Mainland Tanzania, such as Thanda Hotel at Shungimbili in Mafia and Fanjovi Island Hotel Ltd at Songo Songo.

[43] UN Women (2021) Advocating for More Economic Opportunities for Women in the Blue Economy. September 8, 2021 https://africa.unwomen.org/en/news-and-events/stories/2021/09/advocating-for-more-economic-opportunities-for-women-in-the-blue-economy.

[44] the other being the Southern Agricultural Growth Corridor of Tanzania SAGCOT.

In a wider review (McGoodwin, 2001) concludes that "*in most cases the economic benefits stemming from externally- initiated tourism developments in small -scale fishing communities have not been widespread, and have usually benefited only a minority of community members. More commonly, externally- initiated tourism development has prompted social and economic disruption, increased living costs, reduced access to fish stocks and other fisheries resources, and in a few extreme cases the total cultural breakdown of small-scale fishing communities.*"

5.2.2.2.1. Transparency, participation and consultation

Mainland Tanzania

Caplan (2016) documents the story behind a large company based in Kenya applying to locate a prawn farm on Mafia Island in 2002. The scheme raised very differing views among stakeholders including villagers living around the proposed site, Mafia District Councillors, government officials at varying levels, local and national activists, and the prawn farming company. There were opposing views around the rights of local people as citizens to retain control of 'their' resources, versus the needs of 'development' and job creation. There were fierce debates about the importance and meaning of "environment" and "sustainability", and the perceived role of corruption. The level of consultation with local people was deemed by them to be insufficient. There was a relative lack of information available to other local stakeholders, including government officials and District Councillors who were supposed to share information with local people. The decision was finally made to allow the prawn farm to go ahead. Caplan concludes that her analysis revealed the means by which the legal rights of citizens at the local level may be trumped by pressures emanating from those coming from above and outside who wield greater power.

Following the Marine Parks and Reserves Act No.29 of 1994, the Government of Tanzania established a number of state-run marine protected areas (MPAs), referred to as marine parks. The goals of these MPAs are to protect marine biodiversity, enable recovery of overexploited resources, promote ecosystem resilience in the face of climate change and to generate tourism revenue through state-private partnerships. An important feature of marine parks should be that they incorporate community-based approaches to conservation, including collaborative management strategies, geographic inclusion of villages inside park boundaries, conservation education and benefit sharing. However, Tanzanian marine parks face many challenges, including staff shortages and financial constraints. Currently, Tanzania has three marine parks: the Mafia Island Marine Park (MIMP) (gazetted in 1995), the Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP) (2002), and the Tanga Coelacanth Marine Park (TACMP) (2009) (Raycraft, 2020) (see also Environmental Annex 5 for a complete list of Marine Parks and Reserves).

In Mafia, Walley (2004 in Benjaminsen and Bryceson, 2012) wrote that residents of Chole initially felt that the Park (MIMP) was theirs, but later came to hate it, and that by 2000 they felt the Park had become an expanding and increasingly oppressive bureaucracy that threatened their very survival. Although there was community involvement prior to formation and during the initial period after establishment of MIMP, later on there were less frequent meetings of Village Liaison Committees (VLCs) with the marine park administration, and implementation of conservation rules becoming more authoritarian.

In the Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP), Village Liaison Committees (VLCs) have been promoted as community-based mechanisms that include a wide range of resource users. A key weakness of VLCs is that instead of enabling communities to participate in MPA management, they emerged after major decisions had already been made by external agencies. VLCs should serve as primary liaison between communities and MPA management. In recent years, however, VLCs have remained virtually dormant, they lack motivation to fulfil their duties, and family ties and social hierarchy in villages makes the unbiased functioning of VLCs difficult (Katikiro et al,2017). Raycraft (2020) explored local conflicts over marine conservation in MBREMP. Some people were willing to protest openly, for example destroying the park's gatehouse office and directory signs in 2013. However, an immediate violent response to such acts from state paramilitary forces instilled fear in villagers. Rather than risking further repercussions, many villagers engage in 'everyday forms of resistance' through subtle acts of noncompliance to the conservation regulations. These practices are linked with lack of material benefits and moral statements about customary rights to resources.

Zanzibar

Hikmany et al (2015) in a study of legal issues in relation to land acquisition in Zanzibar conclude "*A noteworthy issue in the current trend of acquiring private land rights and interests by the government is that there are laws to guide the land acquisition process, but they are not taken into concern at all. As a result, private lands are acquired contrary to the laws. These include acquiring private lands without paying compensation, absence of notices in the Government Gazette to publicize the acquisition, falling short of holding an inquiry and also jumping to acquire private lands without the court's approval. A great deal of safeguards therefore needs to be introduced by the government in the land acquisition. These include transparency, accountability and public participation*."

New economic activities, particularly tourism, have increased pressure on the land resources where competition and dispute of use has increased between hotel developers and coastal communities involved in fishing and seaweed farming (Haji, 2013). See Box 5.

BOX 5 MNEMBA ISLAND

Mnemba Island is a small island (0.12 km2) about 2.1 km off the north-east coast of Unguja. It was uninhabited, but fishermen from Matemwe and other local villages used Mnemba as a camp from which to stage fishing operations that were on the Mnemba atoll or further offshore. In 1989, the Island was leased by the government to an Italian company that used the island as a resort and built basic infrastructure for holidaying corporate staff. After the lease was secured, local fishermen were prevented from camping on Mnemba and fishing on certain parts of the surrounding reef. They have felt bitter about this prohibition ever since. Today there is a luxury ecotourism lodge on Mnemba Island that is leased from the Revolutionary Government of Zanzibar by an ecotourism operator running numerous lodges across Tanzania. Mnemba Island, along with the surrounding reef, is protected from fishing by provision of its establishment as a Marine Conservation Area in 2002 under the Tanzanian Fisheries Act (No. 8 of 1988). This conservation area was created for two reasons: to protect the marine resources of Mnemba atoll and to provide an end to the contention between local communities and tourism operators using the atoll. The idea was that a marine conservation area would allow government to collect a fee from all tourists visiting the atoll, and this money could be used to provide fishers with equipment that would allow them to fish further offshore as well as being channelled into the development of additional livelihood opportunities for the communities affected by the restrictions. A year after the conservation area was formed the Mnemba Island Marine Conservation Area (MIMCA) Authority was created with the aim to *"manage the use and harvesting of marine and fisheries resources at ecological [sic] sustainable levels, and to manage the development of marine tourism in order to maximize economic benefits to the community*". When the conservation area was established, funds collected from tourism to the reefs were used to buy fishing equipment for local communities. There was communication about finances, benefits were shared between stakeholders, and trust developed. However, shortly after its establishment, the MIMCA was expanded to include many more communities and a longer stretch of coastline, and the bureaucracy of the conservation area became unwieldy. As a result of this and other circumstances, open communication about finances ceased, benefits no longer accrued to local communities, and trust began to decay as communities felt they were sidelined by government, conservation, and tourism. As a result, fishermen from communities in the conservation area have begun to fish indiscriminately on the Mnemba Island reefs (Burgoyne et al.,2017).

5.2.2.2.2. Equity, compensation and justice

Mainland Tanzania

As previously mentioned by Oates et al (2020) the law should ensure payment of full and fair compensation to any person whose land was acquired under the Land Acquisition Act, but in practice land expropriation is still often not conducted in accordance with legal requirements. Rugazia (2021) also concluded that while Tanzanian petroleum laws and practices recognise the duty to give fair compensation to the people affected by petroleum activities before acquiring their lands, there are numerous shortcomings in these laws and practices that prove that the land compensation scheme for petroleum projects in Tanzania fails to meet all the requirements of fairness.

Tagliarino (2017) examined whether national laws in 50 countries provide compensation procedures that comply with international standards on the valuation of compensation. The assessment was made against a set of indicators that are based on the VGGT and other international standards on the valuation of compensation. The author notes that the analysis focuses on compensation procedures as they are written into laws, and does not comprehensively assess whether compensation procedures are implemented or enforced in practice. On this basis, Tanzania was ranked 3rd out of 50 countries; 7 out of 10 indicators were fully met, one partially met and two not met at all (Table 5.2). This analysis appears to refer to Mainland Tanzania.

Compensation Valuation Indicators	Assessment
1. Does the law allow for assessors to follow an alternative approach (*e.g.*, "replacement cost" approach) instead of a "fair market value approach" to calculating compensation in cases where land markets are weak or non-existent?	Yes
2. Does the law provide compensation for unregistered customary tenure rights held by Indigenous Peoples and local communities?	Yes
3. Does the law establish special protections for women landholders regarding compensation entitlements?	Yes
4. Does the law require assessors to take into account the loss of business and other economic activities?	Yes
5. Does the law require assessors to take into account the improvements (*i.e.*, attached and unattached assets on the land (*e.g.*, crops, buildings) made on the land?	Yes
6. Does the law require assessors to take into account intangible land values (*e.g.*, cultural, social, historical land values)?	Yes
7. Does the law provide affected populations with the right to opt for alternative land instead of compensation in cash?	Yes
8. Does the law provide affected populations with the right to negotiate the amount of compensation?	Partial
9. Does the law require that compensation must be paid prior to the taking of possession of the land or within a specified timeframe thereafter?	No
10. Are affected populations granted the right to appeal decisions on the amount of compensation in court or before a tribunal?	No

TABLE 5.2 ASSESSMENT OF TANZANIA LAW AGAINST A LIST OF COMPENSATION VALUATION INDICATORS.
Source: Tagliarino (2017)

Sanga (2019) explains that land resource conflicts (according to the 1995 National Land Policy) are currently resolved through tribunals at various levels. The tribunal approach basically starts from the Village Land Council (VLC) before appeals are lodged to the Ward Tribunal and then the District Land and Housing Tribunal. Major shortcomings of the Tribunal approach include: limited funds to organize periodic sitting of these tribunals ; highly varied outcomes depending on traditions and customs and the composition of the tribunal; and in the case of the VLC limited capacity to deliver products such as Customary Certificate of Right of Occupancy to those who need them within reasonable timeframe.

Benjaminsen and Bryceson (2012) argue that wildlife and marine conservation in Tanzania lead to forms of 'green' or 'blue grabbing'. Dispossession of local people's land and resources has been gradual and piecemeal in some cases, while it involved violence in other cases. It does not primarily take the usual form of privatization of land. The spaces involved are still formally state or village land. It is rather the benefits from the land and natural resources that contribute to capital accumulation by more powerful actors (rent-seeking state officials, transnational conservation organizations, tourism companies, and the State Treasury). The

introduction of 'community-based conservation' worked as a key mechanism for accumulation by dispossession allowing conservation a foothold in village lands. This foothold produced the conditions under which subsequent dispossessions could take place (See Box 6).

Box 6 Mafia Island Marine Park (MIMP)

In Mafia, the key problem with the intervention of the MIMP from the point of view of residents of Mafia Island was that the benefits clearly accrue mainly to the State, to foreign-owned tourism enterprises, to conservation organisations and to visiting foreign tourists, whilst local communities witnessed few gains. This was felt to be in direct contrast to the fact that villagers have lost access to formerly traditionally governed and utilised natural resources (including the most productive coral reefs, mangrove forests and the best beaches), without gaining commensurate economic compensation for losses in fishing rights and land or seascape rights, or being allowed, for example, to make some income by taking visitors on guided tours or snorkelling. Fisherfolk and villagers from within the park repeatedly expressed disappointment and scepticism about the increasingly exclusive practices of both conservation and tourism for these reasons. Mwaipopo (2008) recalls from her interactions with Mafia residents that they asserted they were made to accept that regulations were inevitable and therefore they were obliged to mould their ways and fit into the process without their doubts and questions being satisfactorily answered

On Chole Island and in the large village of Utende within MIMP, some tourist hotels are expanding their land claims and thus preventing access by local residents to prime beaches, national archaeological ruins, landing places, market sites, and freshwater access points, thereby also hindering villagers from benefiting even marginally from tourism. Villagers have appealed to MIMP and District authorities, but they have not supported the complaints of villagers, who have then had to seek legal aid from land rights lawyers based in Dar es Salaam (Benjaminsen and Bryceson, 2012).

Beymer-Farris et al (2019) document cases to show how outsiders, with the assistance of the state, attempted to control areas historically governed by local residents in the name of conservation and climate change policy initiatives. They report the struggles of villagers and their elected leaders in Mafia Island and Rufji Delta in coastal Tanzania for recognition of and respect for their rights in the face of interventions by state institutions and international conservation organizations. They show how the villagers asserted their rights in the face of threats to their livelihoods, while outside interests sponsored or ignored increasingly violent measures by the state. Villagers proved that they were the rightful custodians of the natural resources in Mafia Island and the Rufiji Delta, especially of fisheries and forestry resources, which they have governed traditionally for centuries.

The villagers collaborated with one another and with researchers to appeal to the Tanzanian authorities at the national level, including the Commission for Human Rights and Good Governance. The Commission, in turn, conducted transparent public hearings and reached conclusions that the villagers' rights had indeed been violated. These decisions recognize and apply constitutional principles to the villagers' fundamental and human rights, including their role in the management and governance of the areas and resources where they live, which serve as the sources of their livelihoods.

Zanzibar

The Land Tenure Act 1992[45] provides that land can be leased to a Zanzibari and non- Zanzibari intending to use the land for investment purposes, subject to the approval of the investment project by ZIPA. Provided that in the event the public land (held by government or public person) to be leased is comprised under a Right of Occupancy, the Minister will be required to obtain consent from the holder of the Right of Occupancy before the land is leased. The maximum period of lease is 99 years, however, subject to renewal. Thus foreigners can invest on land/property but must first comply with all the procedures of ZIPA so that the investment may be approved. Lease of any public land developed in accordance with ZIPA may be sold, assigned, sub-leased or sub-divided, inherited or mortgaged. The Lessee is required to obtain approval from the Land Transfer Board before any disposition as well as meet the terms and conditions set by the Minister. Ussi (2012) carried out fieldwork in Nungwi and other tourist areas of Zanzibar. Participants commented that those local people with lands that were taken over for tourism development were compensated according to the Zanzibar Land Tenure Act, but the amount they received was very low. One participant commented: '*These days, people are not afraid of anything… we are aware of the value of our land. We need to be paid in kind [suggesting they should have an agreement with investors]. It is not right…the government paid us little money…it is even not enough to buy a glass of juice…they must change their laws, otherwise we will fight for our right..*'

According to participants in focus groups interviewed by Ussi, for example, a one-off payment of just USD3 dollars was made for each tree growing on the affected land. This system of limited land compensation has

[45] https://www.irglobal.com/article/investment-law-in-zanzibar/

driven communities into poverty and it was suggested in the focus groups that the community should be compensated annually with an amount equivalent to crop income in accordance with that year's market price.

There was general consensus regarding the inappropriateness of Land Tenure Act. As one participant said: '*Land regulations are not good for us. Land was taken from us for tourism development. They gave us little money. They should have another way of compensating us, rather than giving us a small token'.*

Participants were also very much concerned about loss of their land*: 'They took my land to build road. I have never been compensated… the government does not care about the future of the poor people…they have nothing to pay me since nobody knows the exactly value of my land. Before now, we did know the value of our land…but now we know the importance of land… we need our lands back*. '(Ussi , 2012).

Gustavsson et al (2014) explored local participation and justice in governance and management in five villages in the context of Memba Island – Chwaka Bay Marine Conservation Area (MIMCA). The results show that VFCs were participating in the implementation of MIMCA but not in its planning phase. Participation was mainly in the form of manipulative and passive participation. Other local actors did not participate at all. Instead, the government assumed that justice was achieved by distributing equipment, alternative income-generating projects, and relying on tourism for local development. However, the distributed equipment and tourism development have created conflict and injustice within and between villages, because of the insufficient resources which did not target those in need. Tourism created problems such as inequality between livelihoods, environmental destruction and local power asymmetries between hotel management and local people. The MIMCA top-down intervention has not increased participation or justice, nor has it achieved sustainable resource use and conflict resolution.

Fishers' livelihoods have been disrupted by tourist development and the establishment of protected areas. Government strategies have focused on attracting investors – which has been achieved- but there has been insufficient consideration given to attracting investment which will explicitly bring benefits and improve the welfare of coastal fishing communities.

5.2.3 Gender Equality

5.2.3.1. Summary of findings

3. GENDER EQUALITY		
3.1 Economic activities	MLT and ZNZ: Women have relatively little involvement in the major coastal fisheries value chains at the production stage (the major exception being octopus) but are highly involved in post-harvest activities. The extent to which they are active varies with value chain and, to some extent, location. Risks of exclusion are associated with cultural barriers, economic barriers, access to fisheries resources and policy. At the production level, there are risks of being excluded from Octopus catching as diving (predominantly male) becoming increasingly prevalent and from shoreline fishing in some protected areas. There is also a risk that men will displace women that harvest or trade globally goods such as octopus. However, women are becoming increasingly active in post-harvest activities as both managers/ entrepreneurs and workers, suggesting risks of being excluded are diminishing.	Substantial
3.2 Access to resources and services	Tanzania has a dual land tenure system where customary tenure operates alongside statutory tenure. Formal legal provisions guarantee women access to, ownership and protection of their rights to land and equal rights to men. Customary tenure can still be discriminatory. Hence, the situation where many women are still discriminated against and denied their rights to land. Women do have ownership of assets, but for URT as a whole, only 7.4 % of Tanzania's house owners are women. In ZNZ 20.9% of house owners are women. Women in some coastal fishery communities reported house ownership by women to be higher than men. Considerable improvement over the past 20 years, with 68–70 % of Tanzanian women having access to loans through empowerment funds. Access to and quality of informal financial services for women has improved. However, women remain largely excluded from mainstream financial services structures due to a lack of assets. Female traders, in general, face limited access to business development services.	Moderate/Low
3.3 Decision making	Traditionally, most direct decisions related to fisheries production in coastal Tanzania would be made by men. However, women would be directly involved in some fisheries production decisions in the inter-tidal zone such as foot fishing for octopus, net fishing for shrimp and smaller types of fish, collecting shellfish. Women working in fisheries value chains can control their own income. The choice of how the income is used varies with household, but for many the income is used for household needs.	Moderate/Low
3.4 Leadership and empowerment	Women are more likely to belong to groups such as SACCOSs and CBOs than larger organizations. MLT: Women belong to Beach Management Units and hold leadership positions ZNZ: To a much lesser extent women belong to Village Fisheries Committees and don't hold leadership positions	Moderate/Low
3.5 Hardship and division of labour	MLT: women reported that the division of labour within the households is not equal in their communities. ZNZ: women reported that their workload was far higher than men and this was linked to women now having to earn an income as well as most of the household activities. MLT and ZNZ: There was little or no indication that risk of women being subject to strenuous work was being minimised. Increasingly women are obligated to do poor-quality work alongside care responsibilities	Moderate/Low

There have been overall significant improvements according to a number of indicators, but gender equality remains an important issue in Tanzania (UN Women 2020 and UN Women, 2021[46]) and National Fisheries Policy (URT, 2015). In terms of the UN Gender Development Index, URT is in group 3 which comprises countries with medium equality in Human Development Index (HDI) achievements between women and men (absolute deviation of 5–7.5%). However, the URT has a Gender Inequality Index value of 0.556, ranking it 140 out of 162 countries in the 2019 index (UNDP, 2020). An alternative gender gap index score for Tanzania kept stable at 0.71 in 2020, meaning that females were 29 percent less likely to have the same opportunities as males in the country. Tanzania ranked 13th among 35 nations in SSA. However, it still had a low result in the Political Empowerment category[47].

The Constitution of 1997 prohibits discrimination against women. Tanzania has signed all major international and regional gender equality protocols and instruments. It has ratified the 2030 SDG Agenda and the long term 2063 Agenda (both of which include commitment to gender equality). The country has made some efforts to align implementation of the SDGs with national planning frameworks. However, the current National Development Plan does not fully capture gender equality issues and women's empowerment (Badstue et al, 2021).

5.2.3.2. Economic activities

There are no official records regarding the actual number of women taking part in fisheries-related activities throughout Tanzania (Bradford and Katikiro, 2019). A review of gender and fisheries in Tanzania, identified varied yet interconnected barriers faced by Tanzanian women in SSF and aquaculture. The challenges were categorized into four themes- cultural barriers, economic barriers, access to fisheries resources and policy. However, these are all complex and dynamic and research in to understanding barriers women face in the fisheries sector is important and needed to guide potential interventions (Bradford and Katikiro, 2019).

To what extent are women active in the value chain?
Women are highly involved in coastal fisheries value chains, but the extent to which they are active varies with value chain and, to some extent, location.

Small pelagic- anchovy - value chain
Women are strongly involved in post-harvest elements of the small pelagic anchovy value chain on the Mainland (Figure 5.1). They are responsible for most of the boiling and drying and a high proportion of the carrying of fish from boat to processing site. Women also appear to be similar in number as men in the key role of organizing the buying, processing, and sale of small pelagic fish. To a lesser extent, women are also agents and buyers, as well as in a few cases boat owners.

Based on partial information from male key informants from a Cooperative at one landing site in Zanzibar, the picture is similar, but with significant differences. The drying role was reported to be 90% by men, the proportion of middle women was a bit lower (33%) and there were no female agents. The number of female Congolese buyers was estimated to be slightly higher at 35%.

[46] UN Women (2021) Advocating for More Economic Opportunities for Women in the Blue Economy . September 8, 2021 https://africa.unwomen.org/en/news-and-events/stories/2021/09/advocating-for-more-economic-opportunities-for-women-in-the-blue-economy

[47] The Global Gender Gap Index measures gender-based disparities among four fundamental categories, namely Economic Participation and Opportunity, Educational Attainment, Health and Survival, and Political Empowerment. The highest possible score is one, which signifies total equality between women and men. https://www.statista.com/statistics/1220574/gender-gap-index-in-tanzania/#:~:text=The%20gender%20gap%20index%20score%20in%20Tanzania%20kept,placed%2013th%20among%2035%20nations%20in%20the%20region.

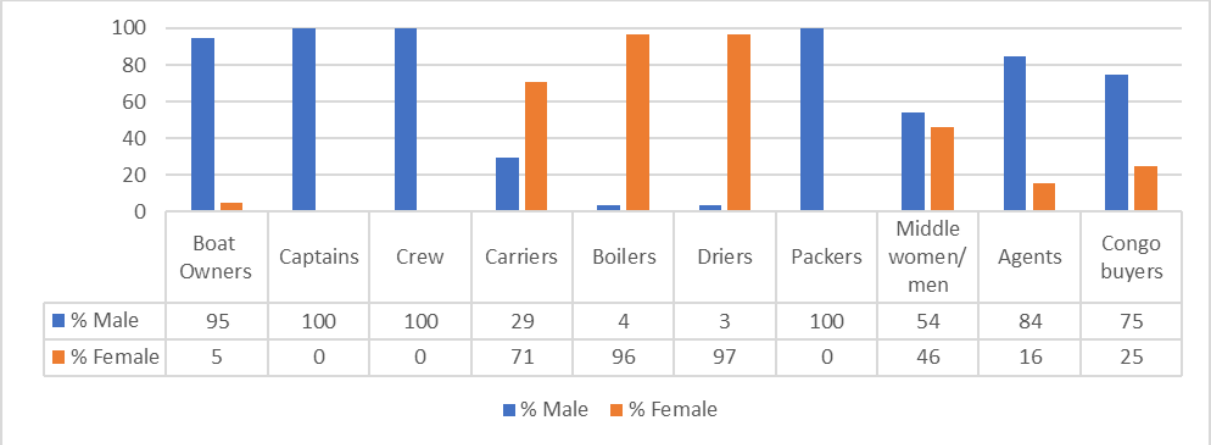
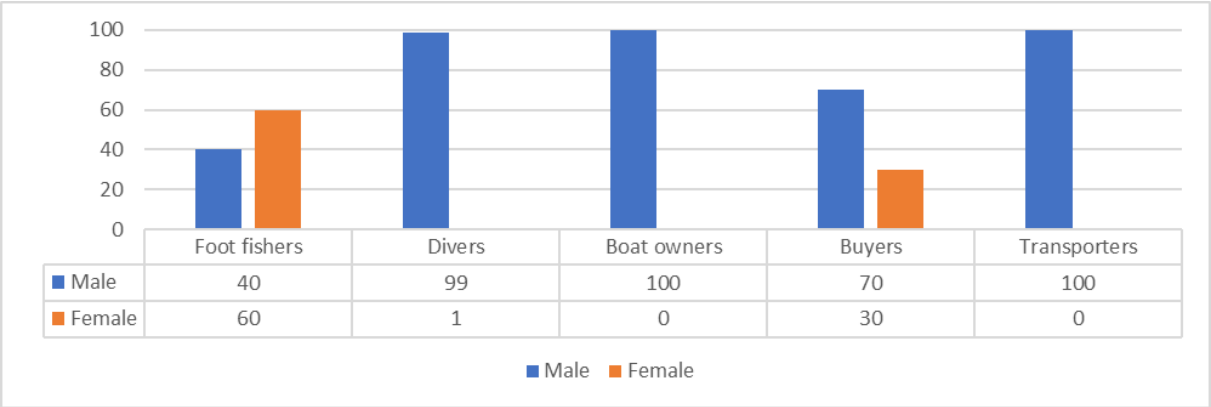


FIGURE 5.1 WOMEN'S PERCEPTIONS OF GENDER OF ACTORS IN SMALL PELAGIC/ANCHOVY VALUE CHAIN: MAINLAND.
Source: Focus Group Discussions with Women (15 in total) in three communities in Mainland Tanzania

Octopus value chain

The Mainland Octopus value chain has the highest proportion of women fishers out of the main sub-chains being considered. This is illustrated by the perceptions of women regarding the gender of actors in the Octopus value chain in Songo Songo (Fig.5.2). Porter et al., (2008) provided helpful context "*Up to a few years ago, women (especially on Songo Songo) trapped octopus in the intertidal zone, partly for household consumption and partly for sale to a few local buyers. They learned how and when to do it from their mothers or grandmothers, and carried out the trapping with a wooden implement. In the mid to late 1990s, octopus started to become a more valuable commodity. As a result, first local traders, and then large Tanzanian fish trading concerns such as TANPESCA, Tanga Sea Product, and VICFISH began to compete to buy from local fishers. This process had a number of consequences for local people. Firstly, as the price rose, men moved into catching octopus. As Faustine (2007) explains, men see themselves as being the principal breadwinner in the household, and because of this, and also because the women's trapping was not considered 'fishing' at all, they felt quite entitled to displace the women. Furthermore, they would act in groups, rather than individually; would rent boats to go out to the reefs (off limits for the women); use scuba diving gear and other modern technology; and would ignore the women's customs of only fishing at certain times of year to preserve the stock. As a consequence of these changes, local middlemen began to intervene, hiring boats to the fishermen (at the exorbitant rate of 10% of the value of the catch) and insisting that the fishermen sell all their catch through them. To compound this situation further, fishermen from outside the area now also dive for octopus on the reefs, and these fishers have even less regard for conservation measures, such as closed seasons. Because there are now far more octopus entering the market, and the cost of trapping them (diving gear, boat hire etc) has risen, the profit made by the fishermen is dropping steadily. Octopus are also becoming increasingly scarce, and it takes longer and more effort to catch the same number as before. This is one clear example whereby as a product enters the international commodity market, and business interests outside the local community take control, it has complex (negative) effects on the whole local community. In particular, women are displaced and lose both a source of food and a source of income*".

While much of Porter et al.'s analysis remains relevant, a key change is that women are now hiring boats to reach reefs in Songo Songo. Women are also active as buyers / traders. In the more formal octopus value chain women are employed in medium and large-scale processing plants in more urban settings.



	Foot fishers	Divers	Boat owners	Buyers	Transporters
Male	40	99	100	70	100
Female	60	1	0	30	0

FIGURE 5.2 WOMEN'S PERCEPTIONS OF GENDER OF ACTORS IN THE OCTOPUS VALUE CHAIN: MAINLAND.
Source: Women's Focus Group (4 participants), Songo Songo

In Zanzibar, Rocliffe and Harris (2016) reported that there were 7,313 octopus fishers, 30% of whom are female. In our three FGDs with women, in both Matemwe and Nungwi, half the participants (6 out of 12) undertook octopus fishing. In Chwaka none of the participants engaged in octopus fishing and they explained that this was 100% a male activity in their community. In Nungwi the focus group estimated that 50% of the octopus fishers in their community were women, but in the past it was a 100% female activity. None of the women in their community were divers, but they knew of female divers in a nearby village.

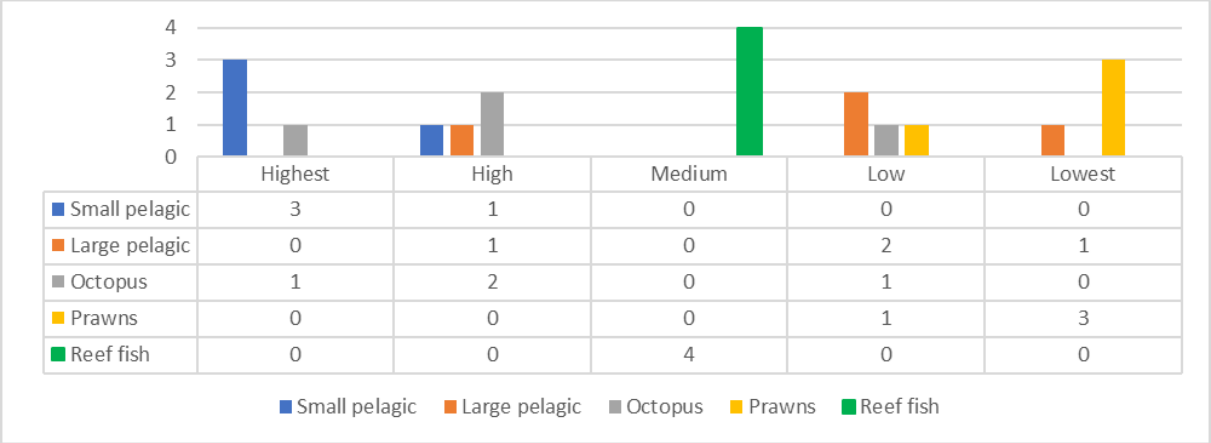
As well as octopus, women were engaged in shellfish collection (3 communities), net fishing close to shore for e.g. dagaa (at least 2 communities), sea cucumber (1 community), and seaweed farming (at least 2 communities; in Nungwi participants reported that they had stopped because of the strong waves).

Prawn value chain
The major prawn fishing grounds in Tanzania are in Bagamoyo, Kisiju, and Rufiji areas, largely influenced by the presence of major rivers. Prawns are harvested by over 4,000 small-scale prawn fishers in fishing communities and a small industrial fishing fleet of less than 12 trawlers per annum at a depth of between 1 m and 15 m. The fishers and collectors are predominantly male. Women fish for small planktonic sergestid shrimp (*Acetes spp.*) locally known as "uduvi". They fish in shallow waters mostly by using mosquito nets. However, they face a number of challenges such as marketing bottlenecks. Women are active as secondary traders, in processing and retailing (Sofreco, 2018). In the more informal sector, women may be involved in frying prawns and retailing dried/ fried seafood products. Women are also employed in the medium – large scale processing factories and there are also women who own mid-size processing companies for export (Sofreco, 2018).

Finfish / Medium-large pelagic, Reef fish
It appears that women have limited involvement in the reef fish sub-sector as fishers or auctioneers, but are active in processing or retailing (Sofreco, 2018). Sofreco (2018) suggests women trading in reef fish is very rare, but other literature and our study team's observations suggest women are increasingly active in finfish trading. Frocklin et al., (2013) report that fish trade in Zanzibar has traditionally been associated with men, which in their study reflected the average number of years men and women traders had been active. Whereas the men had been involved in trading activities for on average 18 years, the number for women was nine. Based on observations and discussions with researchers at the Institute of Marine Sciences, the number of women entering local fish markets has increased over the last years. The respondents reported that this increase was due to the lack of alternative economic activities and the need for all family members to contribute to household income. A further major factor appears to be social and cultural changes. In the Matemwe women's FGD, participants explained that in the past women were not even free to go to the market as a customer, but now they can sell, although no women from within the community were reported to be trading. In Nungwi, women's FGD participants explained that women from both within and outside the community trade in fish. This was a change. In the past it was difficult for a woman to be close to a man, but this has completely changed. The participants attributed this to the influence of female tourists. They

regarded this change as a good thing in the sense that women were now free to go anywhere, but had concerns that other aspects of Zanzibari culture were changing.

Figure 5.3 provides an indication of the perceived importance of the different value chains to women's livelihoods in Kilwa and Mafia districts. Each set of respondents was asked to rank each of the value chains from highest to lowest. It suggests small pelagics are the most important.



	Highest	High	Medium	Low	Lowest
Small pelagic	3	1	0	0	0
Large pelagic	0	1	0	2	1
Octopus	1	2	0	1	0
Prawns	0	0	0	1	3
Reef fish	0	0	4	0	0

FIGURE 5.3 RANKING OF PERCEIVED IMPORTANCE OF FISHERY VALUE SUB-CHAINS TO WOMEN'S LIVELIHOODS IN KILWA AND MAFIA DISTRICTS, MAINLAND.

Source: Four consultations on Mainland Tanzania (Kilwa District Fisheries Officer; Songo Village leaders; Mafia District Fisheries Officers; Women's FG Kilindoni, Mafia)

5.2.3.3. Access to resources and services

In Tanzania a woman can legally travel outside her home in the same way as a man. There are criminal penalties or civil remedies for sexual harassment in employment. A woman can get a job in the same way as a man. The law mandates equal remuneration for work of equal value. (World Bank 2020b in UN Women 2020).

Do women have ownership of assets?

For Tanzania as a whole, only 7.4 % of Tanzania's house owners are women (OECD 2019 in Lambin and Nyyssola, 2022). The Zanzibar Household Budget Survey 2019/20 (ZHBS, 2020) reported that the proportion of households by which the dwelling they were living in was owned by women alone was 20.9 %, whereas those owned by men alone was 75.3 %. A larger percentage of women living in urban areas have more ownership of their homes than women living in rural areas.

On Mainland Tanzania, in Kilwa Kivinje and Somanga participants in women's focus groups reported that within their communities certain assets are more commonly owned by women than men. For example, houses and land are commonly owned by women, while boats, cars and motorbikes are mostly owned by men. In Songo, female octopus fishers owned their own houses. In Kilindoni, Mafia women reported that women can own land, houses, vehicles and boats, but in all cases, men own more than women. In Zanzibar, participants in three focus groups on Unguja island also reported that women can own assets such as land, houses and shops. In Chwaka 6-8 fishing vessels were owned by women (Table 5.3).

Respondents	Comments on Assets
Mainland	
Kilwa Kivinje Women's focus group	About 70% of assets in this community are owned by women – particularly houses and land. However, boats, car and motorbikes are mostly owned by men.
Somanga Women's focus group	Houses – estimate that 70% of houses are owned by women (30% by men). This is because women are hardworking and invest in houses. Farms – estimate that 70% of farms are owned by women (30% by men). Boats – almost all are owned by men. About 6 women used to own boats but they needed to be repaired and were abandoned. Vehicles – 90% of motorbikes owned by men (10% by women) and 100% of cars owned by men (0 by women).
Songo women's focus group	At least 2 out of the 4 women in the focus group had their own house
Kilindoni, Mafia women's group FGD	Women can own land, houses, vehicles and boats, but in all cases men own more than women. .
Zanzibar	
Matemwe Women's focus group	Women can own land and houses. Women can own anything if they have the capacity.
Chwaka Women's focus group	Women can own assets here e.g. land, house, fishing vessels (6-8 in the community)
Nungwi women's focus group	Women can own assets – land, house, shop. No boats yet.

TABLE 5.3 WOMEN'S PERCEPTIONS OF ASSET OWNERSHIP IN COASTAL COMMUNITIES

Do women have equal land rights as men? Women's land rights in the Tanzanian context are restricted by a complex set of both legal provisions (related to land, marriage, and inheritance) and kinship relations defined by local social norms (Lambin and Nyyssola, 2022). Tanzania has a dual land tenure system where customary tenure operates alongside statutory tenure. Formal legal provisions guarantee women access to, ownership and protection of their rights to land and equal rights to men[48]. Customary tenure can still be discriminatory. Hence, the situation on the ground where many women are still discriminated against and denied their rights to land (Myenzi, 2009).

For Tanzania as a whole, only 2% of the population with registered land rights in Tanzania are women (Lambin and Nyyssölä, 2022). Women represent only 19.7% of all agricultural holders in Tanzania (OECD 2019).
In Zanzibar among the households who reported that they have secured the right to agricultural land, 24.7% were women alone and 66.8% were men alone. The proportion who secured agricultural land together (both women and men) was about 8%. The proportion of women who had the secured right to agricultural land alone were fewer compared to men in both the rural and urban areas of Zanzibar (ZHBS, 2020).

In terms of access to marine resources, Baker et al (2021) explained how the establishment of the Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP) in Mtwara resulted in the use of fine-mesh nets being banned in the park's intertidal areas, as well as in core and specified use zones resulting in the prohibition of a customary female practice known locally as *kutanda*, whereby women use a fine mesh pull-net called a *tandillo* to harvest from shallow, intertidal environments. The practice was viewed as destructive by conservation scientists who argued juvenile fish were captured. This top-down decision worked against the villagers' right to self-determination to make decisions about resource use and access. The restrictions minimized women's economic mobility, their ability to contribute to their family's material needs, and interfered with their sense of self and identity as a provider of their household—all key components to relational wellbeing (Baker at al 2021). Similarly Kamat (2018) explained how "*through narratives, people revealed their feelings of angst, disempowerment and vulnerability, emanating from their awareness of the state-directed dispossession they had experienced. The MBREMP's gendered impact was evident as women frequently blamed the park rangers for making their lives difficult through unreasonable and coercive restrictive practices*".

Do women have access to credit?

The evidence suggests considerable improvement over the past twenty years with 68–70% of Tanzanian women having access to loans through empowerment funds, and significant growth of women's formal non-

[48] Tanzania's Land Act, Village Land Act of 1999 (revised in 2019), and Courts (Land Disputes Settlements) Act of 2002 paved the way for some of the most gender-progressive land legislation on the continent Lambin and Nyyssölä (2022).

bank finance compared with informal finance. Access to and quality of informal financial services for women has improved. The literature addressing microfinance services (including those provided by international NGOs such as BRAC/Bangladesh Rural Advancement Committee, local SACCOSs, and village community banking/ VICOBA) in Tanzania suggests that women beneficiaries tend to experience economic and social empowerment, while legal and political impacts remain less reported. Positive impacts on women's freedom, self-esteem, and decision-making power over household finances have also been reported. However, women remain largely excluded from mainstream financial services structures due to a lack of assets (Lambin and Nyyssölä, 2022).

Chale and Medard (2020) explain that in Tanzania, many urban and rural areas still function under traditional customs that put women at a social and economic disadvantage. Women often lack economic freedom and access to decision-making opportunities at all levels. They continue to experience poverty and illiteracy at higher rates than men and are more likely to be subjected to gender-based violence. Women also tend to have less access than men to property ownership, credit, training, and employment. However, those discriminatory traditions, norms, and stereotypes are being challenged. They provide an example from Somanga Village which shows how an informal social system in savings and credits can economically liberate the poorest people and empower women. Interestingly, women in Somanga and Kilwa Kivinje reported that they now had more access to credit than men because women are more involved in business and supported by local government and NGOs (Table 5.4). This was not the case with women in Kilindoni. In Zanzibar, women from Matemwe reported that men had more access to credit because they could pay back quicker. In Chwaka women felt the situation was the same for women and men. Many women belong to SACCOSs.

Respondents	Access to credit
Mainland	
Kilwa Kivinje Women's focus group	Women have more access to credit than men, as they have more businesses.
Somanga Women's focus group	Women can access credit. It is easier for women than men. Most women are doing business. District government and NGOs support women. Access to Services: Yes, particularly on support for entrepreneurship (NGOs and district government).
Songo Songo women's focus group	Women in the community have a savings group, but only one out of the four belongs to a savings group. For the one, the savings group has helped her build a house. Two participants reported if they had a regular income she would join a group, but she is not sure that she can contribute every week. Another participant was not ready to join. She has her own business.
Kilindoni, Mafia women's group FGD	Men have more access to credit than women because you have to own assets to access credit. Services: women have access, but men have more access to services
Zanzibar	
Matemwe Women's focus group	Men have more access to credit than women because they can pay back more quickly. Women belong to SACCOSs (savings and credit groups).
Chwaka Women's focus group	It was just announced that those who need loans should just fill in a form, but nobody has received credit. The situation is the same for women and men 5 out of 6 of the participants belong to SACCOSs
Nungwi women's focus group	Participants variously belonged to 4 SACCOS

TABLE 5.4 WOMEN'S PERCEPTIONS OF ACCESS TO CREDIT IN COASTAL COMMUNITIES

In Tanzania in general, the share of women-owned enterprises grew from 35% in the early 1990s to 54% in 2012, three-quarters of these had only one employee, reflecting a heavy concentration in precarious micro-enterprise. In general, female traders face limited access to business development services in Tanzania (Lambin and Nyyssölä, 2022). Policy practitioners on the ground have highlighted the need for close collaboration with NGOs and civil service organizations to reach and engage with women on the ground and better understand their needs (Lambin and Nyyssölä, 2022).

5.2.3.4. Decision making and control of income

Traditionally, most direct decisions related to fisheries production in coastal Tanzania would be made by men. However, women would be directly involved in some fisheries production decisions in the inter-tidal zone such as foot fishing for octopus, net fishing for shrimp and smaller types of fish, collecting shellfish. As noted

above, some observers have reported that the creation of MPAs and the introduction of restrictions such as banning fine-net fishing in MBREMP in the park's intertidal areas have minimized women's economic mobility, their ability to contribute to their family's material needs, and interfered with their sense of self and identity as a provider of their household (Baker et al, 2021).

The female labour force participation rate in Tanzania is high compared to other parts of Sub-Saharan Africa. However, high levels of female labour force participation do not automatically imply greater levels of gender equality or women's empowerment. In Tanzania, women are often obligated to take up poor-quality work alongside care responsibilities to make ends meet (Lambin and Nyyssölä, 2022). This would appear to be the situation for many women engaging in fisheries value chains.

On the Mainland, the creation of Beach Management Units (BMUs) has in principle increased the opportunity for women members to take part in decisions relating to fishing. For example, decisions around closing and opening of reefs. However, the extent to which this is happening appears to vary significantly between BMUs. In Zanzibar Village Fisheries Committees (VFCs) are mainly made up of fishers and not other stakeholders in fisher communities (as is this case with BMUs). The VFCs do have female members (Matemwe:4 female out of 18 members; Chwaka:2 female out of 11; Nungwi: the women's FGD reported none, while the VFC reported at least 3 out of 12), but there is not the same level of representation as in the BMUs.

Women may also take part in decisions related to fishing in the relatively few cases where women own boats and/ or finance fishing activities.

There were contrasting responses regarding decision-making and control over household income from women in Kilwa and Mafia (Table 5.5). In Kilwa the women in the FGD clearly felt women had a say in decision-making both in their community and in their households and ultimately within the household it came down to who makes the money. In Mafia, women felt they had a say, but men have the final say. In three communities in Zanzibar, women reported that they are able to make their own decision regarding income.

In Zanzibar the proportion of women who make final decision alone on spending farming income was 23.6% but 58.1% for men. A similar pattern was observed for men and women in both rural and urban areas. In the same vein, a higher proportion of males (54.5%) make final decision on spending livestock income than women (25.4%). Across Zanzibar, in rural and urban areas, a very small proportion of men and women both make the final decision to spend farming or livestock income together (ZHBS, 2020).

Respondents	Decision making
Mainland	
Kilwa Kivinje Women's focus group	Women participate in decision making. Women participate in decision making more than men: Women (55%): Men (45%). In BMU meetings, more women participate than men. Within the household, it depends on the family, for most it is 50:50. Who makes the money is in charge.
Somanga Women's focus group	Decision-making In the household, women are more powerful than men. Women control their own income. In most cases women are taking care of household needs because women are taking care of business
Songo Songo women's focus group	All four participants appeared to be heads of household and controlling their income from octopus fishing and other sources They felt that they as fishers did not have sufficient say on reef closures and the price for octopus agreed by the BMU, LG and processing company.
Kilindoni, Mafia women's group FGD	Decision making: Women participate in decision making, but men have the final say. Control of income: Women can control income – "when you take the money to him it's over!" "They are just watching" e.g. one man just sold his house without telling his wife.
Zanzibar	
Matemwe Women's focus group	Most fish that is caught by women is for home consumption. If the fish is sold then women can decide how the money is used, but usually any income is for household purposes.
Chwaka Women's focus group	Women can't even take advice from the husband. The wife cannot even inform the husband how much she has earned. Earnings have to be kept a secret between women and men. An example was given from another village: In another village a woman took a loan for TSH 400,000. The husband found out, took the money and took another wife from Pemba. The woman became very stressed, had high BP and diabetes and lost a leg. She lost her husband and still had to pay back the loan.
Nungwi women's focus group	Women can normally make their own decision, unless it is a big item, e.g. buying a house.

TABLE 5.5 WOMEN'S PERCEPTIONS OF DECISION MAKING AND CONTROL OF INCOME IN COASTAL COMMUNITIES

5.2.3.5. Leadership and empowerment

Women tend to participate in fisheries governance, decision-making and policymaking to a lesser extent than men (Gustavsson et., 2021). FAO has signed an agreement with the Ministry of Livestock and Fisheries Development to provide capacity support towards the implementation of the SSF Guidelines in Tanzania, and a National Task Team is currently taking steps to implement the SSF Guidelines in Tanzania. One such step was the launch of the Tanzanian Women Fish Workers Association (TAWFA) in April 2019. Immediately at the launch, the network was accepted as a member of the African Women Fish Processors and Traders Network (AWFISHNET). Soon after the launch, the members of TAWFA did a thorough review of the Tanzanian fisheries law and submitted their views to the Ministry of Livestock and Fisheries Development. Six months after the launch, TAWFA had over 200 member groups, reaching up to 6000 women[49].

Recognizing the need to understand women's roles in the SSF value chain, the National Task Force Team for implementation of the SSF Guidelines has mapped the women's fisheries collectives in the major marine and freshwater systems including Kilwa, Rufiji, Tanga (Tanga City, Pangani, Muheza and Mkinga) and Mafia. The project aims to form a baseline understanding of women's roles in SSF, and to create awareness of the SSF Guidelines within communities in order to facilitate collaborative implementation. The project will bring to light the capacity gaps and needs of women, with regards to fisheries resources, facilities, financial resources, technology, organizational capacity, and safe working conditions. The project has provided support for the implementation of a Gender Desk at the Ministry of Livestock and Fisheries Development. The Gender Desk will aid in coordinating women's activities and act as a link between TAWFA and the government (Upendo Hamidu, Ministry of Livestock and Fisheries Development, pers. comm., November 13, 2018, in Bradford and

[49] https://www.fao.org/voluntary-guidelines-small-scale-fisheries/news-and-events/detail/en/c/1242127/

Katikiro, 2019 and Our Team discussion with National Task Force Team and Department of Fisheries Development in May, 2022).

In Kilwa Kivinje women's fish processing collectives are common within the dagaa fishery. Groups co-own important processing equipment such as drying racks and trays for frying. The goal is to improve their livelihoods through income generation. Social support is another positive outcome from the collectives, and some groups will give members 20,000 TSH (about 9 USD) to alleviate financial burdens. Women in Kilwa Kivinje commented that women's status in the fishery has changed over the past 5–10 years. In the past, women were not allowed to leave their homes but increased awareness for both men and women regarding women's ability and economic power is allowing them to participate more in the fishery (Upendo Hamidu, Ministry of Livestock and Fisheries Development, pers. comm., November 13, 2018, in Bradford and Katikiro, 2019).

In Zanzibar, women belong to fish processing cooperatives. The Tusiyumbisane cooperative has been together for 15 years. It has 160 members of which 50% are women. Although they are a cooperative, they work as individuals. If there is a tender then they may work together to supply it. In terms of benefits, the chair (a man) explained that "standing alone is a disaster". The government has moved them from previous landing site to their current site. The chair felt the benefit is social as much as economic. At the same landing site is the Tusiaidiane Cooperative which started in 2020. Its members buy, process and sell *dagaa*. It has 51 members, the majority of whom are women. They formed a cooperative because the government told them that it would it make it easier for them to get help and so the main reason they formed was to get access to credit. The credit can be used to buy fresh dagaa, but also other items for trading e.g. soap, clothes. The benefits of members include that they can divide the processing equipment amongst themselves. The membership fee is TSH 10,000 per month. They learnt how to do the dagaa business by "looking and learning" and they learn from each other. Nothing has been learnt from outsiders.

On the Mainland, women belong to BMUs and have leadership positions (See Table 5.11). The Kilwa Kivinge BMU committee members reported that more women participate in decision-making than men in their BMU. In the Somanga Women's focus group, the female chair of the village committee reported that "*it is difficult for women to speak in public because of the culture*". She suggested that she is the village chair because she is competent, can defend her position and lobby.

In Zanzibar, although a number of women do belong to VFCs, they did not occupy any of the most senior leadership positions in the three communities we consulted VFC members. Women can be in a Shehia Committee and in Matemwe one out of the four shehas in the area was a woman and the Women's FGD participants felt better that the sheha is a woman. In Chwaka Women's FGD participants reported that in most organizations most of the higher positions are likely held by men, but the lower positions can be held by women. However, for most SACCOSs the chair and treasurer is a woman because men can't be trusted. In Nungwi, Women's FGD participants commented that there were no women in the VFC, although they are not restricted. Women are in the influential Village Elders Committee and there was one woman in the Market Committee.

More than 30% of members of the national parliament in the United Republic of Tanzania were women in 2019. Measures such as reserved seats (mandated by the constitution and/or legislation), legal candidate quotas (mandated by the constitution and/ or legislation) and voluntary political party quotas are in place (IPU 2020 in UN Women, 2020). Tanzania's first female president, Samia Suluhu Hassan (incumbent as of 2021), has drawn attention to the achievement of SDG 5.4 (recognition, reduction and redistribution of unpaid family care work) has also initiated the development of the Tanzania Generation Equality Programme, a multisectoral initiative seeking to bolster women's economic, social, and political empowerment through gender-responsive macroeconomic planning and employment creation for informal workers, among other goals (Lambin and Nyyssölä, 2022).

Hardship and Division of labour

On the Mainland, women from Kilwa and Mafia reported that the division of labour within the households is not equal in their communities (Table 5.6). Likewise In Zanzibar, women reported that their workload was far

higher than men and this was linked to women now having to earn an income as well as doing most of the household activities.

In Tanzania as a whole, women spend 3.72 times more time than men on unpaid work for the household (OECD 2019), utilizing over 13 hours of their waking hours multi-tasking care work, household chores, and income-generating activities (Lambin and Nyyssölä, 2022).

In Zanzibar, an average of 3.4 hours a day was spent (14% of total hours) doing SNA (System of National accounting) activities (i.e., a) Employment and related activities and b) Production of goods for own final use) while an average of 10.7 hours was spent doing self-care maintenance activities like sleeping, eating & drinking, personal hygiene & care, receiving personal health care, travels related to self-care & maintenance and other self-care and maintenance. On average, males spent more time (5.2 hrs) in doing SNA activities compared to females (1.8 hrs). On the other hand, females spent about five times longer doing unpaid work (4.3hrs) compared to males (0.7 hrs) per day. Self-care and maintenance activities for the population aged 15 years and above were not found to be considerably different between males and females (10.4 hrs and 11.1 hrs respectively) (ZHBS, 2020).

Respondents	Comments on Household division of labour
Mainland	
Kilwa Kivinje Women's focus group	Workload: Childcare – Women = 80-90%; Men = 10-20% 100% women's responsibility if divorced.
Somanga Women's focus group	Women are primarily responsible to work within the household (suggest 70%)
Songo Songo women's focus group	All four participants appeared to be heads of household
Kilindoni, Mafia women's group FGD	100% of the domestic work is done by women
Zanzibar	
Matamwe Women's focus group	Women have a huge workload in the household compared to men. Women's workload has become bigger. This is partly because farmland is further away. The workload has increased because in the past TSH 10,000 could last for a month, but now it can't even last for a morning. Life has become more difficult. Most have to wake up very early in the morning
Chwaka Women's focus group	Women have a greater share of work in the household. Women may be working up to 11.00 pm at night. For the men when they get back from fishing that is it. (A big fish can go to a second woman!)
Nungwi women's focus group	Women have more workload The only role of men is to give a little money. Women have to deal with all the other activities – food, water etc

Table 5.6 Women's perceptions of household division of labour in coastal communities

Are risks of women being subject to strenuous work minimised? In Kilwa Kivinje, women fish carriers reported the strenuous nature of the work carrying fish from the boat to the processing sites. Female octopus fishers in Songo Songo reported the risk associated with boat owners over-loading their boats with fishers to maximise their revenue per fisher and how two women had drowned when an over-loaded boat over-turned.

O'Neill et al, (2018) suggest that gender appears to be a strong organizational category within seafood value chains on the Swahili Coastline, often defining women's activities, for example, their interactions with the tourist industry. However, deviations from the often dominant narrative presented by gender-related fishery studies, i.e., women as secondary, marginal, and often weaker players can be seen in Unguja. In the south of Unguja island five fisherwomen have linked directly to the global market whilst those traders in their sample that have above average incomes included females not trading in a conceived space (not where they are perceived to be), i.e., freezing/icing products from rural areas and transporting them for sale in the central market. These counter-narratives highlight the potential of female actors to adopt more traditionally male economic niches in changing market environments, as a possible requirement for sustainable fisheries.

There is evidence that women are gaining ground, e.g., in positions and numbers, in the SSF market environment. However, there are indications that men have begun to encroach into hitherto distinctly female arenas. Porter et al. (2008) found that women who harvest or trade shellfish, sea cucumbers, seaweed or octopus often get displaced by men when these products become global commodities. Nevertheless, the

stories of women's participation in fisheries that are increasingly connected to global seafood trade are multifaceted and shaped not just by their gender but also by factors such as household assets, size and composition, education and skills. Gender must be placed in the broader social processes at play around the fisheries, rather than being singled out, if researchers and decision-makers are to better understand women's long-term value chain positions (O'Neill et al, 2018).

5.2.4 Food And Nutrition Security

5.2.4.1. Summary of findings

4. FOOD AND NUTRITION SECURITY		
4.1 Availability of food	MLT and ZNZ: Local food production is decreasing in coastal fishing communities (access to land, decline soil fertility, climate, pests & diseases). Food supplies are increasing on local markets. This was at least partly linked to improving infrastructure.	Moderate/Low
4.2 Accessibility of food	MLT and ZNZ: Trends in income from fisheries value chains to be able to purchase food is highly variable for different stakeholders. Relative consumer food prices appear to be increasing. Within fishers' households there is a high reliance on seafood for livelihood and nutrition security. Within fishing communities there appears to be high reliance on purchased food (in general). MLT: 13 out of 20 respondents in fishing communities had consumed fish the previous day (on average 1 meal with fish/ person/ day). In most cases the fish had been purchased. ZNZ: 17 out of 18 respondents in fishing communities had consumed seafood in the previous 3 days (on average just below 1 meal with seafood/ person/day). In most cases seafood had been harvested by family members.	Moderate/Low
4.3 Utilisation and nutritional adequacy	MLT and ZNZ: Women's FGDs suggest that the nutritional quality of available food was improving in markets. MLT and ZNZ: There appears to be a mixed picture regarding nutritional adequacy in diets. Nutritional practices are increasingly dependent on households' ability to buy nutritious food. Non-communicable diseases (high BP and diabetes) are increasing in coastal areas.	Moderate/Low
4.4 Stability	MLT and ZNZ: People are increasingly dependent on purchased food. Risks associated with own food production are reduced. However, risks of high dependency on income associated with fisheries VCs are high for fishers' households given increasing numbers of fishers and also for non-fisher households if stocks are not sustained and /or more people are attracted to their communities and incomes decline.	Moderate/Low

In Tanzania in 2019-21 15.4 million people were severely food insecure (compared to 10.6 million in 2014-16) and 22.6% of the population was considered under-nourished (compared to 20.6% in 2014-16). On the basis of a healthy diet costing USD 2.74 a day, then 87.6% of the population could not afford a healthy diet in 2020 (FAO, IFAD, UNICEF, WFP and WHO, 2022). Tanzania is experiencing the double burden of malnutrition, with 28% of women and 4% of children under five years suffering from overweight and obesity (USAID, 2021).

The prevalence of stunting is the main malnutrition problem affecting children 0 to 59 months in Tanzania. Between 2014 and 2018, stunting in Tanzania, was reduced from 34.7% to 31%. In the Mainland, based on the WHO-UNICEF prevalence thresholds, the 2018 survey results showed a level of stunting considered "very high", exceeding the 30% threshold, in 15 out of the 26 regions of the Mainland and for the Mainland as a whole it was 32%. Only one of these regions was on the coast, Tanga where there was a significant increase of the prevalence of stunting to 34% compared to 2014 when it was 23.8%. Other coastal regions ranged from 20.1% in Dar es Salaam to 29.6% in Mtwara. For Zanzibar, stunting rates were ranging from 20.4% in Stone Town to 23.8% in Unguja North. In all 5 regions, prevalence of stunting was lower than in 2014.

Wasting, or acute malnutrition, is a reduction or loss of body weight in relation to height. The prevalence of global acute malnutrition (GAM) among children under five years decreased from 3.8% in 2014 to 3.5% in 2018 in Tanzania. In the Mainland the prevalence of GAM was exceeding the 5% threshold in one region only, Singida with a GAM prevalence of 5.2%. However, for Zanzibar, the prevalence of GAM was ranging from 4.3% in Unguja South to 7.7% in Unguja North. The GAM prevalence for Zanzibar as a whole exceeded the GAM thresholds of 5%, but decreased from 7.2% in 2014 to 6.1% in 2018.

In Tanzania as a whole, marine and freshwater fish provides approximately 22.5 % of animal protein consumed (Taylor et 2019). According to FAO statistics, Tanzania had a per capita consumption level of 16.4 kg/year in 1990, declining by 2017 to 7 kg/year and increasing to 8.5 kg in 2020 (MLF 2021 in Peart et al, 2021). Fish consumption per capita is much higher in Zanzibar than in the Mainland, based on slightly older data 23–30 kg per) (Lange and Jiddawi, 2009 in Sekadende et al. 2020). Marine fishes provide over 90% of the animal protein requirements in ZNZ (RGoZ, 2020).

Marine small pelagic fisheries constitute a major source of this protein in coastal communities, especially for low-income households. The consumption of small pelagics by urban communities has also steadily increased over the last two decades (Sekadende et al. 2020). Fisheries appear to play an important role either directly or indirectly in terms of food security and nutrition within coastal communities. A survey by Taylor et al, 2019 found that 79% of marine fishers in Tanzania report that they eat all or a portion of their catch.

In common with the situation globally, limited attention has been given so far to fish as a key element in food security and nutrition strategies at national level and in wider development discussions and interventions in Tanzania. Debates have focused predominantly on questions of biological sustainability and on the economic efficiency of fisheries, neglecting issues linked to their contribution to reducing hunger and malnutrition and to supporting livelihoods. Yet increased consumption of fish, and its addition to the diets of low-income populations (including pregnant and breastfeeding mothers and young children), offers important means for improving food security and nutrition for several reasons. Firstly, the bioavailability of fish protein (amount of protein that can be broken down into usable amino acids) is approximately 5–15% higher than that from plant sources. Fish also contains several amino acids essential for human health; especially lysine and methionine. Secondly, the lipid composition of fish is unique, having long-chain, poly- unsaturated fatty acids (LC-PUFAs) with many potential beneficial effects for adult health and child development. Many low-cost, small pelagic fish such as anchovy and sardine are some of the richest sources of LC-PUFAs. Thirdly, fish is an important source of essential micronutrients –vitamins D, A and B, minerals (calcium, phosphorus, iodine, zinc, iron and selenium) – especially so for many small fish species that are consumed whole (HLPE, 2014).

5.2.4.2. Availability of food

Food appears to be readily available in coastal fishing communities. Improved infrastructure supports availability of food in local markets. However, availability of locally produced food has almost certainly declined over time, at least in some locations (Table 5.7). For example, Moshy and Bryceson (2016) refer to a community in Mafia and explain that "*prior to the 1970s, villagers produced their own food, and rainy seasons and neap tide days were allocated to farming. Since then, more people have become dependent on fisheries*".

5.2.4.3. Accessibility of food

Access to food varies depending on factors such as availability, consumers' income, food prices. Other factors (e.g., social, cultural, religious, health status, taste preference) may influence the actual food consumed. Some fishing communities (e.g. Songo Songo and Mafia households) have for a long time purchased or traded to access a significant amount of the food they consume (Songo Songo Community leaders and Caplan, 2006). In other communities, this appears to be a more recent trend.

Fishers' households' access to food and nutrition security

Based on 293 interviews with artisanal fishers from six coastal communities located in Zanzibar/Unguja, Pemba, Mafia, and Tanga, Taylor et al. (2021) found a high reliance on fish for nutrition in all four areas as, on average, fishers eat fish six days a week. The frequency of fish consumption is much higher than meat in all four regions. The most common method to acquire fish is through own catch. However, a third of fishers in Pemba and Zanzibar rely on a mixed strategy of own catch and purchasing fish from the local market. The percentage of fishers utilising this mixed strategy in Tanga and Mafia is not nearly as high (10% and 12% respectively). These results report a high reliance on fish for both livelihood and nutrition security in fishers' households. In these locations, the proportion of fishers who were also farming ranged from 50% in Tanga, 52% in Mafia, 64% in Unguja/ Zanzibar and 92% in Pemba.

Taylor et al. (2021) report how fishers at the individual level target different groups of species for either commercial or subsistence purposes. The most commonly targeted species in Tanga for both commercial and subsistence purposes were small pelagics and large pelagics. A large portion of fishers only targeted pelagics (large and/or small) for both purposes.

There appear to be a number of fishers (35%) in Pemba who only targeted large pelagics for commercial purposes and not subsistence purposes. These fishers rather target small pelagics and reef fish for self-consumption. Overall, the most targeted species in Pemba are the large pelagics for commercial purposes and reef species for subsistence purposes.

Large pelagics are extremely important in fishing strategies within Zanzibar (Unguja), being the most targeted species for both commercial and subsistence purposes. There is a large group of fishers (20%) who were not connected to many species and rather solely target large pelagic fish for both purposes. The majority of fishers within Zanzibar commonly targeted large pelagic species with reef species.

A large group of fishers (20%) in Mafia only target reef species for both commercial and subsistence purposes. Small pelagics held a more prominent role in fishing strategies in Mafia compared to Zanzibar. Overall, reef species are the most commonly targeted for both commercial and subsistence purposes.

Less wealthy fishers in islands of Unguja, Pemba, and Mafia tend to target fewer species, making them less able to absorb changes in management measures which may be species- or area-focused. Likewise, those with higher wealth scores and higher adaptive capacity will be able to better absorb the short-term losses of fishery closures when compared to those with lower wealth and adaptive scores who rely on higher levels of fishery connectivity (Taylor et al, 2021).

A study of 120 households from four fishing communities in Mafia suggests that 94% of "fish" (tuna species, groupers, emperor, mackerel) are sold and 6% consumed at home; 99% of *dagaa mcheli* (highly preferred type of small pelagic) and 93% of octopus are sold (Mpemba, 2016).

Fishing communities' access to food and nutrition security

Mainland Tanzania: There appears to be a very high dependence on purchased food (in general) in the fishing communities we visited (Table 5.7), with many households not having access to shambas (farms) to grow their own food. In Somanga, where a high proportion of households were reported to have access to agricultural land, the village chairperson reported that people mostly grow commercial crops (sesame, cashew, cassava for sale) and depend on buying food. From the 20 women who shared information about the food that they had consumed the previous day, 13 out of 20 (65%) had consumed fish and on average one meal with fish had been consumed per person (Social Analysis Appendix Figure 1). In most cases, the fish had been purchased and the most commonly consumed fish was *dagaa*, followed by *Tasi/* rabbit fish (Table 5.8).

Respondents	Comments on Food and nutrition security
Mainland	
Kilwa Kivinje Women's focus group	• Around 20% of households in this community have land for agriculture (shamba) • 80% of households have to buy all or a large proportion of their food. • In the past, people would own land, but young people sold theirs. Also, young people moved for jobs. • Fishing is going up and farming is going down in this community. One participant reported that 7 of her children are going for fishing. • Fishing started to come strong in the 1990s. • Food and nutrition security has improved since 1990s.
Somanga Women's focus group	• 90% of households have shambas, 10% have no shambas. • However, most grow commercial crops (sesame, cashew, cassava) and depend on buying food. • Fishing income is large compared to farming income.
Songo Songo village leaders	• There are two main types of shambas – Mwani (Seaweed) and Minazi (coconut) • Most households depend on the ocean for their "farms". Most of Songo Songo is hard rock. So most people depend on buying food. They exchange with those who produce food crops. • Food security has improved, but many women are doing seaweed farming so may miss mid-day meals. • Level of fish consumption has declined. Most fish caught are now being sold. Most fish are going to Dar. • As consumption of fish has gone down, the consumption of some other foods has increased e.g. amaranthus, beans. On balance, nutrition has gone down. • In the past coastal communities preferred rice (and ugali?), but now cassava, sorghum (?) and banana. • All foods are fairly available.
Kilindoni, Mafia women's group FGD	• In past there were no shops, but now there is plenty of food available. Problem is (lack of) employment. • In the past when farming they harvested a lot, but now nothing. • The food types being eaten have not changed.
An individual woman from rural Mafia	• The food situation is the same as in the past. • She has a shamba – growing maize and okra. • She estimates 20-30% have a shamba and 70-80% are without.
Zanzibar	
Matemwe Women's focus group	• Agricultural yields have gone down – *baraka* (God's blessing) has gone down. • Number of households farming gone down from 100% in the past to two thirds of households today. • Sorghum and millet has gone • People are travelling more freely. This pushes them away. • Seaweed farming has gone down because of waste water from tourism. • The weather has changed. • Food in the market has changed. Now there are more vegetables and fruit. • Diversity of food in the market has increased • In the past people cultivated their own food and very little perished. Now it is the reverse. • In the past there was not much selling of octopus and shellfish, but now more is being sold. • There are more food shortages than in the past. Sometimes people only eat two meals a day. • People have low purchasing power. • This is linked to fishing because there is less fish caught today
Chwaka Women's focus group	• Some crops have changed. E.g. millet and sorghum were grown much more in the past. Maize grown in the past and today, but now get much more pests & diseases. Sometimes there is no harvest from maize. • New commercial crops e.g. lime, water melon, vegetables, tomatoes. • These crops push you down because of a mixture of the weather and pests & diseases. There are completely new pests. Pesticides must be used to get any harvest. This is linked to people's health. • Large proportion of food is purchased & not from the farm. Most people buy most of their food from the market or shop. • In the past, they farmed and harvested more. Now they have to buy. • The quality of food has gone down • Factor are the weather, soil infertility, less population in the past • Less income – no employment even if children are educated. • Value of money has gone down. • More people are going for fishing so everyone is getting less and less. May be with modern equipment. (*the situation would improve*)?
Nungwi women's focus group	• Local production of food has gone down dramatically. Millet, sorghum & maize has gone down. This is due to land scarcity. Large portion of land sold to tourist sector. In the past, people were energetic. Livestock moving freely in the community. • More new things . For example, cooking oil – in the past used coconut oil, but now use purchased oil. • In past, sorghum *ugali* was made grinding all, but now only the inner part is used and the outer part is wasted. • In the past, the pumpkin seed including the outer layer was ground to make porridge for children. • Culture is changing. • People were self-sufficient because they were living and helping together. Could get free food from a neighbour. But no social capital now. • No link with fisheries. • Generally social capital has been reduced, but it varies with place. • People had more food in the past from the farm. Now if you don't have money you starve.

TABLE 5.7 WOMEN'S PERCEPTIONS OF ASPECTS OF FOOD AND NUTRITION SECURITY IN COASTAL COMMUNITIES

Zanzibar: There was also a high dependence on purchased food in the three fishing communities we visited. The results suggest a decline in the proportion of households farming, declining yields and a move away from more resilient and nutritious crops such as sorghum and millet. In at least one village, the decline in farming was linked to a reduction in access to land due to tourist developments. There were also changes in how food was processed suggesting some of the more nutritious parts of a crop were being discarded. From the 18 women who shared information about whether or not they had consumed seafood in the previous three days[50] ,17 out of 18 (94%) had consumed fish and on average just under one meal per day with fish had been consumed per person. The one person who had not consumed any fish (or meat) in the previous three days explained that this was because she could not afford to make a purchase. In most cases the fish had been harvested by family members, followed by purchasing and gifts. Gifts include "*kuchunda*", where 1 or 2 fish are requested from fishers when they land. The most commonly consumed fish was *kibua/* mackerel and *Tasi/* rabbit fish (Table 5.9). However, a wide diversity of fish was mentioned suggesting that 26 different types of seafood had been consumed in the previous three days.

	Respondents eating fish	Meals with fish	Dagaa	Mackerel (Kibua)	Kingfish (Nguru)	Sahewa	Rabbit fish/Tasi	Grouper	Bluestripe/Blackspot Snapper (kelea)	Not specified
Purchased	7	11	6	0	1	0	3	0	0	1
Gift	4	6	3	0	0	0	2	0	1	0
Harvest	1	1	0	1	0	0	0	0	0	0
Not Specified	1	2	0	0	0	1	0	1	0	0
	13	20	9	1	1	1	5	1	1	1

TABLE 5.8 SEAFOOD CONSUMPTION ON PREVIOUS DAYS BY TWENTY WOMEN IN KILWA AND MAFIA DISTRICTS.
Source: Individual responses from women interviewed in Kilwa Kivinje, Somanga, Songo Songo, and Kilindoni

	Respond-ents eating fish	Meals with fish/seafood	Dagaa	Mackerel (Kibua)	Kingfish (Nguru)	Sahewa	Rabbit fish/ Tasi	Changu	Pono/ parrot fish	Shellfish	Other
Purchased	4	11	1	4	1	2	1				2
Gift	3	9	0	1	0		2		1		5
Harvest	9	27	1		1	1	3	4	2	1	14
Purchase/ harvest	1	3	1	1						1	0
	17	50	3	6	2	3	6	4	3	2	21

TABLE 5.9 SEAFOOD CONSUMPTION ON PREVIOUS DAYS BY 18 WOMEN IN UNGUJA, ZANZIBAR.
Source: Individual responses from women interviewed in 3 communities in Unguja

Wider community Food and Nutrition Security

In Tanzania, only 46% of rural women meet minimum dietary diversity (i.e., consume at least 5 food groups out of 10 daily), a measure of micronutrient adequacy, and women's intake of protein, fruits, and vegetables is low. A study in coastal Rufiji district found maternal overweight (24.3%) and obesity (13.1%) were high. The median Prime Diet Quality Score (PDQS)was 19 (PDQS; 21 food groups; range,0–42)). Households produced two food crops yearly. Food crop diversity was positively associated with PDQS, but the association was strengthened by proximity to markets. For women living close (<1.1 km) to markets, producing 1 additional food crop was associated with a 0.67 increase in PDQS, versus a 0.40 increase for women living farther away. The PDQS increased with women's salaried employment. Household food production may interact with access to markets for sales and purchases, while non-farm income also improves women's diet quality in rural Tanzania. Programs to improve women's diet quality should consider improving market access and women's access to income (source of empowerment), in addition to diversifying production (Madzorera et al, 2021).

Table 5.10 shows examples of how frequently households in Zanzibar had consumed different types of food in the previous week and how the food had been accessed. Fish was one of the most frequently consumed foods by the population as a whole (4.6 times in the previous week). However, only 7.2% of households had caught their own fish and 87% of households had purchased the fish that they consume. The most popular

[50] It should be noted that our visit took place during a period of fasting and hence the different approach to enquiring about food consumed in Zanzibar compared to the Mainland.

fish, in terms of percentage of expenditure on fish, were mackerel (19.3%) and small sardines (15.1%), followed by various reef fish (Social Analysis Appendix Figure 2). In general, there was a high dependence on purchased food. More than 80% of the households consume vitamin A-rich food on a daily basis, but protein was consumed on a daily basis by only 64.8 % of the households and iron-rich food was found to be in the daily diet of only 33 % of the households. The urban areas had higher daily intake of vitamin A, protein- and iron-rich foods than the rural areas (ZHBS, 2020). Keller (2012) attributed low consumption of fruits and vegetables in Zanzibar to unfavourable cooking habits, restricted availability and high price (compared to people's average income) of fruits and vegetables observed in urban and especially rural areas.

	a) Percentage of Households by Main Source of Food in the Preceding Week								b) Frequency of food consumption		
Type of food	**Purchase**	**Own Prodn**	**Traded goods/ Service barter**	**Borrowed**	**Received as gift**	**Food aids**	**Others**	**Total**	**Rural**	**Urban**	**Total**
Fish	87.0	7.2	0.1	2.0	3.6	0.2	0	100	4.7	4.5	4.6
Cereals & grain	91.8	3.3	0	2.7	1.9	0.1	0.1	100	5.3	5.4	5.4
Roots&tubers	65.9	26.3	0	2.3	5.3	0.1	0.1	100	3.4	3.9	3.6
Legumes	91.7	2.4	0	3.0	2.5	0.4	0	100	2.0	2.1	2.0
Leafy veg.	52.2	37.2	0	1.2	8.3	0.1	1.0	100	2.1	2.4	2.3
Fruit	57.7-55.8	27.7-32.7	0.1	1.8-1.3	12.1-9.1	0.2-0.3	0.5-0.7	100	3.0-3.1	2.6-2.9	2.8-3.0
Meat	82.9	8.5	0	1.9	6.2	0.5	0	100	1.7	2.1	2.0
Eggs	75.6	20.4	0.1	1.5	2.3	0.2	0	100	1.6	2.0	1.8

TABLE 5.10 A) PERCENTAGE OF HOUSEHOLDS BY MAIN SOURCE OF FOOD AND B) FREQUENCY OF FOOD CONSUMPTION IN THE PRECEDING WEEK IN ZANZIBAR
Source: ZHBS, 2020

5.2.4.4. Utilisation and nutritional adequacy

Studies by Cochrane and D'Souza (2015) and Ochieng et al. (2017) found a significant lack of diversity in diets and insufficient intake of foods rich in micronutrients within Tanzania households (Taylor et al, 2021). Many of the 20 women on the Mainland who shared information about the foods that they consumed the previous day appear to have quite a diverse diet (Social Appendix 8.5 Table 8.15). HLPE (2014) suggests that gender, along with intersectional factors (such as economic class, ethnic group, age or religion), is a key determinant of the many different ways by which fisheries affect food security and nutrition outcomes, availability, access, stability and diet adequacy, for the population groups directly involved in fish production and supply chains, but also beyond.

Msanja et al., (2021) assessed the contribution of fish in improving micronutrients, specifically vitamin A, zinc and iron contents in complementary foods for children aged 6 to 23 months old children in coastal Lindi Rural District. A cross-sectional study was done; interviews were conducted on 212 caregivers with children aged 6 to 23 months at Mchinga Ward where fishing activities take place. About 89% of children were given fish-based complementary foods. On average, fish-based complementary foods had higher vitamin A concentrations (279 µg RE/100 g serving) compared to non-fish-based complementary foods (4 µg RE/100 g serving), but were lower in iron and zinc concentrations (0.66 and 0.067 mg/100 g serving, respectively) than non-fish-based complementary foods (0.74 and 0.074 mg/100 g serving respectively. Around 39% of the households had members who are involved in any fishery-related business, but no association was found with child's fish consumption ($p>0.01$).

5.2.4.5. Stability

People are increasingly dependent on purchased food. Risks of periodic food shortages associated with own food production are reduced. However, people are then more exposed to risks of fluctuating food prices[51].

[51] Baffles et al (2019) examined the drivers of monthly changes in maize (major staple) prices across 18 Tanzanian markets. Local prices respond three to four times faster to the main regional market (Nairobi) than to the international benchmark (US Gulf). Shocks from Nairobi account for one third of the explained variation in domestic prices; but the

Risks associated with high dependency on income associated with fisheries VCs are high for fishers households, given increasing numbers of fishers, and also for non-fisher households if stocks are not sustained and /or more people are attracted to their communities and incomes are driven down.

5.2.5 Social Capital

5.2.5.1. Summary of findings

5. SOCIAL CAPITAL		
5.1 Strength of producer organisations	MLT and ZNZ: There is a range of formal and informal organizations participating in fisheries VCs. Externally instigated organizations have had a strong focus on marine conservation. Goals and performance of these different organizations appears to vary considerably. Many fishers interviewed did not feel well represented. Inclusivity of membership varies according to a number of factors including their purpose, location and governance. BMUs (MLT) are much more inclusive than VFCs (ZNZ). The recently formed TAWFA provides a network for organizations involving women in fisheries-related activities. BMU and VFC leadership is periodically elected and in that sense is representative and accountable. However, many of the fishers interviewed did not feel well represented. In general fishers appear to negotiate on an individual or very small group (crew) basis. Examples of fishery-related organizations who negotiated on behalf of their members included a Cooperative to secure large tenders for dagaa in ZNZ; fishers forming informal and formal groups to secure a boat and gear on Mafia. BMUs and VFCs appear to have a role negotiating for improved equipment and infrastructure on behalf of their members.	Moderate/Low
5.2 Information and confidence	Services are generally weak. BMUs (MLT) and VFCs (ZNZ) have a role providing information about illegal fishing practices and fisheries policy. There is a complex web of social and economic relations in which SSF market actors are embedded. This includes various forms of informal credit arrangements based on trust	Moderate/Low
5.3 Social involvement	BMUs, VFCs and VLCs (if protected areas) are institutional arrangements which in principle enable communities to participate in marine resource decisions that impact on their livelihoods. In practiced performance is very variable. Traditional knowledge and resources are not well respected in coastal resources management. BMU, VFC and VLC Committee members carry out their role on a voluntary basis. Various other example of voluntary participation in community activities were reported.	Moderate/Low

5.2.5.2. Strength of producer organisations

There is a range of formal and informal organizations associated with small scale fishers. These include:

- Fishers Associations at various levels which aim to representing fishers (e.g., Mijini District Fishers Association, Zanzibar; the newly formed Tanzania Women Fish workers Association (TAWFA),
- Informal groupings of fishers, (e.g., Usishanghai group owning a ringnet fishing boat, Kilindoni, Mafia),
- More formal groups of fishers (cooperatives) (e.g., Twendekazi fish cooperative, Mibulani ward, Mafia).

The inclusivity of membership of these organizations varies according to a number of factors including their purpose, location and governance. For example, District Fishers Association represent fishers in a specific district. The chair of the Mjini District Fishers' Association in Zanzibar reported that their membership included female shellfish fishers (who were traditionally foot fishers, but now hire boats). The Twendekazi fish cooperative in Mibulani ward, Mafia has a focus on octopus and out of its 30 members, eight are women. The

remaining two-thirds is accounted for by domestic influences (including harvest cycles, weather shocks, and trade policies). Remoteness and the local agroecology systematically influence the behavior of food prices.

Usishanghai group owns a ring net fishing boat in Kilindoni, Mafia and consists of ten fishers (all men) who came together to buy a boat, engine, and gear to enable them to move away from working for others.

It is not clear to what extent members feel that they have representative and accountable leadership. The few crew members interviewed in Kilwa Kivinje and Mafia reported that they had no organization representing them as fishers and similarly women Octopus fishers on Songo Songo.
What benefits does membership of fisher organizations offer? The Mjini District Fishers Association chair explained that a key benefit of membership was support and conflict resolution. Two examples were cited. Fishers from Mjini district went to the Mainland to fish and were "arrested" by local people. Fishers Association leadership went there to pacify and secured a guarantee that it wouldn't happen again. Another time fishers from Mjini went to Tanga and following a similar incident, some sort of Memorandum of Understanding was negotiated. The Twendekazi fish Cooperative (supported by Action Aid) has an account at NMB bank with some significant savings and has started to build an office. The Cooperative has only one fishing boat, but with 32 members, half of the members go in one season (time in the month) and half the next. They would like to get a second fibreglass boat. They are reluctant to borrow the money as a cooperative because they feel the risk is too big. They plan to get a freezer to store octopus and other fish such as changu (emperor fish). The Usishanghai group leader explained how he started a savings culture with his colleagues. They managed to save enough to buy a boat and, after initially hiring, they bought an engine and fishing gear. The chair noted three lessons: those involved were collecting money themselves, to keep the group together requires regular, well-managed meetings and the importance of good leadership of the group.

Fishers may also belong to organizations which are aiming to achieve **co-management in the governance of coastal resources.** These include:

- Beach Management Units (BMUs) on Tanzania Mainland-multi-stakeholder organizations aiming to manage, protect and conserve fisheries,
- Village Fisheries Committees (Shehia Fishermens' Committees) in Zanzibar,
- Cooperative Fishery Management Areas (CFMA), which combine several BMUs,
- Marine Protected Areas (MPAs): Mafia Island Marine Park (MIMP), established in 1995; the Mnazi Bay Ruvuma Estuary Marine Park (MBREMP), established in 2000; and the Tanga Coelacanth Marine Park (TCMP), established in 2009 (Katikiro et al, 2017). Village Liaison Committees (VLCs) are comprised of village members who, in theory, serve as the primary liaison between each park-associated village and MPA management (Katikiro et al., 2017 in Baker et al 2021).

Performance of these different organizations appears to vary considerably.

Beach Management Units (BMUs) are organizations that seek to facilitate community participation and collaboration in the management of coastal resources. BMUs bring together a group of stakeholders in a fishing community whose task is to manage, protect and conserve. In a BMU, the community is supposed to be the steward of its own resources. The Tanzania guidelines for BMUs lists the following tasks: enforce the fishing act, prepare by-laws, ensure sanitation and hygiene, collect fish data and information, educate fishers, prepare and implement livelihood projects, ensure the security of people and property (Katikiro et al 2017).

The Kilwa District Fisheries Officer explained that between 2006 and 2009 BMUs were formed at village level. Initially there were problems including: lack of good governance, management plan and financial sustainability. As a results BMUs were dormant. After working with NGOs (e.g. WWF and Sea Sense in Kilwa) most BMUs are now active. There are 27 BMUs in Kilwa district – 1 BMU per (coastal) village. BMU leaders are selected by village members. Each BMU has 22 leaders: Chair, Vice-chair, Secretary, Vice-Secretary, Accountant, Store keeper, An elder, 3 sub-groups: Marine Control and Surveillance (MCS) – 5 members; Financial committee-5 members; Inspection and data collection- 5 members. Functions include: Beach protection, data collection, collection of money. There should be one meeting per month in each village.

Ponte at al. (2020) note that according to fisheries regulations, there should be 739 BMUs in Tanzania. However, many exist only on paper and a considerable number have not been effective in implementing the management guidelines and hence have become inactive. In Mtwara region, the formation of BMUs started as a pilot project (2008–2011) under the Ministry of Livestock and Fishery Development, the World Bank-financed Marine and Coastal Environmental Management Plan (MACEMP) and in collaboration with WWF Tanzania. The introduction of BMUs was not welcomed in all villages, and within villages many fishers resisted their establishment. This led MACEMP to promise fishers access to new and legal fishing gear and boats, as

well as alternative income-generating activities, such as goat breeding, poultry rearing, and fish farming. However, many of these projects either never took off, or folded soon after external support ceased (Ponte at al, 2020).

Katikiro et al. (2017) observed that some BMUs have been affected by elites occupying more powerful positions within the BMU committees and creating conflict within them. Like the VLCs, BMUs are also reported to be affected in terms of gender composition, with women often lacking decision-making powers. The emergence of BMUs is also creating tension and conflicts between community-based structures such as the Village Environment Management Committees (VEMCs), which have substantial overlap of functions and activities (Katikiro et al, 2017). BMUs face major challenges in collecting revenue. While BMUs can raise revenue through levy collection at landing sites, from fishing licenses, from fines from patrols, and/or other forms of local taxation on fishing-related activities, this task often clashes with the mandate of the district-level fisheries division (Ponte et al., 2020).

The potential role of community-based management institutions in the management of small pelagic resources is open to question. This is because of the significant geographic range of the fleet, with the fishery taking place largely outside of the boundaries of local management institutions and the largely commercial nature of this fishery compared to rather more adjacent reef, mangrove and seagrass-based fisheries. (Sekadende et al 2020).

Silas et al., (2022) reported that the periodic, temporary closure, organized by BMUs, has positive economic benefits to coastal fishing villages. Besides increased catch and profit, they also fuel other sectoral development, including housing and groceries. Therefore, it is important to up-scaling the temporal closure to other fishing villages to maximise the fishery's octopus production and sustainability and improve community wellbeing. However, temporal octopus closure is associated with increasing effort. Therefore, it is important to investigate if increased effort causes overharvests and destruction of reefs by trampling and clearing octopus dens.

How inclusive is BMU membership? Based on the four Focus Group Discussions with BMU Committee members, female membership of BMUs ranged from approximately 25% (Somanga) to 67% (Songo Songo) (Table 5.11). In at least some BMUs women clearly have leadership positions, for example in Kilwa Kivinje both the chair and secretary are women. The Kilwa Kivinje BMU Committee members explained that the BMU is for any person living in the K. Kivinje area. These included: i) Fishers ii) Fish mongers iii) Fish carriers iv) Fish consumers v) Fish driers vi) Net menders vii) Boat builders/ repairers viii) Fish transporters (motor bike to markets).

BMU	Female	Male	Total	% female	Comments
Kilwa Kivinje	250	350	600	42	Chair and treasurer are female
Somanga	1000	3000	4000	25	For one female member of the Finance Committee, the BMU is dealing with conservation of the ocean fisheries to realize benefits. Other people saying the BMU is nothing, but she tells them they are in the BMU because they benefit from the ocean. It was difficult for women to participate because they feared. She was convinced by others to put her name forward. Now she may compete for other positions e.g. secretary.
Songo Songo	400	200	600	67	Secretary is female.
Kilindoni	334	922	1256	27	30 leaders (10 female).

TABLE 5.11 FEMALE MEMBERSHIP AND LEADERSHIP POSITIONS IN BMUS.
Source: BMU Committee members Focus Group Discussions

In Focus Group Discussions with BMU Committee members a number of successes were reported (Social Analysis Appendix Table 2). For example, closure of a coral reef by Songo Songo BMU and creation of infrastructure at Somanga. The views of community members varied with both support and criticism of the BMUs (Social Analysis Appendix Table 3). For example, female Octopus fishers in Songo Songo reported "*BMU*

leaders agree no one should go to the reef during closure, but when it is open, they allow anyone from anywhere to go there. But it is we who have waited for 3 months during the closure".

BMU Committee Members were open about the challenges that they faced (Table 5.12). These included: A lack of means to carry out marine patrols and responding to accidents at sea; In some cases, lack of a close working relationship with government officials and local political leaders; In at least one case the lack of payment to BMU leaders. Future plans included: Identifying new sources of revenue; Further infrastructure (e.g., an ice plant); In the case of Kilindoni BMU, to look for ways to support alternative livelihoods for their members (e.g., fish trading, farming).

BMU	Challenges	Future Plans
Kilwa Kivinje BMU committee	• Fish catches sometimes come late and so difficult to bring to auction. Need storage facilities • Need to have a large fibre boat to rescue fishers. They have engine and fuel, but currently need to borrow a boat. Most accidents are between November – February – 15 + incidents plus others they are not aware of. March – October – few accidents. • No payment to BMU leaders to solve issues for their families.	• Develop more revenue sources e.g. Ice plant for BMU. • BMU needs transport in the water and on land (e.g. motorbike, car) to transport illegal fishing gear. They currently hire a motorbike. • Office facilities – need somewhere to store records and have a computer. This would help to share information with other BMUs and communicate with the government. • BMU as an organization needs to work with close supervision from government officials and political leaders. Currently failing to have good communication with local political leaders. Illegal fishers can go to local political leaders and make their case (which undermines the role of the BMU leaders).
Somanga BMU Committee Members	• Local political leaders – BMU may plan a patrol, but local leaders then defend illegal fishers. • Other BMUs don't have enough resources so this BMU has to go to support other BMU patrols. • Lack a speedboat and the illegal fishers have a higher speed boat. • When collecting resources, some fishers use abusive language. • Not getting support from Fisheries Officers in other areas.	• Identify new sources of revenue • Support more community projects e.g. support a primary school in Somanga North. • Project for fish storage -an ice plant. • Construct a drying rack for drying dagaa.
Songo Songo BMU committee	• During opening of the reef most buyers and skippers are not giving actual catch data and this is causing a loss of revenue for the BMU (TSH 500 per kg of octopus). • Insufficient funds for marine patrols (fuel and allowances) especially during reef closure • During closure some fishers try to steal octopus. • Miss good cooperation from fish buyers to collect revenue • Migrant fishers are not reporting to the BMU leaders • Lacking first aid kit in the patrol boat.	• To add one more patrol boat to be able to patrol a second reef. • Build BMU office. • Construct a public toilet at the landing site (The NGO Sea Sense has built one toilet at one site) • Start a fish market at one of the landing sites
Kilindoni BMU Committee, Mafia	• Market is a major challenge - • The market levy being charged is not very friendly • Inadequate number of fish processing factories • Transport cost is high for small amounts of produce. • Lack of fishing gear and equipment • Illegal fishing • Climate change - rainfall is no longer predictable which makes sun drying of dagaa difficult	• To promote use of a cold chain system if they can provide the system. • Look for ways to support alternative livelihoods e.g. fish trading; Farming (rice, cassava, coconut).

TABLE 5.12 CHALLENGES AND FUTURE PLANS REPORTED BY BMU COMMITTEE MEMBERS

In Zanzibar, Village Fishery Committees are composed of fishers only and not wider stakeholders. Two of the three VFCs that we met emphasised the idea did not come from the community itself and that they were a requirement of the government. The Nungwi VFC, however, explained that it was the first VFC to be established in Zanzibar and the idea originated from the villagers themselves. The government then borrowed

the idea. The VFC reported that it was established in 1965. Unlike the BMUs, the VFCs are for fishers only and not wider stakeholders. The VFCs explained their aims as broadly: i) Conserving marine resources including beaches, mangroves. ii) Participate in rescuing fishers from accidents iii) To unite fishers iv) to resolve conflicts v) to access modern fishing equipment and infrastructure.

The VFC members must be fishers and are periodically elected. Matemwe had 21 elected members (4 women); Chwaka had 11 elected members (2 female) and Nungwi 12 elected members. The Sheha and the Beach recorder are also members of the VFCs, which provides a direct link with the village government. The positions of chair, secretary and treasurer were all held by men. In Nungwi the VFC reported that assistant chair, secretary and treasurer positions were held by women.

In Focus Group Discussions with VFC members a number of benefits/ achievements were reported (Social Analysis Appendix Table 4). For example, reduction in illegal fishing practices was reported by Matemwe, Chwaka and Nungwi VFCs; Good cooperation among the members at Nungwi and reduction in number of conflicts and great unity among fishers in Chwaka Bay by Chwaka VFC; Quick exchange of information with the Department of Fisheries by Chwaka and close follow up on infrastructure developments (market) by Nungwi VFC.

At Unguja Ukuu, the Retired Beach Recorder who helped set up the Kaipwani Fishers Committee, explained that the fish market/ auction building belongs to the VFC. The auction system was introduced 6 years ago through “a participatory approach”. The Beach recorder had the idea of the market and then donated the foundation stone. Menai Bay Conservation Area Authority then contributed, followed by the MP and the district government contributions. A levy is collected on all fish sold through the auction. This is used to pay the broker /auctioneer, the cost of the market and a contribution to the VFC Up to TSH 8 million can be collected in 6 months.

The views of fishers about their VFCs were generally more favourable in Nungwi and less favourable in Matemwe and Chwaka. (Social Analysis Appendix Table 5). For example, Matemwe fishers didn’t feel that they had any organization which represented them. Although they send their problems to the VFC, they don't help. They reported that they are not involved in deciding who is in the VFC. Chwaka fishers explained that they are frequently contacted by government which raises their expectations, but nothing has happened. When the VFC was new it was active, but over time it has become less active. They felt it was not reporting to responsible authorities. They don’t get any feedback. They wonder if the VFC members are getting something from government. The VFC was established by government and they (the fishers) can only change the committee after a fixed time. The Nungwi fishers FGD also reported that they are consulted frequently about assistance from government, but when the assistance comes, they don’t get any modern fishing equipment (e.g., fibreglass boat, large sized mesh net, equipment to help pull in the net.). The distribution is controlled by the Sheha who may give it to people who do not need it. The Shehia committee is not trusted by the fishers or the community because the Sheha will choose close relatives. There is more trust in the VFC, the Market Committee and especially the Village Elders Committee.

VFC members shared the challenges that they faced and there were both similarities and differences amongst the three VFCs (Table 5.13). All three of the VFCs identified lack of resources as a challenge, although the level of current resources did vary. Conflict with fishers who were fishing illegally was a challenge for all three VFCs, but perhaps less so for Nungwi. Future plans included: Accessing modern fishing equipment; Investments in infrastructure (e.g.an anchovy drying kiln provided by WWF to Nungwi) and in the case of Chwaka VFC working with the Department of Fisheries to reduce the number of fishers by looking for ways to support alternative livelihoods for their members (e.g. training in tourism).

VFC	Challenges	Future Plans
Matemwe VFC	• Conflict between the fishers and the VFC when fishers fish in conservation areas or use illegal fishing gear. • After fishers sell their catch to auction, some money should go to the auctioneer and some to the VFC. But the VFC has not received any money in the last 7 years. • The VFC works for free. • The VFC should help to solve problems, but it is not getting any money to do that*. For example, "Under the Wave" project -if people report others taking turtle eggs then they get paid. • VFC reports to Department of Fisheries and the Manager of MIMCA.	• Need modern fishing equipment as promised by the president. • Need strong equipment for the strong seas. • This includes: Boat; GPS so they know where they are and can return to the same place to fish. Fish finder (people from the patrol have one).
Chwaka VFC	• We don't have an office • We don't have financial capacity • We don't have our own boat, so have to depend on KMKA. • In surrounding communities' VFCs there is tension and use of illegal fishing gears.	• "Dreams!" • So many fishers in a small area so looking for alternative livelihoods, especially farming (land is not a problem). Irrigation e.g. spices which do not take along time, have commercial value. • Set a side a conservation area in the bay so production will be high and can harvest for a short time. Income from this can the support other activities. • Have a plan with Fisheries Dept. reduce numbers by 20 people per year to reduce dependency on the Bay e.g. training in tourism.
Nungwi VFC	• They have a boat, but it doesn't have good rescue facilities e.g. life jackets • Don't have cold room for storage, so difficult when there is a large catch. • Don't have enough vessels for rescue if more than one rescue at a time. After prompting • Rare case there is conflict with fishers over illegal fishing. They get support from KMKA which does patrols which can stop illegal fishers. • Good cooperation because: – Both fishers and VFC are in agreement in terms of who is elected e.g. there is only one auctioneer. – Very strong Elders Committee – the members are motivated because they "get something". Challenges for fishers in the community • Lack of modern fishing equipment	• More modern fishing equipment to go to deeper sea. • Investments in projects (e.g. a hotel) to generate income. • Anchovy drying kiln – provided by WWF to Village Elders, but manged by VFC.

TABLE 5.13 CHALLENGES AND FUTURE PLANS REPORTED BY VFC MEMBERS

5.2.5.3. Information and confidence in other value chain actors

Fishers in the value chain may have formal or informal means of accessing information on fishery practices, fishery policies, and market prices.

The Kilwa District Fisheries Officer explained that District Fisheries Officers have two main functions: Implementing regulations under the Fisheries Act (40%) and providing extension services (60%). Previously the main focus was on enforcing regulation. This changed with the introduction of collaborative fisheries management by the Ministry of Livestock and Fisheries. The government works with International NGOs such as WWF and SeaSense. MWAMBAO is an evolving network of coastal communities in Tanzania that is working to build capacity of communities and bring them together while also linking with scientists, government institutions, practitioners, and experts to facilitate cross-learning, information sharing and joint action) (ICSF 2015). The idea of collaborative fisheries management came from an earlier project (MACEMP) in 2006 and still appears to be taking place mostly where there is active donor support (Ponte at al, 2020).

The Kilwa District Fisheries Office has a number of challenges. There are insufficient staff – should be 14, but currently only 6. There is no boat and hence have to use a public boat and hire a boat to go on patrol. There

is a lack of disbursement of funds and hence the office is dependent on NGOs. NGOs have given boats to some BMUs – the agreement is between the NGO and the BMU.

BMUs and VFCs should play a role in providing information about fisheries policy and practices. As explained above, the extent to which this is happening varies tremendously. On a positive note, Kakama (2020) found that almost 100% of the 84 individual respondent members of 12 BMUs from six districts (Pangani, Bagamoyo, Tangacity, Lindi urban, Kilwa and Kinondoni) were aware of the Fisheries Act, Policy and Regulations. In many locations, fish auctions are replacing a system where traders bought fish directly from boats. This provides a degree of transparency with regard to fish prices.

To what extent is the relation between value chain actors perceived as trustworthy?
In a survey of middlemen in Zanzibar (Crona et al, 2010), 66% reported engaging in credit activities, providing loans to fishermen on an as-needed basis. In line with informal credit relations described elsewhere, the loans which are issued are strongly based on trust. No contracts are written (if not recurring or for loans taken to invest in boats) and no interest is charged, in accordance with traditional Islamic conduct. However, loans are used by middlemen to tie fishermen to their operations thus securing income, and loans are seen by many respondents as a means of business investment. The primary method of repayment is through fish sales, as reported by 85% of all middlemen, and fishermen tied to a middleman are bound by strong social norms and a mutual agreement to sell their fish to that specific dealer. Attention is needed on how access to credit can best promote sustainable investments in the fishery or alternative livelihoods which do not threaten the integrity of the natural resource base in the long term (Crona et al, 2010).

O' Neill et al (2018) explored the nature of patron-client relations and how the presence or not of such arrangements affects benefit distribution for fishers and Traders in Zanzibar.
Interestingly it appears that fishers tied to a trader do not appear to be any worse off, in terms of daily income, than their counterparts who sell on a more ad hoc basis. The opposite is true among trading agents. Those who engage in predetermined sales arrangements with their clients receive relatively higher economic benefits. This could be due to the commonality of these arrangements with the tourist industry, which demands high value and volumes of products.
Although quantitative analysis shows that fishers receive no clear economic benefit from making predetermined sale arrangements, they are able to access a range of other benefits through them. In Unguja, providing help to fishers, or vice versa, does not necessarily imply a counter obligation; many of the exchanges can be regarded as gifts according to respondents suggesting a generalized type of reciprocity.
The generalized reciprocity observed by O'Neill et al. (2018) in Unguja can be relatively effective as an insurance mechanism to the individual or households in the short term because one can access food or cash off a wide range of actors in the fishery. Feelings of social obligations mixed with economic imperatives appear to underlie arrangements. Indeed, within these interlinked systems of personal transactions the possible discovery of dishonesty, unwillingness, or avoidance by an agent in one transaction is made too costly for him or her in terms of the spill-over effects threatening other transactions and the general loss of goodwill within these relatively small rural villages or towns.
There is a **complex web of social and economic relations in which SSF market actors are embedded.** Aspects of the reciprocal arrangements discussed above may be important as social insurance mechanisms for individuals, while at the same time creating inflexible structures that may perpetuate unsustainable resource extraction. However, while, these relations do appear to play a critical role in structuring the marketplace and conduct, they are generally not explicitly considered in fisheries-related policy or governance (O'Neill et al, 2018).

5.2.5.4. Social involvement

The BMUs seek to facilitate community participation and collaboration in management of fishery resources. The main focus is on resource management rather than improving livelihoods *per se*, but some BMUs are addressing wider livelihood issues. In principle, any member of a community can join a BMU and participate in decisions. However, it is clearly important that a good working relationship is developed with local politicians who are also elected by local community members. In Zanzibar, only fishers are eligible to join VFCs.

Are there actions to ensure respect of traditional knowledge and resources? It is not all clear that traditional knowledge and resources are respected in fisheries/ coastal resources management. Besta (undated) observed that prior to the setting up of a BMU "*Songo Songo islanders are very wary of implementing the issue of the Beach Management Unit (BMU). There were heated debates at various meetings with district and Ministry government officials responsible for natural resources, at which islanders contested the establishment of the BMU in their area. The BMU will officially transfer the responsibility for resource monitoring to the resource users. If enforced, it is likely to undermine the authority of elders, traditional and local norms about leadership and possibly the role of elders as sources of local ecological knowledge*". However, Katikiro et al. (2015) in a study carried out in five coastal villages in Mtwara rural district situated in the Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP), created in 2000, where 60% -80% of people in the study villages rely on marine fisheries resources for their livelihood strategies, the "*traditions cherished in the past are nowadays rejected by many young people as they strive to earn money from declining resources*". It was "*likely that social structures within coastal villages in the Mtwara rural district are changing due to the influx of diverse groups of people from villages without a fishing culture*".

A lot of literature has been critical of the top-down nature of MPA management (Benjaminsen and Bryceson (2012, Baker et al, 2021, Raycraft, 2020). A key informant based in Unguja UKuu, Zanzibar reported that "*The Menai Bay Conservation Area Authorities have fractured people. They are considered liars. The Conservation Area is no longer performing as it was. Compliance is now enforced by the fishers themselves*".

Village Liaison Committees (VLCs) are comprised of village members who, in theory, serve as the primary liaison between each park-associated village and MPA management. However, the literature suggests that this arrangement has generally not been very successful (Katikiro et al., 2017 in Baker et al 2021).

Mclain et al. (2018) examined the environmental outcomes of marine protected areas governed under different types of property regimes. Their review highlighted the importance of three mechanisms—perceptions of legitimacy, perceptions of the likelihood of benefits, and perceptions of enforcement capacity—and how these interact under different socio-ecological contexts to trigger behavioural changes that affect environmental conditions. The approach revealed the multi-faceted and interactive nature of perceptions of legitimacy, in which legal legitimacy, social acceptability, and ecological credibility combined to create robust legitimacy.

Sustainable fisheries require strong management and effective governance. The effectiveness of these approaches relies upon some level of cohesion among resource users to facilitate agreement on common policies and practices regarding common pool fishery resources. Understanding the factors driving the formation and maintenance of community cohesion in SSF is therefore critical in supporting effective participatory governance approaches and empowering decentralized, localized, and community-based resource management approaches. Research by Alexander et al. (2018) elsewhere, suggests that multiple drivers are at play, but that collectively, gear-based homophily (i.e., the formation of social ties between individuals who share some commonality such as fishing gear type), geographic proximity, and leadership play particularly important roles. Understanding the critical drivers in coastal Tanzania is key.

5.2.6 Living Conditions

5.2.6.1. Summary of findings

6. LIVING CONDITIONS		
6.1 Health services	MLT and ZNZ: Womens FGD participants reported that health facilities and services had improved. Women attributed improvement in facilities to the government. Out-of-pocket spending on health accounts for 23 % (MLT) and 30% (ZNZ) of household expenditure. Blood pressure and diabetes were reported to be increasing in all communities visited.	Moderate/Low
6.2 Housing	MLT: Women's FGDs and official survey statistics indicate major increase and high proportion (84 % and 76.6% in rural areas); of houses with "modern" roof (iron sheets) and to a lesser extent walls and floors. Womens FGDs report fisheries income has contributed ZNZ: Women's FGDs and official survey statistics indicate major increase and high proportion (91.3 % and 85.7% in rural areas); of houses with "modern" roof (iron sheets) and to a lesser extent walls and floors. Womens FGDs report fisheries income has contributed MLT: 88% of households (91.8% in rural areas) have access to an improved water source in the wet season. This drops to 73% (65% in rural areas) in the dry season. Tanga (58.7%), Mtwara (59.9%), Lindi (62.7%) are below the dry season rural average for the MLT while Pwani (73.4%) is above. Women's FGD reported a mixed situation with availability and increasing saltiness of water a problem in some locations. Improvements in water supply were not linked to fisheries. ZNZ:, 94.7% of households (91.8% in rural areas) have access to a protected water source and 98.8% of households (98% in rural areas) are within 1 km of source of drinking water.	Substantial
6.3 Education and training	MLT: primary school net enrolment rate is 83.4% (81.3% in rural areas). Fisheries-related income had contributed to educational costs and in Songo Songo exam performance. ZNZ: primary school net enrolment rate is 81.4% (78% in rural areas). 97.9% of households (97.1% in rural areas) are within 2 km of a primary school. Average time spent travelling to primary school is 12.7 minutes (14.5 minutes in rural areas). Women in FGDs reported that there was more access to education now and particularly it was now equal for both girls and boys. Mixed responses regarding link with fisheries.	Substantial

Major changes have taken place in: The provision of health facilities and services; Housing; Water & Sanitation and Education in Tanzania in general and coastal communities, in particular. However, there are still high levels of poverty, for example, on the Mainland 26.4% (MHBS 2020) and in Zanzibar 25.7% of the population are below the basic needs poverty line (ZHBS, 2020).

Data available for the Mainland mainly comes from the 2017/18 Household Budget Survey[52] (MHBS, 2020) and for Zanzibar, mainly from the Zanzibar Household Budget Survey 2019/20[53] report (ZHBS, 2020). Where possible for coastal Mainland Tanzania more disaggregated data is used to identify trends related to coastal communities. However, the more recent data is only available at a regional (not a district) level. Key informant interviews and focus groups discussions provide some useful information on perceived trends and links with coastal marine fisheries.

5.2.6.2. Health services

On the Mainland, the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) is the lead for most health sector policies. This ministry administers 42% (FY 2018/19) of the health funds. As decentralization gathers pace, local and regional authorities were responsible for delivering 45% of health

[52] Data collection was carried out over a period of 12 consecutive months from 1st December 2017 to 30th November 2018.
[53] Data collection took place over 12 consecutive months starting from 1st March 2019 to 28th February 2020.

budget (FY 2018/19). The allocation accounts for 6.7% of the total national budget[54], down from 7% in2017/18. Tanzania faces a critical shortage of health staff (UNICEF, 2020).
In Zanzibar, almost all health services are administered by the Ministry of Health, receiving 87% of all health sector funding. Health services accounted for 7.7% of the government's budget in FY 2017/18. Zanzibar has very low prevalence of communicable diseases of global public health significance compared to Mainland Tanzania and much of sub-Saharan Africa. Malaria, HIV and AIDS and tuberculosis incidence rates are all less than 1% (UNICEF, 2018). There is some indication that the pattern of diseases has changed from communicable to non-communicable diseases (NCDs) (e.g., diabetes and high blood pressure) over the years in Zanzibar (ZHBS, 2020).

Mainland Tanzania faces a critical shortage of health staff. There are significant variances in per capita health sector allocations to regions driven by the availability or lack of health facilities and medical personnel. The accessibility of essential health services for vulnerable groups and people in hard-to-reach areas remains a real challenge (UNICEF, 2020). In Zanzibar 63% of households (49.5% in rural areas) reported that they were less than 1 km and 85% (79.6% in rural areas) were less than 2 km from a primary health centre (ZHBS, 2019/20). The ZHBS 2019/20 reports that one-tenth of the respondents had faced some problems at the time they visited the health facility for medical services. The most common problem was long waiting time (10% of the respondents who visited a health care facility). Long waiting time was observed more in the urban areas (14.1%), representing an increase of about 6 percentage points from the 2014/15 results. Availability of drugs at the facility was the second most common problem (1.9% of the patients), which is a decline by about 8 percentage points from the 2009/10 figure.

The ZHBS 2019/20 sought to understand whether individuals incurred costs when visiting health care facilities and what services were paid for. 57.8% of the respondents said no payment was made for the medicine and almost 35.7% for examinations and medical tests. Payment for health services was higher among urban residents than rural residents, and this is probably because most private health facilities are located in urban areas. However, out-of-pocket spending on health accounts for 30% of household expenditure in Zanzibar compared to 23% in mainland Tanzania (UNICEF, 2018).

ZHBS 2019/20 found that of all the respondents who were ill or injured but failed to consult a health care professional, 94.4% of them believed there was no need, 1.6% thought the medical services were too expensive, and less than 1% thought medical help was too far from them. The proportion of the ill or injured who said that medical help was too expensive declined by about 7 percentage points from the 2014/15 HBS result.

In coastal Mainland communities, participants in FGDs generally reported that health facilities and services had improved (Social Analysis Appendix Table 6). The incidence of diseases such as malaria was reported to be low or lower, while diabetes and high blood pressure (BP) were perceived to have increased. In Kilwa Kivinje and Somanga, this was attributed to feeding habits and life style by women in FGDs.

In Zanzibar, participants in women's FGDs also generally reported that health facilities and services had improved. In Matemwe there is a hospital and a dispensary and for both Chwaka and Nungwi there was a nearby health centre, which was not the case in the past. The main health issues reported from all three communities were high BP and diabetes. In Matemwe body pain from seaweed activities was reported. The improvement in health facilities was linked to the government and not fisheries-related activities. The BP and diabetes was considered to be a rich person's problem in the past, but now it is more common. In Nungwi, they suggested BP and diabetes have increased because they rely on the cheapest rice. They also commented that some products from the sea are not so available e.g., octopus.

5.2.6.3. Housing , water and sanitation

In Mainland Tanzania, the percentage of households reporting that they have a modern roof was 84% (76.6% in rural areas); modern walls 59.1% (49.7% in rural areas) and modern floors 51.0% (32.1% in rural areas) (MHBS, 2017/18). Owner occupancy is more prevalent in rural areas (85.3%) than urban areas (63.2 %). There

[54] The Abuja Declaration target allocation for health by all member governments of at least 15% of their national budgets.

has been a small decrease in the proportion of households living in owner-occupied dwelling units, from 76.4% in 2011/12 to 75.1 % in 2017/18 HBS.

In Mainland Tanzania, 88% of households (91.8% in rural areas) have access to an improved water source in the wet season. This drops to 73% (65% in rural areas) in the dry season. Tanga (58.7%), Mtwara (59.9%), Lindi (62.7%) are below the dry season rural average for the Mainland, while Pwani (73.4%) is above. 94.2% of households (91.4% in rural areas) have a toilet facility. Tanga (90.7%) is below the rural average, while Mtwara (94.1%), Lindi (97.3%) and Pwani (94.7%) are above. 29% of households (10.4% in rural areas) are connected to the electricity grid. All the coastal regions are above the rural average Tanga (28.7%), Mtwara (21.9%), Lindi (12.7%) and Pwani (32.1%) (MHBS, 2017/18).

In Zanzibar, the percentage of households reporting that they have a modern roof was 91.3 % (85.7% in rural areas); modern walls 82.3% (70.5% in rural areas) and modern floors 82.7% (72% in rural areas) (ZHBS, 2019/20). Owner occupancy is more prevalent in rural areas (88.1%) than urban areas (72.4 %). There has been a small decrease over the past five years in the proportion of households living in owner-occupied dwelling units, from 83.7 percent in 2014/15 to 81.1 percent in 2019/20 HBS.
In Zanzibar, 94.7% of households (91.8% in rural areas) have access to a protected water source and 98.8% of households (98% in rural areas) are within 1 km of a source of drinking water. 87.5% of households (78.9% in rural areas) have a toilet facility. 57% of households (33.3% in rural areas) are connected to electricity grid (ZHBS, 2019/20).

In coastal Mainland communities, participants in FGDs generally reported that the standard of housing had improved with an increase in the number of houses with cement block walls and iron sheet roofs replacing mud brick and thatched houses (Social Analysis Appendix Table 7). More houses have electricity. In Somanga, the women's focus group reported that most of the changes are due to (income from) fishing. In Kilindoni, Mafia women reported that housing had improved for some, but not for others. The situation regarding water supply varied. In Kilwa Kivinje public and private wells had increased. It was also reported that the water was now a bit salty. In Songo Songo, although water quality and sanitation had improved village leaders reported that the amount of water is insufficient. In Kilindoni women reported that water was a problem.

In Zanzibar women in FGDs also reported that housing had improved. For example, thatch being replaced with iron sheets for roofing. Water services had also improved in the three communities. The improvement in housing was linked with income from fishing, e.g., in Matemwe they thought that although quantities of fish caught were low, prices were high. The improved water facilities were not linked to fishing.

5.2.6.4. Education and training

On Mainland primary school net enrolment rate is 83.4% (81.3% in rural areas). Secondary school enrolment rate is 32.9% (23.2% in rural areas). 2.8% of children on Mainland aged 7-13 were not attending school because they were working. No children in the coastal regions were reported to be in the category.

In Zanzibar primary school net enrolment rate is 81.4% (78% in rural areas). Secondary school enrolment rate is 52.1% (44.3 % in rural areas). 97.9% of households (97.1% in rural areas) are within 2 km of a primary school. Average time spent travelling to primary school is 12.7 minutes (14.5 minutes in rural areas) and secondary school 14 minutes (14.9 minutes in rural areas).

In coastal Mainland communities, participants in FGDs generally reported that the standard of education was better now than in the past (Social Analysis Appendix Table 8). In Kilwa Kivinje women compared the education situation today with the 1990s when fishing started to become much bigger. They reported that standard of classrooms is better; number of teachers has increased; number of students going to secondary school has increased and that all children of primary school age are going to school. Songo Songo community leaders reported that, in terms of exam performance, the number 1 (primary) school in Kilwa district and number 7 school in Lindi region is in Songo Songo. In Somanga, women reported that fishing -related activities pay for school costs such as uniforms. In Songo Songo, women reported that octopus fishing income had contributed to improvements. Community leaders in Songo Songo reported that income from fishing

provides food and time for children to study. Parents contribute money to the school, and this allows the pupils to be at the school from 6.00 am to 6.00 pm when preparing for exams.
In Zanzibar, women in FGDs reported that there was more access to education now and particularly it was now equal for both girls and boys (in the past more boys were educated). In Matemwe and Chawka participants didn't think were was a link with fishing. In Nungwi participants reported that fishing has both a positive and negative link. On the positive side, money from fishing may be used to support a child's education. On the negative side, some students may be attracted to fishing because of market opportunities. Interestingly, the fishers FGD participants commented that they want their children to complete their education so that they can do "modern fishing".

5.3. Conclusions, key issues and mitigation measures

The overall findings on the social sustainability of Tanzania coastal fisheries are summarised in the radar diagram (Figure 5.4). Working conditions are generally challenging in the mainly informal coastal fisheries value chains. There are concerns regarding land rights, coastal resource property rights and small-scale fishers' rights in coastal fishing communities in Tanzania. There have been major improvements in gender equality in Tanzania, but gender equality remains an important issue.. Women are participating in and benefiting from coastal fisheries value chains, but further improvements can be made. Coastal fishing communities are becoming increasingly dependent on purchased food which increases their reliance on fisheries-related income and vulnerability to food price changes. Living conditions in terms of education, housing and facilities appear to be improving for many in coastal communities and, particularly in the case of housing, income from fisheries value chains appears to be contributing. However, there are concerns regarding health and negative social outcomes, such as increasing incidence of high blood pressure and diabetes. Social capital varies considerably in the value chains, but in general, fishers report that they are not well represented.

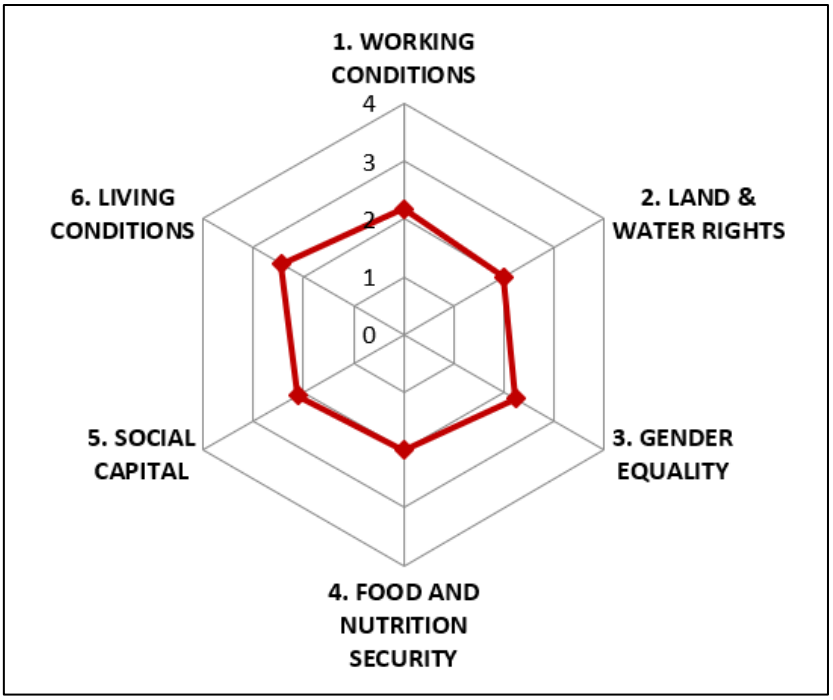


Figure 5.4 Social Profile of the Coastal Tanzania Fisheries Value Chains

Working conditions: There is weak enforcement of labour rights and standards, lack of occupational safety and health, and weak organization of workers in general in Tanzania. Most of those working in the fisheries sector are in the informal sector where enforcement of rights and organization of workers is particularly challenging. Seafood companies targeting the EU market are required to meet minimum standards and receive regular inspections. There appears to be relatively little information available on the informal contractual arrangements in the SSF sector. Such an analysis would be important to explore opportunities to improve working conditions. Job safety remains an important issue, but official data does not appear to be

readily available. In spite of the challenges, people, including women and youth, are attracted to fisheries value chains.

Land & water rights: There are both fisheries/ marine resource and land rights (in common with other countries (Fabiniyi, 2020)) to consider with respect to fishers and coastal communities. Fishers "property rights" appear to be mainly being affected by the creation of protected areas by state (and non-state) actors in the Mainland and Zanzibar and coastal developments, particularly in Zanzibar. Policy and legislation related to land and natural resources differ between the Mainland and Zanzibar. Tanzania is a leading country in terms of plans to take forward implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (the SSF Guidelines). Mainland fisheries policy is much more explicit about following SSF Guidelines. In Zanzibar, previous fisheries policy has been criticized for not being sufficiently aligned with SSF Guidelines and the extent to which these concerns are being addressed under the implementation of the new Blue Economy policy under the umbrella of the Ministry of Blue Economy is not entirely clear. Future interventions should align with the principles and explore ways of supporting the implementation of these guidelines. There is a strong case for supporting the National SSF Guidelines Taskforce Team on the Mainland and the equivalent in Zanzibar with MWAMBAO.

Gender equality: There have been significant social and economic improvements according to several indicators, but gender equality remains an important issue in Tanzania. Women have relatively little involvement in the coastal fisheries value chains at the production stage (the major exception being octopus) but are highly involved in post-harvest activities. Based on visits to a relatively small number of coastal communities and the literature, some women are becoming significantly more economically empowered at least partly through engaging with fisheries values chains and taking up leadership positions. At the same time, other women, and men (younger and older) are earning income from fisheries value chains but with varying degrees of vulnerability. Women's participation in fisheries value chains is multifaceted and shaped not just by their gender but also by factors such as household assets, size and composition, education and skills. Gender must be placed in the broader social processes at play around the fisheries, rather than being singled out, if decision-makers are to better understand women's long-term VC positions. Future interventions need an informed analysis of the current and potential role of both women and men, and other specific social groups based on engagement with these different stakeholder groups in differing contexts. Support to TAWFA and other appropriate partners could provide an effective means of both exploring and improving gender equality in fisheries.

Food and nutrition security: Fisheries (coastal and fresh) make an important contribution to national food and nutrition security. In coastal communities, fisheries make both a direct and indirect (through income) contribution to food and nutrition security. Based on consultations in a relatively small number of coastal communities, many households do not appear to have access to agricultural land and appear to be very dependent on purchased food. Much more analysis is needed to understand the relationship between food and nutrition security and fisheries at the level of fisher's households, coastal fishing communities and more widely. This should be part of a wider dialogue around sustainable and inclusive food systems in Tanzania to inform decision-making processes.

Social capital: There is a range of formal and informal organizations associated with coastal fisheries value chains. The performance of these organizations appears to vary tremendously. Several multi-stakeholder co-management arrangements have been introduced (e.g., in BMUs in Mainland and VFCs in Zanzibar). This appears to have had some positive results in some locations, although all those we met reported significant challenges. It is difficult to identify a realistic alternative to such multi-stakeholder initiatives, but future interventions should strive to support such organizations in ways which fairly distribute both costs and benefits. Aligning such organizations with existing institutions to minimize destructive conflict was identified as important in both existing literature and our field experience. Understanding the factors driving the formation and maintenance of community cohesion in SSF is critical to inform strategies for supporting effective participatory governance approaches and empowering decentralized, localized, and community-based resource management approaches. Supporting initiatives which are facilitating learning amongst coastal communities is important.

Living conditions: Globally, many small-scale fishing communities face significant challenges in terms of health, water & sanitation and education services, alongside housing. A review of secondary information available (e.g., Recent democratic and health surveys and other literature) appears to align with a relatively

positive trend reported in the relatively few coastal communities we visited. However, a more disaggregated analysis of the situation, drivers and trends is needed to inform decision-making aiming to improve sustainable livelihoods within coastal communities (Torell et al, 2017). Alongside this supporting a multi-stakeholder learning process involving local and national decision makers and other stakeholders should be considered to explore solutions and co-design ways forward to address the complexity of issues around coastal marine livelihoods and systems.

6. IS THE VALUE CHAIN ENVIRONMENTALLY SUSTAINABLE?

The environmental analysis carried out in the frame of this VCA4D aimed at a quantitative and qualitative appraisal of the environmental sustainability of the United Republic of Tanzania (URT)'s coastal fisheries value chain.

The environmental sustainability of the URT coastal fisheries has been evaluated using a twofold approach: 1) the Life Cycle Assessment (LCA) methodology has been applied to quantify the potential impacts (damages) of the value chain on the three Endpoint Indicators/Areas of Protection (AoP), namely Human Health, Ecosystems, Resources, and on the midpoint indicator Climate Changes (Sections 6.1 and 6.2); 2) an exploratory assessment of the biodiversity, based on literature review and observations made on the field, has been carried out to highlight potential risks for the biodiversity (Section 6.3).

6.1. Life Cycle Assessment – methodology and general assumptions

The Life Cycle Impact Assessment methodology (ISO 14040:2006, 14044:2006) has been used to evaluate the environmental performances of URT's coastal fishery (disaggregated for Mainland Tanzania-MLT, and Zanzibar-ZNZ).

The LCA approach follows the guidelines of the Joint Research Centre of the European Commission (JRC, 2010) and is organized accordingly to four standardized phases: Goal and Scope, Life Cycle Inventory (LCI), Life Cycle Impact Assessment (LCIA), and Interpretation of the results.

6.1.1 Goal and Scope

The *goal* of this study is to assess the environmental performance of URT's marine coastal fisheries, determine its potential impacts and identify potential areas for improvement. URT's marine coastal fisheries are predominately small-scale, artisanal in nature, carried out mainly by means of sail/paddle-propelled wooden vessels (although the number of fiberglass boats and outboard engines is increasing) and rather close to the shoreline. Most fishing activities are in fact restricted to limited areas (approximately 30,000 km²) due to a narrow continental shelf at a depth of less than 200 m (Silas et al., 2020). Landed seafood is usually sold as fresh at the landing sites and urban markets, although a big share is processed in different ways according to the seafood type: 1) small pelagic (anchovies and anchovy-like species) are mostly dried and sold in local and regional (neighbouring countries) market. Also, there is a substantial quantity of seafood being fried and sold in urban markets, 2) finfish (medium-large pelagic and reef fishes) are mainly sold fresh/chilled or frozen in industrial processing plants or by means of domestic chest freezers. Similar to anchovies, finfish are also fried. 3) Octopus and prawns are sold fresh/chilled or frozen, mainly processed in industrial plants for export. However, a small share of octopus is fried and sold in urban markets (Section 2 for further details).

The *scope* of the study is the analysis of the material and energy flows through the processes/segments of the identified sub-chains (following the recommendation of Linton, 2021), as below:

- small pelagic (anchovy and anchovy-like) (for both MLT and ZNZ),
- finfish (for both MLT and ZNZ),
- octopus (for both MLT and ZNZ),
- prawns (only for MLT, as in ZNZ, there is no prawn fishery).

A cradle-to-gate analysis of the sub-value chains has been carried out (i.e., from the resource extraction stage to the stage where the final product is made available to consumers), considering the following processes: i) the fishing activity, ii) the processing phase, and iii) transport of fresh and processed seafood, within the country borders. It has to be pointed out that the primary data related to transport were not always available or completely reliable. Therefore, the transport-related LCIA has a certain degree of uncertainty, as it was based on fragmentary information. For all the sub-chains, the system boundaries included the above-mentioned processes and the material and energy inputs and emissions' output throughout the systems. For the system modelling, the attributional principle was adopted. The attributional approach seeks to provide information on what portion of the overall burden a product can be associated with. On the other end, the consequential approach attempts to provide information on the environmental burdens that occur, directly or indirectly, as a consequence of a decision (usually represented by changes in demand for a product" (Sonnemann and Vigon, 2011)). When necessary, the mass-physical allocation was adopted as the

methodological approach to solve the cases of multifunctionality. Mass allocation illustrates the biophysical flows of materials and resources from one segment of the value chain to the next and is not sensitive to wide price variations that may occur, for example, due to touristic season, or shocks in the global/regional markets.

Three *Functional Units* (FU) were chosen:

1) 1 t of landed seafood
2) 1 t of processed seafood (dried, fried, chilled, or frozen)- at the processor gate
3) 1 t of transported seafood (from the fishing activity to the transport to the final destination. In the case of export seafood, the final destination has been considered the country border).

Important note: 1) unlike the economic analysis, the environmental analysis does not provide for the subdivision of the finfish value chain into sub-categories (F1-4), as the criterion underlying such subdivision is the economic value of the fish.

For the description of the fishing and processing activities, please refer to Box 2 and 3.

General assumptions adopted:

- **Wooden fishing vessels**: there are two types of wooden fishing boats in Tanzania. They can be dugouts or plank-based vessels. Dugouts are built by hand-carving logs. They may have a rounded hull section and be equipped with outriggers (in the case of the *ngalawa*). These boats are generally propelled with sails or paddles. They are generally made of mango or cashew logs. Some parts of the boat can be built from other types of wood, e.g., eucalyptus in the case of the mast. Plank-boats are made of a range of wood types, different for each boat part. The keel is frequently made out of *Afrormosia*. In the past, the use of African teak was also common, but nowadays its use declined due to conservation purposes. Other types of wood used are mango and eucalyptus for the planking. For framing timbers, the red mangrove was used in the past, but given that its harvesting is nowadays illegal, boat builders use neem as an alternative (Cooper et al., 2022). Field observations have also documented the use of African mahogany.
  The collection of quantitative data for the construction of fishing boats has been difficult. In fact, although the cost of the materials used is easy to find, respondents often could not quantify the volume or weight of the material used. For this reason, an approximate volume of raw material (from Avadí et al., 2020 and FAO, 1972 and interviews) was used to create the LCA model of fishing activities, but no differences were made in the tree species used for the boat construction.
- The **weight of the nets** derives from primary and secondary data (e.g., assumptions from Prado et al., 2001; Cloâtre, 2018; Avadí et al., 2020).
- Primary data collected during field missions highlighted that the boats are sometimes treated with a mixture (1:1) of **regular paint and shark or hippopotamus liver oil** (called *sham* and *seafam*, respectively). Given the absence of such products in the databases used for the LCA, the only acrylic paint item was used as a proxy for the boat paint.
- The **fuel** used for vessel propulsion was either gasoline or diesel. For the LCI, the item "diesel burned in fishing vessels" use chosen, according the literature (Andres et al., 2020, a similar VCA4D report) and for the high level of detail in this inventory item. The engines used in the different fishing activities are variable in terms of HP, as mentioned above. However, all the engines were described by the respondent as old, obsolete, frequently in need of maintenance and low-performance.

Both in MLT and ZNZ, landed seafood can be processed directly at landing sites, in street markets or in mid/large size processing plants (the latter only in MLT). The most common types of processing are drying, frying, chilling (with ice or at a collection centre), and freezing (See Box 3 for further details).

- The traditional ***drying*** process consists of placing the seafood (mainly anchovies and anchovy-like species) on tarpaulins. Drying takes place under sunlight. Before this operation, fresh seafood (75% in MLT and 100% in ZNZ of the product intended to be dried) is boiled because of consumer preferences or to avoid excessive spoilage, especially in the case of large catches or during the rainy season. Boiling is performed using firewood. The amount of firewood needed to boil a certain amount of seafood (e.g., per week) has been obtained during the interviews as kg firewood/kg seafood for MLT and as number of bundles (for example, the number of bundles bought by a processor per week) for ZNZ. In ZNZ, the mass of the firewood required was in fact impossible to obtained from the respondents. Therefore, the authors weighted 3-4 bundles (composed of around

15 pieces), of the same type used by the processors, from a vendor on the street in ZNZ. The materials and energy used for processing seafood during one week have been multiplied by the number of working weeks. The drying usually takes place at the landing sites or close-by.
In the MLT, one case of a drying process by means of an experimental device was observed.

- In the MLT, the central node of the seafood market is the FFM in Dar es Salaam. Here, part of the product is processed through ***frying***. In the past (between the 1990s and 2000s), the fuel used for frying was firewood (the amount of firewood has been given as number of bundles of 10 pieces/kg seafood to be boiled; given that was not possible to weight the same type of bundle in MLT, the amount of firewood used for frying a certain amount of seafood has been derived using the data obtained in ZNZ, applying a correction to account for the different number of pieces contained in the bundles used in MLT). Recently, the Local Government Authority (LGA), in agreement with the group of fryers at the FFM, has set up dedicated spaces for this activity (48 stalls). Nowadays, at the FFM, the use of firewood as fuel has been replaced by the use of LPG. In remote areas and other urban markets different from the FFM, the frying activity is still carried out using firewood, therefore, both frying methodologies have been analysed for the MLT (see the paragraph above for estimation of amount of firewood used for frying seafood). In ZNZ, frying using LPG was not observed at the time of the field missions.
- ***Chilling*** of fresh seafood is done both at the landing site/market (ice=30% seafood mass, Claussen et al., 2011), with ice produced through the use of domestic freezers, or at a collection centre, with ice produced through an ice machine (only in the MLT, e.g., the collection centre in Kilwa-Kivinje).
- ***Freezing*** in the MLT is carried out in medium- or large-scale processing plants. In ZNZ, freezing is carried out by more traditional methods, using domestic chest freezers. The product that is frozen (mainly, some finfish species, octopus and prawns) enters into the regional or international market (export to neighbouring African countries and EU) or is marketed for the ZNZ's tourism sector (hotels and restaurants).
- ***Losses****:* physical post-harvest losses (i.e., the spoiled seafood, the non-eatable discards deriving from the processing, and the water loss occurring along the segments of the value-chains) are accounted in the calculation according to the species and the type of processing, or passage from one step of the value chain to the one downstream, according to the yield reported in the LCI tables (Table 6.5-6.9) and the graphs included in Section2 (Functional analysis, Figures 2.15-2.18), as "marketable seafood". A general observation is that physical post-harvest losses appeared to be moderate-to-high, at least in terms of processed weight (see Chapter one for the derivation of wet weight equivalent losses). In fact, once the fresh product starts to spoil (or is thought to be spoiled in a short time), it is processed (boiled or fried) to extend its shelf life and it is sold as processed seafood. However, this leads to a nutritional post-harvest loss due to the start of spoiling and/or processing. No data is available on this topic, and it would be of interest to explore the differences among diverse fresh and processed products from a nutritional perspective.
- Similarly, product ***yields*** (= amount of seafood minus the amount of discard/loss, in%) differ among types of processing and/or species. The yield/losses values are given both in Tables 6.5-6.9 and in Figures 2.15-2.18.
- For fresh seafood transport (***domestic transport***), only trips >50 km has been modelled. For MLT, it has been assumed that an average (from primary data) of 10 t of fresh seafood per trip is transported for around 287 km (the average distance from Tanga, Bagamoyo, Rufiji Delta, Kilwa Kilvinje, Mtwara to Dar es Salaam, the central market node for the fresh seafood). Fresh seafood in ZNZ is usually marketed and consumed <50 km from the landing sites.
- For ***processed seafood transport*** (mainly for export), it has been considered that an average (from primary data) of 10 t frozen seafood and 5 t of chilled seafood are transported each trip to reach different destinations: Tunduma, at the Tanzania/Zambia border (regional export, 1000 km from Dar es Salaam), Dar es Salaam harbour (EU and ZNZ export, 30 km from industrial plants in Dar es Salaam) and Stone Town, ZNZ (30 km to the harbour and 70 km sea transport).
- Data on energy consumption at the processing plants were obtained from the respondents. Data on electricity consumption for freezing using domestic chest freezers were derived from Sofreco (2018c). For the electricity consumption, the electricity Tanzania country mix was adopted.
- Emission factors for combustion of diesel, light fuel oil, kerosene, liquid petroleum gas (LPG), charcoal, and firewood were derived from IPCC (Gómez et al., 2006). For emission of particulate matter (PM 2.5) the EMEP/EEA air pollutant emission inventory (2019) has been used.

6.1.2 Life Cycle Inventory (LCI)

For the LCI construction, all the foreground data were collected during the field missions and remote surveys, through semi-structured interviews with selected representative actors, as defined in Functional analysis Section 2.1.6 of this report. However, secondary data from various sources and/or assumptions were used to fill gaps in the primary data, as outlined above.

The Ecoinvent 3 database was used to retrieve data on the production of electricity (Tanzania country mix), fuel, raw materials, and transport (background data). The LCIs were built with a "typical-case" approach: for each type of actor, the quantitative data (e.g., seafood volumes, amount of materials and energies used) obtained from the semi-structured interviews (about 1-3 respondents/type of actor) were first averaged. These data were then compared to and validated with available secondary data. The landings/year referring to a typical fishing unit (boat or fisherman) described in the tables has been derived from primary data collection, literature review, and other assumptions (White et al., 2020). It has to be noted that there is a high degree of uncertainty and underestimation in the official fisheries statistical reports both for the mainland and Zanzibar.

The LCIs for the different fishing units are given in Tables 6.1-6.4. Tables 6.1 and 6.2 pertain to the MLT fishing activities; Tables 6.3 and 6.4 pertain to the ZNZ fishing activities.

Tables 6.5-6.9 outline the LCI for different categories of processing, namely 1) the traditional and experimental drying process, 2) the frying process, 3) the chilling/storage with ice of the fresh product at a collection centre, 4) ice production for chilling, 5) the processing and freezing at industrial plants. Table 6.10 refers to the LCI related to the transport.

Target group - MLT	Small Pelagic	Octopus			
Fishing Unit	Purse-seiner	Diver - FBR boat	Diver - Wooden boat	Foot fisher - FBR boat	Foot fisher - wooden boat
OUTPUT					
Catch/fishing unit/year (t)	100	1.1	1	0.45	0.45
Emission to the atmosphere from fuel combustion					
CO_2 (kg)	20578.3	1035.8		423.1	
CH_4 (kg)	2.9	0.1		0.1	
N_2O (kg)	0.2	0.1		0.0	
PM2.5 (kg)	20.2	0.6		0.2	
INPUT					
Fishing days/year	180	240	240	150	150
Main boat type and length	Wooden boat – 12 m	FBR boat – 10 m, shared with 12/13 ppl	Wooden boat – 4 m, shared with 10 ppl	FBR boat – 10 m, shared with 12/13 ppl	Wooden boat – 4 m, shared with 3 ppl
Main boat lifespan (years)	15	20	10	20	10
Material required for main boat construction	Wood - 4.5 m^3	FBR - 460 kg	Wood - 2.5 m^3	FBR - 460 kg	Wood - 2.5 m^3
Supporting boat, type, length, wood volume, and lifespan	2 plywood dingi/main boat – 2 m – 0.12 m^3– 2 yrs				
Propulsion	Engine HP 40	Engine HP 15	Nylon sail	Engine HP 15	Nylon sail
Item lifespan	11	5		5	
Boat fuel consumption (L/yr)	9494 L (+5400 L for generator) + 3132 L kerosene	434.5 L (per diver)		177.5 L (per diver)	
Gear type	Purse-seine, nylon	Iron stick	Iron stick	Iron stick	Iron stick
Gear lifespan	2.5 yrs	2 months	2 months	2 months	2 months
Gear weight (kg)	328	0.3	0.3	0.3	0.3
Floats in EVA, number	900				
Ropes weight (kg/yr)	105				
Other materials	Paint (60 kg)	Mask, flippers	Mask, flippers, paint (24 kg)	Plastic sandals	Plastic sandals, paint (24 kg)
FUI (Fuel Use Intensity) (L/t)	95	395	0	395	0

TABLE 6.1 SIMPLIFIED LCI FOR THE SMALL PELAGIC AND OCTOPUS FISHING ACTIVITIES FOR THE MLT. DATA REFER TO PRIMARY DATA COLLECTED DURING THE FIELD MISSIONS AND SECONDARY DATA. DATA REFER TO ONE YEAR.

Target group - MLT	Finfish				Prawn
Fishing Unit	Handliner – non motorized	Longliner – motorized	Ringnetter	Gillnetter	Gillnetter – non motorized
OUTPUT					
Catch/fishing unit/year (t)	5.6	33	300	54	4
Emission to the atmosphere from fuel combustion					
CO_2 (kg)		14160.1	214890.3	24229.5	
CH_4 (kg)		1.9	29.0	3.3	
N_2O (kg)		1.1	17.4	2.0	
PM2.5 (kg)		7.7	117.3	13.2	
INPUT					
Fishing days/year	210	246	288	180 (60 trips)	90
Main boat type and length	Wooden boat – 7 m	FBR boat – 7 m	Wooden boat – 18 m	Wooden boat – 11 m	Wooden boat – 4 m
Main boat lifespan (years)	10	20	7.5	20	2.5
Material required for main boat construction	Wood - 3.2 m^3	FBR - 350 kg	Wood - 7 m^3	Wood - 4.3 m^3	Wood - 2.5 m^3
Propulsion	Nylon sail (10 m^2)	Engine HP 10/15	Engine HP 50/60	Engine HP 15 + sail	Nylon sail (8 m^2)
Item lifespan		5	15	15	
Boat fuel consumption (L/yr)		5940 L	90144 L	10164 L	
Gear type	Nylon handline + steel hooks	Nylon longline + steel hooks	Ringnet	Gillnet	Gillnet (or beach seine)
Gear lifespan			2 years	2 years	1 month
Gear weight (kg)	1.5 (nylon), 1.6 (steel)	115.5 (nylon), 7 (steel)	2016	207	33.4 (nylon)
Floats in EVA, number			9000	700	
Ropes weight (kg/yr)	42		430	221	
Other materials			Sinker (400 kg)	Ice (1200 kg)	
FUI (Fuel Use Intensity) (L/t)	0	180	300	188	0

TABLE 6.2 SIMPLIFIED LCI FOR THE FINFISH AND PRAWNS FISHING ACTIVITIES FOR THE MLT. DATA REFER TO FOREGROUND DATA COLLECTED DURING THE FIELD MISSIONS AND SECONDARY DATA. DATA ARE REFERRED TO ONE YEAR.

Target group - ZNZ	Small Pelagic	Octopus		
Fishing Unit	Purse-seiner	Diver -FBR boat	Diver -Wooden boat	Foot fisher
OUTPUT				
Catch/fishing unit/year (t)	87	2.6	1	0.5
Emission to the atmosphere from fuel combustion				
CO_2 (kg)	28247.0	1311.1		
CH_4 (kg)	3.9	0.2		
N_2O (kg)	1.8	0.1		
PM2.5 (kg)	17.2	0.7		
INPUT				
Fishing days/year	180	220	220	220
Main boat type and length	Wooden boat – 10 m	FBR boat – 7 m, shared with 5 ppl	Wooden boat – 4 m, shared with 5 ppl	Wooden boat – 4 m, shared with 5 ppl
Main boat lifespan (years)	15	20	20	
Material required for main boat construction*	Wood - 4 m^3	FBR - 250 kg	Wood - 2.5 m^3	Wood - 2.5 m^3
Supporting boat, type, length, wood volume, and lifespan	2 plywood dingi/main boat – 2 m – 0.12 m^3– 2 yrs			
Propulsion	Engine HP 60	Engine HP 15	Cotton sail (4 m^2)	Cotton sail (4 m^2)
Item lifespan	10	20	3	3
Boat fuel consumption (L/yr)	7200 L (+1800 L for generator) + 1320 L kerosene	550 L (per diver)		
Gear type	Purse-seine, nylon	Iron stick	Iron stick	Iron stick
Gear lifespan	20 years	2 years	2 years	2 years
Gear weight (kg)**	718	0.5	0.5	0.5
Floats in EVA, number	600			
Ropes weight (kg/yr)	29			
Other materials	Sinkers (244 kg), Paint (42 kg)	Mask, flippers, paint (12 kg)	Mask, flippers	
FUI (Fuel Use Intensity) (L/t)	83	211	0	0

TABLE 6.3 SIMPLIFIED LCI FOR THE SMALL PELAGIC AND OCTOPUS FISHING ACTIVITIES FOR ZNZ. DATA REFER TO FOREGROUND DATA COLLECTED DURING THE FIELD MISSIONS AND SECONDARY DATA. DATA ARE REFERRED TO ONE YEAR.

Target group - ZNZ	Finfish				
Fishing Unit	**Handline**	**Longline**	**Ringnetter**	**Gillnetter**	**Trap-non motorized boat**
OUTPUT					
Catch/fishing unit/year (t)	5.6	12	39	15	3
Emission to the atmosphere from fuel combustion					
CO_2 (kg)		11442.5	27462.0	6436.4	
CH_4 (kg)		1.5	3.7	0.9	
N_2O (kg)		0.9	2.2	0.5	
PM2.5 (kg)		6.2	15.0	3.5	
INPUT					
Fishing days/year	166	240	288	180	300
Main boat type and length	Wooden boat – 5 m	FBR boat – 6 m	Wooden boat – 10 m	Wooden boat – 7 m	Wooden boat – 4 m
Main boat lifespan (years)	20	18	20	10	10
Material required for main boat construction*	Wood - 3.2 m^3	FBR - 233 kg	Wood - 4 m^3	Wood - 3.4 m^3	Wood - 2.5 m^3
Propulsion	Sail, nylon (10 m^2)	Engine HP 15	Engine HP 40	Engine HP 15	Sail, nylon (10 m^2)
Item lifespan	10	10	10	10	
Boat fuel consumption (L/yr)		4800 L	11520 L	2700 L	
Gear type	Handline, nylon Hooks, steel	Longline, nylon Hooks, steel	Ringnet	Gillnet	Wooden trap (palm) (12/fisher)
Gear lifespan	2 months	2 years	20 years	2 years	3 months
Gear weight (kg)**	1 kg nylon, 0.06 kg steel	3.5 kg nylon, 0.23 kg steel	2100 kg	17.3 kg	3 kg
Floats in EVA, number			750		
Ropes weight (kg/yr)		19.5			
Other materials	Paint (12 kg)	Paint (12 kg)	Paint (12 kg)	5 PE buoys	
FUI (Fuel Use Intensity) (L/t)	0	400	295	180	0

TABLE 6.4 SIMPLIFIED LCI FOR THE FINFISH FISHING ACTIVITIES FOR ZNZ. DATA REFER TO FOREGROUND DATA COLLECTED DURING THE FIELD MISSIONS AND SECONDARY DATA. DATA ARE REFERRED TO ONE YEAR.

DRYING PROCESSING		
Item	**MLT**	**ZNB**
OUTPUT		
Dried anchovies for human consumption (t/year)	8.6 (88%)	5.5 (73%)
Dust (for chicken meal) (t/year)	1.2 (12%)	1.9 (27%)
Emission to the atmosphere from fuel combustion		
CO_2 (kg)	7862.40	35992.32
CH_4 (kg)	21.06	96.41
N_2O (kg)	0.28	1.29
PM2.5 (kg)	16.85	77.13
INPUT		
Fresh anchovies (averaged t/year)	20	20
➢ **% fresh anchovies boiled before drying**	75	100
➢ **Yield of the boiled anchovies (%)**	97	97
➢ **Yield of the dried anchovies (%)**	50	40
Final weight of boiled/fresh anchovies to be dried (t/year)	19.6	19.4
For boiling		
Firewood for boiling (t/year)	4.5	20.6
Aluminium pot (kg/year)	8	6
Salt (kg)	NA	167
For drying		
Tarpaulins - number	50	3
➢ **Dimensions**	20 x 2 m	11 x 11 m
➢ **Lifespan (years)**	1	1
For drying with an experimental drying device (only MLT) – data referred to one drying cycle		
OUTPUT		
Dried anchovies (t/cycle)	0.9	NA
Emission to the atmosphere from fuel combustion		
CO2 (kg)	165.20	
CH4 (kg)	0.30	
N2O (kg)	0.001	
PM2.5 (kg)	0.10	
INPUT		
Fresh anchovies/4 hrs drying cycle (t)	1.8	NA
➢ **Yield of the dried anchovies (%)**	48	
Charcoal (kg/cycle)	50	
Lifespan of the device (years)	7	
Material used for the device construction	NA	
Electricity used kWh/cycle (Tanzania country-mix)	423.1	

TABLE 6.5 SIMPLIFIED LCI FOR THE TRADITIONAL AND EXPERIMENTAL DRYING PROCESS. DATA REFER TO FOREGROUND DATA COLLECTED DURING THE FIELD MISSIONS. DATA ARE REFERRED TO ONE YEAR.

FRYING USING LPG (LIQUEFIED PETROLEUM GAS)		
Item	**MLT**	**ZNZ**
OUTPUT		NA
Fried seafood* (t)	27	
Emission to the atmosphere from fuel combustion		
CO2 (kg)	10209.59	
CH4 (kg)	0.81	
N2O (kg)	0.02	
PM2.5 (kg)	0.77	
INPUT		
Fresh seafood to be fried (kg)	54	
➢ **Yield of fried seafood (%)**	50	
LPG (kg)	3420	
Cooking oil (kg) (1 L=0.90 kg)	12034	
FRYING USING FIREWOOD		
Item	**MLT**	**ZNZ**
OUTPUT		
Fried seafood* (t)	3	4.8
Emission to the atmosphere from fuel combustion		
CO2 (kg)	10483.20	11356.80
CH4 (kg)	28.08	30.42
N2O (kg)	0.37	0.41
PM2.5 (kg)	22.46	24.34
INPUT		
Fresh seafood to be fried (t)	6	9.6
➢ **Yield of fried seafood (%)**	50	50
Firewood (ton/year)	6	6.5
Cooking oil (ton) (1 L=0.90 kg)	1.3	0.9

Table 6.6 Simplified LCI for the frying process. Data refer to foreground data collected during the field missions. Data are referred to one year.

**In the 90s, these small processors were used to fry both small pelagic and reef fish, using firewood as the heating method. Nowadays, the use of LPG is common, but the main seafood fried are anchovies.*

CHILLING AT THE COLLECTION CENTRE		
Item	**Amount**	**%**
OUTPUT		
Chilled finfish (t)	177.6	58
Chilled octopus (t)	125.7	41
Chilled prawns (t)	2.1	1
Total product (t)	305.4	
Product yield		90-98
INPUT		
Raw finfish (t)	181.2	
Raw octopus (t)	128.2	
Raw prawns (t)	2.1	
Ice machine - type	flakes	
Ice machine - capacity (t)	60	
Electricity consumption/year (kwh)	279223	
Freshwater m^3	from the private well, not possible to quantify	
Marine water m^3/year	2400	

TABLE 6.7 SIMPLIFIED LCI FOR THE COLLECTION AND CHILLING (WITH ICE) OF THE PRODUCT. DATA ARE REFERRED TO ONE YEAR AND REPRESENT PRIMARY DATA COLLECTED AT THE COLLECTION CENTRE IN KILWA-KIVINJE. THIS LCI HAS BEEN USED AS PROXY FOR A TYPICAL COLLECTION CENTRE.

ICE PRODUCTION	
Item	**Amount**
OUTPUT	
Ice (kg)	1
Seafood:ice ratio	10:3
INPUT	
Fresh water (m^3)	0.001
Electricity (kWh)	0.068

TABLE 6.8 SIMPLIFIED LCI FOR ICE PRODUCTION. DATA FROM CLAUSSEN ET AL., 2011

PROCESSING AND FREEZING AT INDUSTRIAL PLANT		
Item	**Mid-size plant**	**Large-size plant**
OUTPUT		
Frozen seafood/year (t)	366	2005
Product yield (%)	92	70-88
Destination market	Europe	Regional market
Emission to the atmosphere from fuel combustion		
CO2 (kg)	3218.21	6198.03
CH4 (kg)	0.43	0.84
N2O (kg)	0.26	0.50
PM2.5 (kg)	1.76	3.38
INPUT		
Raw seafood/year (t)	365	2538
Electricity consumption/year (kWh)	336 000	95 189
Fuel consumption/year (L)	1080	2080
Freshwater consumption/year (m^3)	27.5	3600
Cardboard boxes – kg/year	5000	10125
Polyethylene (PE) sheets for packaging kg/year	1350	1650
Plastic (PE) tables number	20	NA
Plastic (PE) tables measures	1 x 3 x 0.05 m	NA

TABLE 6.9 SIMPLIFIED LCI FOR THE PROCESSING AT THE INDUSTRIAL, MID-SIZE AND LARGE-SIZE, PROCESSING PLANT. DATA ARE REFERRED TO ONE YEAR, AND DERIVE FROM PRIMARY DATA COLLECTED DURING THE FIELD MISSIONS. ONLY FOR MLT, NO PROCESSING PLANTS ARE PRESENT IN ZNZ

Transport	t seafood /trip	Km/trip	Mode
MTZ Domestic	10	287 (road)	Lorry with refrigeration machine, 7.5-16 ton, euro3
MTZ Frozen seafood transported to Tunduma (Regional export)	10	1000 (road)	Refrigerated (freezing) lorry 3.5-7.5 metric ton, euro3
MTZ Frozen seafood transported to Dar es Salaam harbour (EU export)	10	30 (road)	Refrigerated (freezing) lorry 3.5-7.5 metric ton, euro3
MTZ Dried anchovies transported to Tunduma (Regional export)	10	1000 (road)	Lorry 7.5-16 metric ton, euro3
MTZ Chilled seafood transported to Zanzibar	5	30 (road) 70 (sea)	Lorry 3.5-7.5 metric ton, euro3; Ferry
ZNZ Dried anchovies transported to Tunduma (Regional export)	10	70 (sea); 1000 (road)	Ferry; Lorry 3.5-7.5 metric ton, euro3

TABLE 6.10 LCI OF THE HYPOTHETICAL TRANSPORTATION MODES. DATA ARE BASE IN FRAGMENTARY PRIMARY DATA AND OBSERVATIONS DURING THE FIELD MISSIONS. DATA REFER TO ONE TRIP.

6.2. Human Health, Ecosystems and Resources - Life Cycle Impact Assessment (LCIA)

The LCIA was evaluated with the software SimaPro 9.1.0.7 (PRé Consultants), adopting the ReCiPe 2016 Endpoint (H) for the impact assessment at the AoP. In this case, the LCIA is expressed using Endpoint indicators, which give an estimate of impacts on the three AoP. The endpoint characterization factors used in ReCiPe 2016 are described in Table 6.11. The relation among the Midpoint indicators (particular matter formation, tropospheric ozone formation, ionizing radiation, global warming, and so on), the damage pathways and the resulting Endopoint indicators (AoP) are depicted in the Environmental Appendix

(Supplementary Figure 6.1). The hierarchist perspective (H) was chosen, as it is based on the most common policy principles with regard to time-frame and other issues (Huijbregts et al., 2017; PRé Sustainability, 2020).

Endpoint Indicators – Areas of Protection	Unit	Meaning
Human Health	DALY (Disability Adjusted Life Years)	number of year-life lost and the number of years lived disabled
Ecosystems	species.year	loss of species over a certain area, during a certain time
Resources	USD2013	surplus costs of future resource production over an infinitive timeframe (assuming constant annual production), considering a 3% discount rate

TABLE 6.11 ENDPOINT INDICATORS CORRESPONDING TO THE AOP, RECIPE 2016 ENDPOINT (H).

The results of the LCIA to the AoP can be presented as i) characterization (i.e., the substances that contribute to an impact category are multiplied by a characterization factor that expresses the relative contribution of the substance; specific units are used to indicate the impacts relative to each AoP), ii) normalization, which expresses the total impact occurring in a reference region for a certain impact or damage category (e.g. climate change, eutrophication, Human Health, Ecosystems, etc.) within a reference year. In Recipe 2016, normalization is based on Sleeswijk et al. 2007, in which the year 2000 was chosen as the reference year, and the information at the global spatial level were used; the endpoint indicators are dimensionless after normalization); iii) weighting (*i.e.*, Single Score) (this means that the impact (or damage) category indicator results are multiplied by weighting factors and are added to create a single score). The ReCiPe Impact Assessment method uses a panel weighting approach. In this approach, a panel of people is used to establish weighting factors for different environmental impact categories and thus the relative importance of the three damage categories (PRé Sustainability, 2020, https://support.simapro.com/articles/Article/Perspectives-and-weighing-approach-in-ReCiPe-method).

For the purpose of this report, the LCIA results at the endpoint level will be given according to the weighting (Single Score) method to make easier the reading and comparison. The detailed LCIA according to the characterization method is given in the Environmental Appendix.

6.2.1 Fishing Activity – MLT

The potential environmental damages to the three AoP associated with the different MLT fishing activities are shown in Figure 6.1A and Supplementary Table 6.1. In Figure 6.1B, the contribution analyses of the inputs to the overall impact assessment of the different fishing activities are presented.

The environmental damages associated with different fishing activities appear to be variable in terms of overall damages, but, as described below, they share similarities: for all fishing activities, the greatest potential damages are to AoP Human health (Figure 6.1A), regardless of whether the fleet is motorized or not. In general, the fisheries showing the greatest impacts on the three AoPs are those that are motorized, *i.e.* that use fuel. In fact, as depicted in Figure 6.1B, the input that contributes most significantly to the overall impact of the motorized fisheries is fuel consumption (see also Section 3, Economic analysis). Fuel production and combustion release CO_2 and particulate matter that are harmful to human health. The non-motorized fishing units have the lowest environmental damage. It has to be noted that, among the motorized fishing units, the one with the lowest environmental damages associated with all AoPs is the small pelagic (anchovies and anchovy-like species) fishery. This result can be explained by the Fuel Use Intensity (FUI), i.e., the amount of fuel (in L) used to capture one tonne of product (95 L/ton; Table 6.1), which is a measure of fishery efficiency. Small pelagics are shoaling species, *i.e.*, fish (generally belonging to the same species) that tend to swim and stay in group for social reasons, as, for example, for defence against predators or improved foraging behaviours. This means that large quantities are caught with relatively minimal fuel consumption. Small

pelagic capture is also facilitated by the fishing mode and fleet composition (the lead boat waiting for the dinghy boats to attract the shoals). These results are in agreement with other studies that highlight that the environmental performance of the fisheries is tightly linked to the FUI and that small pelagic fishery shows a low environmental impact compared to other fisheries. For example, Avadi et al. (2020) reported a Single Score equals to 30-46 Pt for the artisanal small pelagic fishery in Gambia. On the other end, the fishing activities with the greatest environmental impact appear to be those associated with octopus fished by both divers and fishers using motorised boats (Figure 6.1A). The reason is again associated with the FUI: according to data gathered during this study, 395 L of fuel is required to land 1 t of octopus (Table 6.1). The reason behind the high FUI of octopus fishing activities could rely on the fact that it is carried out in reefs that can be far from the coast, which is expensive in terms of fuel consumption. Once at the fishing grounds, fishers seek octopus (walking or diving). The amount of catch per trip can vary, but on average can be 3-4 kg/trip (about 6-8 octopuses), with the exception of re-opening days for fishing in specific reefs (in this case, the catch can be larger).

With regard to non-motorised fishing activities, they have little environmental impact compared to motorized ones. The main contributors to such low impact are the use of paint and wood used for the boats and nylon for the gears.

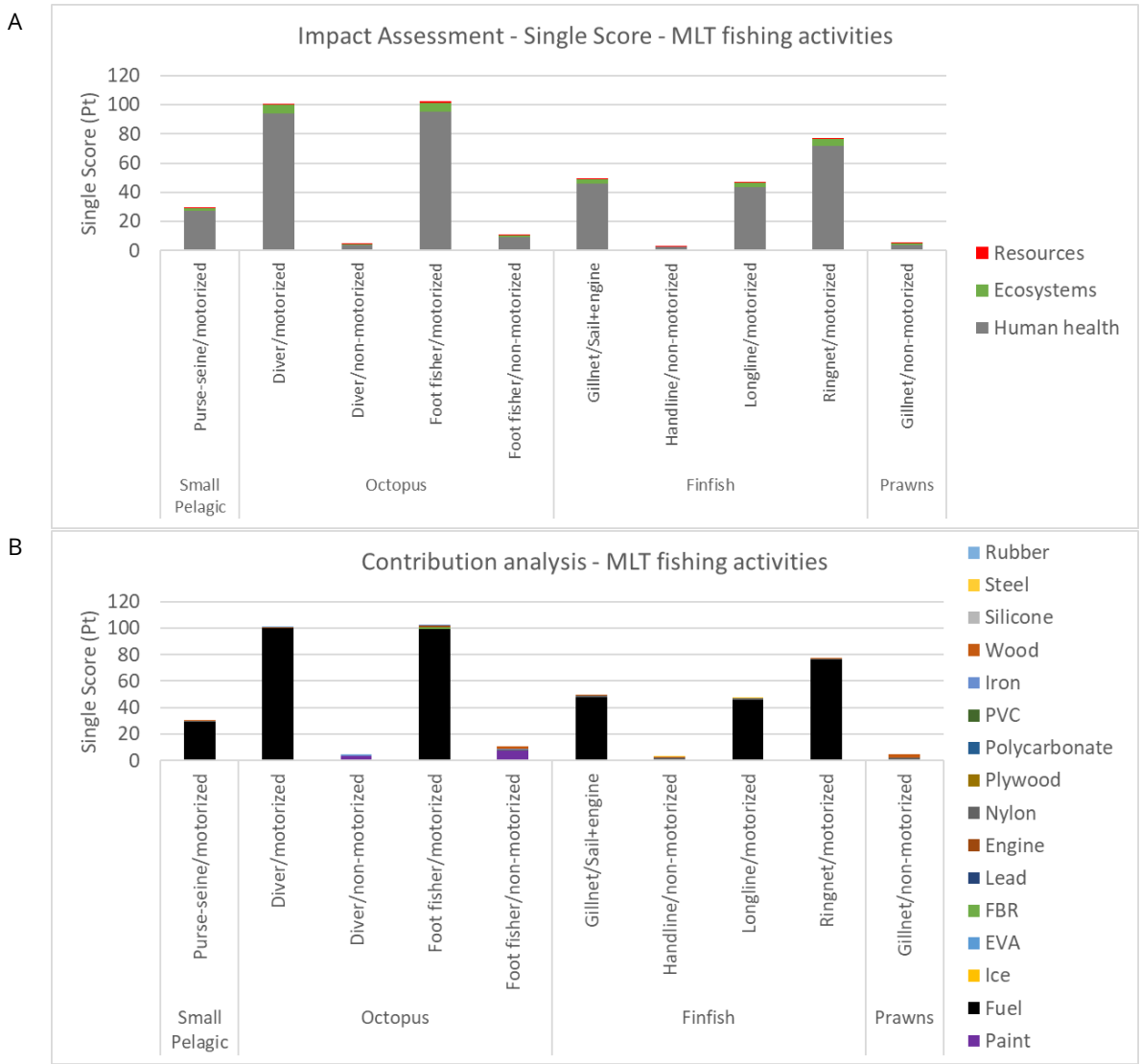


Figure 6.1 A) Impact Assessment for MLT fishing activities – Areas of Protection (AoP), Single Score (Pt) and B) corresponding contribution analysis for MLT fishing activities. Results are referred to 1 t of landed seafood.

6.2.2 Fishing Activity – ZNZ

Similar trends and observations as those reported for the MLT can be done for the ZNZ fishing activities (Figure 6.2 and Supplementary Table 6.2). In fact, even in this case, the greatest potential environmental damages are those referred to motorized fishing activities and occur for the AoP Human Health (Figure 6.2A). The overall environmental impacts of the motorized ZNZ fishing activities are mainly driven by the utilization and combustion of fuel used for engine operations (Figure 6.2B). Also for the ZNZ fisheries, the motorized fishing activity having the smallest overall environmental damage is the one related to the landing of small pelagic (anchovies and anchovies-like species). In the case of the ZNZ, the fishery that shows the greatest overall environmental damage is the Finfish fishery which makes use of longline and motorized vessels. This is different from the MLT situation (=octopus fisheries are those having the greatest overall damage). From the results of these analyses seems in fact that ZNZ octopus fisheries are more efficient than the MLT ones, in terms of the amount of caught octopus per amount of fuel used (FUI). This is probably linked to the localization of octopus fishing grounds in ZNZ. On the other end, ZNZ longliners are less efficient in terms of catch per amount of fuel used compared to the MLT ones. This can rely on the fact that MLT longline fishers use multiple and/or longer longlines, with a different arrangement of hooks, allowing an increased catch per trip (and a lower FUI). MLT and ZNZ ringnetters appear to be quite similar in terms of efficiency (FUI). See also Economic Analysis, Section 3.

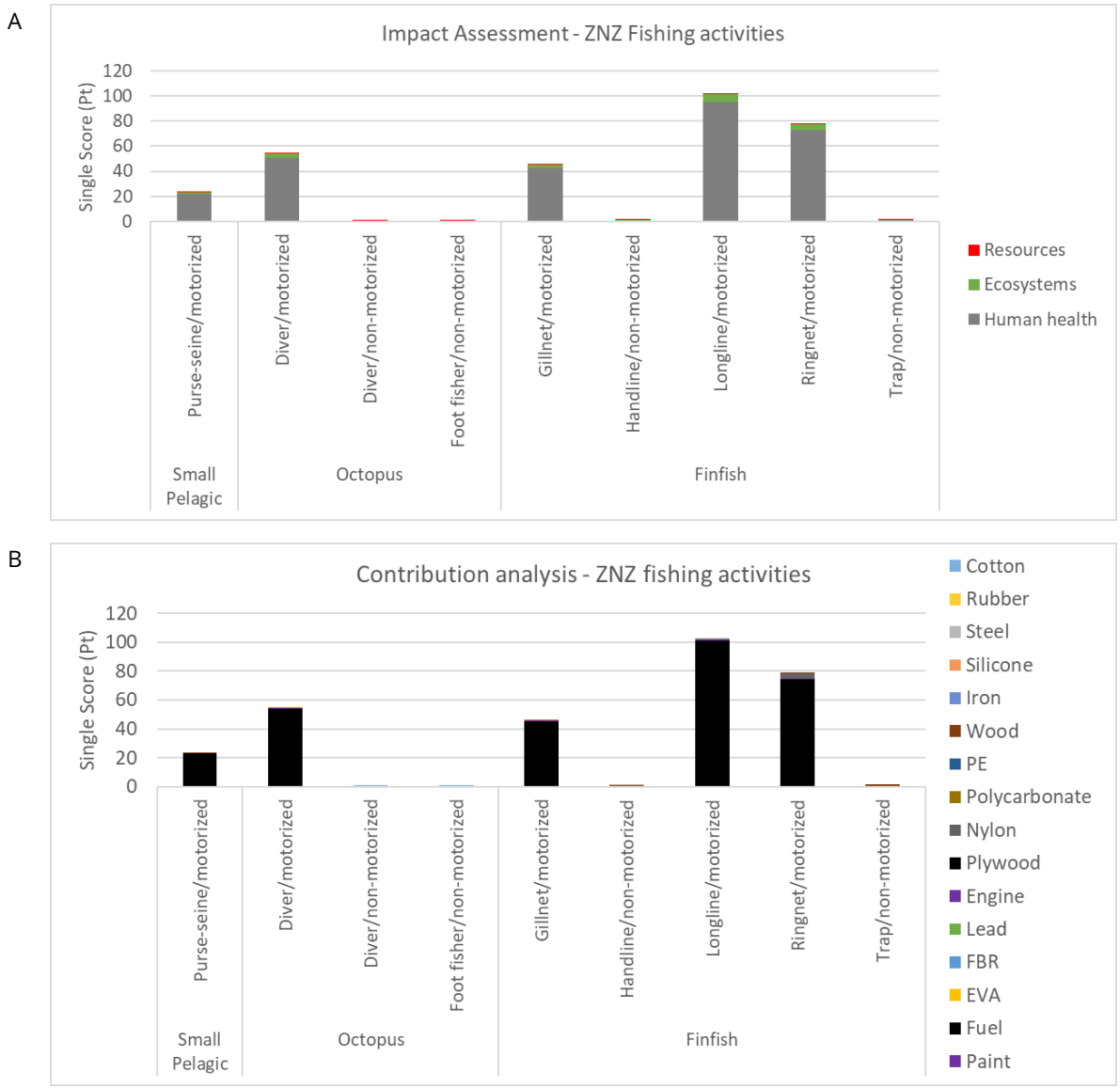


Figure 6.2 A) Impact Assessment for ZNZ fishing activities – Areas of Protection (AoP), Single Score (Pt) and B) corresponding contribution analysis for MLT fishing activities. Results are referred to 1 t of landed seafood.

6.2.3 Processing

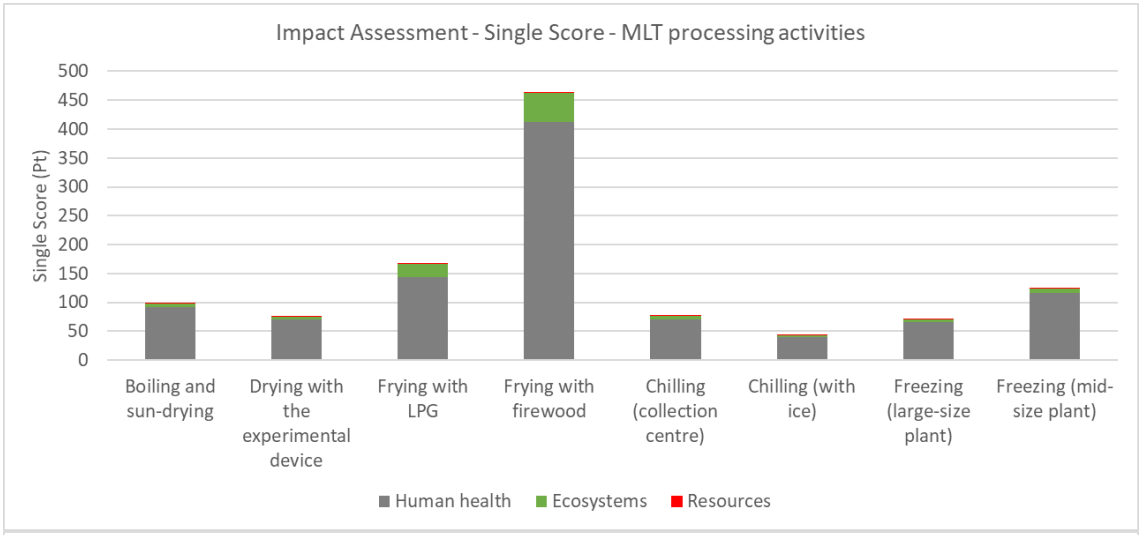
The impact assessment for MLT processing activities at the level of the AoPs (Figure 6.3A, Supplementary Table 6.3) reveals that also in this case the greatest damage that all treatment activities have is on Human Health. The AoP Ecosystem and Resources are relatively little affected, with the exception of the case of both frying processing (using LPG and firewood), where the score assigned to the AoP Ecosystem is higher than for the other processing activities. These results appear clearer when observing the contribution analysis of the processing activities (Figure 6.3B): for almost all the processing activities, the majority of the damages derived from the fishing activity, and a relatively little contribution to the overall impact comes from the use of firewood for boiling and drying, and electricity for drying with the experimental device and chilling. These observations do not hold for the frying processing. In these cases, a major driver of the overall impact is the use of cooking oil, and, in the case of frying with firewood, the combustion of wood. The use of LPG for frying seems to have very little contribution to the overall damage.

The damages of fishing activities (mainly deriving from fuel combustion) to Human Health have been already mentioned in the previous section. Concerning the use of firewood, similar observations can be made: burning wood releases greenhouse gasses (GHG) and particulate matter, thus being harmful to Human Health. The use of firewood also impacts the Ecosystems AoP because of wood harvesting/deforestation. However, it must be specified that the firewood used during processing could be either actively cut in the forests but also simply harvested from the ground and then sold. Unfortunately, the data collected is not sufficient to model the last scenario. The other main driver of the overall damage, and in particular Human Health AoP (Supplementary Figure 6.2), is the use of vegetable cooking oil. Production of vegetable oil has multiple environmental negative outcomes: it requires land transformation and habitat loss, use of fertilizers and consequent chemical pollution of soil and waters, and use of fossil fuels for planting, harvesting, and processing.

The drying of the product itself with the traditional method has no major environmental impacts since drying is done by exposing the product to the sun, and the only input is the plastic material of the tarpaulins. Besides the fishing activity, in fact, the main contributor to the overall impact is the use of firewood required for the boiling phase.

An attempt in evaluating the environmental performances of the small pelagic drying process using an experimental drying system has been carried out. Also in this case, the AoP presenting the largest damages is the AoP Human Health. Similar to the MLT traditional drying process, the impacts associated with the use of an experimental drying device are mainly due to the impacts deriving from the fishing activities (Figure 6.3). In this case, electricity consumption and the use of charcoal combined with the associated emissions represent almost 20% of the overall damage at the AoP, slightly less than the damages associated with the use of firewood in the traditional boiling and sun-drying procedure, as charcoal has lower particulate matter emissions than firewood.

A



B

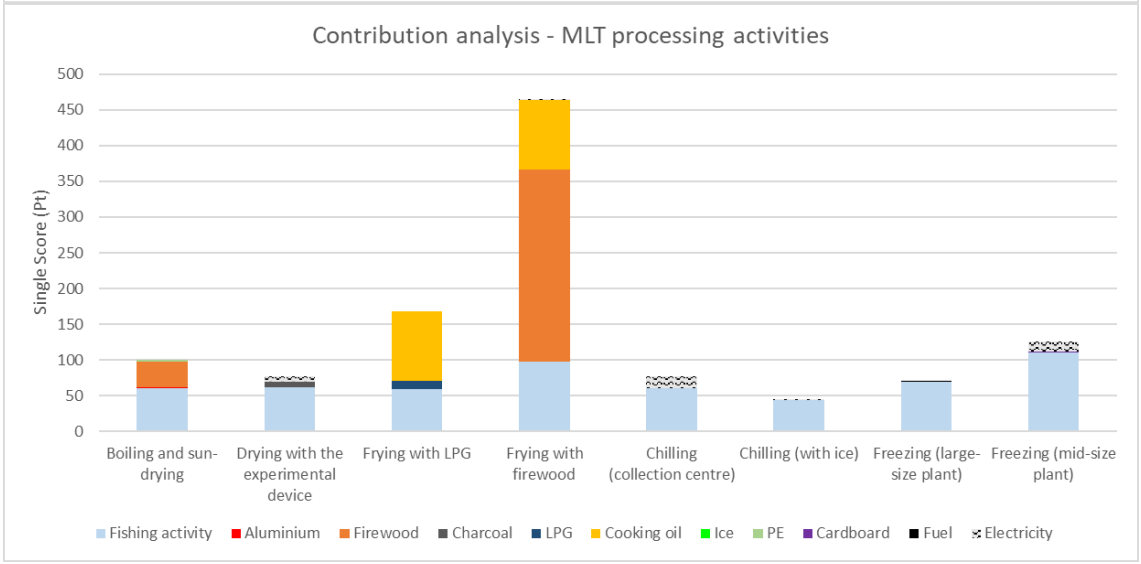


FIGURE 6.3 A) IMPACT ASSESSMENT FOR MLT PROCESSING ACTIVITIES – AREAS OF PROTECTION (AOP), SINGLE SCORE (PT) AND B) CORRESPONDING CONTRIBUTION ANALYSIS FOR MLT PROCESSING ACTIVITIES.

Results are referred to 1 t of processed seafood.

The damages to the AoP of ZNZ supply of processed seafood have similar trends to that of MLT's (Figure 6.4, Supplementary Table 6.4): the main damages are in fact those to the Human Health AoP, for all the processing activities analysed. Boiling and sun-drying and frying using firewood have larger overall damages than chilling and freezing. Also, damages to Ecosystem AoP are higher in the case of boiling and drying and frying. This is linked to the use of firewood and cooking oil.

As far as the comparison between MLT and ZNZ is concerned, the boiling and drying processing leads to higher damages in ZNZ than in MLT. This relies on the fact that in ZNZ 100% of the fresh seafood that goes through the drying process is first boiled, while in the MLT, due to consumers' preferences, only 75% follows this fate (the other 15% is directly sun-dried). Therefore, for the same amount of dried seafood, in ZNZ, higher consumption of firewood is observed.

On the other end, frying seafood in ZNZ seems more efficient than in MLT: as can be depicted in Figures 6.3B (MLT) and 6.4B (ZNZ), this can be attributed to the quantity of firewood and cooking oil used for frying the same amount of seafood, which in ZNZ is reduced by 32% and 58% for cooking oil and firewood, respectively, compared to MLT.

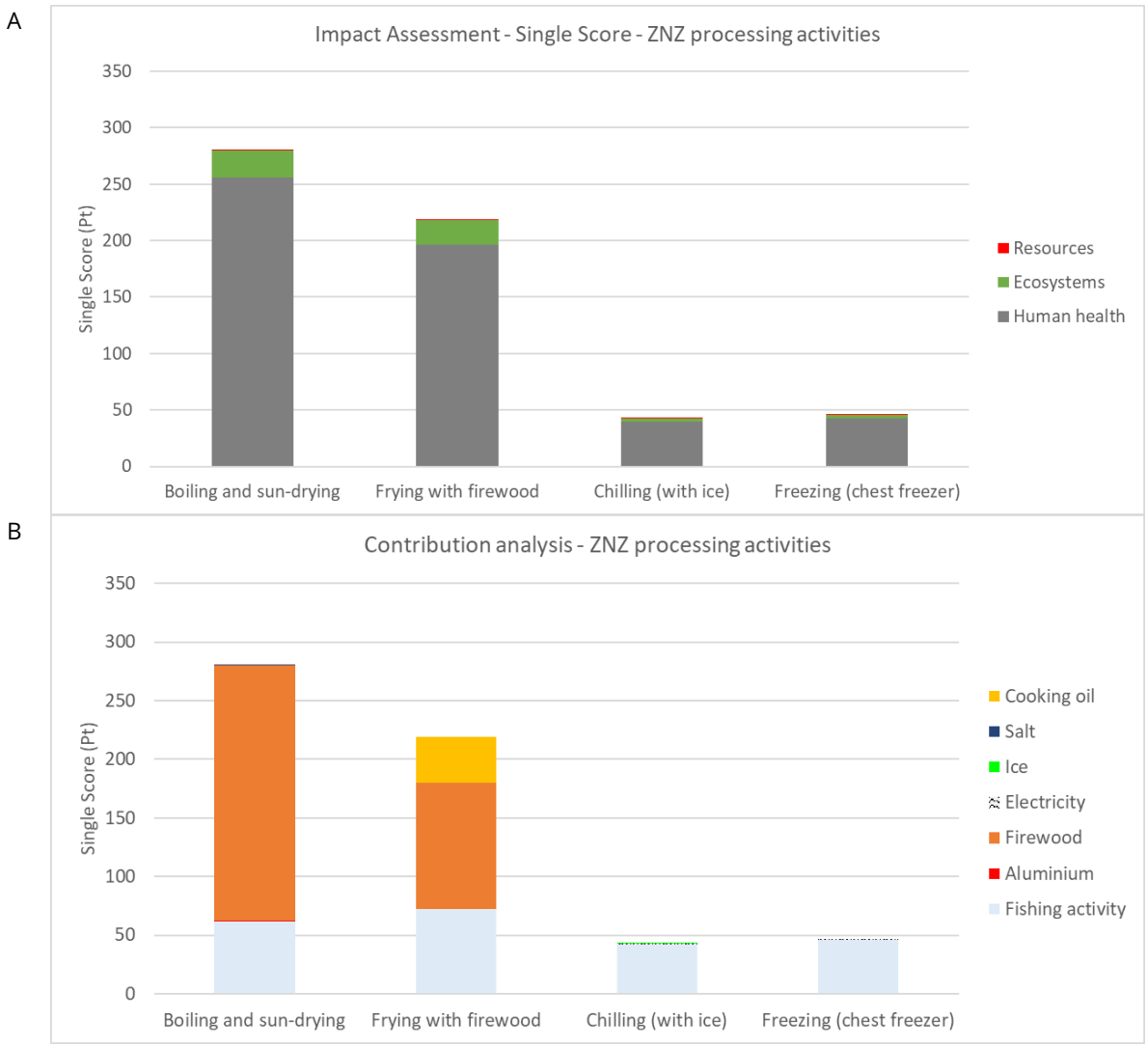


FIGURE 6.4 A) IMPACT ASSESSMENT FOR ZNB PROCESSING ACTIVITIES – AREAS OF PROTECTION (AOP), SINGLE SCORE (PT) AND B) CORRESPONDING CONTRIBUTION ANALYSIS FOR ZNZ PROCESSING ACTIVITIES.
Legend: Results are referred to 1 t of processed seafood.

6.2.4 Transported seafood

As mentioned above, the transport of seafood within the country has been modelled in a simplified way on the base of a few assumptions (see also Table 6.10).

Domestic transport of fresh seafood has been considered for distances >50 km. Thus, it was modelled only for MLT, as in ZNZ it has been assumed that all landed seafood is processed and marketed quite close to the landing sites.

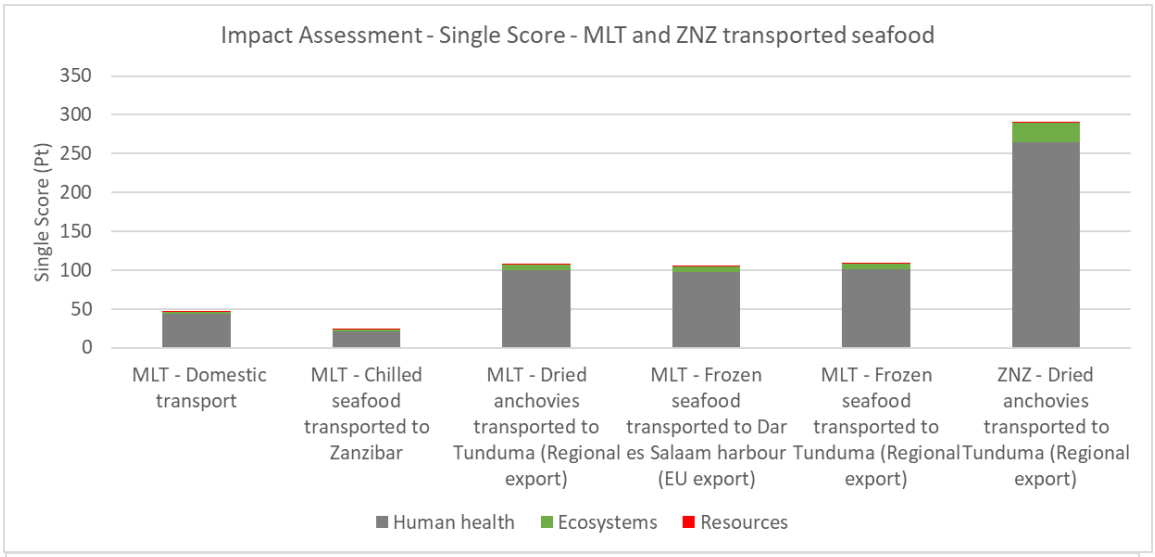
Part of the processed seafood is exported to the regional market (neighbour African countries) and, in the case of the seafood produced in the MLT also in the EU and to ZNZ.

In the MLT, the dried anchovies and anchovy like-species are seafood exported to regional market, whereas frozen octopus and prawns are exported to regional and EU markets. Chilled prawns are also “exported” to ZNZ. In the case of ZNZ, the only processed seafood exported is dried anchovies and anchovy-like species to the regional market.

The damages to the three AoPs of exported seafood in MLT and ZNZ are represented in Figure 6.5A (see also Supplementary Table 6.5). In Figure 6.5B, the contribution analysis of 1 t of exported seafood is depicted. The considered transport is within the URT’s country borders.

For both MLT and ZNZ, the transport itself has a minor contribution to the overall damage (Figure 6.5B). For the MLT, the main driver of the overall damage associated with the transported seafood is the fishing activities (anchovies and anchovy-like species, finfish, octopus and prawns). The processing phase has little impact, as the majority of the processed seafood is frozen. On the other hand, in ZNZ, boiled and dried anchovies and anchovy-like species are major seafood types being exported. As a consequence, the processing phase is the one affecting most the overall impact.

A



B

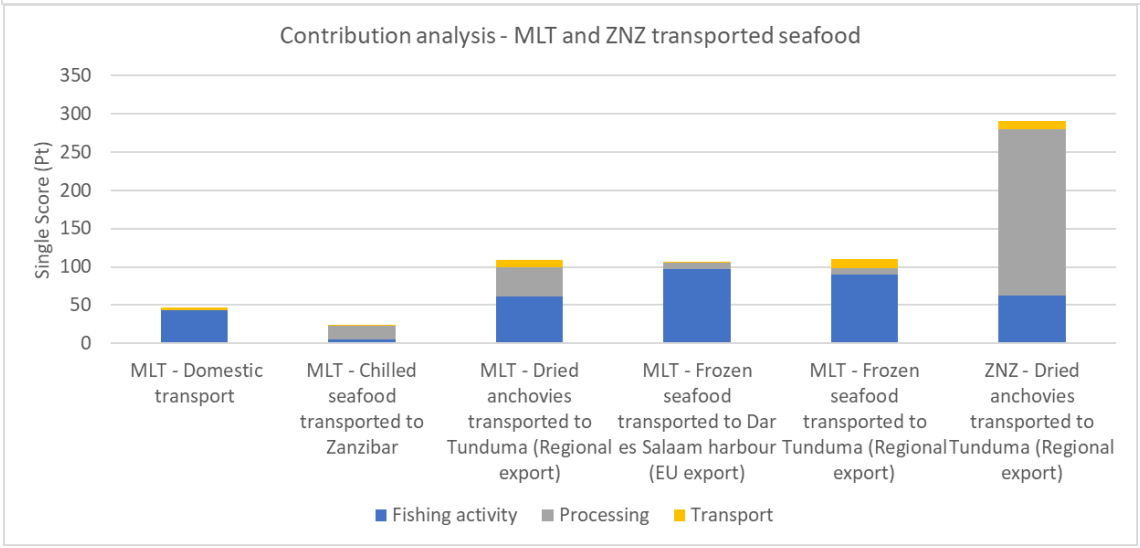


FIGURE 6.5 A) IMPACT ASSESSMENT OF MLT AND ZNZ TRANSPORTED SEAFOOD AND B) CONTRIBUTION ANALYSIS OF EXPORTED SEAFOOD IN BOTH MTL AND ZNZ. DATA REFER TO 1 T OF EXPORTED SEAFOOD, WITHIN THE URT'S COUNTRY BORDERS.

6.3. Climate change (Global Warming Potential) - Life Cycle Impact Assessment (LCIA)

The assessment of the effects of URT coastal fisheries on Climate change follows the same methodological procedure used for the assessment of the effects on the AoPs Human Health, Ecosystem and Resources (Section 6.1). For Goal and Scope definition and LCI please refer to Section 6.1.

With regards to the LCIA, the ReCiPe 2016 Midpoint (H) was adopted for the assessment of the impact category Climate Change. In this case, the LCIA is expressed using the relevant midpoint indicator according to the characterization method (Table 6.12).

Midpoint Indicator	Unit	Meaning
Global Warming Potential	Kg CO_2 eq	amount of additional radiative forcing integrated over time (100 years) caused by the emission of 1 kg of GHG relative to the additional radiative forcing integrated over that same time horizon caused by the release of 1 kg of CO2

Table 6.12 Midpoint indicator – Global Warming Potential, ReCiPe 2016 Midpoint (H).

The hierarchist perspective (H) was chosen, as it is based on the most common policy principles with regard to time-frame and other issues (Huijbregts et al., 2017; PRé Sustainability, 2020).

6.3.1 Fishing activity – MLT and ZNZ

With regard to the assessment of potential environmental impacts to the Global Warming impact category (Midpoint Indicator), the contribution to GHG emissions of the different fishing activities of the MLT and ZNZ are given in Figure 6.6A and B.

The fishing activities contributing most to the Global Warming Impact Category are, as expected, those associated with the use of fuel for engine operation: among MLT motorized fisheries, the least efficient ones in terms of Global Warming potential are the motorized octopus fishery (about 1000 kg CO_2/t landed seafood); while among ZNZ fisheries, finfish fishery using longline is the one with the highest CO_2 eq emissions (1071 kg CO_2/t landed seafood). GHG-related emissions' trends similar to the above-mentioned are reported by Parker et al. (2018), who averaged various fishing activities worldwide according to the fishing sector, and give values of 2.8 kg CO_2 eq/kg landed cephalopods and 1.9 kg CO_2 eq/kg landed pelagics > 30 cm (size comparable to the category Finfish of this study).

For all fishing activities using motorized boats, the input contributing most to the Global Warming potential is the use and combustion of fuel (Supplementary Table 6.6 and 6.7, Supplementary Figures 6.3 and 6.4). All these fisheries, both for the MLT and ZNZ, are those associated with the highest FUI (L of fuel consumed/t landed product). The exception is the case of the small pelagic (anchovies and anchovy-like) fishery: among the activities using motorized vessels, this is the one with the lowest GHG emissions. Although also in this case, the main driver of Global Warming impact category is fuel consumption, small pelagic fisheries appear to be the one with the lowest FUI. In turn, this indicates that this fishery is the most efficient among those analysed. Small pelagic fisheries have been already described as the most efficient in terms of GHG-related emissions (483 kg CO_2 eq/t landed seafood in MLT; 313 kg CO_2 eq/t landed seafood in ZNZ), as also reported in Parker and Tyedmers, (2014) and Parker et al. (2018): FUI values for this and similar fisheries (surrounding nets) are generally <100 L/t (also as low as 8 and 10 L/t), and have an average (considering all the fisheries analysed worldwide) of 0.2 kg CO_2 eq/kg landed seafood (small pelagic <30 cm). FUI for small pelagic fisheries in MLT and ZNZ are 95 and 83 L/t seafood, respectively.

On the other end, the fishing activities with the lowest Global Warming potential are the ones using non-motorized fishing vessels (MLT: finfish fishery using handlines, octopus foot fishers and prawn fishery; ZNZ: finfish fisheries using traps and handlines, and octopus fishers using non-motorized vessels). The Global Warming potential associated with the fisheries using non-motorized vessels is mainly driven by the use of wood and paints for the boat and nylon gears (Supplementary Table 6.6 and 6.7, Supplementary Figures 6.3 and 6.4). The production and manufacturing of all these inputs require electricity and fuel consumption. In addition, nylon, like other plastics, is a product derived from petroleum. Its manufacture requires a considerable amount of energy and produces a large quantity of nitrous oxide (N_2O) (Thiemens and Trogler, 1991), a greenhouse gas, thus contributing to the impact category Global Warming.

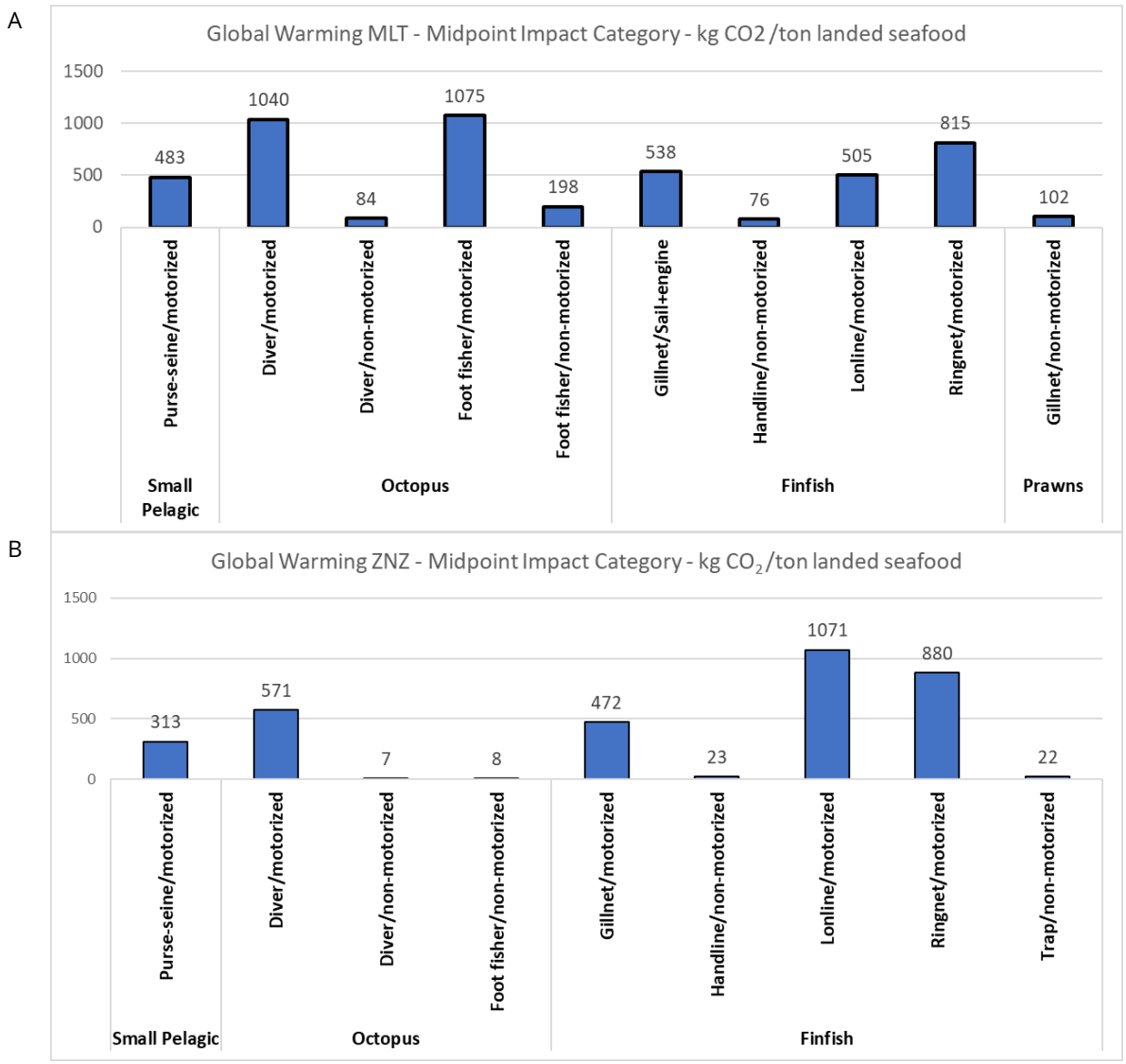


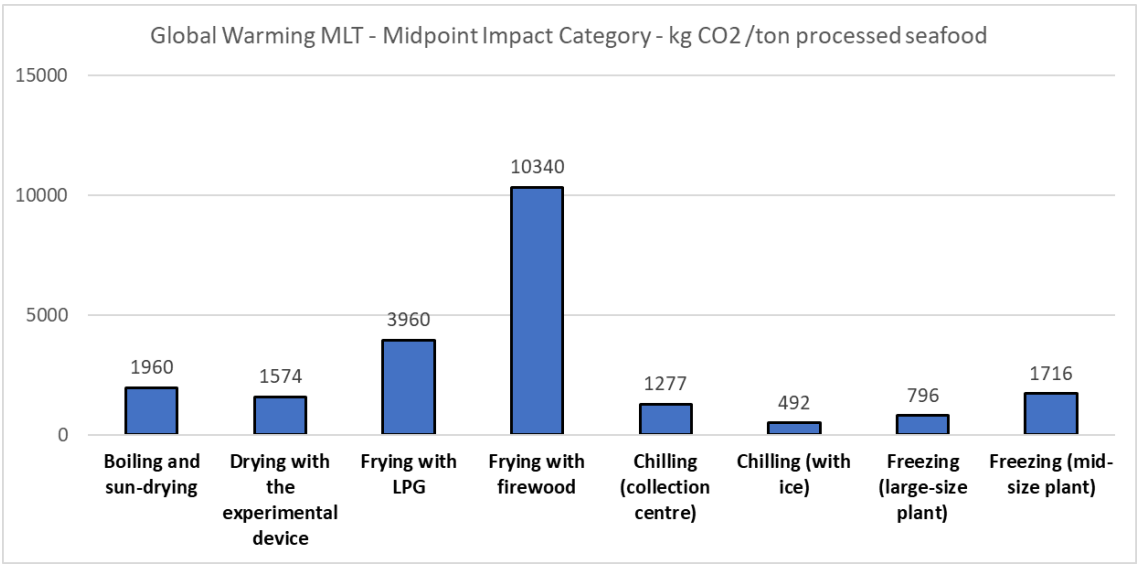
Figure 6.6 Impact assessment of fishing activities – Global Warming – Characterization. A) MLT and B) ZNZ. Results are referred to 1 t of landed seafood.

6.3.2 Processing – MLT and ZNZ

With regard to the assessment of potential environmental impacts to the Global Warming impact category (Midpoint Indicator), the contribution to GHG emissions of the different processing procedures of the MLT and ZNZ are given in Figure 6.7A and B and Supplementary Tables 6.8 and 6.9.

Both for MLT and ZNZ, the processing activities with the lowest GHG-related emissions are chilling and freezing. On the other hand, some differences can be highlighted between the two systems (MLT vs ZNB): in the MLT, the least efficient processing is frying using firewood as fuel, while in ZNZ it is boiling and sun-drying. However, the high Global Warming potential associated with both these processing activities is linked to the use of firewood for boiling and frying, respectively. In the case of frying, the use of cooking oil has indeed a large contribution. Higher levels of GHG emissions are related to the combustion of firewood. Firewood is used in a kind of stone brazier, similar to open fire, for both boiling and frying. Pots with water or oil are placed on top of the brazier, depending on the type of processing. The fact that firewood is used in an open fire results in a certain inefficiency. Apparently, in the MLT, processors are more efficient with the use of firewood during the boiling procedures before drying anchovies (also, in the MLT only 75% of the product destined to be dried is boiled first), while the amount of firewood used to fry a certain amount of seafood is higher than in ZNZ. However, it is worth reminding that a certain contribution to the Global Warming Potential of the processing activities derives from the artisanal fisheries providing the seafood (Supplementary Tables 6.8 and 6.9).

A



B

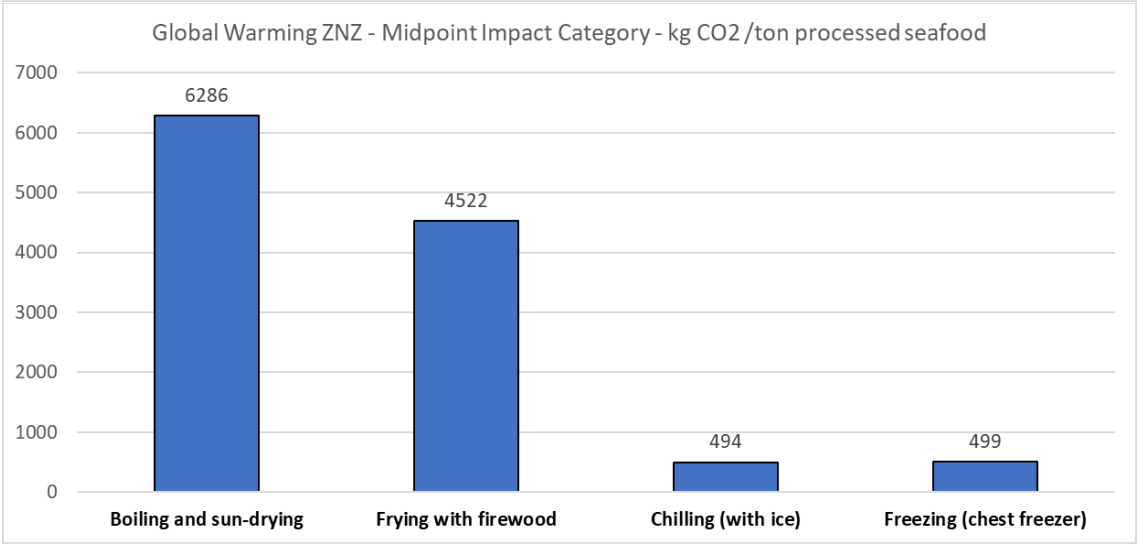


FIGURE 6.7 IMPACT ASSESSMENT OF PROCESSED SEAFOOD – GLOBAL WARMING – CHARACTERIZATION. A) MLT AND B) ZNZ. RESULTS ARE REFERRED TO 1 T OF PROCESSED SEAFOOD.

6.3.3 Transported seafood – MLT and ZNZ

Similar to what was observed at the level of the damage assessment to the three AoPs, for both MLT and ZNZ, the transport itself has a minor contribution to the Global Warming impact category (Figure 6.8). For the MLT, the main driver of the overall impact (Global Warming) associated with the exported seafood is the fishing activities (anchovies and anchovy-like species, finfish, octopus and prawns). However, the processing phase represents about 35% of the contribution of GHG-related emissions. On the other hand, in ZNZ, the exported seafood is mainly boiled and dried anchovies and anchovy-like species. As a consequence, the processing phase is the one affecting most the overall impact.

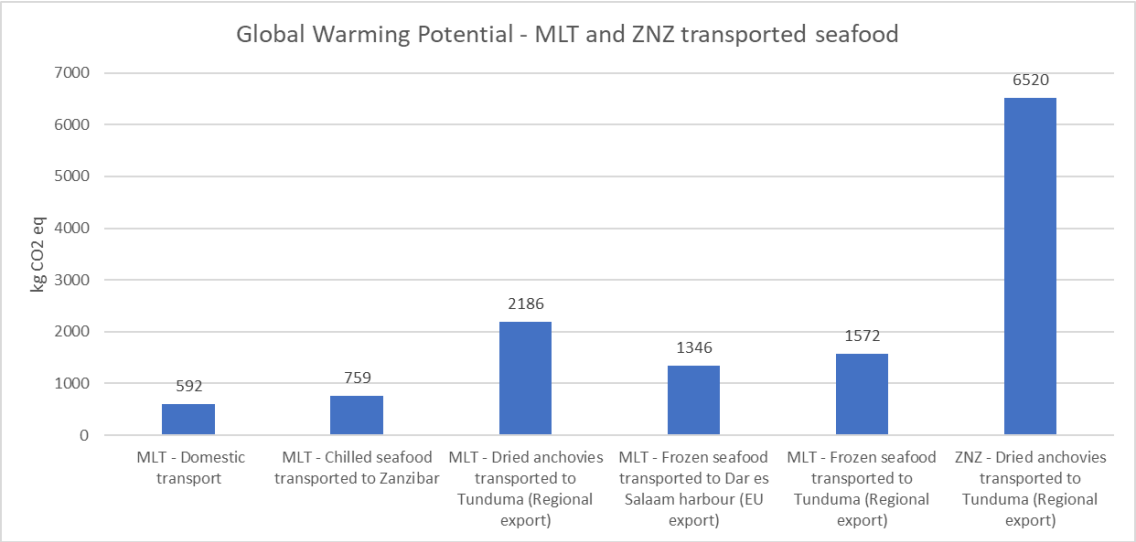


FIGURE 6.8 IMPACT ASSESSMENT OF TRANSPORTED SEAFOOD – GLOBAL WARMING – CHARACTERIZATION. RESULTS ARE REFERRED TO 1 T OF EXPORTED SEAFOOD.

6.4. Life Cycle Assessment Interpretation

Although some differences exist between MLT and ZNZ in terms of environmental sustainability of specific segments of the value-chains considered, in both geographical entities, the impacts associated with the value-chains analysed (fishing activities, processing, and export seafood) affect predominantly the AoP Human Health. As described in the previous sections, this is due to the amount of fossil fuels used for engine operations and other biomasses for processing (i.e., firewood, cooking oil) because of the GHG-related and particulate matter emissions. This general trend is in agreement with other similar VCA4D studies carried out in Mali and Gambia (Andres et al., 2020; Avadì et al., 2020).

Concerning the fishing activities, those having the highest environmental impacts (both on the AoPs and Global Warming Potential) are the ones having high FUI. To reduce the environmental burdens associated with URT fisheries, the engines should be upgraded with those having higher efficiency, as the ones currently in use seem to be obsolete and low efficiency, or better, hybrid or electric engines could replace the traditional/high-consuming ones (provided electricity is obtained from renewable energy sources). Also, the skipper's performance should be improved, for example through training courses and by the use of GPS to easily find the best fishing grounds and come back to the landing site straightforwardly, therefore reducing the amount of fuel required per trip at sea. However, this requires a thorough analysis regarding trade-offs between reducing fuel consumption and overfishing driven by reduced cost of fishing.

Together with the need of improving the efficiency of the fishing vessels, also observed by the fishers and other institutional people during interviews and meetings, for example at the Ministry of Blue Economy of ZNZ, close monitoring of its potential contribution to stock depletion is highly recommended, especially if the available information on the status of the targeted stocks is scarce. To the best available knowledge, targeted stocks seem to be all fully exploited (details in Section 5.3).

When considering the processing activities, the ones showing the greatest impacts are those using firewood and cooking oil for frying (MLT and ZNZ) and firewood for boiling (mostly for ZNZ). Indeed, the use of firewood has important environmental and health consequences (e.g., particulate matter and GHG emissions, but also deforestation if the wood fuel is cut). For example, from the data gathered during this study, in one year, firewood consumption in URT for processing seafood would amount to about 55 000 tons. However, in the case of ZNZ and MLT, it has to be kept in mind that the wood may not be directly cut but just collected from fallen trees (thus weighing less on the deforestation issue). The need for such types of processing procedures is tightly linked to the preservation need and thus of avoiding high post-harvest losses (both physical and nutritional losses). The general sanitary conditions of the landing sites and urban markets, together with the relatively low capacity of the Cold Chain System (CCS) and its poor territorial distribution, both in MLT and ZNZ, necessarily results in high rates of post-harvest loss, physical, quality and nutritional losses. An example is that of the anchovies and anchovy-like species value chain: being small species, they spoil rapidly if they are not dried within a short time. For this reason, they are immediately processed after landing. The processing

method of choice is drying, which takes at least one day during the dry season. During the rainy season, drying times become longer, or often drying cannot be carried out by traditional methods. Most of the catch, in this case, can be lost if no alternative processing is used: boiling before drying and frying the seafood that starts to spoil are then carried out to try to make up for the losses. Improved hygienic conditions and modernized infrastructure (ice machines, cooling, and freezing systems, and modern processing devices) would therefore be desirable in order to decrease or limit product losses, thus increasing the overall efficiency of the coastal fishery sector.

From the perspective of the environmental performance of the processing methods, frying using LPG appears to have fewer environmental burdens than frying using firewood. The initiative to install LPG frying stalls undertaken at the FFM could be extended to other urban market nodes throughout the URT. This would reduce damage to AoP and GHG-related emissions from burning wood, that is often mangrove.

Another aspect to consider is the fate of waste oil from frying. The analysis of waste is outside the scope of this study. However, an important initiative could be to search for solutions for the recycling and valorisation of this waste product, which has an important weight on the environmental impact of this sector.

The transport associated with fresh or processed seafood has no major environmental effects, compared to the other activities of the value chains. This appears to be similar to what was reported also for the Gambia fishery sector (Avadì et al., 2020).

6.5. Biodiversity

The URT belongs to the Western Indian Ocean (WIO) region and is characterized by a high diversity of coastal and marine ecosystems like coastal forests, salt marshes, seagrass beds, coral reefs, sandy beaches, cliffs, estuaries, mangrove forests, and muddy tidal flats that host a wide range of biological resources. This environmental and biological diversity plays a key role in supporting the socio-economic growth and livelihood associated with the small-scale fisheries. URT's fishery production shows an overall increasing trend over the last 12 years, with a slight inflection during 2015-2017 (FAO, FishStatJ, adjusted according to SeaAroundUs.org, Figure 2.3 in Section 2, Functional Analysis). However, Silas et al. (2020) noted a remarkable ~50 % reduction in terms of both catches per fisher and fishing unit from 1984 to 2016. The reasons underlying these observations can be multiple and act synergistically, and be identified, for example, as climate changes, habitat degradation, increased fishing effort, overfishing, and use of illegal fishing gears. Careful planning for the utilization and development of marine resources that are appropriate to the local cultural and socio-economic context, and that are within the limits of the natural carrying capacities, is essential to minimize the risks of environmental degradation (EcoAfrica Environmental Consultants, 2012a,b) and to ensure the livelihood of the coastal community.

6.5.1 Overview of national policies, instruments and interventions for coastal and marine environment conservation implemented in the URT

The management of marine fisheries is regulated by different policies at the institutional level of Tanzania mainland (Ministry of Livestock and Fisheries), Zanzibar (Ministry of the Blue Economy and Fisheries), and the Deep Sea Fishing Authority (DPSA), the latter focuses on the management of offshore tuna fishery. There is a range of policies, laws, and agreements promoting the conservation and management of marine and coastal resources in mainland Tanzania and Zanzibar. A non-exhaustive list of these policies has been already presented in the Table 2.10, in Section 2, Functional analysis (and in Appendix 2C, Functional Analysis). It includes measures directly aimed at the conservation of marine ecosystems and biodiversity and those that indirectly target them (EcoAfrica, 2012a,b; Yahya, 2021). The URT has also ratified several international conventions and protocols aimed at the sustainable management of marine resources and ecosystems (Table 2.11, in Section 2, Functional analysis, and in Appendix 2C, Functional Analysis).

The most common instruments implemented for marine resources' conservation and sustainable use are, for example, Marine Protection Areas (MPAs), spatial and temporal fishing closures, bans on dynamite fishing or other destructive/illegal fishing gear. Examples of research programs and other initiatives are also listed below.

- **MPAs**

A Marine Protection Area (MPA) is defined by the IUCN as "any area of inter-tidal or sub-tidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment."

The primary objective of MPA is biodiversity protection. Other main functions of MPAs (Marine Conservation Areas (MCAs) in Zanzibar) are i) protection of ecosystems functions and services through the appropriate use of fisheries resources and habitats, ii) mitigation of the negative impacts of fishing (e.g., overfishing) and other anthropogenic activities on marine resources, iii) regulation of fishing methods (destructive fishing activities and use of appropriate mesh sizes of the nets), iv) empowering on the use of coastal and marine resources (Machumu and Yakupitiyage, 2013; Machumu, 2021; Yahya, 2021).

MCAs and MPAs are regulated by the Marine Parks and Reserves Act, 1994 (Act No. 29 of 1994) in Mainland, with the establishment of the Marine Park and Reserve Unit (MPRU), and by the Environmental Act in Zanzibar (1996, 2015), with the establishment of the Marine Conservation Unit (MCU). These regulations aim the guidance on MPA/MCA management and administration.

In Tanzania mainland, 3 formal MPAs and 15 Reserves are present (a total area of 2142.57 km2) (Machumu, 2021). In MLT, non-formal MPAs, known as Collaborative Management Areas (CMAs) are also present. The CMAs are based on participatory resource management (co-management) among local communities, principally through the establishment of Beach Management Units (BMUs) (also discussed in Section 5, Social Analysis). In Zanzibar, 6 formal MCAs are present (total area= 2281.7km^2, about 85% of Zanzibar landing sites belong to MCAs, (RGoZ, 2020, Yahya, 2021, IUCN, 2020). Zanzibar does not have non-formal MPAs. In Figure 6.9, the spatial distribution of MCAs and MPAs in MLT and ZNZ, respectively, is depicted. The list of MPAs and MCAs for MLT and ZNZ are given in Supplementary Table 6.10 and 6.11. Participatory approach is the basic guiding principle for establishment of MCAs and MPAs. The thrust is placed on co-management among local community members and other key stakeholders who are involved at different levels of management such as planning, decision-making and implementation of conservation activities, benefit-sharing, and evaluation (Machumu, 2021; Section 5 Social Analysis).

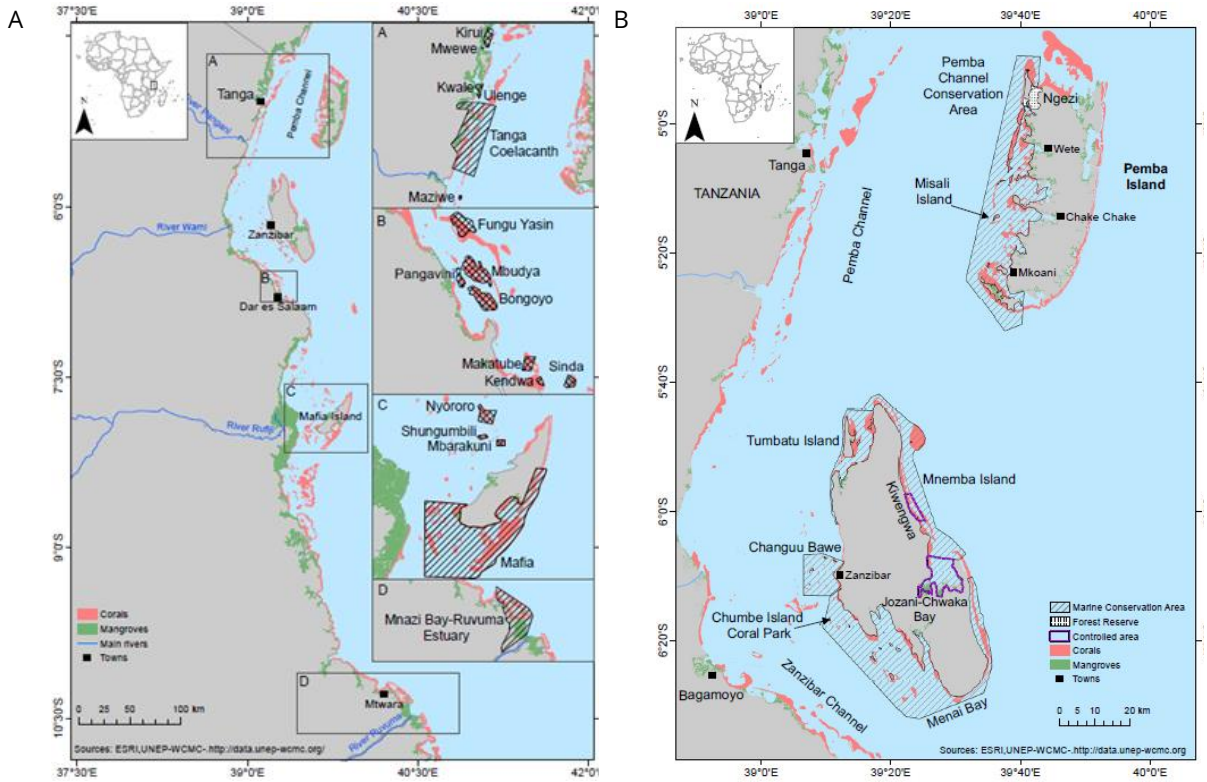


FIGURE 6.9 A) TANZANIA MARINE PARKS AND MARINE RESERVES. SOURCE: MACHUMU, 202; B) ZANZIBAR MARINE PROTECTED AREAS. SOURCE: YAHYA, 2021

- **Fishing closures**

Temporal and/or spatial closures of the fishing grounds are among the input controls that can be implemented for the conservation and sustainable management of marine ecosystems. The fishing closures have to be planned according to the level of fishing mortality appropriate to the status of the target stock or management unit. In Tanzania, fishing closures have been established for octopuses and prawns.

The first attempt in the URT of octopus closing schemes has been carried out in Pemba, Zanzibar. This pilot study was implemented by the NGO Mwambao in 2015. The site chosen for this attempt was Kisiwa Panza, within the PECCA (Pemba Channel Conservation Area) marine area. After the success of the octopus closure period in Pemba, this model was applied in the mainland Tanzania. In November 2017, the octopus fishery closures was initiated by WWF Tanzania in collaboration with the Government, local communities, and the private sector. Following the example of Pemba, the three-month fishing closure period initially covered the reef within the Songo Songo Island fishing area. At the end of the closure period, four days of octopus fishing yielded almost 11 t, worth 43,284,000 TZS. Given the success of the first attempt, a second closed fishing period was conducted from May to August 2018. This second attempt yielded 19 t of octopus, worth 77,088,000 TZS. Due to the success of the closing periods, this scheme has been extended to other locations: Somanga and Songomnara communities in Kilwa District and Jojo and Banja communities in Mafia District (https://www.wwf.mg/?333165/Fishers-in-Songosongo-reap-millions-from-octopus-fisheries).

Closed periods undoubtedly bring numerous benefits to fishermen (at least to the majority, although some were complaining about the higher competitiveness during the re-openings) and the octopus population targeted by the closure. The closures in fact allow the restoration of the habitats concerned and the rebuilding of exploited stocks by precluding fishing activities during spawning periods and at spawning sites, allowing individuals to grow to marketable size (500 g).

In Songo Songo, there are two closed periods each year for octopus fishing. One during the southern monsoon period and the other during the northern monsoon. Despite the many benefits of the closed period, from a management point of view, the re-opening days can be costly. For three days, a large number of military or civilian personnel are employed for sea patrolling, carried out with two fiberglass boats.

According to one respondent, the closure during the northern monsoon season could not be strictly necessary: due to high seawater and air temperatures and the development of algal blooms, octopuses tend to move to deeper areas of the reef, accessible only to divers. Fishing pressure is therefore not high during these periods. In contrast, during the period of the southern monsoon, the establishment of a closed season is seen as more appropriate. It is important to note that during the reopening days, there is a large influx of fishers, even from very distant areas. The high influx in limited areas could lead to physical damage to the barriers, especially by foot fishers.

Between 1988 and 2007, the prawn catches in mainland Tanzania experienced a marked declining trend, a sign of unsustainable exploitation levels, at the point that the Government, in agreement also with the private sector, declared a moratorium on industrial prawn fishing between 2007 and 2017. A few years after the lifting of the moratorium, the revised Prawns Fisheries Management Plan 2022-2027 has been developed (URTMLF, 2021b). In view of fulfilling the plan's mission of ensuring that fishery resources are developed, managed, conserved, and utilized in a sustainable manner for economic growth and improved livelihoods, the PFMP aims to implement a number of measures, including closed seasons for prawns fishing. The main stakeholders, i.e. fishes from the communities involved in the prawn fishery, participated in consultations to determine the modalities of the fishery closures. The majority of the stakeholders agree with the closed season regime, although they strongly suggested the review of the timing. In fact, the prawn populations located at different fishing grounds can have different biological characteristics (for example, different reproductive periods, life cycles, and oceanographic conditions). However, given that precise scientific data on these topics are currently lacking, TAFIRI would maintain the precautionary approach and suggested maintaining the closure periods regime (URTMLF, 2021b).

- **Ban illegal fishing methods (dynamite fishing or fishing gear)**

Some fishing gear has been declared illegal, both in mainland Tanzania and Zanzibar. Their use is especially controlled within the MPAs. For example, dragnets, beach seines, and spearguns are among the banned fishing gears. In addition, for the other types of nets, the definition of the mesh size of the permitted fishing nets is established. However, the use of illegal fishing methods is still reported both in MLT and ZNZ. For example, the Zanzibar Fishery Frame Survey 2020 (MoBEFZ, 2020a) reports that 7% of the total number of fishing gears used in the ZNZ archipelago are illegal, and remarkably they are also used within the MPAs. The same applies also to the MLT.

Dynamite fishing has been practiced in Tanzania since 1960s and, although banned in 1970, it is still currently practiced (but in decline). Given that mining is a predominant activity in Tanzania, there is easy access to explosives, which are considered to be cheap and more efficient than the traditional fishing methods. Dynamite fishing is highly destructive and can seriously harm the critical habitats where it is deployed, their biodiversity, and the fishers. With the aim of making enforce the ban on these destructive fishing practices and other environmental crimes, the government has established the Multi-Agency Task Team, which involves officers from different ministries. The dynamite fishing practices have been reduced to a great extent along the coast, but the total control of this practice and its disappearance has not been reached yet. Other illegal practices damaging biodiversity and sensitive habitats are still in use. For example, trawling, mangrove cutting (Torell et al., 2007), use of monofilament nets. Ghost fishing (i.e., fishes or other marine organisms trapped in abandoned/lost fishing gears, such as traps, nets, or lines) is another important issue to be monitored.

- **Programs and research projects**

NGOs and academic and private institutions operating in the URT's territories aim at limiting the degradation of and improving the environmental status of marine ecosystems and people's living conditions associated with the rich biodiversity and marine coastal fisheries activities. Among them, it is worth mentioning institutions such as "Maricultures" (https://www.marinecultures.org/en), "Mwambao" (https://mwambao.or.tz/), and the "World Fish Center" (https://www.worldfishcenter.org/about-us), WWF, WIOMSA, TAFIRI, the University of Dar es Salaam and Zanzibar, and the World Bank. All these organizations have projects and initiatives in ZNZ, and in MLT. These programs and initiatives aim at supporting people in developing sustainable aquaculture to reduce the pressures on fish stocks, setting up sponge culture as an alternative income-generating activity (AIGA), protecting and restoring coral reefs (e.g., Reefball project), conserving fish stocks (Octopus and co-management capacity project in Pemba), protection of marine mammals from being accidentally trapped in fishing nets (Pinga project, Institute of Marine Science, University of Dar es Salaam in ZNZ) , building awareness among fishers and other stakeholders on the effects of the use of destructive fishing methods (Community Blast-fishing monitoring network), enhance the role of fish in national food and nutrition security agenda, enhance governance of coastal small-scale fisheries, investment and policy research to increase women and youth participation and benefits derived from aquaculture and aquaculture-related activities, improve the management of fish stocks (support in the drafting of management plans, e.g., DFD, 2019a-c, PECCA General Management Plan, and fish stock assessment for small pelagic being carried out by TAFIRI). The SWIOFISH project was financed by the World Bank for improving the management of selected fisheries in the WIO, included the ones of the URT. Under the Nairobi Convention, the following projects have been implemented: "Strengthening community-based EBM approaches in Subsistence and Small Scale Artisanal Fisheries for Sustainable livelihoods and Management of Pemba Channel Conservation Area, Zanzibar, Tanzania" (https://www.nairobiconvention.org/clearinghouse/node/702) and "Developing collaborative management plan and sustainable mangrove restoration model in the Rufiji Delta, Tanzania" (https://www.nairobiconvention.org/clearinghouse/node/536). Indeed, mangrove forests deserve to be carefully monitored and managed because of the multiple ecosystem services they provide: shoreline stabilisation, erosion protection, they prevent coral reefs from silting up by trapping sediment, build up soil through the accumulation of silt and debris, and absorb pollutants transported from land. In addition, as far as the fishery sector is concerned, mangroves provide shelter, food and breeding grounds for a wide variety of fish, shrimps and molluscs (oysters), being therefore recognized as vital for small-scale fisheries. Mangroves have also a remarkable role in the carbon sequestration potential.

Some of these research programs are aimed at finding solutions (often technological tools) to make fishing activities more sustainable. One example is the "Pinga project" that developed and tested an experimental device to be installed on the fishing nets for enabling dolphins to detect them and avoid being trapped (N.

Jiddawi, pers.comm.), Although highly appreciated by the communities, after the end of the project, the use of this device could not be implemented by the fishers because of the lack of economic resources to build/buy the device.

Other interventions aimed at promoting biodiversity conservation are:

- VFC (and maybe BMU) train fishers on the importance of conservation;
- VFC and (maybe BMU) get training from Fisheries departments and NGO (Mwambao);
- Under The Wave is a Non-Profit Organization located at Matemwe, rewarding people who report turtle nests on the beach in order to secure them.

6.5.2 Threats to ecosystems and biodiversity and fishers' perceptions of fisheries resources

Threats to biodiversity in the URT can be identified mainly in human activities and human-induced factors. Among human activities, mangrove cutting, use of illegal and destructive fishing gears and tourism-derived outcomes (habitat loss, deforestation, impeded access to land, pollution), absence of good management, unplanned coastal development and poor awareness education and destruction or degradation of fish spawning and nursery grounds, and feeding areas are perceived as the most important ones (AFDP, 2020; Torell et al., 2007, data from field missions). Other factors include the effects of climate changes: during 1901-2012, WIO's seawater temperature rose up to 1.2 °C, compared to an increase of 0.7 °C in other parts of the Indian Ocean. Projected changes include an additional increase of 1° C by 2100. Sea level along all Indian Ocean coasts has increased by about 13 cm since the1960s (AFDP, 2020) and it continues to rise. The effects of sea level rise include increased sedimentation and influences on coastal fish species due to the loss of intertidal areas which act as important nursery areas for both resident and migratory species. It also causes saltwater intrusion in groundwater, especially in the case of low-lying islands (Magnan et al., in press). Sea level rise in the WIO does not receive complete acceptance. Some sources indicate that the sea level in WIO is rising (Magnan et al., in press), other sources mention that it has risen in the MLT but not in ZNZ (AFDP, 2020), and others that seawater level rise has not been observed in some regions of the MLT (Beymer-Farris et al., 2019).

The increased frequency of extreme climate events (tropical cyclones, storm surges and flooding, heavy rainfall, changes in currents and winds' patterns) has been also observed in the last years. One of the consequences of climate change is also coral bleaching phenomena, decreased coral coverage, and changes in the biological communities (corals, fishes' migrations) (AFDP, 2020; Cinner et al., 2012).

Specifically concerning the threats that the fishery sector has on the marine ecosystem and biodiversity, the JRC work carried out in the frame of this VCA4D study on the potential impacts of fisheries (only anchovies, mackerel, sardine and tuna) on the maintenance of biodiversity in Tanzania (JRC, 2022), based on the maps produced by Kuguru et al., 2022, highlighted that the fisheries analysed potentially impact 6 threatened mammal species, 3 threatened bird species, 46 threatened shark species and 43 threatened coral species, given that these fisheries operate in areas where these species are found and due to the fact that the fishing activities intersect 161 protected areas (both MCA/MPA and coastal and terrestrial protected areas). According to the JRC report, threatened mammal species include three endangered species (the sei whale *Balaenoptera borealis*, the blue whale *Balaenoptera musculus*, and the Indian Ocean humpback dolphin *Sousa plumbea*) and three vulnerable species (the *Dugong dugon*, the common *Hippopotamus amphibious*, and the sperm whale *Physeter macrocephalus*). Threatened bird species comprise two endangered species (the Cape gannet *Morus capensis* and the Madagascar pond-heron *Ardeola idae*) and one vulnerable species (the Matsudaira's storm-petrel *Hydrobates matsudairae*). Threatened shark species include 12 critically endangered species, 15 endangered species and 19 vulnerable species. Threatened coral species are all vulnerable species.

Other negative impacts of activities on marine ecosystems and biodiversity are the use of destructive fishing gears, ghost fishing, illegal seafood harvest and trade, touristic activities that damage coral reefs.

Silas et al. (2020) reported that fishers perceive overfishing and environmental changes related to climate changes as the major reasons behind the decline of fishery in URT (Figure 6.10).

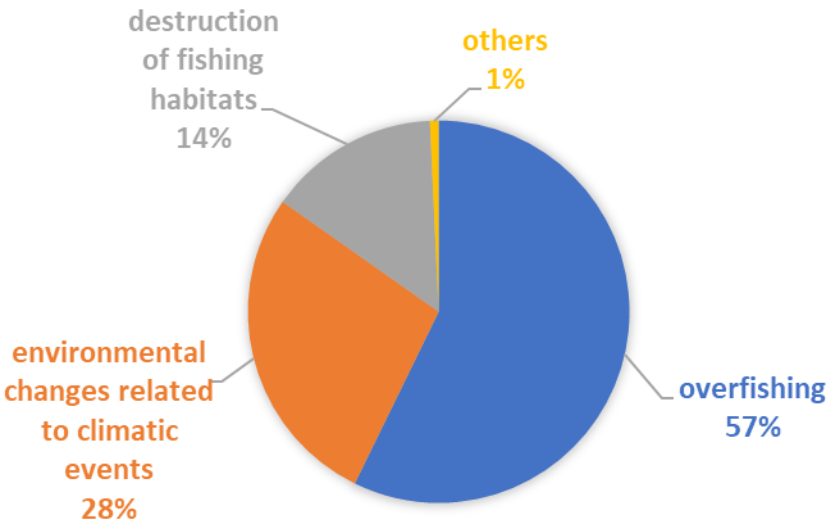


FIGURE 6.10 REASONS FOR FISHERY DECLINE OVER THE PAST DECADES IN TANZANIA ACCORDING TO THE PERCEPTION OF THE INTERVIEWED FISHERS (FROM SILAS ET AL., 2020)
Legend: Environmental changes include unpredictable rainfall patterns, drought and increased sediment load to estuaries in intense rain periods.

The decline of the marine coastal fisheries has been reported by most of the interviewees also during the field missions. Similar testimonies to those reported in Silas et al., (2020) and perceptions about the underlying causes were collected:

- overfishing: the number of fishers is increased, even in small areas, because of the lack of alternative opportunities;
- capture of juvenile stages of several species (also observed at the auctions);
- the increased pressures on the marine and forestry resources can be the cause of the declined catches. The government should do something to address these problems (e.g., employment),
- climate change: fishers reported that sea conditions are more difficult nowadays, the sea is more turbulent. This makes fishing activities very dangerous for fishers and problematic for the maintenance of fishing equipment that is damaged, lost or their lifespan reduced (e.g., traps);
- during periods of heavy rainfall, the concentration of salt in the sea drops and this affects the seagrasses on which the fish feed. The fish stock is reduced and therefore the catch suffers;
- due to seawater temperature rising, fishes are leaving the coastal areas, moving more offshore, and fishers do not have the capacity to fish offshore;
- again: lack of appropriate equipment to go fishing far from the coast (boats and fishing gears), need for technological devices such as GPS and fish finders.
- other reasons reported were associated with the touristic facilities that discharge the waste waters into the sea, thus damaging the ecosystem by reducing the water quality and also the use of illegal fishing gears. These factors make fishing/aquaculture activities suffer, e.g., for seaweed farming. Touristic activities have been reported also to disturb the fishing practices, for example, because of the destruction of gears or damages to the reefs.

6.5.3 Fish stock status

For Tanzania, there are no stock assessment studies for any of the target species analysed in this work. TAFIRI has recently started the stock assessment for small pelagics. Given the lack of updated data, the status of fish stock presented in Table 6.13 relies on the only available information (FAO Fisheries Resource and Monitoring System and WIOFish Western Indian Ocean Fisheries Database), which can be outdated.

Sub-chain	Target species	Assessment	Comment
Large Pelagic	Tuna and tuna-like species	(a-c) Overexploited (Yellowfin tuna, Narrow barred Spanish mackerel); Not overexploited, but some subjected to overfishing (Albacore tuna, bigeye tuna, skipjack tuna, kawakawa, swordfish); Unknown (others) Two coastal tuna stocks have been classified both as overexploited and not overexploited by the (c)	For some species (overexploited), increased fishing pressure has been observed. For this species should be recommended to reduce the catches. For other species (subjected to overfishing), as a precaution, is recommended to reduce the catches and closely monitor the stocks to inform of the potential increase/decrease of stock productivity. There is insufficient information to evaluate the stock status of other target species and the effect that the fishery can have on the resources. In addition, given that large pelagic represent a common stock between MLT and ZNZ, it is highly desirable that the two Governments put in place a common stock management plan.
Small Pelagic	Anchovies, sardines, Indian mackerel	(a, b) Moderately to fully exploited (d) not possible to determine	Pending the formal stock assessment that is being carried out by TAFIRI, and given the lack of consistent information, as a precaution, it is recommended to reduce both the fishing effort and the catches. In addition, given that small pelagic represent a common stock between MLT and ZNZ, it is highly desirable that the two Governments put in place a common stock management plan.
Reef Fish	Lethrinidae, Scaridae, Siganidae, Nototheniidae, Carangidae	(a, b) Fully exploited (c) both overexploited and non-overexploited	Given the inconsistency of available information and lack of assessment, it is recommended not to exceed the current fishing pressure but closely monitor the resources.
Octopus	Mainly *Octopus cyanea*, also *O. vulgaris and O. aegina*	(b, d) Overexploited, Although (c) not overexploited	It is recommended to closely monitor the catch volumes and reduce fishing pressure by extending the closure periods to other reefs.
Prawns	Mainly *Paneus indicus* and *P. monodon*	(b) Depleted/ (d) overexploited	This assessment (b) is outdated. The trawler prawn's fishery has been closed for 10 years (2007-2017), as the stock was severely depleted. In 2017, the closure was suspended, but fishing is only allowed for six months of the year. A management plan for the prawns fishery was recently published (URTMLF, 2021b). In it, it is proposed to maintain the closed seasons and completely close the Rufiji River Delta area, the most important area for the shrimp stock, to fishing. However, some propose differential closures for different fishing areas, in accordance with the biological differences of the species. In the absence of supporting scientific data, it is advisable to maintain time closures of the fishery and not to exceed fishing effort.

TABLE 6.13 EXPLOITATION STATUS AND RECOMMENDATIONS FOR THE SUB-CHAINS UNDER INVESTIGATION

Data source: a) https://www.wiofish.org/explore-fisheries (ref. year up to 2016), b) http://firms.fao.org/firms/resource/browse-inventory/en (ref. year 2009), c) AFDP (2020), MoP-07-23 (Meeting of the Parties of the South (MoP7) - Indian Ocean Fisheries Agreement, November 2020), d) Silas et al. (2021)

6.6. Conclusions and key issues

Please note: with regard to the Core Questions CQ4.1-4.4, it should be reminded that all comparisons refer to the *functional unit* (reference unit volume of seafood to which the damages to the AoP and Global Warming Potential refer to) used, i.e., 1 t of landed fish; 1 t of processed seafood. Therefore, the comparisons made are for example 1 t of octopus vs. 1 t of finfish (considering the fishing methodology); or 1 t of fried seafood vs. 1 t of dried seafood vs. 1 t of frozen seafood.

The potential damage **AoP Resource** focuses on abiotic resource depletion. Fuel use is the largest contributor to potential impacts. In fact, the highest potential damages to this AoP are exerted by those fisheries using motorised fishing vessels: those octopus divers and foot fishers using a vessel to reach the fishing grounds in MLT and finfish longliners in ZNZ. For both MLT and ZNZ, the fishery that follows in contributing most to the damages to the abiotic resources is the finfish ringnetters. These potential damages are associated with the extraction of fossil fuels.

Concerning the processing phases, in MLT the highest potential damage to abiotic resource depletion is found in the frying with LPG processing activity. This activity relies on fossil fuel extraction at the levels of the supplying fishing activity, use of LPG as fuel, and cooking oil manufacturing. In MLT, the freezing processing also results in damages to resources, due, also in this case, to the supplying fisheries together with the use of electricity (Tanzania country-mix) and polyethylene (derived from petroleum) materials for the packaging. The use of vegetable oil is the main driver of damage to Resource in the case of frying using firewood. For the ZNZ processing activities, the highest damage to Resource is given by the frying and sun-drying processing. Besides the supplying fishing activities, the use of cooking oil is a relevant driver to damages for the frying processing, while the main contribution to damages for the sun-drying processing is given by the supplying fishery (the drying itself does not lead to major damages, since the drying processing is done by simply spreading the seafood under the sunlight, and the use of tarpaulins is the only contributor to abiotic resource depletion).

Water used for producing ice does not seem to contribute to the damage to resources, because of the little amount of ice used compared to other inputs. However, if there will be an improvement of the cold chain system and therefore an increased consumption of ice for prolonging seafood lifespan, the water used would deserve to be re-assessed.

The fishing activities that show the highest potential damages to the **Ecosystem AoP** are, similar to the Resource AoP, the octopus fishery diver and foot fisher using motorised vessels for MLT and finfish longliner in ZNZ. For both MLT and ZNZ, the finfish ringnetters present quite relevant potential damages to Ecosystem AoP. The main driver of such results is again the use of fuel for engine operation, which contributes to the ecotoxicity and eutrophication of terrestrial and aquatic ecosystems. When considering the processing activities, both in MLT and ZNZ, the frying processes are the ones having the highest potential impact on the AoP Ecosystem. This is due to the use of cooking oil, whose production leads to ecotoxicity and eutrophication of terrestrial and aquatic ecosystems. In ZNZ, also the sun-drying processing shows relevant damages to the AoP ecosystem because of the use of firewood. It has to be pointed out that firewood consumption during processing operation has been modelled using a specific inventory item (bundle-energy fuel), but likely, a share of the firewood used is not actively cut, but simply harvested from the ground. A specific investigation regarding the use of firewood in both MLT and ZNZ is recommended.

Human health is potentially the most impacted AoP both in MLT and ZNZ and for all the value chains' segments. This is linked to the pollutants and molecules (GHG and particulate matter) emitted mainly by the manufacture and combustion of fuels, and cooking oil manufacturing and combustion of firewood in the case of boiling and frying (the processing methodologies with the highest potential damages to Human Health). For example, firewood-related emissions are significantly higher than the LPG ones (Supplementary Figure 6.2). GHG- and particulate matter emissions are linked to particulate matter formation, tropospheric ozone formation, stratospheric ozone depletion, global warming, and ionizing radiation, which combined together result in increased respiratory diseases and various types of cancer.

The LCA methodology does not allow for the assessment of food safety and the health risk to consumers and a specific study on the loss of nutritional quality of the seafood according to its freshness and type of processing would be of interest.

The **Global Warming Impact category** appears to be most affected by those activities using fossil fuels, e.g., for engine operations for fishing activities: those contributing most are, as expected, those associated with the highest FUI. Among MLT motorized fisheries, the least efficient ones in terms of Global Warming potential are the motorized octopus fisheries (about 1000 kg CO_2 eq/t landed seafood=1 kg CO_2 eq/kg landed seafood; FUI=395); while among ZNZ fisheries, finfish fisheries using longline is the one with the highest CO_2 eq emissions (1071 kg CO_2 eq/t landed seafood=1.07 kg CO_2 eq/kg landed seafood; FUI=400). GHG-related emissions' trends (within a certain degree) similar to the above-mentioned are reported by Parker et al. (2018), who averaged various fishing activities worldwide according to the fishing sector, and give values of 2.8 kg CO_2 eq/kg landed cephalopods (without specifying the species or the fishing methodology) and 1.9 kg CO_2 eq/kg landed pelagics > 30 cm (comparable to the category Finfish of this study). For the sake of comparison, the Global Warming Potential of beef production (without bone, in UK) is 23 kg CO_2 eq./kg food; that of chicken in UK is 6.6 kg CO_2 eq./kg food, that of farmed salmon in Canada is 3.6 kg CO_2 eq./kg food and that of soybeans in Brazil is 0.38 kg CO_2 eq/kg product (González et al., 2011).

Concerning the processing activities, the highest Global Warming Potential Impacts are associated with the frying with firewood process in MLT, and with boiling and drying, and frying processing in ZNZ. These results are tightly linked to the GHG- and particular matter-related emissions of firewood combustion.

Actions aimed at improving the efficiency of the fishing and processing activity, for example by boosting the transition towards hybrid or electric engines, switching to more efficient ovens/kilns for boiling/drying and frying and spreading the use of LPG cooking systems (thus reducing the firewood consumption used in low-efficiency braziers, as currently occurs) would be helpful for reducing the impact of the fisheries sector to the Global Warming Potential. Indeed, this should be combined with the improvement of the cold chain system and enhances electricity distribution from renewable energy sources, which would help to prolong the shelf life of the seafood, thus reducing the need for processing.

Assessing the impacts of the fisheries sector related to **biodiversity** is not easy with the available information.

The problem of weak reporting of landed products and the absence of up-to-date information on the status of fish stocks makes it difficult to understand whether Tanzania's artisanal fisheries have a major impact on the stocks of marketed species.

From the scarce available information, however, it would appear that almost all stocks are fully exploited and some are overexploited. This information, together with that commonly reported by fishers interviewed during the field missions and by other authors, gives indications that 'there are no more fishes'.

This may be the result of multiple causes that may act synergistically: increased numbers of fishermen resulting in decreased CPUE; use of destructive fishing systems or practices (mangrove cutting, construction of tourist resorts) that can damage sensitive ecosystems and habitats and lead to quality degradation of, for example, coral reefs, seagrass beds, mangrove forests, thus compromising spawning, nursery and foraging environments for many species; climate change that causes species to migrate (e.g. further offshore) or leading to shifts in community composition.

To solve the main issue, i.e., lack of information on stock status, in the absence of financial resources and time to perform a stock assessment, it would be necessary to generate knowledge and deepen the existing data on, for example, fishers, catch per unit effort, annual yields per unit areas (e.g., as explored in Kuguru et al., 2022), the average length of fishes caught (and register the fishing of juvenile specimens). In a few words, it is recommended to improve the flow information system.

7. SYNTHESIS AND RECOMMENDATIONS

7.1. Answering the framing questions

7.1.1 Functional analysis

Two distinct systems were described in the functional analysis in Mainland and in Zanzibar as the coastal fisheries sector are managed separately by the Ministry of Agriculture and Fisheries in Mainland, and the Ministry of Blue Economy in Zanzibar. Within each region, the functional analysis described the value sub-chain systems:

- Anchovy-like small pelagic, other finfish, octopus and prawn in Mainland,
- Anchovy-like small pelagic, other finfish, and octopus in Zanzibar.

Given the complexity of the two systems and their peculiar characteristics, the data and the analyses at the sub-chain level were disaggregated for MLT and ZNZ. These findings were later consolidated to provide an overall analysis of the economic, social, and environmental sustainability of coastal fisheries at the level of MLT and ZNZ.

7.1.2 FQ1: What is the contribution of the value chain to the economic growth?

Over 50 operations, operational costs units were processed in the economic analysis for MLT and the same number for ZNZ, this resulting in high a range of results, for actors, sub-chains, and regions. However, when consolidated at the actor levels, sub-chains and regional systems, general trends are emerging which are hereunder highlighted:

Profitability & Sustainability of key actors

The fishers profitability, expressed by the individual fisher's monthly income varies between 62-756 USD/month in MLT and 42-288 USD/month in ZNZ, depending on the métier, the fish landing price and the catch volume. Some crew members are potentially vulnerable, with a revenue below a minimal wage of 80-130 USD/month. The most critical cases are related to the purse seiners, targeting anchovy-like small pelagic in ZNZ and in MLT, with potential estimated monthly incomes around 50 USD/month or less.
When the boat is motorized, the fuel cost represents 27 % (when a sail is also used) to 94 % of the total of the Intermediate Goods and Services (IGS) costs for cases associated to fiberglass boats, ring-netters or purse seiners, making this fuel cost a key factor for profitability in fisheries. Consequently, good pricing of the landed fish coupled with high trip catch rates are conditioning the profitability of ring-netters, fishers using motorized fiberglass boats and purse seiners, although this observation is less obvious in MLT. The profit generated by the boat owners (as expressed by the Return on turnover, NOP/Output in %) varies from 4 % to 36 %. In both MLT and in ZNZ, the Return on turnover for boat owners is better in situations of artisanal fisheries using sails, as investments and operational costs are lower.

The profitability of traders and processors is varying according to the sub-chain, the region and the sub-categories identified in both regions. Returns on turnover range from 12-39 % in MLT traders and processors, and 2-30% in ZNZ traders and processors. Monthly incomes generated for the MLT traders and processors are within the range of 144-1,564 USD and 332-49,598 USD for traders and processors, respectively, depending on the sub-chains and the sub-categories of actors. Monthly incomes generated for the ZNZ traders and processors are lower, within the range of 102-545 USD and 72-332 USD, respectively.

The lowest profitability and most vulnerable groups are found in the categories of artisanal processors, or small-scale traders, particularly when the fish landing price is increasing and the gross potential margin getting tighter for these actors. In MLT, the highest profitability rates are found in the sub-chains where industrial processors are operating for the export market in Europe (Octopus sub-chain): 22% for the traders, and 39% for the processors. In ZNZ, the highest Returns rate on turnover (28%) are found in the category of traders-exporters of dried anchovy to the regional foreign market, and to a lesser extent in fish importers or traders dealing with tourism market, hotels.

Total effects within the MLT and ZNZ economies

The importance of Indirect VA (i.e. the VA generated by the supplies of goods and services to the actors of the VC) expressed through the Driving effect ratio (Indirect VA / Direct VA) is very similar between the two regions,

indicating quite high a rate of integration of coastal fisheries in the local economy in MLT, and in ZNZ, although this observation may be lower in some sub-chain, for instance the Octopus sub-chain in ZNZ.
The contribution of coastal fisheries in MLT, and of fisheries in ZNZ, to the GDP (national and agriculture) is higher than the official figures, because of the addition of indirect effects and because of the overall methodology of the VCA4D economic analysis.

- ✓ In MLT, the estimations of the relative contribution of costal fisheries to the GDP, and the agriculture GDP are 0.29% and 1.07%, respectively, slightly higher than the official reported figures. Our estimate of the Total Value Added represents more than 16% of the estimated GDP due to the national fisheries contribution in MLT. If reported to five coastal regions (including Dar-Es-Salaam), our total VA estimate is closed to 1% of the GDP of the coastal regions in MLT.
- ✓ In ZNZ, the direct contribution of the fisheries value chain to the economy is in the order of magnitude of the official statistics. The estimation of indirect effects allows a significant addition of added value to the ZNZ economy as compared to the current official estimations of the fisheries value added. As a result, the total contribution of the fisheries VC to the overall ZNZ economy (GDP) is **6.32 %** and to the agriculture GDP is **30%** .
- ✓ For the URT (summing MLT and ZNZ findings), the contribution of coastal fisheries VC to the URT GDP is 0.46% and 1.74% of the Agriculture URT GDP.

The public fund balance (tax income minus subsidies) is positive for the two systems, MLT, ZNZ, as no subsidies were encountered in our calculations. It is also very likely that the tax collection is not optimized in both regions. Total imports of goods and services by the actors of the VCs are within the same range of 10-11% of the total Production for both. Total exports are reported to be 50,5562 MTZS in MLT and 53,414 MTZS in ZNZ, resulting in a slightly negative balance of trade for MLT, and positive for ZNZ. The overall resulting URT balance of trade is positive in the Tanzanian economy mostly because of the ZNZ dried anchovy exports to the foreign regional market.

Comparison of sub-chains

In both regions, the Finfish sub-chains (reef fish, medium-large pelagic fish) captures more than 2/3 of the Total VA in MLT. The Anchovy-like, Octopus and Prawns sub-chains share 11%, 14% and 7% of the Total VA, respectively in MLT. The importance of frozen octopus and prawns as exports of high value products is, however, highlighted through the other economic performance indicators. In ZNZ, the Anchovy-like, and Octopus sub-chains share 25%, and 4% of the Total VA, respectively. However, the Anchovy sub-chain displays a profile with stronger overall economic performances.
From an overall economic growth perspective, all the considered value sub-chains in both systems MLT and ZNZ are playing major and complementary roles. For instance, the Octopus and Prawn sub-chains in MLT are not as significant in terms of Direct VA when compared to the Finfish sub-chain. But they are balancing the balance of trade, through the export figures, and become therefore quite crucial from a macroeconomic perspective. In ZNZ, such significant balancing role is also played by the Anchovy-like sub-chain, because of the very significant export trades.

Many interactions are encountered between the two regions, at all levels of their coastal fisheries value chains, influencing the economic findings, this major observation advocating for more cooperation between MLT and ZNZ with regard to coastal fisheries management.

7.1.3 FQ2: Is the economic growth inclusive?

Income distribution along the value chains

Overall, these estimated monthly incomes compared to a reference minimal wage (130 USD/month) and previous studies (Ibengwe et al. 2022; Linton, 2021; Sofreco, 2018; Stanek, 2015) range from are 0.5 to 4 times this rate.

The lowest monthly incomes are observed in ZNZ, the fishers (purse seiners) or artisanal processors of finfish (around 50 USD/month). The highest income is seen in the industrial processors in MLT. But this last finding must be refined by the exact total number of employees in those factories.

The share of the fisher's landing price in the final end-user price, widely varies, among sub-chains and the two regions, ranging from 9 % (Anchovy in ZNZ) to 56 % (Finfish and Octopus in ZNZ), and between 14% (Anchovy ML) to 41 % (Finfish FF3) in MLT, indicating here again a potential higher inequality on the sub-chains.

Gini coefficients

Overall, our study shows that the Gini's coefficients are indicating less inequality in MLT, as compared to ZNZ. The best Gini's coefficients are found in MLT finfish sub-chains (0.5216), particular in the low value finfish sub-chain ("FF1") mostly covering the fisheries of medium pelagic and reef fish, for local markets. The "worst" Gini coefficients are seen in ZNZ, in the Anchovy-like sub-chain and in the Octopus sub-chain; 0.8566 and 0.8482, respectively. However, all the explored sub-chains are displaying Gini's coefficients much higher than the proposed acceptable value of 0.35 proposed by the FAO in 1980.

Participation in the value chain governance

Marginalized and vulnerable groups

Vulnerability in the coastal fisheries value chains may be considered in terms of sensitivity (the intrinsic degree to which people and economies depend on fisheries) and adaptive capacity (the ability of people and socioeconomic systems to anticipate, respond to, and adjust to the impacts of a change, and to minimize, cope with, and recover from the consequences). Guided by the above definition, a very high proportion of the stakeholders in the coastal fisheries value chains may be considered vulnerable. According to our estimates, the fishers appear as a vulnerable group in most sub-chains although in some cases, their income can exceed three times or more the minimal wage.

Women's contribution

In common with most fisheries value chains, with the exception of Octopus value chains, women are traditionally involved in downstream activities as retailers, artisanal processors (frying, boiling, and drying). But women are now getting more and more involved in the primary traders, buyers at the auction places, emerging as entrepreneurs. However, their positioning is still very limited. We estimate the women overall participation in the explored VCs in the coastal value chains, at 26%, 15%, and 21%, for MLT, ZNZ, and Tanzania, respectively.

Employment types

Most of the jobs, while they are may or may not be skilled, are unqualified (>90%). Traders and artisanal processors are mostly self-employed. The rate of formal employment is important in the sub-chains where industrial processors play a major role (Octopus and Prawn sub-chains in MLT), around 30%, while it is very low for all the others. Seasonal, temporary, partial jobs are seen in the seasonal fisheries (Octopus, Prawns, Anchovy-like) while in the finfish sub-chains, the activities could be practiced the whole year long.

7.1.4 FQ3: Is the coastal fisheries value chain socially sustainable?

Working conditions: *CQ3.1 Are working conditions throughout the VC socially acceptable and sustainable?*

MLT and ZNZ have separate, although similar, labour law regimes. There is recognition that gaps exist in the laws, as well as inconsistencies between the laws applying in the MLT and ZNZ. There is weak enforcement of labour rights and standards, lack of occupational safety and health, and weak organization of workers in general in Tanzania. There is no evidence that seafood processing companies (only operating on MLT) are not respecting labour standards, but most workers in coastal fisheries value chains are in the informal sector where enforcement of rights and organization of workers is particularly challenging. Both MLT and ZNZ law prohibits exploitation of children in the workplace, but both MLT and ZNZ have limited capacity to enforce.

The overall child labour rate is high in Tanzania. Children work in fisheries (freshwater and marine) but the extent, particularly of child labour, is not clear. Job safety in the fisheries sector remains an important issue, but official data is not readily available. A number of risks associated with fisheries were reported during our field visits including accidents and deaths at sea and the lack of appropriate rescue services and equipment. In spite of the challenges, people, including women and youth, are attracted to fisheries VCs in MLT and ZNZ. Measuring attractiveness of remunerations in fisheries value chains is challenging; it varies with sub-chain, stakeholder, location & over time. Many fishers reported that they are fishing because of a lack of alternatives.

Land and Water rights: *CQ3.2 Are land and water rights socially acceptable and sustainable?*
There are both fisheries/ marine resource and land rights to consider with respect to fishers and coastal communities. Fishers "property rights" appear to be mainly being affected by the creation of protected areas in MLT and ZNZ and coastal developments, particularly in ZNZ. Policy and legislation related to land and natural resources differ between MLT and ZNZ. Tanzania is a leading country in terms of plans to take forward implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (the SSF Guidelines). MLT fisheries policy is much more explicit about following SSF Guidelines. There is an active National Task Force and a National Plan of Action (NPoA) to implement the Small Scale Fisheries (SSF) Guidelines. Fishers "property rights" are mainly being affected by the creation of protected areas by state actors. In ZNZ, previous fisheries policy has been criticized for not being sufficiently aligned with SSF Guidelines and the extent to which these concerns are being addressed under the implementation of the new Blue Economy policy is not entirely clear. A NPoA to implement SSF Guidelines has been drafted.

No recent large -scale acquisitions by private sector actors in coastal fisheries VCs were identified. Fishers "property rights" are mainly being affected by the creation of protected areas by state actors and coastal developments not directly linked to fisheries value chains, particularly tourism. In both MLT and ZNZ, early stages of discussions with local communities around Marine Protected Area (MPAs) appear to align with an open, co-management approach but then benefits to local communities fail to materialize. In ZNZ, the level of prior disclosure for tourist and other coastal development investments is not clear, but observers suggest there needs to be more transparency, accountability and public participation. In Tanzania, land policy and law is widely considered to have been designed to protect citizens' rights and enable all citizens to participate in decisions on matters concerned with their occupation of land. However, the implementation is often not in accordance with the rules. In ZNZ the Minister is required by law to obtain consent from the holder of the Right of Occupancy before land is leased. Observers have expressed concerns, however, that rules are not always followed and levels of compensation are not always appropriate. Future interventions should align with the principles of the SSF Guidelines, and explore ways of supporting the implementation of the SSF guidelines.

Gender equality: *CQ3.3 Is gender equality throughout the VC acknowledged, accepted and enhanced?*
There have been significant social and economic improvements, but gender equality remains an important issue in Tanzania. In MLT and ZNZ, women have relatively little involvement in the major coastal fisheries value chains at the production stage (the major exception being octopus) but are highly involved in post-harvest activities. The extent to which they are active varies with value chain and, to some extent, location. Risks of exclusion are associated with cultural barriers, economic barriers, access to fisheries resources and policy. However, women are becoming increasingly active in post-harvest activities as both managers/ entrepreneurs and workers, suggesting risks of being excluded are diminishing. Formal legal provisions guarantee women access to, ownership and protection of their rights to land and equal rights to men, but customary tenure can still be discriminatory. Women do have ownership of assets, but for URT as a whole, only 7.4 % of Tanzania's house owners are women. In ZNZ 20.9% of house owners are women. There has been considerable improvement over the past 20 years, with 68–70 % of Tanzanian women having access to loans through empowerment funds. However, women remain largely excluded from mainstream financial services structures due to a lack of assets. Female traders, in general, face limited access to business development services.

Traditionally, most direct decisions related to fisheries production in coastal Tanzania would be made by men. However, women would be directly involved in some fisheries production decisions in the inter-tidal zone such as foot fishing for octopus, net fishing for shrimp and smaller types of fish, collecting shellfish. Women

working in fisheries value chains can control their own income. The choice of how the income is used varies with household, but for many the income is used for household needs. Women are more likely to belong to groups such as SACCOSs and CBOs than larger organizations. In MLT, women belong to BMUs and hold leadership positions while in ZNZ, to a much lesser extent, women belong to VFCs and don't hold leadership positions. Women reported that the division of labour within the households is not equal in their communities. and this was linked to women now having to earn an income as well as doing most of the household activities. In MLT and ZNZ, there was little or no indication that risk of women being subject to strenuous work was being minimised.

Some women are becoming significantly more economically empowered at least partly through engaging with fisheries values chains and taking up leadership positions. At the same time, other women, and men (younger and older) are earning income from fisheries value chains but with varying degrees of vulnerability. Women's participation in fisheries value chains is multifaceted and shaped not just by their gender but also by factors such as household assets, size and composition, education and skills. Future interventions need an informed analysis of the current and potential role of both women and men, and other specific social groups based on engagement with these different stakeholder groups in differing contexts.

Food and Nutrition Security *CQ3.4 Are food and nutrition conditions acceptable and secure?*
Fisheries (coastal and fresh) make an important contribution to national food and nutrition security. In coastal communities, fisheries make both a direct and indirect (through income) contribution to food and nutrition security. In MLT and ZNZ, local food production is decreasing in coastal fishing communities (diminishing access to land, declining soil fertility, changing climate, pests & diseases). Food supplies are increasing on local markets and this was at least partly linked to improving infrastructure. In MLT and ZNZ: trends in income from fisheries value chains to be able to purchase food is highly variable for different stakeholders. In MLT and ZNZ, women's Focus Group Discussions suggest that the nutritional quality of available food was improving in markets, but there appears to be a mixed picture regarding nutritional adequacy. Nutritional practices are increasingly dependent on households' ability to buy nutritious food. Non-communicable diseases (high Blood Pressure and diabetes) are increasing in coastal areas. For MLT and ZNZ, risks of high dependency on income associated with fisheries VCs are high for fishers' households given increasing numbers of fishers and also for non-fisher households if fish stocks are not sustained and /or more people are attracted to their communities and incomes decline. Much more analysis is needed to understand the relationship between food and nutrition security and fisheries at the level of fisher's households, coastal fishing communities and more widely. This should be part of a wider dialogue around sustainable and inclusive food systems in Tanzania to inform decision-making processes.

Social Capital: *CQ3.5 Is social capital enhanced and equitably distributed throughout the VC?*
In MLT and ZNZ there is a range of formal and informal organizations participating in fisheries VCs. Externally instigated organizations have had a strong focus on marine conservation. Goals and performance of these different organizations appears to vary considerably. Many fishers interviewed did not feel well represented. Inclusivity of membership varies according to a number of factors including their purpose, location and governance. Beach Management Units (BMUs-MLT) are much more inclusive than Village Fisheries Committees (VFCs -ZNZ). The recently formed TAWFA provides a network for organizations involving women in fisheries-related activities. BMU and VFC leadership is periodically elected and in that sense is representative and accountable. However, many of the fishers interviewed did not feel well represented.

In general fishers appear to negotiate on an individual or very small group (crew) basis. However examples of fishery-related organizations who negotiated on behalf of their members were identified. BMUs (MLT) and VFCs (ZNZ) have a role providing information about illegal fishing practices and fisheries policy, but performance varies in practice. There is a complex web of social and economic relations in which SSF market actors are embedded. This includes various forms of informal credit arrangements based on trust. Formal support service capacity to fishers is generally weak.

BMUs, VFCs and VLCs (if protected areas) are institutional arrangements which in principle enable communities to participate in marine resource decisions that impact on their livelihoods. In practice, performance is very variable. Traditional knowledge and resources are not well respected in coastal resources management. It is difficult to identify a realistic alternative to such multi-stakeholder initiatives, but future interventions should strive to support such organizations in ways which fairly distribute both costs and

benefits. Aligning such organizations with existing institutions to minimize destructive conflict is important. Understanding the factors driving the formation and maintenance of community cohesion in SSF is critical to inform strategies for supporting effective participatory governance approaches and empowering decentralized, localized, and community-based resource management approaches. Supporting initiatives which are facilitating learning amongst coastal communities is important.

Living conditions*. CQ3.6 To which standards are major social infrastructures and services acceptable and do the vanilla value chain operations contribute to improving them?*
Globally, many small-scale fishing communities face significant challenges in terms of health, water & sanitation and education services, alongside housing. In MLT and ZNZ, women's FGD participants reported that health facilities and services had improved. Women attributed improvement in facilities to the government, although out-of-pocket spending on health accounts for 23 % (MLT) and 30% (ZNZ) of household expenditure. High Blood Pressure and diabetes were reported to be increasing in all communities visited. In terms of housing in MLT and ZNZ, women's FGDs and official survey statistics indicate a major increase and high proportion of houses with "modern" roof (iron sheets) and to a lesser extent walls and floors. Womens FGDs reported that fisheries income has contributed. With regards to water and sanitation, on MLT women reported a mixed situation with availability and increasing saltiness of water a problem in some locations. In ZNZ:, 94.7% of households (91.8% in rural areas) have access to a protected water source and 98.8% of households (98% in rural areas) are within 1 km of source of drinking water. Improvements in water supply were not linked to income from fisheries. With regards to education and training, on MLT, primary school net enrolment rate is 83.4% (81.3% in rural areas). Fisheries-related income had contributed to educational costs and in Songo Songo exam performance. In ZNZ: primary school net enrolment rate is 81.4% (78% in rural areas). Women in FGDs reported that there was more access to education now and particularly it was now equal for both girls and boys. There was a mixed responses regarding a link with fisheries.

A review of secondary information appears to align with a relatively positive trend reported in the relatively few coastal communities we visited. However, a more disaggregated analysis of the situation, drivers and trends is needed to inform decision-making aiming to improve sustainable livelihoods within coastal communities. Alongside this, supporting a multi-stakeholder learning process involving local and national decision makers and other stakeholders should be considered to explore solutions and co-design ways forward to address the complexity of issues around coastal marine livelihoods and systems.

7.1.5 FQ4: Is the coastal fisheries value chain environmentally sustainable?

Please note: with regard to the Core Questions CQ4.1-4.4, it should be reminded that all comparisons refer to the *functional unit* (reference unit volume of seafood to which the damages to the areas of protection (Resources, Ecosystems, Human Health) and Global Warming Potential refer to) used, i.e., 1 t of landed fish; 1 t of processed seafood. Therefore the comparisons made are for example 1 t of octopus vs. 1 t of finfish (considering the fishing techniques); or 1 t of fried seafood vs. 1 t of dried seafood vs. 1 t of frozen seafood.

CQ4.1. What is the potential damage of the VC on **resource depletion**?

The potential damage AoP Resource focuses on abiotic resource depletion. Fuel use is the largest contributor to potential impacts. In fact, the highest potential damages to this AoP are exerted by those fisheries using motorised fishing vessels: the fisheries having the highest impacts in the two geographical areas are those octopus divers and foot fishers using a vessel to reach the fishing grounds in MLT and finfish longliners in ZNZ. For both MLT and ZNZ, the fishery that follows in contributing most to the damages to the abiotic resources is the finfish ringnetters. These potential damages are associated with the extraction of fossil fuels.

Concerning the processing phases, in MLT the highest potential damage to abiotic resource depletion is found in the frying with LPG processing activity. This activity relies on fossil fuel extraction at the levels of the supplying fishing activity, use of LPG as fuel, and cooking oil manufacturing. In MLT, the freezing processing also results in damages to resources, due, also in this case, to the supplying fisheries together with the use of electricity (Tanzania country-mix) and polyethylene (derived from petroleum) materials for the packaging of exported seafood. The use of vegetable oil is the main driver of damage to Resource in the case of frying using firewood. For the ZNZ processing activities, the highest damage to Resource is given by the frying and sun-drying processing. Besides the supplying fishing activities, the use of cooking oil is a relevant driver to damages for the frying processing, while the main contribution to damages for the sun-drying processing is given by the supplying fishery (the drying itself does not lead to major damages, since the drying processing is done by simply spreading the seafood under the sunlight, and the use of tarpaulins is the only contributor to abiotic resource depletion).

Water used for producing ice does not seem to contribute to the damage to resources, because of the little amount of ice used compared to other inputs. However, if there will be an improvement of the cold chain system and therefore an increased consumption of ice for prolonging seafood lifespan, the water used would deserve to be re-assessed.

CQ4.2. What is the potential damage of VC on **ecosystem quality**?

The fishing activities that show the highest potential damages to the Ecosystem AoP are, similar to the Resource AoP, the octopus fishery diver and foot fisher using motorised vessels for MLT and finfish longliner in ZNZ. For both MLT and ZNZ, the finfish ringnetters present also quite relevant potential damages to Ecosystem AoP. The main driver of such results is again the use of fuel for engine operation, which contributes to the ecotoxicity and eutrophication of terrestrial and aquatic ecosystems. When considering the processing activities, both in MLT and ZNZ, the frying processes are the ones having the highest potential impact on the AoP Ecosystem. This is due to the use of cooking oil, whose production leads to ecotoxicity and eutrophication of terrestrial and aquatic ecosystems. Production of vegetable cooking oil has in fact multiple environmental negative outcomes: it requires land transformation and habitat loss, use of fertilizers and consequent chemical pollution of soil and waters, and use of fossil fuels for planting, harvesting, and processing. In ZNZ, given that all the seafood (especially anchovies and anchovy-like species) is first boiled and then dried, also the sun-drying processing shows relevant damages to the AoP ecosystem because of the use of firewood for boiling. It has to be pointed out that firewood consumption during processing operation has been modelled using a specific inventory item (bundle-energy fuel), but likely, a share of the firewood used is not actively cut, but simply harvested from the ground. A specific investigation regarding the use of firewood in both MLT and ZNZ is recommended.

CQ4.3. What is the potential damage of the VC on **human health**?

By presenting the LCA results according to the weighted method (Single Score), Human health is potentially the most impacted AoP both in MLT and ZNZ and for all the value chains' steps. This is linked to the pollutants and molecules (GHG and particulate matter) emitted mainly by the manufacture and combustion of fuels, and

cooking oil manufacturing and combustion of firewood in the case of boiling and frying (the processing techniques with the highest potential damages to Human Health). For example, firewood-related emissions are significantly higher than the LPG ones. GHG- and particulate matter emissions are linked to particulate matter formation, tropospheric ozone formation, stratospheric ozone depletion, global warming, and ionizing radiation, which combined together result in increased respiratory diseases and various types of cancer.

The LCA methodology does not allow for the assessment of food safety and the health risk to consumers and a specific study on the loss of nutritional quality of the seafood according to its freshness and type of processing would be of interest.

CQ4.4. What is the potential impact of the VC on **climate change**?

The Global Warming Impact category appears to be most affected by those activities using fossil fuels, e.g. for engine operations for fishing activities: those contributing most are, as expected, those associated with the highest Fuel Use Intensity (FUI). Among MLT motorized fisheries, the least efficient ones in terms of Global Warming potential are the motorized octopus fisheries (about 1000 kg CO2 eq/t landed seafood=1 kg CO2 eq/kg landed seafood; FUI=395); while among ZNZ fisheries, finfish fisheries using longline is the one with the highest CO2 eq emissions (1071 kg CO2 eq/t landed seafood=1.07 kg CO2 eq/kg landed seafood; FUI=400). GHG-related emissions' trends (within a certain degree) similar to the above-mentioned are reported by Parker et al. (2018), who averaged various fishing activities worldwide according to the fishing sector, and give values of 2.8 kg CO2 eq/kg landed cephalopods (without specifying the species or the fishing methodology) and 1.9 kg CO2 eq/kg landed pelagics > 30 cm (comparable to the category Finfish of this study). For the sake of comparison, the Global Warming Potential of beef production (without bone, in UK) is 23 kg CO2 eq./kg food; that of chicken in UK is 6.6 kg CO2 eq./kg food, that of farmed salmon in Canada is 3.6 kg CO2 eq./kg food and that of soybeans in Brazil is 0.38 kg CO2 eq/kg product.

Concerning the processing activities, the highest Global Warming Potential Impacts are associated with the frying with firewood process in MLT, and with boiling and drying, and frying processing in ZNZ. These results are tightly linked to the GHG- and particular matter-related emissions of firewood combustion.

CQ4.5. Does the potential impact of the VC on **biodiversity** deserve specific studies?

Assessing the impacts of the fisheries sector related to biodiversity is not easy with the available information.

The problem of weak reporting of landed products and the absence of up-to-date information on the status of fish stocks makes it difficult to understand whether Tanzania's artisanal fisheries have a major impact on the stocks of marketed species.

From the scarce available information, however, it would appear that almost all stocks are fully exploited and some are overexploited, for example the yellowfin tuna, paneid prawns and (likely) octopus. This information, together with that commonly reported by fishers interviewed during the field missions and by other authors, gives indications that 'there are no more fishes'.

This may be the result of multiple causes that may act synergistically: increased numbers of fishermen resulting in decreased CPUE (Catch Per Unit Effort); use of destructive fishing systems or practices (mangrove cutting, construction of tourist resorts) that can damage sensitive ecosystems and habitats and lead to quality degradation of, for example, coral reefs, seagrass beds, mangrove forests, thus compromising spawning, nursery and foraging environments for many species; climate change that causes species to migrate (e.g. further offshore) or leading to shifts in community composition.

In conclusion, the value chains analysed, both for MLT and ZNZ, appear to be poorly efficient at all levels. In addition, there are some issues related to the exploitation status of the stocks, which seem in decline (e.g., overexploitation, habitat degradation, climate change effects). Therefore, the coastal fishery value chain appears weak in terms of environmental sustainability, leaving wide room for improvement within the implementation of a BE strategy. Efforts at increasing efficiency should consider the environmental impact per unit and be guided by environmentally sustainable principles.

7.2. The risk analysis

We conducted the risk analysis, one for MLT and one for ZNZ, and identified 13 main risk categories. The risk analysis was then combined into a single output, through which it is possible to identify the risks that are common and those specific to the two geographical systems examined. The identified risks were contextualised with a description of the rationale and qualitative scoring was commented, where necessary. For reasons of space, we have chosen to show in this main document the simplified risk analysis, where only the risk and the score are visible. **We kindly ask the reader to refer to the full risk analysis in the Appendix 7, Table 1, for a full understanding of the analysis conducted.**

PROBABILITY ASSESSMENT		
low	moderate	high

SEVERITY ASSESSMENT			
low	moderate	high	extreme

	Risk category	Risk description, Rationale	Probability	Severity			
				Growth	Inclusiveness	Social	Environment
1	Local market trends- ML and ZZB	**Risk:** for local consumers and some actors along the value-chain unable to absorb or pass on the increased price, (excessive) increase in prices, particularly for larger fish types.	MLT				
			ZNZ				
2	International market trends (export, mainly octopus and prawns VCs) – ML	**Risk:** The export industry (EU mainly) drops down.	MLT				
	International market/Global shocks – ZZB	**Risk**: The tourist industry declines and the prices for seafood drop down in ZZB.	ZNZ				
3	Regional market – ML and ZZB	**Risk:** Decline of export to the regional market (East and Central Africa markets)	MLT and ZNZ				

	Risk category	Risk description, Rationale	Probability	Severity			
				Growth	Inclusiveness	Social	Environment
4	Logistics and infrastructure and access to supplies – ML and ZZB	**Risk:** Higher post-harvest wastes and losses	MLT and ZNZ				
5	Policies - ML	**Risk:** Lack of alignment and increase of ongoing conflicts between the relevant sectors, with an interest in the Blue Economy and the coastal resources.	MLT				
	Policies - ZZB	**Risk:** The BE high-monetary sectors are prioritized compared to low-monetary sectors, such as SSF.	ZNZ				
6	Governance and institutions - ML	**Risk:** Insufficient capacity of formal and informal institutions to cope with the multiple drivers affecting the coastal socio-ecological systems.	MLT				
	Governance and institutions - ZZB	**Risk:** The governance and institutional capacity are not strengthened sufficiently to meet BE challenges and expectations.	ZNZ				
7	Social relations – ML and ZZB	**Risk:** Rapid social and economic change affects social relations with uncertain, but potentially negative impacts.	MLT and ZNZ				
8	Gender, age and alternative livelihood options – ML and ZZB	**Risk:** Lack of alternative livelihood options, leading to increasing numbers of people attracted to fisheries VCs and increasing vulnerability	MLT and ZNZ				

	Risk category	Risk description, Rationale	Probability	Severity			
				Growth	Inclusiveness	Social	Environment
9	Food safety and sanitary situation – ML and ZZB	**Risk:** Degradation of food, safety and sanitary situation endangered.	MLT and ZNZ				
10	Weather and climate change – ML and ZZB	**Risk:** Highly reduced availability of the biotic and abiotic resources on which SSF depends	MLT and ZNZ				
11	Fish stock status – ML and ZZB	**Risk:** Potential stock depletion	MLT and ZNZ				
12	Natural environment – ML and ZZB	**Risk:** Destruction of sensitive ecosystems, reduced availability of biotic and abiotic resources, scarce recruitment	MLT				
			ZNZ				
13	Investment in fisheries capacity	**Risk:** Increased overexploitation of fisheries	MLT and ZNZ				
14	Investment in fisheries capacity	**Risk:** perceived or actual unfair distribution of government support	MLT and ZNZ				

TABLE 7.1 RISK ASSESSMENT OF COASTAL FISHERIES IN MLT, IN ZNZ AND IN URT (TEAM ELABORATION) (DETAILED ANALYSIS IN APPENDIX SECTION 7 TABLE 1 (*TEAM ELABORATION)*

7.3. Summing benefits and negative impacts (strengths and weaknesses)

Based on the VCA4D findings, specific strengths and weaknesses were identified in terms of sustainability and inclusiveness for each sub-chain analysed, both in MLT and ZNZ, as follows. Resulting Opportunities/ Threats and challenges are presented in detail in the Appendix Section 7, Tables 2A to 2G for each sub-chain. They contributed to identify the risks. The following last section of recommendations is resulting from all these elements.

7.3.1 Strengths and weaknesses of Mainland sub-chains

Small pelagic (anchovy-like) value sub-chain in Mainland

MAINLAND SMALL PELAGIC (ANCHOVIES) VALUE CHAIN (11% of the total VA in MLT)	
STRENGTHS	**WEAKNESSES**
It employs different stakeholders in terms of gender, age and seems to provide a consistent source of income, particularly for non-fishermen stakeholders.	High dependency on Congolese buyers – vulnerability – and presumed illegal market.
Essential position of middlemen/women – is an asset. Entrepreneur capacity. These actors drive employment.	High post-harvest losses due to spoilage, thus the need for drying processing. But the drying processing is strongly dependent on the season. During the rain season, despite the processing, the post-harvest losses are high.
The investment cost for the processing phase is relatively low to set up and run.	The investment costs for the fishing phase are high.
It makes a significant contribution to some coastal rural local economies.	No information on fish stock status and migration patterns of the targeted species.
Important for food and nutrition security, at the national and regional level. Good source of a product of high nutritional value, accessible to low-income consumers.	Potentially, the stock is fully exploited. However there is uncertainty of stock size and catch volumes. In this regard, the report of catches and processed volumes is not thorough (no good traceability- e.g., through auctions, and little monitoring of fish catch at the landing sites). The official catch data are underestimated.
The by-product from the anchovies processing gets value entering the feed industry (dust for the chicken meal).	Limited use of the Mainland and Zanzibar fisheries management plans in coordinating the common resources.
The sub-chain provides employment, with a high rate of female participation.	Use of wood for boiling and frying procedures and cooking oil for frying (high damages to Human Health and impact to Global Warming Potential). Use of plastics.
The high contribution of the sub-chain to the overall seafood market. E.g., anchovies account for 43% of the product passing through the FFM (2019).	The revenue collection for local government and BMU is weak to an extent that the amount collected is low.

Table 7.2 Benefits/Strengths and Impacts (due to weaknesses) identified in the sub-chain Small pelagic (anchovy-like) in MLT

Finfish value sub-chain in Mainland

MAINLAND FINFISH VALUE CHAIN (68% of the total VA in MLT)	
STRENGTHS	**WEAKNESSES**
Most of the catch (70%) passes through the auctions. This helps to record official catch tonnages. The auction provides transparency in the marketing system.	Medium and large pelagic fish stocks assessments need to be carried out or updated.
A high percentage of the catch transits through the FFM. This is a big node and improves the tracing.	As for the small pelagic value chain, the stocks are common between the Mainland and Zanzibar. Risk of overexploitation.
Multispecific actors at all levels, high degree of adaptation and agility of actors according to market trends.	Limited use of the Mainland and Zanzibar fisheries management plans in coordinating the common resources.
Diversity of species, the offer is wide and could be high quality.	Reef fish stocks are unknown, risk of overexploitation. The knowledge of the ecological status of the reef is lacking.
BMU and the CFMA (Collaborating Fisheries Management Area) allow for area-specific management. Different communities are sharing common reefs.	The continental shelf is narrow and as consequence also the amount of resources.
This co-management is particularly important for this value chain because the fishers using purse seine and ringnet are not linked to a specific landing site.	Auction facilities are often unhygienic, with poor facilities and no refrigeration systems.
This value chain is a key component for the food security of coastal communities	Uncertainties on flows, and exact figures at all levels. Inadequacy between numbers (fishers, vessels, catches)
High numbers of small artisanal fisheries, through canoe, sails. Low investments.	The unclear status of ring netters. Their catches are high, are not fully "registered" in the official statistics, and are not included in the Collaborative Fisheries Management Area CFMA. Very low license costs compared to the catches they can get and compared to other fishing units. Ring netters do not necessarily unload the catch at the landing site linked to the fishing area. This precludes BMUs from collecting levies.
Import and export are not allowed. This helps in protecting the local market.	Dynamite fishing practices are still on.
	Insufficient ice and cold chain facilities, quality degradation at all levels.
	The more and more dominating situation of industrial processors leading to the vulnerability of small size actors, independent traders, and artisanal processors.
	The low percentage of registered vessels.
	The extent to which the BMU and CFMA manage the areas is variable.
	Possible damages to the reef.

Table 7.3 Benefits/Strengths and Impacts (due to weaknesses) identified in the sub-chain Finfish in MLT

Octopus value sub-chain in Mainland

MAINLAND OCTOPUS VALUE CHAIN (14% of the total VA in MLT)	
STRENGTHS:	**WEAKNESSES**
The co-management system of the fishing activity with the closures is an interesting initiative and has some benefits.	The system of closures is an initiative proposed by NGO, an external stakeholder.
Women have knowledge and skills that enable them to engage and benefit from primary production and in the VC.	The concern of some stakeholders on the access to the fishing ground by migrant/occasional fishers, especially during the opening of the closed season.
High-value product and relatively low cost for fishers.	Lack of area-specific management plans for octopus fisheries.
Value chain based on low- trophic and short life cycle species.	Bulk production during the opening of closed season creates an oversupply of the market. Despite the fact that BMU, the local government and the companies agree on a fixed price for the 3 days of the closed season, thereafter prices drop.
Specific (legal) fishing gears avoid unintentional by-catch.	Insufficient cold storage capacity.
Ban of destructive fishing methods (dynamite, spear guns).	The closure system is resulting in winners, but some actors perceive themselves as losers, e.g. some women foot fishers in Songo Songo (see below).
Royalties are an asset for the Government.	Weak enforcement regime, including non-monitoring of the migrant fishers reduces the income for local fishers and increases pressure on the stock.
Processing plants provide employment for men, women, and youth in the formal sector and therefore protected by employment law.	An increasing number of divers (predominantly men) is creating overcapacity and reducing the opportunities for foot fishers (predominantly women).
	The net profit seems to be unbalanced among fisher typology (foot fishers vs divers, male vs female), but also along the value chain (potential unbalanced profits in the VCA, profits mostly in the traders).
	High dependency on a limited market, especially tourist and EU markets. This can result in vulnerability to short-term shocks (e.g. COVID or EU fluctuations on octopus demand).
	The Royalty level for export is creating potential distortion compared with the international market. Compared to other countries, the royalties are perceived to be too high.
	Potentially, the royalties can be the reason for the illegal export to North and South.
	Illegal imports from Mozambique are apparently relevant and there could be a loss of income for the Government. There could be increased pressure on octopus stock in Mozambique.
	The use of illegal fishing methods is still reported (dynamite, spear guns).
	Little information on the biological characteristics of the species (size at maturity, reproductive areas, stock status, that is likely fully exploited)
	The fishing method (in particular foot fishing and the use of the spear) can damage the reefs, especially during the opening season (high number of fishers).
	The current fishing methods (use of the spear) do not allow the evaluation of the octopus size before its capture (and killing), the capture of undersized specimens is likely.
	The limited capacity of the BMU for monitoring, control, and surveillance (MCS) of the system.

Table 7.4 Benefits/Strengths and Impacts (due to weaknesses) identified in the sub-chain Octopus in MLT

Prawn value sub-chain in Mainland

MAINLAND PRAWN VALUE CHAIN (7% of the total VA in MLT)	
STRENGTHS:	**WEAKNESSES**
Good monthly income for fishers during the season, compared to the other value chains and minimum wage.	Poor working conditions and precarity for the fishers. The areas where prawns fishing takes place are wetlands, where the likelihood of contracting malaria can be high.
Virtually all fishers are small-scale for the primary sector. The value chain can provide an additional income to fishers and collectors of the coastal community. The majority (3/5) have no costs but receive a lower price from selling. Entry capital costs are approximately zero.	Some highly productive areas are not easily accessible to fishers (lack of infrastructures).
Demand is much higher than production.	Lack of a stock assessment and its weak control and evaluation. Lack of comprehensive knowledge of species biology.
High capacity of medium and large-scale processing plants.	Illegal market, lack of MCS system.
Processing plants provide employment for men, women, and youth in the formal sector and therefore protected by employment law.	Prawn farm in Mafia not currently working. The reasons are not clear. Processors complain about the shortage of products.
Royalties are an asset for the Government.	Limited involvement of women in the primary production sector.
	Processing plants work under capacity because of the low supply.
	The Royalty level for export is creating potential distortion compared with the international market. Compared to other countries, the royalties are perceived to be too high.
	Limited creation of non-fisher value chain employment in rural areas. The product is processed at medium-large processing plants for the export market.
	Use of small inches mesh size nets and other gear types (cast nets and barrier net at the mouth of the rivers) can have negative effects on the resources (capture of juvenile stages and undersized fishes)
	Degradation of critical habitats, e.g., sea-bottom with the use of the trawlers.
	Damage to the mangrove habitats.
	Impact of the generalized closed season on sustainable livelihood. Different fishing areas can host different species with their peculiarity in terms of the life cycle. No purpose in having the same closure season for the different areas if life cycles are different.
	Weak data and information flow system.
	Excess pressure on Rufiji resources.
	Conflicts between trawler fishers and small-scale fishers.
	Weak institutional linkages and user participation (BMU).
	High cost of prawn fisheries management (MCS system is expensive to operate).
	Although not comprehensive, data on catches indicate that the stock is exploited over its capacity.
	Lack of scientific and economic data.

TABLE 7.5 BENEFITS/STRENGTHS AND IMPACTS (DUE TO WEAKNESSES) IDENTIFIED IN THE SUB-CHAIN PRAWNS IN MLT

7.3.2 Strengths and weaknesses of Zanzibar sub-chains

Small pelagic (anchovy-like) value sub-chain in Zanzibar

ANCHOVY-LIKE ZANZIBAR VALUE CHAIN (25% of the total VA in ZNZ)	
STRENGTHS:	**WEAKNESSES**
The value chain creates significant local employment, including women and youth	The monopoly of the foreign buyers can generate vulnerability
Middlemen-women position, entrepreneurship	The perceived high tax level driving (presumed) illegal export.
The value-chain contributes to the export, royalties.	Migrant fishers can land their catch outside Zanzibar, thus limiting the traceability of catches
Compared to industrial processing, this value-chain needs relatively low investment for processing, which enables the establishment of collective processing enterprises by diverse groups.	High fish loss and waste due to spoilage and poor market environment
Contribution to local economies	Weak data and information flow systems, including stock assessment and limited catch volumes passing through the auctions, lead to uncertainties in actual catch figures and existing potential yield.
The value-chain contributes to the availability of food with a high nutritional value (although the majority is exported)	The common resources between the mainland and Zanzibar are not managed collaboratively by the two governments
The « dust », a by-product, gets value entering the channel of chicken feed industry	The massive use of firewood for boiling and frying contributes to deforestation and harmful emissions. Sustainable management of wood resources could limit the deforestation issue. Use of firewood also has damages on Human Health and impact on Global Warming
Large seafood market share	Weaknesses in waste management, including the use of plastics.
Small Pelagic Fisheries Management Plan is in place (Department of Fisheries Development (2019). Small Pelagic Fisheries Management Plan. Ministry of Agriculture, Natural Resources, Livestock and Fisheries, Zanzibar. 103 pp)	

TABLE 7.6 BENEFITS/STRENGTHS AND IMPACTS (DUE TO WEAKNESSES) IDENTIFIED IN THE SUB-CHAIN SMALL PELAGIC (ANCHOVY-LIKE) IN ZNZ

Finfish value sub-chain in Zanzibar

ZANZIBAR FINFISH VALUE CHAIN (71% of the total VA in ZNZ)	
STRENGTHS:	**WEAKNESSES**
A high percentage of the catch passes through the auctions. This helps to record official catch tonnages. The auction provides transparency in the marketing system.	Weak data and information systems, including stock assessment, lead to uncertainties in actual catch figures and existing potential yield.
A high percentage of the catch transits through the urban markets. They are big nodes and improve the market network.	There is often tension between MCA managers, fishers, and local communities. Fishers are complaining that they are « pushed » away. Local community members' expectations of benefits from MCAs are often not met.
Very significant sub-chains for economic growth and employments.	Common resources (med-large pelagics) between the mainland and Zanzibar are not managed collaboratively by the two governments.
Multi-specific actors at all levels, greater opportunity for adaptation, compared to the other identified VCs, and capacity of actors according to downstream market trends and the upstream resource fluctuation.	Different communities are sharing common reefs. This leads to major conflicts between communities.
Diversity of species, the offer is wide.	Fishers using purse-seines and ring nets are not linked to a specific landing site and may have less commitment to the sustainable management of the local resources.
Mostly good quality product when landed, because of the type of fishing gears used (e.g. handlines, traps), this contributes to higher prices.	The increased frequency of stronger winds and waves damages the fishing gears and shortens their lifespan.
The high percentage of the fishing grounds are placed under MCAs for improved resource management	Seasonally, whales could damage passive fishing gears.
Reef fisheries management plans are published. (Department of Fisheries Development. (2019). Reef Fisheries Management Plan. Ministry of Agriculture, Natural Resources, Livestock and Fisheries, Zanzibar. 91 pp.)	Inadequate monitoring, control, and surveillance (MCS) system for dealing with illegal fishing practices (e.g., small mesh sizes, torches), even within the MCAs.
Village fishers' committees potentially allow area-specific management.	Low percentage of registered vessels.
This value chain is a key component for the food and nutrition security for rural and urban households.	Ghost fishing (e.g., lost traps, monofilament net) occurs and causes damage also to other marine species
The sub-chain is essentially labour-intensive, contributing to local employment.	Little energy efficiency/high fuel intensity for motorized fishing activities.
High numbers of non-motorised vessels having lower environmental impact	Poor marketing infrastructure, including auctioning platforms.
The tourist sector provides a lucrative market for reef fish and med-large pelagic.	Large pelagic management plan to be published.
	Weaknesses in controlling harmful practices on coral reefs.
	Absence of closure periods during the breeding periods of reef species

TABLE 7.7 BENEFITS/STRENGTHS AND IMPACTS (DUE TO WEAKNESSES) IDENTIFIED IN THE SUB-CHAIN FINFISH IN ZNZ

Octopus value sub-chain in Zanzibar

ZANZIBAR OCTOPUS VALUE CHAIN (4% of the total VA in ZNZ)	
STRENGTHS:	**WEAKNESSES**
The co-management system of the fishing activity with the closures is an interesting initiative and has some benefits.	The system of closures is an initiative proposed by NGO, an external stakeholder. Expansion very limited in Zanzibar.
Women have knowledge and skills that enable them to engage and benefit from primary production and in the VC.	The concern of some stakeholders on the access to the fishing ground by migrant/occasional fishers, especially during the opening of the closed season. Octopus fishers who do not make use of vessels in Zanzibar are not licensed (about 15% of all foot fishers and divers).
High-value product and relatively low cost for fishers.	Lack of area-specific management plans for octopus fisheries.
Value chain based on medium/low-trophic and short life cycle species. Breeding dens are less accessible by foot fishers (> 5m deep water) (but divers?)	No industrial processing facilities. Insufficient cold storage capacity.
Specific (legal) fishing gears avoid unintentional by-catch. Ban (although not completely effective) of destructive fishing methods (dynamite, spear guns).	The current fishing methods (use of the spear) do not allow the evaluation of the octopus size before its capture (and killing), the capture of undersized specimens is likely. The limited capacity for monitoring, control, and surveillance of the system
Octopus Fisheries Management Plan published Different actions aimed at restoring the reef (e.g., ReefBall). Most of the reefs, octopus fishing grounds are placed in MCAs. NGOS are operating in these areas and providing support (e.g. Mwambao).	The fishing method (in particular foot fishing and the use of the spear) can damage the reefs, especially during the opening season (high number of fishers). The use of illegal fishing methods is still reported (dynamite, spear guns).
Importance of the tourism sector as consumers, « local » export.	Little information on the biological characteristics of the species (size at maturity, reproductive areas, stock status).

Table 7.8 Benefits/Strengths and Impacts (due to weaknesses) identified in the sub-chain Octopus in ZNZ

7.4. Mains issues and recommendations

On the basis of the VCA4D findings, the main cross-cutting issues between MLT and ZNZ are combined to propose common recommendations for both regions. Specific issues to some sub-chains are also highlighted associated to specific recommendations.

7.4.1 Cross-cutting issues and main resulting recommendations

Data and Information systems

For all the sub-chains included in this study, and for both MLT and ZNZ, there are weak data and information systems, including stock assessment, lead to uncertainties in actual catch figures and existing potential yield.

Recommendations are:

- Strengthen capacity (including technical and financial support) to address a number of crucial issues regarding the overall sustainability of all these value chains.
- Use a holistic approach to develop an integrated data and information flow system (biological information- especially for common stocks between MLT and ZNZ, market data, social and economic aspects, environmental data).
- Solve the main issue, i.e., lack of information on stock status, in the absence of financial resources and time to perform a stock assessment, it would be necessary to generate knowledge and deepen the existing data on, for example, fishers, catch per unit effort, annual yields per unit areas (e.g., as explored in Kuguru et al., 2022), the average length of fishes caught (and register the fishing of juvenile specimens). In a few words, it is recommended to improve the flow information system.
- Develop an integrated system involving actors collecting and analysing the information and those using the information (and development of guidelines for standard data collection methods, leading to appropriate control measures of fisheries).
- Strengthen collaboration between stakeholders at different levels, e.g., BMU, beach officers, district officers, local authorities, and other stakeholders should be improved.

Social issues

The multiple social issues related to coastal fisheries are similar in MLT and ZNZ, although intensified in ZNZ due to, for example, population pressure and tourism. The plans for the implementation of the SSF Guidelines in ZNZ are not as well developed as in MLT.

- Future interventions should align with the principles of the SSF Guidelines, and explore ways of supporting the implementations of these guidelines and an informed analysis of the current and potential role of both women and men, and other specific social groups (e.g. youth) based on engagement with these different stakeholder groups in differing contexts.

Limited attention has been given to date to fisheries' important contribution to national food and nutrition security. In coastal communities, fisheries make both a direct and indirect (through income) to food and nutrition. The issue is common to MLT and ZNZ, but even greater in ZNZ where there is a higher dependency on fisheries for the population.

- Much greater attention is needed to understand the relationship between food and nutrition security and fisheries in coastal communities and nationally. For example, trends in the contribution of coastal seafood to nutrition of different social groups in coastal communities and elsewhere; the importance of fisheries income, increasing dependence on purchased food and health outcomes in coastal communities. This should be part of a wider dialogue around sustainable and inclusive food systems in Tanzania to inform decision-making processes.

Emerging fisheries co-management arrangements show some success, but also multiple challenges. There is a range of formal and informal organizations associated with coastal fisheries value chains and resource management. The performance of these organizations appears to vary tremendously. Several multi-stakeholder co-management arrangements have been introduced (e.g., in BMUs in MLT and VFCs in ZNZ). This appears to have had some positive results in some locations, although all those we met reported significant challenges. It is difficult to identify a realistic

alternative to such multi-stakeholder co-management initiatives. The VFCs in ZNZ are fishers only, while in the MLT the BMUs are multi-stakeholder. There is a need to consider justice and fairness in both the process and outcomes of these initiatives.

- Multi-stakeholder co-management initiatives are very important, but future interventions should strive to support such organizations in ways that fairly distribute both costs and benefits.

Environmental issues

The environmental issues are overall common between MLT and ZNZ. These include: High FUI for almost all fishing activities using motorised vessels; fuel combustion for processing (firewood) and poorly efficient processing facilities/equipment; use of cooking oil for processing; weak flow information system that doesn't allow for a good estimation of catches' volumes; in some areas, weak enforcement of input/output measures related to the fishing activities; fish stocks seem to have reached the fully/overexploited status.

Several aspects of the coastal fishery sector could be improved, as follow:

- Co-design ways of reducing the amount of fuel required per trip at sea. For example:
  - upgrade of the engines with those having higher efficiency, as the ones currently in use seem to be obsolete and low efficiency. Evaluation of the use of hybrid or electric engines (provided electricity is obtained from renewable energy sources).
  - improvement of skippers' performance through training courses and by the use of GPS to easily find the best fishing grounds and come back to the landing site straightforwardly.

- Frying using Liquefied Petroleum Gas (LPG) appears to have fewer environmental burdens (GHG- and particulate emissions) than frying using firewood. The initiative to install LPG frying stalls undertaken at the Ferry Fish Market (FFM) could be extended to other urban market nodes throughout the URT. The improvement of the efficiency of the kilns/ovens used for processing should also be considered.

- Improved hygienic conditions and modernized infrastructure (efficient ice machines, cooling, and freezing systems, and modern processing devices) would be desirable in order to decrease or limit product losses, thus increasing the overall efficiency of the coastal fishery value chain. However, the environmental (and economic) impacts associated with a range of different scenarios, including an improved cold-chain system, should be investigated.

- Assess waste management. The analysis of waste is outside the scope of this study. However, an important initiative could be to invest in solutions for the recycling and valorisation of used cooking oil, which can have important outcomes on the environmental impact of this sector. Concerning other types of waste (e.g., plastic materials), the observations made during the field missions reveal that this is a further weak spot. A study specifically designed to understand the impact of waste disposal and its fate would be desirable.

- Assess post-harvest losses in terms of both quality and physical loss (analysis of the nutritional quality of fresh and processed seafood).

- Close monitoring of the potential contribution of URT fisheries to stock depletion is highly recommended, especially if the available information on the status of the targeted stocks is scarce.
  Given the difficulty in the assessment of the stock status and the Maximal Sustainable Yield (MSY), it would be useful to monitor and record the catch at landing sites in more detail to thus understand the Catch Per Unit Effort (CPUE) (but also to record and try to limit the fishing of juvenile individuals).

- Following the precautionary principle and given the available information on the status of the exploited stocks, it would be appropriate to try to decrease fishing efforts and create space for alternative income-generating activities and sources of marine animal protein such as the aquaculture of marine species of low trophic level (e.g., molluscs) or the development of multi-trophic breeding systems such as IMTA (Integrated Multi-Trophic Aquaculture).

Coastal fisheries issues in the context of Blue Economy

Both in Mainland and in Zanzibar, there are issues related to the institutional environment related to the Blue Economy implementation.

- There is a need to develop an integrated planning framework for all aspects of the blue economy and an appropriate institutional arrangement for Blue Economy development

There is a risk of lack of coordination among different donors:

- Donors interested in developing actions in relation to the Blue Economy could join together in an organized group to make interventions more efficient and faster.[55]

There is a risk of inappropriate investment in the Blue Economy.

- There is a need to strengthen arrangements to support responsible investments e.g., through the application of principles of sustainable Blue Economy finance (proposed by the UN[56] and the EU[57]).

Coastal fisheries issues in the context of Agroecology

There is increasing interest in situating small-scale fisheries in research, debate, practice and movements around agroecology. Ertör et al. (2020) argue that food sovereignty and agroecology offer urgently needed visions for transforming the food system and note that fisher movements have been working to articulate what this means in a fisheries context. The Declaration of the international forum for agroecology (Nyéléni, 2015) states, for example, that production practices of agroecology include traditional fishing, territories are a fundamental pillar of agroecology and people have the right to maintain their own spiritual and material relationships to fishing grounds. The World Forum of Fisher Peoples (KNTI and WFFP, 2017) suggests a need to apply: Biophysical and environmental practices and principles of agroecology; Social and political practices and principles of agroecology; Economic practices and principles of agroecology. There are clearly links with the SSF guidelines.

- Explore how agroecology practices and principles can contribute to the economic, environmental and social sustainability of coastal fisheries systems.

7.4.2 For the small pelagic (Anchovy and Anchovy-like) sub-chains in Mainland and in Zanzibar

There are wide similarities and linkages between MLT and ZNZ in the small pelagic value chain. The stock is shared between MLT and ZNZ, as well as the medium and large pelagic stocks.

- There is a strong requirement for more cooperation and collaboration between Mainland and Zanzibar for its management and governance. In this context, the need for a jointly developed and implemented common anchovy and anchovy-like fishery management plan, cannot be overemphasized.

This chain is significant in terms of contribution to local coastal economic growth and providing many local jobs in coastal rural and urban areas. It is well organized in an informal way. The middlemen and women are playing a central role in this chain, which is involving more and more women. The sub-chain appears to be the more efficient in terms of environmental performance, compared to other sub- chains. The mobile nature of small pelagic fisheries may create a challenge for the co-management of resources.

- It is important to support initiatives being taken in addressing challenges faced by actors in this chain including high food fish losses and waste, especially during the rainy season. Researchers, fishers, processors, and other stakeholders should work together to co-design solutions which are economically, environmentally and socially sustainability.
- Explore the viability of supporting national, regional, and local associations of the main actors of this sub-chain, in particular fishers, middlemen and women (who are central players), as well as traders. Foreign buyers may be given more official recognition for a better organization and performance of the chain, including the marketing environment.

[55] In fact, there has been just a recent initiative coordinated by the UN in Tanzania, to coordinate donor initiatives related to Blue Economy (May 2022 information).
[56] UN principles: https://www.unepfi.org/blue-finance/the-principles/
[57] EU BE financing principles: https://oceans-and-fisheries.ec.europa.eu/ocean/sustainable-ocean-finance_en

- Much greater attention is needed to understand how small pelagic fisheries contribute to food and nutrition security in coastal communities and nationally to inform decision-making processes.

There are very contrasting results for the exports figures in MLT (8,868 MTZS) and ZNZ (53,414 MTZS). This may be linked to a significant disparity between the two regions in terms of tax and royalty regimes. These very different economic flows between the two entities may be favouring unreported exchanges or illegal exports.

- The cooperation between Mainland and Zanzibar related to this sub-chain should carefully encompass all the business environment, including the tax regime, and its traceability.

7.4.3 For the Finfish sub-chains in Mainland and in Zanzibar

Finfish, particularly reef fish, are important for food and nutrition security, for fishers' households, and coastal communities. Moreover, they play a very significant role in the coastal economy. Large pelagic and a few reef fishes are high-value fish and are mostly marketed to the tourist sector in ZNZ as well as in MLT, in the Dar-es-Salaam area.

In MLT, finfish are traded through the auctions system and FFM, where a large part of the catch is traded. An important action is to improve the way these nodes are functioning. With regards to auctions, the system is similar in both regions, though coverage is wider in ZNZ with auctioning found in almost all landing sites. Market nodes in ZNZ are smaller and include scattered urban fish markets.

- Improve the process for faster and more precise data collection and processing in these key nodes, to improve the reporting and monitoring of volumes, and price trends.
- With regards to fish landing nodes, there is an urgent need for cost-effectively improving the storage capacities, the ice supplies, provision of sheds for protection from the sun, energy supply, and the general working conditions for all the actors gathered in those key places. This should be done through co-design with key stakeholders (e.g., BMU or VFCs, auctioneers, local authorities, and district officers). Key criteria for success will be positive impacts on sustainability of the sub-chain and the livelihoods of actors.
- The processing facilities should be improved to increase their efficiency and decrease firewood consumption.
- Waste management should be explored, including the collection and valorisation of cooking oil.

Regarding the market trends and social issues:

- Much greater attention is needed to understand the relationship between food and nutrition security and finfish fisheries in coastal communities and nationally to inform decision-making processes. This should include:
- Monitoring fish price trends, and finfish consumption patterns to assess the on-going contribution of the sub-chain to food and nutrition security.

Regarding the primary sector, and the environmental issues:

- An evaluation of costs/benefits for various fishing technologies to enable fishing capacities to be strengthened in a sustainable manner. For example, the expansion of ring-netters may constitute a threat for overexploitation or disbalance in the chain, the expansion of fiberglass motorized vessels, and any initiative to promote the use of Fish Aggregating Devices (FAD).
- Attention should be paid to promoting initiatives aimed at preserving and valuing (or secondarily, restoring) critical ecosystems and biodiversity hotspots, such as reefs and mangroves in fair and just ways.
- Alternative Income-Generating Activity (AIGA) should be jointly explored with fishing community stakeholders and building on lessons from previous initiatives to reduce the pressure on exploited stocks.
- Upgrading the efficiency of the fishing vessels to reduce the FUI.

7.4.4 For the Octopus sub-chains in Mainland and in Zanzibar

This sub-chain provides a significant contribution to the local economic growth in some coastal areas. In MLT, it represents a contribution for foreign currencies as it is an export product. In ZNZ, it is also important, through the tourist market. Women – particularly as foot fishers -play an important role in the primary sector, but there are threats to this role because of the growing number of male diver fishers. The closure periods, promoted by NGOs,

but being acknowledged to a certain degree by local communities are very promising initiatives to sustainably manage the resource. In Zanzibar, closures take place within MPAs.

- Consider how this closure system could be expanded to other reefs, but with an area-specific approach which ensures that local women are central in decision-making and that inclusiveness is considered throughout the chain. Fishing zones per category of fishers (divers of foot fishers) should be defined and separated.
- Any expansion of the closure system to other reefs should be associated with a good monitoring of the catches, the numbers of fishers and the outcomes in terms of winners and losers.

In MLT, compared to the other sub-chains, the octopus value chain appears inefficient in terms of environmental performance, due to the high FUI.

- Upgrading the efficiency of the fishing vessels to reduce the FUI.
- Together with a more capillary and efficient cold chain system, these measures could lead also to the improved environmental performance of the fishing activity, allowing the exploitation of reefs that are closer but less served by ancillary services.
- Emphasis should be placed on participatory development and effective implementation of Octopus fishery Management plan

In MLT, this sub-chain creates employment in the formal sector, mainly through processing factories in urban centres. This is not the case for Zanzibar, because of the absence of processing plants.

- An improved sustainability of the products could be further explored and promoted through labels, and a good traceability system from fisher to end-users, including EU consumers.
- Promotion of investment in Cold Chain Development (CCD) has a great potential for transforming this sub-chain.

7.4.5 For the Mainland Prawn sub-chain

This sub-chain looks minor in terms of volumes and contribution to the coastal economic growth. However, the number of artisanal fishers is very significant, and this activity seems to generate quite a significant additional income to fishers for 5-6 months. The natural resource has been threatened, but the Prawn management plan (under discussion, URT 2021) may be a great opportunity if it is implemented correctly. In addition, this chain engages artisanal fishers and industrial players to provide for export markets and tourist markets looking for a high-quality product. This involves a cost-effective cold chain to be assured from the fishers to the end-users.
The Management plan could constitute a great opportunity to have this sub-chain to become emblematic, providing income to local communities for an export market in the future. The vision would be that: all actors of the chain are secured, there would be better management of stocks and the number of fishers, the working conditions for fishers are improved, traceability more detailed, and the management of the logistics towards the end markets improved to maintain quality for export or local tourist markets.

- Ensure the Prawn management plan when fully finalized has adequate means to be implemented.
- Continue to explore and support certification such as Marine Stewardship Council (MSC) or Fair Trade but ensure all the relevant stakeholders are included in the process.

8. REFERENCES

Akande, G.R and Diei-Ouadi, Y (2010). Post-harvest losses in small-scale fisheries. Case studies in five sub-Saharan African countries. FAO Fisheries and Aquaculture Technical Paper No. 550. Rome, FAO. 72ppAFDP (Agriculture and Fisheries Development Programme), Prime Minister's Office (PMO), Government of Tanzania, Environmental and Social Management Framework (ESMF) DRAFT REPORT July 2020

Alexander S.M., Bodin O., Barnes M.L., 2018. Untangling the drivers of community cohesion in small-scale fisheries International Journal of the Commons Vol. 12, no 1 2018, pp. 519–547 Publisher: Uopen Journals URL:http://www.thecommonsjournal.org DOI: 10.18352/ijc.843

Andres L., Acosta Alba I., Nicolay, G., Oswald, M., Zerbo, H., 2020. Analyse de la chaîne de valeur de la pêche au Mali. Rapport pour l'Union Européenne, DG-DEVCO. Value Chain Analysis for Development Project (VCA4D CTR 2016/375-804), 195 p + annexes.

ARCHITECT AFRICA (2022) Zanzibar opens up a further nine smaller islands for investment opportunities. 15th Feb 2022. https://apex.architectafrica.com/2022/02/15/zanzibar-opens-up-a-further-nine-smaller-islands-for-investment-opportunities/ Accessed 10.7.22

Avadí, A., Dème, M., Mbaye, A., Ndenn, J., 2020. Fisheries Value Chain Analysis in The Gambia. Report for the European Union, DG-DEVCO. Value Chain Analysis for Development Project (VCA4D CTR 2016/375-804), 134p + annexes

Badstue L, Farnworth C.R., Umantseva A., Kamanzi A. & Roeven L., 2021. Continuity and Change: Performing Gender in Rural Tanzania, The Journal of Development Studies, 57:2, 310-325, DOI: 10.1080/00220388.2020.1790534

Baffes J, Varun Kshirsagar, Donald Mitchell, What Drives Local Food Prices? Evidence from the Tanzanian Maize Market, The World Bank Economic Review, Volume 33, Issue 1, February 2019, Pages 160–184, https://doi.org/10.1093/wber/lhx008

Barange, M., T. Bahri, M. C. Beveridge, K. L. Cochrane, S. Funge-Smith, and F. Poulain. 2018. Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. FAO.

Benjaminsen, T.A. and Bryceson, I., 2012. Conservation, green/blue grabbing and accumulation by dispossession in Tanzania. Journal of Peasant Studies, 39(2), pp.335-355.

Bank of Tanzania, 2020. Annual report 2019/20. ISSN 0067-3757. 247 pages. https://www.bot.go.tz/Publications/Filter/34.

Benansio, J. S., W. Mathias, B. Annette, and J. Narriman. 2016. Have the fishing communities of Zanzibar Island benefited from increasing tourism development? Journal of Development and Agricultural Economics **8**:95-107.

Besta N.A., undated. Seaweed Farming and Intra-Household Gender Relations on Songo Songo Island, Tanzania. A thesis submitted for the degree of Doctor of Philosophy at the School of International Development University of East Anglia

Beymer-Farris, B. A., Bryceson, I., & Peter, C. M., 2019. The human rights dimensions of conservation and climate change initiatives in Coastal Tanzania: Examples of villagers' successful struggles for their rights. In Climate Change and Coastal Resources in Tanzania (pp. 169-202). Springer, Cham.

Bladon A,, Gunilla Tegelskär Greig, and Yuko Okamura (2022) Connecting Social Protection and Fisheries Management for Sustainability: A Conceptual Framework. SOCIAL PROTECTION & JOBS | POLICY & TECHNICAL NOTE MAY 2022 | No. 25

Bradford K., Katikiro R.E., 2019. Fighting the tides: A review of gender and fisheries in Tanzania. Fisheries Research, Volume 216, 2019, Pages 79-88, ISSN 0165-7836, https://doi.org/10.1016/j.fishres.2019.04.003.

Breuil, C. and Bodiguel, C., 2015. Report of the Meeting on Marine Small Pelagic Fishery in the United Republic of Tanzania. SFFAO/2015/34, IOC-SmartFish Programme. FAO

Breuil, C. and Grima, D., 2014. Baseline Report Tanzania. SmartFish Programme of the Indian Ocean Commission, Fisheries Management FAO component, Ebene, Mauritius. 43 pp.

Brüntrup M, Thomas Absmayr, Jonas Dylla, Franziska Eckhard, Kerstin Remke, Konrad Sternisko (2016) Large-scale agricultural investments and rural development in Tanzania: lessons learned, steering requirements and policy responses. Paper prepared for presentation at the "2016 WORLD BANK CONFERENCE ON LAND AND POVERTY" The World Bank - Washington DC, March 14-18, 2016. https://www.idos-research.de/uploads/media/Bruentrup-230-230_paper.pdf

Buck BH, Troell MF, Krause G, Angel DL, Grote B and Chopin T (2018) State of the Art and Challenges for Offshore Integrated Multi-Trophic Aquaculture (IMTA). Front. Mar. Sci. 5:165. doi: 10.3389/fmars.2018.00165

Burgoyne, C.N., Kelso, C. & Mearns, K. (2017) The impact of stakeholder relations on the Mnemba Island Marine Conservation Area, Zanzibar, Tanzania. Tourism in Marine Environments, 12 (3-4), 239-252

Caplan P. (2016) Sustainable Development? Controversies over Prawn Farming on Mafia Island, Tanzania. Conservation and Society 14(4): 330-344, 2016

Caplan, P., 2006. ''Is It Real Food?' Who Benefits from Globalisation in Tanzania and India?'. Sociological Research Online, 11(4) caplan <http://www.socresonline.org.uk/11/4/caplan.html>

CBI, 2020. Entering the European market for octopus Last updated: 16 December 2020. https://www.cbi.eu/market-information/fish-seafood/octopus-0/market-entry Accessed December 2021

Chale, T. and Medard, M., 2020. How community banking empowers women in Tanzania How community banking empowers women in Tanzania | Stories | WWF (worldwildlife.org) https://www.fao.org/voluntary-guidelines-small-scale-fisheries/news-and-events/detail/en/c/1242127/

Cinner, J. E., McClanahan, T. R., Graham, N. A., Daw, T. M., Maina, J., Stead, S. M., ... & Bodin, Ö. (2012). Vulnerability of coastal communities to key impacts of climate change on coral reef fisheries. Global Environmental Change, 22(1), 12-20.

Claussen, I. C., Indergård, E., & Grinde, M. (2011). Comparative Life Cycle Assessment (LCA) of production and transport of chilled versus superchilled haddock (Melanogrammus aeglefinus) fillets from Norway to France. Procedia Food Science, 1, 1091-1098.7

Cloâtre T., 2018. Rapport méthodologique du projet ICV Pêche. 86 p.

Colbert-Sangree, N., 2012. The state of artisanal fisheries in southern Unguja: governance, conservation and community. Independent Study Project (ISP) Collection. [online] URL: http://digitalcollections.sit.edu/isp_collection/1279

COLEACP, 2022. VCA4D – COLEACP Market profile: Fisheries from Tanzania. 29 pages

Cooper, J.P., Blue, L., Ghidoni, A., and Ichumbaki, E.B. (2022): Contemporary Wooden Watercraft of the Zanzibar Channel, Tanzania: Type and Technology, Continuity and Innovation, International Journal of Nautical Archaeology, DOI: 10.1080/10572414.2021.2015913

Corno, Guido, 2021. Status of marine and coastal ecosystem management in Tanzania (mainland, Pemba, Zanzibar and Mafia Island) and options for the EU to build a Blue Economy intervention in Tanzania. Unpublished.

Courtney, C. A., Pomeroy, R., and Brooks, S. H., 2019. Taking stock of the status of implementation of the Voluntary Guidelines for Securing Sustainable Small-scale Fisheries: a country-level assessment framework. Marine Policy, 100, 361-370.

Crona B., Nystrom M., Folke C., Jiddawi N., 2010. Middlemen, a critical social-ecological link in coastal communities of Kenya and Zanzibar Marine Policy 34 (2010) 761–771

Daurès, F., V. M. Trenkel, and O. Guyader. 2013. Modelling the fishing costs of French commercial vessels in the Bay of Biscay. Fisheries Research 146:74-85.

Diei-Ouadi, Y and Mgawe, Y (2011) Post-harvest fish loss assessment in small-scale fisheries: A guide for the extension officer, FAO Fisheries and Aquaculture Technical paper No. 559.Drury O'Neill, E., B. Crona, A. J. G. Ferrer, R. Pomeroy, and N. S. Jiddawi., 2018. Who benefits from seafood trade? A comparison of social and market structures in small-scale fisheries. Ecology and Society 23(3):12.https://doi.org/10.5751/ES-10331-230312

EcoAfrica Environmental Consultants 2012a. An Assessment of Legal and Institutional Framework for Effective Management of Marine Managed Areas in Tanzania. Mainland Tanzania Report. Marine Parks and Reserves Unit, Dar es Salaam, Tanzania. PP 83.

EcoAfrica Environmental Consultants. 2012b. An Assessment of Legal and Institutional Framework for Effective Management of Marine Managed Areas in Tanzania. Zanzibar Report. Marine Conservation Unit, Zanzibar, Tanzania

EMEP, E., & Guidebook, E. A. P. E. I. (2019). Technical Guidance to Prepare National Emission Inventories. EEA: Copenhagen, Denmark.

Ertör I. , Brent Z.W., Gallar D. and Josse T. (2020) Situating Small-Scale Fisheries in the Global Struggle for Agroecology and Food Sovereignty. Published by Transnational Institute; Association Pleine Mer; and Solidaritas Perempuan Amsterdam November 2020. https://www.fao.org/family-farming/detail/en/c/1332520/

Fabinyi, M (2020) The role of land tenure in livelihood transitions from fishing to tourism. Maritime Studies 19, 29–39 (2020). https://doi.org/10.1007/s40152-019-00145-2

FAO, 1972. Second FAO/Swedish training centre on small fishing boat design and construction. Entebbe, Uganda, 22-27 February 1971. FAO, Rome. 1972. 208p.

FAO, 1980. Farm management research for small farmer development. Food and Agriculture Organization, Rome, Italy.

FAO, 2015. Meeting on the Small Pelagic Marine Fishery in the United Republic of Tanzania Bagamoyo – Tanzania.90 pages

FAO, IFAD, UNICEF, WFP and WHO. 2022. The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable. Rome, FAO. https://doi.org/10.4060/cc0639en

Fröcklin S, de la Torre-Castro M, Lindström L, Jiddawi NS, 2013. Fish traders as key actors in fisheries: gender and adaptive management. Ambio. 2013; 42(8):951-962. doi:10.1007/s13280-013-0451-1

Fujimoto, M., 2018. Economic Impact of the Dagaa Processing Industry on a Coastal Village in Zanzibar, Tanzania. African study monographs. Supplementary issue 2018, 55: 145-162

García-de-la-Fuente, L., J. González-Álvarez, L. García-Flórez, P. Fernández-Rueda, and J. Alcázar-Álvarez. 2013. Relevance of socioeconomic information for the sustainable management of artisanal fisheries in South Europe. A characterization study of the Asturian artisanal fleet (northern Spain). Ocean & Coastal Management 86:61-71.

Gómez, D. R., Wattersson, J., Americano, B. B., Ha, C., Marland, G., Matsika, E., ... & Treanton, K. (2006). Stationary combustion. Energy, 2006 IPCC Guidelines for National Greenhouse Gas Emissions Inventories, Intergovernmental Panel on Climate Change, Geneva.ù

González, A. D., Frostell, B., & Carlsson-Kanyama, A. (2011). Protein efficiency per unit energy and per unit greenhouse gas emissions: potential contribution of diet choices to climate change mitigation. Food policy, 36(5), 562-570.

Gustavson, K., Kroeker, Z., Walmsley, J., and Juma, S., 2009. A process framework for coastal zone management in Tanzania. Ocean & Coastal Management, 52(2), 78–88. http://indicators.ohchr.org/

Gustavsson M., Lindström L, Jiddawi N.S., de la Torre-Castro M. (2014) Procedural and distributive justice in a community-based managed Marine Protected Area in Zanzibar, Tanzania, Marine Policy, Volume 46, 2014, Pages 91-100, ISSN 0308-597X, https://doi.org/10.1016/j.marpol.2014.01.005. https://www.irglobal.com/article/investment-law-in-zanzibar/

Gustavsson M., Katia Frangoudes, Lars Lindström, María Catalina Álvarez Burgos, Maricela de la Torre-Castro (2021) Gender and Blue Justice in small-scale fisheries governance, Marine Policy, Volume 133, 2021, 104743, ISSN 0308-597X, https://doi.org/10.1016/j.marpol.2021.104743

Haji M.H., 2013. The need of effective land policy in Zanzibar a case study of west district. A Dissertation Submitted in Partial Fulfillment of the Requirements for Award of the Degree of Master of Science in Development Policy (MSc. DP) of Mzumbe University

Hikmany Abdul-Nasser H., Sharifah Zubaidah Bt Syed Abdul Kader and Ahmad Azam Othman (2015) Legal Issues of Land Acquisition in Zanzibar. Confrenence paper presented at the International Conference on Advanced Research in Business and Social Sciences 2015 2nd to 3rd September, 2015, Kuala Lumpur Convention Centre, Malaysia. https://www.researchgate.net/publication/283565656_Legal_Issues_of_Land_Acquisition_in_Zanzibar/citations

HLPE, 2014. Sustainable fisheries and aquaculture for food security and nutrition. A report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2014

Huijbregts, M., Steinmann, Z., Elshout, P., Stam, G., Verones, F., Vieira, M.,. & Zijp, M. (2017). ReCiPe 2016 v1. 1-A harmonized life cycle impact assessment method at midpoint and endpoint level: Report I. Characterization (No. RIVM Report 2016–0104a). Natl Inst Public Health Environ Bilthoven Neth.

Ibengwe, L. J., Onyango, P. O., Hepelwa, A. S., & Chegere, M. J., 2022. Regional trade integration and its relation to income and inequalities among Tanzanian marine dagaa fishers, processors and traders. Marine Policy, 137, 104975.

ICSF, 2015. Workshop to introduce the FAO voluntary guidelines for securing sustainable small- Scale fisheries in the context of food security and poverty eradication (VG-SSF) in Tanzania. International collective in support of fishers and fishworkers (ICSF) and Mwambao coastal community network, Tanzania. Bagamoyo, 17-18th august 2015

ILO and Tanzania National Bureau of Statistic, 2016. Tanzania National Child labour survey 2014: Analytical Report / International Labour Office; Fundamental Principles and Rights at Work Branch (Fundamentals); Tanzania National Bureau of Statistics. - Geneva: ILO, 2016

ILO, 2013. Decent Work Country Programme 2013-2016. https://www.ilo.org/africa/countries-covered/tanzania/WCMS_248019/lang--en/index.htm

International Labour Office, Fundamental Principles and Rights at Work Branch (FUNDAMENTALS) Child labour and the youth decent work deficit in Tanzania / - Geneva: ILO, 2018

IUCN, 2020. Worldwide catalogue of case studies on Aquaculture and Marine Conservation, N°1: Zanzibar. In: PROGRAM, G. M. A. P. (ed.) Worldwide catalogue of projects/case studies: Aquaculture in Marine Protected Areas. Gland, Switzerland: International Union of Nature Conservation.

Iversen, S. A., Myklevoll, S., Lwiza, K., and Yonazi, J., 1984. Tanzanian marine fish resources in the depth region 10–500 m investigated by R/V Dr Fridtjof Nansen. In The Proceedings of the NORAD-Tanzania Seminar to Review the Marine Fish Stocks and Fisheries in Tanzania. Mbegani, Tanzania (pp. 6-8).

Jacquet, J., Fox, H., Motta, H., Ngusaru, A., and Zeller, D., 2010. Few data but many fish: marine small-scale fisheries catches for Mozambique and Tanzania. African Journal of Marine Science, 32(2), 197-206.

J a n u a r y M. a n d N g o w i H.P. (2010) 'Untangling the Nets' The Governance of Tanzania's Marine Fisheries. The South African Institute of International Affairs R E S E A R C H R E P O R T 5. https://www.africaportal.org/documents/898/SAIIA_Research_Report_no_5.pdf

Jiddawi, N.S. and Ohman, M.C., 2002. Marine fisheries in Tanzania. AMBIO A J. Hum. Environ. 31 (7), 518–527.

JRC, C.E., 2010. ILCD Handbook - General guide on LCA - Detailed guidance, Constraints. https://doi.org/10.2788/38479

JRC, C.E., 2022. Investigating the potential impacts of fisheries on the maintenance of biodiversity in Tanzania: insights from the Digital Observatory for Protected Areas. DRAFT

Kachule M., 2021. Fishery supply chain process in Tanzania: A case of Ferry market at Ilala district in Dar es Salaam. A dissertation submitted in partial fulfillment of the requirements for the award of Masters of Supply Chain Management (MSCM) of the College of Business Education, Dar es Salaam.

http://dspace.cbe.ac.tz:8080/xmlui/bitstream/handle/123456789/888/Mwanamosi%20-%20Revised%20%20research%20%20report_1%20NYINGINE.pdf?sequence=1&isAllowed=y

Kakama, G. 2020. Assessing performance of decentralized fisheries management in artisanal marine waters of Tanzania: A case study of Tanga, Coast, Dar es Salaam, and Lindi regions. UNESCO GRÓ Fisheries Training Programme, Iceland. Final project. http://www.grocentre.is/ftp/static/fellows/document/Grace19prf.pdf

Kamat V.R., 2018. Dispossession and disenchantment: The micropolitics of marine conservation in southeastern Tanzania. February 2018Marine Policy 88:261-268. DOI: 10.1016/j.marpol.2017.12.002

Katikiro R., Ashoka Deepananda K.H.M., Macusi E. (2015) Interplay between perceived changes in fishery and social structures in Tanzanian coastal fishing communities, Fisheries Research, Volume 164, 2015, Pages 249-253, ISSN 0165-7836, https://doi.org/10.1016/j.fishres.2014.12.009.

Katikiro, R. E., Namkesa, F., and Ponte, S., 2017. Sustainability Partnerships for the Governance of Coastal Resources in Tanzania, NEPSUS Working Paper No. 17-5. Dar es Salaam: Copenhagen Business School. doi:978-87-93571-04-4.

Katikiro, R. E., Namkesa, F., and Ponte, S., 2017. Sustainability Partnerships for the Governance of Coastal Resources in Tanzania, NEPSUS Working Paper No. 17-5. Dar es Salaam: Copenhagen Business School. doi:978-87-93571-04-4

Keller A.(2012) , « Food and Diseases in Zanzibar », Les Cahiers d'Afrique de l'Est / The East African Review [En ligne], 45 | 2012, mis en ligne le 07 mai 2019, consulté le 15 juillet 2022. URL : http://journals.openedition.org/eastafrica/502 ; DOI : https://doi.org/10.4000/eastafrica.502

Kironde J.M. Lusugga (2009) Improving Land Sector Governance in Africa: The Case of Tanzania Paper prepared for the "Workshop on "Land Governance in support of the MDGs: Responding to New Challenges" Washington DC March 9-10 2009. http://fig.net/resources/proceedings/2009/fig_wb_2009/papers/gov/gov_1_kironde.pdf

KNTI and WFFP (2017) Food Sovereignty and Agroecology in Small-scale Fisheries. International Secretariat of the World Forum of Fisher Peoples, Cape Town, South Africa https://worldfishers.org/2017/09/20/food-sovereignty-agroecology-small-scale-fisheries/

Kuboja B.N. (2013) Policies and legal frameworks for Marine Protected Areas governance in Tanzania mainland: their potential and limitations for achieving conservation and livelihood goals. United Nations-Nippon Foundation of Japan Fellowship Programme. December 2013

Kuguru,B., I. Sailale, H.K. Peter, G. Marwa (2022). Use of satellite data to identify and delineate potential fishing zones and in marine waters of Tanzania. Final technical report submitted to Deep Sea Fishing Authority.

Kweka, O., Katikiro, R., Minja, R. A., & Namkesa, F. (2017). Partnerships for the Governance of Coastal

Resources: A Literature Review. Copenhagen Business School, CBS. NEPSUS Working Paper Vol. 2017 No. 4

Lambin R. and Nyyssölä M.(2022) Employment policy in Mainland Tanzania: what's in it for women? WIDER Working Paper 2022/67. June 2022. https://www.wider.unu.edu/sites/default/files/Publications/Working-paper/PDF/wp2022-67-employment-policy-Mainland-Tanzania-women.pdf

Lange, G.-M. 2015. Tourism in Zanzibar: incentives for sustainable management of the coastal environment. Ecosystem Services 11:5-11. http://dx.doi.org/10.1016/j.ecoser.2014.11.009

Le Floc'h, P., O. Thébaud, J. Boncœur, F. Daurès, and O. Guyader. 2008. Une évaluation des performances économiques de la pêche côtière: le cas de la Bretagne. Revue d'Économie Régionale & Urbaine:753-771.

Le Floc'h, P. 2009. La mesure des performances économiques des entreprises de pêche. Université de Bretagne occidentale - Brest.

Le Gouvello, R. 2019. Circular economy in a small-scale fishery-dependent social-ecological system: characteristics, evaluation, opportunities and challenges. PhD. University of Brest, Brest, France.

Lindström L., de la Torre-Castro M., 2017. Tuna or Tasi? Fishing for Policy Coherence in Zanzibar's Small-Scale Fisheries Sector. In: Jentoft S., Chuenpagdee R., Barragán-Paladines M., Franz N. (eds) The Small-Scale

Fisheries Guidelines. MARE Publication Series, vol 14. Springer, Cham. https://doi.org/10.1007/978-3-319-55074-9_5

Linton, J., 2021. Scoping study of the coastal fisheries in Tanzania. Univ. of Greenwich/ NRI. Agrinatura. 37 pages

Machumu, M. E., & Yakupitiyage, A. (2013). Effectiveness of marine protected areas in managing the drivers of ecosystem change: a case of Mnazi Bay Marine Park, Tanzania. Ambio, 42(3), 369-380.

Machumu, M.E. 2021. Marine & Coastal Areas under Protection: United Republic of Tanzania: Tanzania Mainland, p. 187–202, In: UNEP-Nairobi Convention and WIOMSA. 2021. Western Indian Ocean Marine Protected Areas Outlook: Towards achievement of the Global Biodiversity Framework Targets. UNEP and WIOMSA, Nairobi, Kenya, 298 pp

Madzorera I, Mia M Blakstad, Alexandra L Bellows, Chelsey R Canavan, Dominic Mosha, Sabri Bromage, Ramadhani A Noor, Patrick Webb, Shibani Ghosh, Joyce Kinabo, Honorati Masanja, Wafaie W Fawzi, Food Crop Diversity, Women's Income-Earning Activities, and Distance to Markets in Relation to Maternal Dietary Quality in Tanzania, The Journal of Nutrition, Volume 151, Issue 1, January 2021, Pages 186–196, https://doi.org/10.1093/jn/nxaa329

Magnan, A.K., M. Garschagen, J.-P. Gattuso, J.E. Hay, N. Hilmi, E. Holland, F. Isla, G. Kofinas, I.J. Losada, J. Petzold, B. Ratter, T.Schuur, T. Tabe, and R. van de Wal, 2019: Cross-Chapter Box 9: Integrative Cross-Chapter Box on Low-Lying Islands and Coasts. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.

Marchal, P., B. Andersen, D. Bromley, A. Iriondo, S. Mahévas, F. Quirijns, B. Rackham, M. Santurtún, N. Tien, and C. Ulrich. 2006. Improving the definition of fishing effort for important European fleets by accounting for the skipper effect. Canadian Journal of Fisheries and Aquatic Sciences 63:510-533.

Masanja H., Jumbe T., and Pacific R., 2021. Contribution of fish in improving micronutrients content in complementary foods for children aged 6 to 23 months in Lindi Rural District. African Journal of Food Science. Vol. 15(5) pp. 203-217, May 2021.DOI: 10.5897/AJFS2021.2086

Mayala, P. J., 2018. Assessment of the socio-economic value of the small pelagic fishery in Mafia Island, Tanzania. United Nations University Fisheries Training Programme, Iceland [final project]. http://www.unuftp.is/static/fellows/document/philipo16prf.pdf

MBEFZ, 2020b. Zanzibar Fisheries Annual Report. Ministry of Blue Economy and Fisheries in Zanzibar, Zanzibar City.

McGoodwin, J.R. (2001) Understanding the cultures of fishing communities: a key to fisheries management and food security. FAO Fisheries Technical Paper. No. 401. Rome, FAO. 2001. 287p

McLain R., Lawry S., Ojanen M. (2018) Fisheries' Property Regimes and Environmental Outcomes: A Realist Synthesis Review, World Development, Volume 102, 2018, Pages 213-227, ISSN 0305-750X, https://doi.org/10.1016/j.worlddev.2017.09.016.

Meunier, M., P. Le Floc'h, and F. Daures. 2014. Observatoire Economique Régional des pêches de Bretagne : Résultats des flotilles artisanales 2013. UMR-AMURE, IFREMER, Brest.

Mgawe, Yahya I., 2020. Assessment of socio-economic and biological consequences of the fishmeal and fish-based feed production industry in Sub Saharan African region, National Technical Report: TANZANIA 44 p

Mgawe, Y.I (2017) Experience with regard to Cold Chain Development in Small-Scale Fisheries: Lessons from Tanzania. A paper presented at FAO Technical consultation meeting on Cold Chain Development in developing countries in the Context of Rural Transformation. Rome, Italy 22-24 November 2017. Rome: FAO.

MHBS (2020) Ministry of Finance and Planning - Poverty Eradication Division (MoFP- PED) [Tanzania Mainland], National Bureau of Statistics (NBS) and the World Bank(2020) Tanzania Mainland Household Budget Survey 2017/18. Final Report Dodoma, Tanzania MoFP-PED, NBS and Washington DC USA, and WB

MoBEF, 2020a. Zanzibar Fisheries Frame Survey. Ministry of Blue Economy and Fisheries in Zanzibar, Zanzibar City.

Moshy VH, Bryceson I (2016) Seeing through fishers' lenses: exploring marine ecological changes within Mafa Island Marine Park, Tanzania. SAGE Open 6(2):1–18

Mpemba A., 2016. Contributions of fishing to the household income in Mafia district, Tanzania a dissertation submitted in partial fulfillment of the requirements for the degree of master of sciences in environmental and natural resource economics of the sokoine university of agriculture. Morogoro, Tanzania

Mrema, E.J., Ngowi, A.V. and Mamuya, S.H.D., 2015. Status of Occupational Health and Safety and Related Challenges in Expanding Economy of Tanzania. Annals of Global Health, 81(4), pp.538–547. DOI: http://doi.org/10.1016/j.aogh.2015.08.021

Mwaipopo, Rosemarie. Tanzania: Labour, Fraught with Danger. Samudra Report no. 77 (2017). https://www.icsf.net/images/samudra/pdf/english/issue_77/4309_art_ Sam77_e_art08.pd

Myenzi, Yefred 2009. Women land rights in Tanzania A paper prepared for presentation at the workshop organized by Mzumbe University DSM Campus on 10th January2009. HAKIARDHI Jan 10, 2009. landwise.resourceequity.org › documents › 2067

Nyéléni (Mali 27 February 2015). Declaration of the international forum for agroecology.
http://foodsovereignty.org/wp-content/uploads/2015/02/Download-declaration-Agroecology-Nyeleni-2015.pdf

Oates, L., Gillard, R., Sudmant, A. and Gouldson, A. 2020. Secure and equal access to land for all: Lessons on land governance and climate resilience from Dar es Salaam, Tanzania. Coalition for Urban Transitions, London and Washington, DC. Available at: http://newclimateeconomy.net/content/cities-working-papers

O'Neill, E. D., B. Crona, A. J. G. Ferrer, R. Pomeroy, and N. S. Jiddawi. 2018. Who benefits from seafood trade? A comparison of social and market structures in small-scale fisheries. Ecology and Society 23.

Parker, R.W.R., Blanchard, J.L., Gardner, C., Green, B.S., Hartmann, K., Tyedmers, P.H., Watson, R.A., 2018. Fuel use and greenhouse gas emissions of world fisheries. Nat. Clim. Chang. 8, 333–337. https://doi.org/10.1038/s41558-018-0117-

Parker, R.W.R., Tyedmers, P.H., 2014. Fuel consumption of global fishing fleets: current understanding and knowledge gaps. Fish Fish. n/a-n/a. https://doi.org/10.1111/faf.12087

Peart J, Tran N, Chan CY, Maskaeva A, Shoko AP, Kimirei IA and Madalla NA. 2021. A review of fish supply–demand in Tanzania. Penang, Malaysia: WorldFish. Program Report: 2021-32

Ponte, S., Noe, C., & Mwamfupe, A. (2020). Private and public authority interactions and the functional quality of sustainability governance: Lessons from conservation and development initiatives in Tanzania. Regulation & Governance. https://doi.org/10.1111/rego.12303

Porter, M., Mwaipopo, R., Faustine, R., Mzuma, M., 2008. Globalization and women in coastal communities in Tanzania. Development 51, 193–198. https://doi.org/10. 1057/dev.2008.4.

Prado, J., Dremiere, P. Y., & Ferretti, M. (2001). Guida pratica del pescatore.

Randon L. (2020) Transnational land deals and land grabbing in Tanzania. Corso di Laurea Magistrale in Lingue Moderne per la Comunicazione e la Cooperazione Internazionale Classe LM-38. https://thesis.unipd.it/bitstream/20.500.12608/23217/1/Randon_Lucia_2020.pdf

Raycraft, J. (2020). The (un)making of marine park subjects: Environmentality and everyday resistance in a coastal Tanzanian village. World Development, 126, 104696. https://doi.org/10.1016/j.worlddev.2019.104696

RGoZ Revolutionary Government of Zanzibar - Department of Fisheries Development (DFD) 2020. Marine Fisheries Frame Survey 2020, Zanzibar. Ministry of Blue economy and Fisheries Zanzibar. SWIOFish Project/World Bank. pp51

RGoZ Revolutionary Government of Zanzibar - Department of Fisheries Development. (2019)a. Small Pelagic Fisheries Management Plan. Ministry of Agriculture, Natural Resources, Livestock and Fisheries, Zanzibar. 103 pp

RGoZ Revolutionary Government of Zanzibar - Department of Fisheries Development (2019)c. Octopus Fisheries Management Plan. Ministry of Agriculture, Natural Resources, Livestock and Fisheries, Zanzibar. 90 pp.

RGoZ Revolutionary Government of Zanzibar - of Fisheries Development. (2019)b. Reef Fisheries Management Plan. Ministry of Agriculture, Natural Resources, Livestock and Fisheries, Zanzibar. 91 pp.

RGoZ Revolutionary Government of Zanzibar (2020) Zanzibar Blue Economy Policy. October 2020.

RNLI (2019) Evidence, Perceptions and Knowledge of drowning risk in Zanzibar. Research Project ID: INT18.1. https://rnli.org/-/media/rnli/downloads/international_research_summary_-_zanzibar_final.pdf?rev=2e72ea61ae7340eead7a5676131b34be&hash=82633753AF01C96414765A9D9B72B194

Rocliffe, S., and Harris, A., 2016. The status of octopus fisheries in the Western Indian Ocean. Blue Ventures. London.

Rugazia, A.R. 2021. The right to fair compensation for land acquired for petroleum activities: a critique of law and practice in Tanzania. . ,Faculty of Law ,Department of Public Law. http://hdl.handle.net/11427/3605

Sanga, A. S.(2019). Practitioners' perspectives on land resource conflicts and resolution inTanzania. The Journal of Rural and Community Development, 14(2), 87–106

Sekadende B., Scott L., Anderson J., Aswani S., Francis J., Jacobs Z., Jebri F., Jiddawi N., Kamukuru A.T., Kelly S., Kizenga H., Kuguru B., Kyewalyanga M., Noyon M., Nyandwi N., Painter S.C., Palmer M., Raitsos D.E., Roberts M., Sailley S.F., Samoilys M., Sauer W.H.H., Shayo S., Shaghude Y., Taylor S.F.W., Wihsgott J., Popova E. 2020. The small pelagic fishery of the Pemba Channel, Tanzania: What we know and what we need to know for management under climate change, Ocean & Coastal Management, Volume 197, 2020, 105322, ISSN 0964-5691, https://doi.org/10.1016/j.ocecoaman.2020.105322.

Silas, M. O., Kishe, M. A., Mgeleka, S. S., Kuboja, B. N., Ngatunga, B. P., and Matiku, P., 2022. The octopus fishing closures positively impact human wellbeing and management success; case of Tanzania. Ocean and Coastal Management, 217(106022), 71-9.

Silas, M. O., Kishe, M. A., Mshana, J. G., Semba, M. L., Mgeleka, S. S., Kuboja, B. N., ... & Matiku, P., 2021. Growth, mortality, exploitation rate and recruitment pattern of Octopus cyanea (Mollusca: Cephalopoda) in the WIO region: A case study from the Mafia Archipelago, Tanzania. Western Indian Ocean Journal of Marine Science, 20(1), 71-79.

Silas, M.O., Mgeleka, S.S., Polte, P., Skold, M., Lindborg, R., De La Torre-Castro, M., Gullstrom, M., 2020. Adaptive capacity and coping strategies of small-scale coastal fisheries to declining fish catches: insights from Tanzanian communities. Environ. Sci. Pol. 108, 67–76.

Slade L., Thani A., and Myaipopo R. (2016) Learning, Sharing, Acting. A workshop held at the coastal town of Bagamoyo during 17—18 August 2015 addressed the role of the SSF Guidelines in meeting the challenges of coastal communities in Tanzania. https://aquadocs.org/handle/1834/35720

Sleeswijk, A.W.; van Oers, L.F.; Guinée, J.B.; Huijbregts, M.A.J. 2007. Normalization in product life cycle assessment: An LCA of the global and European economic systems in the year 2000. Sci Total Environ 390 (1):227-240.

Sofreco, 2018a. Value Chain Analysis For the Fisheries Sector in the United Republic of Tanzania Annexes: Shrimp

Sofreco, 2018b. Value Chain Analysis For the Fisheries Sector in the United Republic of Tanzania Annexes: Changu and reef fish

Sofreco, 2018c. Value Chain Analysis For the Fisheries Sector in the United Republic of Tanzania Annexes: Tuna and by-catch

Sofreco, 2018d. Value Chain Analysis for the Fisheries Sector in the United Republic of Tanzania. Draft final report. South-West Indian Ocean Fisheries Governance and Shared Growth Program (SWIOFISH) project- December 24th l 2085. World Bank report. + the appendices.

Sonnemann, G., & Vigon, B. (2011). Global guidance principles for Life Cycle Assessment (LCA) databases: a basis for greener processes and products. United Nations Environment Programme.

Stanek, Shavonne, 2015. The Pelagic Artisanal Fishing of Mangapwani,Northern Unguja, Zanzibar. Independent Study Project (ISP) Collection. 2047. https://digitalcollections.sit.edu/isp_collection/2047

Taylor S.F.W, Roberts M.J., Milligan B.and Ncwadi R., 2019. Measurement and implications of marine food security in the Western Indian Ocean: an impending crisis. Food Security (2019) 11:1395–1415 https://doi.org/10.1007/s12571-019-00971-6

Taylor, S., Aswani Canela, S., Jiddawi, N., Coupland, J., James, P., Kelly, S., Kizenga, H., Roberts, M., Popova, E., 2021. The complex relationship between asset wealth, adaptation, and diversification in tropical fisheries. Ocean & Coastal Management 212(25):105808 DOI: 10.1016/j.ocecoaman.2021.105808

Thiemens, M. H., & Trogler, W. C. (1991). Nylon production: an unknown source of atmospheric nitrous oxide. Science, 251(4996), 932-934.

Thyresson, M., B. Crona, M. Nyström, M. de la Torre-Castro, and N. Jiddawi. 2013. Tracing value chains to understand effects of trade on coral reef fish in Zanzibar, Tanzania. Marine Policy **38**:246-256.

Torell, E., McNally, C., Crawford, B., & Majubwa, G. (2017). Coastal liveli-hood diversification as a pathway out of poverty and vulnerability: Experiences from Tanzania. Coastal Management, 45(3), 199– 218. https://doi.org/10.1080/08920 753.2017.130371

Torell, E., Mwanahija S., Julius F., Baraka K., Renalda M., 2007, Tanzania Biodiversity Threats Assessment: Biodiversity Threats and Management Opportunities for Fumba, Bagamoyo, and Mkuranga, Coastal Resources Center, University of Rhode Island, Narragansett, 47 pp.

UN Women (2020) Women's economic empowerment in the Indian ocean rim: progress and challenges. Economic Empowerment Section of UN Women.

UN Women (2021) Advocating for More Economic Opportunities for Women in the Blue Economy . September 8, 2021 https://africa.unwomen.org/en/news-and-events/stories/2021/09/advocating-for-more-economic-opportunities-for-women-in-the-blue-economy

UN Women, 2020. Women's Economic Empowerment in the Indian Ocean Rim: Progress and Challenges. https://www.unwomen.org/sites/default/files/Headquarters/Attachments/Sections/Library/Publications/2020/Womens-economic-empowerment-in-the-Indian-Ocean-Rim-Progress-and-challenges-en.pdf

UN Women, 2021. Advocating for More Economic Opportunities for Women in the Blue Economy. September 8, 2021, https://africa.unwomen.org/en/news-and-events/stories/2021/09/advocating-for-more-economic-opportunities-for-women-in-the-blue-economy

UNDP (United Nations Development Programme), 2020. Human Development Report 2020: The Next Frontier: Human Development and the Anthropocene. New York

UNICEF (2020) HEALTH BUDGET BRIEF 2020 MAINLAND TANZANIA. https://www.unicef.org/esa/media/8416/file/UNICEF-Tanzania-Mainland-2020-Health-Budget-Brief-revised.pdf

UNICEF, 2018. Zanzibar Health Budget Brief. https://www.unicef.org/tanzania/media/1321/file/UNICEF-Zanzibar-2018-Health-Budget-Brief.pdf

United States Department of Labor Bureau of International Labor Affairs (updated). Child Labor and Forced Labor Reports Tanzania 2020. Retrieved from https://www.dol.gov/agencies/ilab/resources/reports/child-labor/tanzania

URT, 1997. National Environmental Policy. Vice President's Office, Dar Es Salaam

URT, 1998. National Forest Policy. Dar Es Salaam

URT, 2007. The Wildlife Policy of Tanzania. Ministry of Natural Resources and Tourism

URT, 2013. Population and Housing Census 2012: Population distribution by administrative area. National Bureau of Statistics Ministry of Finance Dar es Salaam. Office of Chief Government Statistician President's Office, Finance, Economy and Development Planning Zanzibar.

URT, 2015. National Fisheries Policy of 2015. The United Republic of Tanzania Ministry of Livestock and Fisheries Development.

URTMLF, 2018. Marine Fisheries Frame Survey, 2018 Report. The United Republic of Tanzania Ministry of Livestock and Fisheries, Dodoma, Tanzania.102 pages.

URTMLF, 2019. The Annual Fisheries Statistics report (January-December 2020). United Republic of Tanzania, Ministry of Livestock and Fisheries, Dodoma.

URTMLF, 2020. The Annual Fisheries Statistics report (January-December 2020). United Republic of Tanzania, Ministry of Livestock and Fisheries, Dodoma.

URTMLF, 2021a. National Plan of Action (NPoA) to implement the Voluntary Guidelines for Securing sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (the SSF Guidelines). United Republic of Tanzania Ministry of Livestock and Fisheries.

URTMLF, 2021b. The United Republic of Tanzania Ministry of Livestock and Fisheries. Revised Prawn Fishery Management plan. Draft July 2021.

US Department of State, 2021. Tanzania 2020 Human Rights Report. Bureau of Democracy, Human Rights and Labor.

USAID (2021) Tanzania: Nutrition Profile. https://www.usaid.gov/sites/default/files/documents/Copy_of_tagged_Tanzania-Nutrition-Profile.pdf

Van Hoof, Luc, and Marloes Kraan, 2017. Scoping Mission Marine Fisheries Tanzania. Mission Report Tanzania, Wageningen University & Research Report C004/1767 pages.

Wang, P., Tran, N., Enahoro, D.K., Chan, C.Y., Shikuku, K.M., Rich, K.M., Byrd, K. and Thilsted, S.H. 2021. Spatial and temporal patterns of consumption of animal-source foods in Tanzania. Agribusiness VL38 IS 2 SN 0742-4477 https://doi.org/10.1002/agr.21729

White, R., E. Page and S.-L. Noël. 2020. Tanzania: Updated catch reconstruction for 2011 – 2018, p. 77-80. In: B. Derrick, M. Khalfallah, V. Relano, D. Zeller and D. Pauly (eds). Updating to 2018 the 1950-2010 Marine Catch Reconstructions of the Sea Around Us: Part I – Africa, Antarctica, Europe and the North Atlantic. Fisheries Centre Research Report 28(5).

World Bank (2021) Transforming Tourism : Toward a Sustainable, Resilient, and Inclusive Sector (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/794611627497650414/Transforming-Tourism-Toward-a-Sustainable-Resilient-and-Inclusive-Sector

WWF, 2020. Value Chain Analysis on Octopus fishery in Tanzania Mainland. Tanzania Country Office. Final Report

Yahya, S. 2021. Marine & Coastal Areas under Protection: United Republic of Tanzania: Zanzibar, p. 203–214, In: UNEP-Nairobi Convention and WIOMSA. 2021. Western Indian Ocean Marine Protected Areas Outlook: Towards achievement of the Global Biodiversity Framework Targets. UNEP and WIOMSA, Nairobi, Kenya, 298 pp.

ZAFICO, 2021. Assessment on production status, effort and distribution of anchovy fishery in Zanzibar, unpublished report. Chapter one, 24 pages.

ZHBS (Zanzibar Household Budget Survey), 2020. Household budget survey, 2019/20. Main Report. Office of the Chief Government Statistician, Ministry of Finance and Planning. The Revolutionary Government of Zanzibar. December 2020