Food and Agriculture Organization of the United Nations

FISH4ACP
Unlocking the potential of sustainable fisheries and aquaculture in Africa, the Caribbean and the Pacific

ANALYSIS AND DESIGN REPORT

The Lake Tanganyika sprat, sardine, and perch value chain in United Republic of Tanzania

December 2022

german cooperation
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Acknowledgements

The authors would like to thank the following and acknowledge their important contributions to the report: Staff of the Ministry of Livestock and Fisheries (MLF), Tanzania Fisheries Research Institute (TAFIRI, the National Partner of FISH4ACP in Tanzania), Lake Tanganyika Authority (LTA), Lake Tanganyika Fisheries Management (LATAFIMA) project, and The Nature Conservancy (Tuungane Project) for their support and engagement with the VCA team; the value chain stakeholders and experts who gave their time to meet with the VCA team and provide information; the peer reviewers of this report (David Neven, Martinus van der

Knaap, Kelly Siobhan, Milica Petruljeskov, Felix Marttin, Nicole Franz); the staff of the FISH4ACP Project Management Unit who provided technical and administrative support (Gilles van de Walle, Steven Ciocca, Kathrin Hett).

Citation

This report should be cited as follows: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

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Abbreviations and acronyms

AU-IBAR	African Union – Interafrican Bureau for Animal Resources
AWFishNET	African Women Fish Processors and Traders Network
BMU	Beach Management Unit
CIFAA	Committee for Inland Fisheries and Aquaculture of Africa
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
EMEDO	Environmental Management and Economic Development Organization
ETP	Endangered, threatened, and protected
FAO	Food and Agriculture Organization (of the United Nations)
FDD	Fisheries Development Division
FGMP	Framework Fisheries Management Plan
FPO	Fish Processing Organisation
IUU	Illegal, Unreported and Unregulated
ITC	International Trade Centre
LATAFIMA	Lake Tanganyika Fisheries Management
LTA	Lake Tanganyika Authority
Km	Kilometre
M	Metre
MALF	Ministry of Agriculture, Livestock and Fisheries
MCS	Monitoring, Control and Surveillance
MLFD	Ministry of Livestock and Fisheries Development
MLF	Ministry of Livestock and Fisheries
MT	Metric Tonne
NEMC	National Environment Management Council
OACPS	Organization of African, Caribbean and Pacific States
%	Percent
RTA	Regional Trade Agreement
SADC	South African Development Community
SAP	Strategic Action Plan (of the LTA)
SME	Small and Medium Enterprises
SPS	Sanitary and Phytosanitary Standard
TAFIRI	Tanzania Fisheries Research Institute
TBS	Tanzania Bureau of Standards
TIFPA	Tanzania Industrial Fish Processing Association
TNC	The Nature Conservancy
TZS	Tanzanian Shillings (local currency)
USD	United States Dollar (USA currency)
VC	Value Chain

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Glossary

Carbon footprint	Calculated as the kg CO_2e/year per at actor level, functional level, core VC level, and per kg of end product
Contribution to GDP	100 * (total value added over national GDP), expressed as a percentage (%)
Dagaa	Sprat and sardine, often dried (local vernacular)
Direct value added	The sum of net profits (after taxes) for the companies, net wages for their workers, and government revenue in the form of taxes and fees.
Electricity use	Calculated as the kWh/year at actor level, functional level, core VC level, and per kg of end product
Fishing pressure	Refers to the level of fishing efforts (active fishing licenses or boats, number of days fishing, number of hooks a day, yield per day, etc.) that the fish stock is subject to.
Food loss and waste	Refers to the quantitative and qualitative loss of aquatic products that have been intended for human consumption but have either suffered due to, e.g. poor transportation and processing practices, and are thus no longer fit for human consumption, or have been discarded by different actors based on, e.g. consumer preferences and demands. To measure food loss, the quantities of aquatic products lost along the value chain, from production up to, but no including, retail are calculated. Food waste refers to the aquatic food lost in the retail and consumption functions of a value chain.
Fuel consumption	Calculated as MJ/year at actor level, functional level, core VC level and per kg of end product
Fulltime equivalent (FTE) jobs	The total number of 8-hour working days divided by 230 (days)
Indirect value added	The cost of the domestic goods and services that the VC actors purchase from outside of the core VC (therefore does not include the cost of raw materials (whole tuna) sold/bought along the VC)
Net impact on balance of trade	Calculated by deducting imports from exports (in USD) for all products related to the VC, including both the VC's products and the inputs/services used in the VC.
Net impact on public funds	The net impact on public funds is expressed in USD and equals taxes plus fees minus subsidies.
Overfished	A stock is considered overfished when exploited beyond an explicit limit beyond which its abundance is considered "too low" to ensure safe reproduction. In many fisheries fora the term is used when biomass has been estimated to be below a limit biological reference point that is used as the signpost defining an "overfished condition".

Overfishing	A term used to refer to the state of a stock subject to a level of fishing effort or fishing mortality such that a reduction of effort would, in the medium term, lead to an increase in the total catch. Often referred to as overexploitation and equated to biological overfishing.
Profit	Revenues minus costs
Rate of integration	The rate of integration (expressed as a percentage) indicates how much the VC is part of the national economy. It is calculated as 100 * (total VA/(total VA+ imported consumables)).
Return on investment	100 * (operating profit over total cost), expressed as a percentage (%)
Return on sales	100 * (net profit over total revenues), expressed as a percentage (%)
Stock status	The stock status refers to the biomass (B) of fish in the water and provides information on whether a stock is overfished, maximally sustainably fished or underfished. The amount of biomass (B) that produces the maximum sustainable yield (MSY) is referred to as BMSY. If the biomass of fish in the water is below BMSY, the stock is overfished. If the amount of fish in the water is more than what would produce MSY, the stock is underfished.

Executive Summary

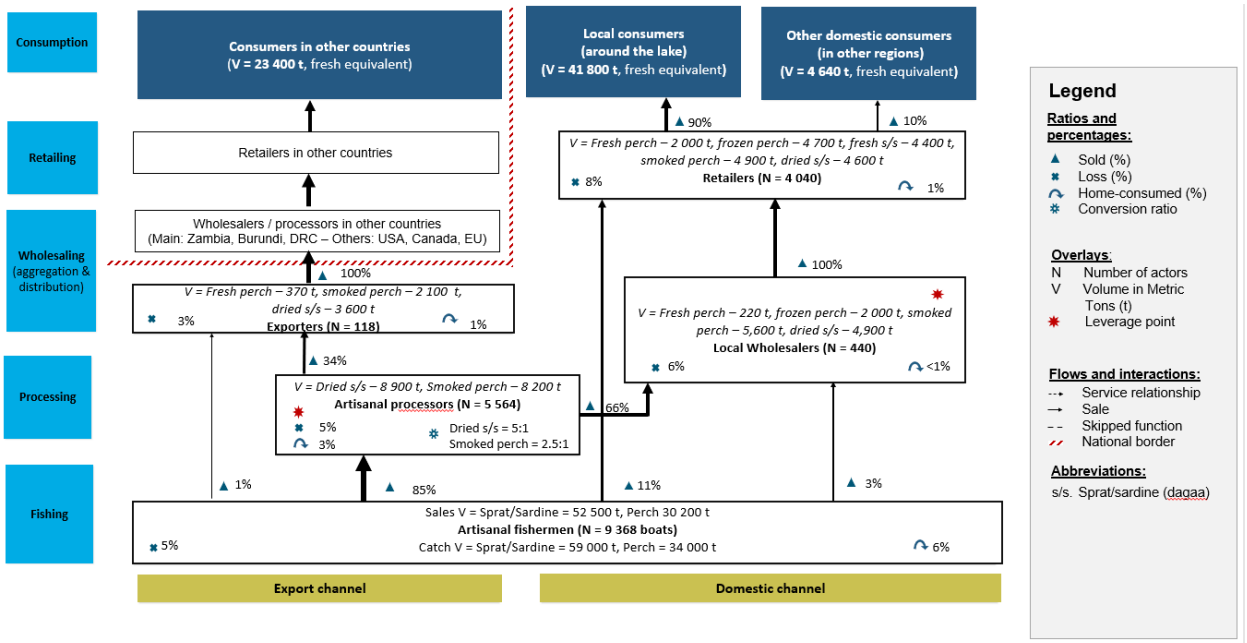
FISH4ACP is an initiative of the Organization of African, Caribbean and Pacific States (OACPS) to support sustainable fisheries and aquaculture development. The five-year value chain (VC) development programme (2020 – 2025) is implemented by the Food and Agriculture Organization of the United Nations (FAO) with funding from the European Union and the Germany's Federal Ministry for Economic Cooperation and Development (BMZ).

The Lake Tanganyika Sprat, Sardine and Perch value chain in the United Republic of Tanzania is one of 12 value chains competitively selected from over 70 proposals worldwide for support from the FISH4ACP programme. This report presents the outputs of design work completed during 2021 to complete a functional analysis of the VC, assess its sustainability and resilience, develop an upgrading strategy to which the FISH4ACP programme will contribute, and plan for full implementation from April 2022.

The **FISH4ACP methodology** used to carry out this study is an approach based on FAO's Sustainable Food Value Chain (SFVC) and Agrinatura's Value Chain Analysis for Development (VCA4D) methodologies. It has four main components: functional analysis; sustainability assessment; upgrading strategy development; and implementation planning (actions and investments). The approach is highly participatory, involving value chain stakeholders from the public and private sector from the outset in order to ensure national ownership of all four components, thereby increasing the likelihood of success of the project interventions.

The **functional analysis** enabled the preparation of the VC map presented below. There are two market channels in the Value Chain (VC) for Lake Tanganyika sprat, sardine and perch. The largest is the domestic channel which accounts for 64 percent of the total fish catch (fresh equivalent) supplying local communities around the Tanzanian lakeside and other regions in United Republic of Tanzania. The export market channel accounts for 36 percent

of the total fish catch and mainly supplies the neighbouring countries of Democratic Republic of the Congo, Burundi and Zambia.



All the fish are caught by small-scale fishers [1] who are predominantly men, and approximately 85 percent of their total catch is sold to local small-scale processors who are predominantly women. The fish are processed into smoked perch or dried sprat and sardine, called *'dagaa'* in the local vernacular. Wholesalers, exporters and retailers purchase the remainder. In addition to processing carried out by small-scale processors, all actor types may carry out some fish processing, mainly for preservation purposes to prevent losses. Processors sell 66 percent of their product to wholesalers and 34 percent to exporters.

Consumers prefer to buy perch fresh for cooking at home. Since there have been significant improvements in the supply of electricity, perch is also sold frozen on the domestic market and now accounts for 4 700 tonnes of retail sales, more than twice the volume of fresh perch. However, due to the still limited availability of refrigerated transport and storage, smoked perch still accounts for 70 percent of total perch sales (fresh equivalent), mainly to other regions of United Republic of Tanzania and export markets.

As Lake Tanganyika sprat and sardine are smaller, they tend to deteriorate quicker, so are dried as soon as possible after landing. Due to this very little sprat and sardine is sold fresh. Also, freezing sprat and sardine affects quality so it is not a popular means of preservation.

[1] Labour-intensive fisheries using relatively small crafts (if any) and little capital and equipment per person-on-board. Most often family-owned. May be commercial or for subsistence. Usually low fuel consumption. Often equated with artisanal fisheries (UN Atlas of the Oceans)

Considering the large number and central role of small-scale processors with the value chain, they are the core actor with the most potential as a leverage point, especially for reducing fish losses and improving product quality.

An **assessment of the economic performance of the VC** revealed low profitability for processors (USD 591 per processor/year) and apart from fishers, the number of actual full-time remunerative jobs in the VC is only 10 percent of total Full-Time Equivalent (FTE) jobs. Return on Sales (RoS) for processing are very low (4 percent), when compared to that of fishers, wholesalers and retailers selling fresh or frozen fish (i.e. 21 percent, 18 percent and 20 percent respectively) and considering processing ratios. Fish quality first starts deteriorating in the boat which can have a large impact on prices received all along the VC and there are comparatively high level of losses for wholesalers and retailers during transport and storage (6 percent and 8 percent respectively). Fresh perch are preferred over all other fish except Emperor Cichlid for taste and are cheaper than many substitutes but a large proportion has to be smoked for preservation purposes.

Analysis of the social performance of the VC showed unequal income among VC actors and workers, especially between men and women. There was also unequal division of roles between men and women, a limited number of women holding decision making positions and women had limited access to land (for sun-drying dagaa). For hired workers there was an absence of formal work contracts and health and safety standards. Access to financial services by both male and female actors was limited in the VC

In assessing the environmental sustainability of the VC, there was found to be a heavy dependence on fossil fuel (especially diesel and petrol) and a high dependency on fuel wood for fish smoking. The impact of VC actors on biodiversity and ecosystems is concerning and fishing vessels do not have measures in place to mitigate impacts on endangered, threatened, and protected (ETP) and associated species. There is a lack of adequate monitoring and enforcement of laws and regulations related to illegal fishing, water pollution and air pollution. There are limited facilities to handle waste water and organic pollutants generated from VC. Overall, there is a limited awareness amongst VC actors regarding problems associated with over fishing, water pollution and air pollution and a lack of proper fisheries management plan and regular formal stock assessments which limits information on the stock status

Considering the VC and shifting from analytical complexity to strategic simplicity, an analysis of the strengths, weaknesses, opportunities and threats of the VC is provided below.

Strengths (internal)

- Market linkages are already established with national and neighbouring country buyers
- Perch and dagaa are nutritious foods
- Limited barriers to entry
- Low market concentration / dominance by single actors
- Boat owners are able to finance much of their own investment
- The use of mobile banking by some VC actors helps to facilitate transactions and access to finance (e.g. advanced payment) without the need to have bank accounts
- Trustful relationships exist between many VC actors
- Some fisheries policies/regulations and various organizations (e.g., ministries, BMUs, LTA) are already in place to support sustainable fisheries management

Weaknesses (internal)

- Limited linkages to high-value markets
- High level of losses due to lack of knowledge of and equipment/inputs and services for proper handling of fish (e.g., ice, insulated boxes, refrigerated transport and cold storage)
- Inadequate investment in the VC due to limited financial resources of VC actors
- Limited outreach of banks to provide formal bank loans to VC actors. High interest rates
- Lack of easily accesible quality testing laboratory to service exporters to intenational markets
- Apart from fishers, the number of fulltime equivalent remunerative jobs in the VC is low
- VC coordination inefficiencies related to small-scale-based system
- Gender norms restrain women's participation in and benefits from the VC
- Inadequate sustainable fisheries policies due to lack of data on stock status, fishing effort and catch, which is due to lack of technical/financial capacities
- Inadequate government funding for monitoring and enforcement of laws related to licensing and illegal fishing
- Persistence of IUU fishing due to limited financial means of fishers and weak and inconsistent enforcement of laws
- Flooded landing sites due to climate change
- Limited facilities at landing sites due to lack of investment

Lake Tanganyika Sprat, Sardine & Perch Value Chain in Tanzania

Opportunities (external)

- Increasing and unmet demand for VC products, especially in high-value markets in Tanzania urban centers and neighbouring countries
- Premiums paid for higher quality products
- Increasing demand for convenience foods 'prepared fish products'
- Increased access to electricity (for cold chain)
- Improved road connectivity to main urban centres in Tanzania
- Availability of perch in Rukwa
- Availability of labour to work in the VC

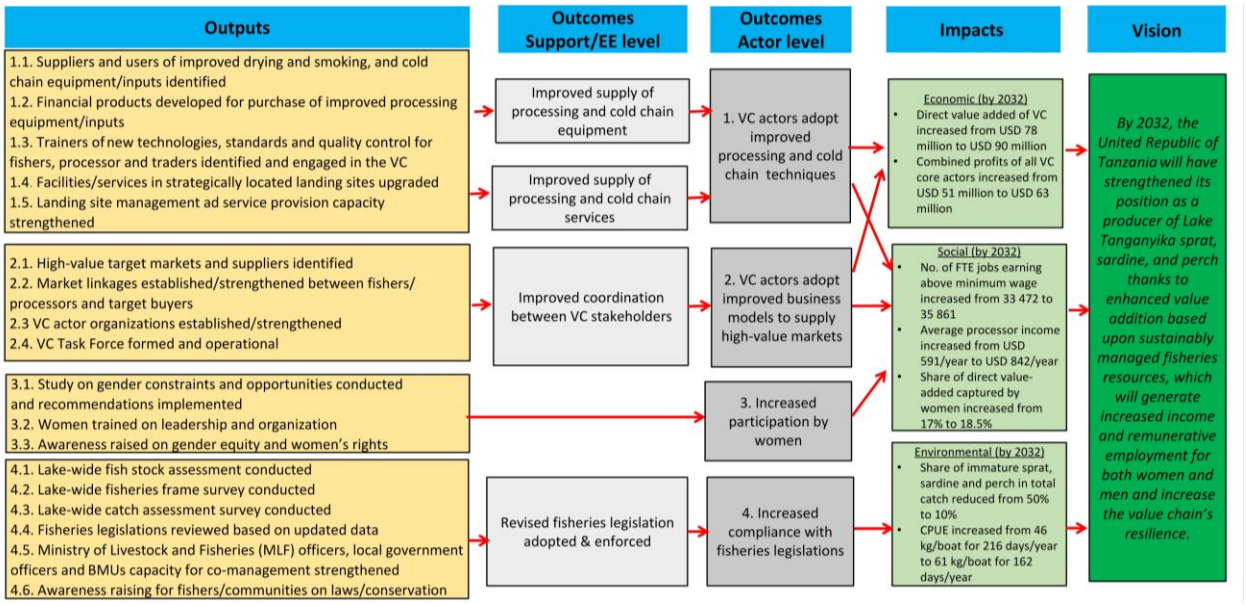
Threats (external)

- Uncertain sustainability of fish stocks
- Competition from cheaper fish substitutes
- Climate change induced floods destroy lakeside infrastructure
- Unpredictable weather patterns due to climate change pose challenges to VC operations
- Shocks such as covid disrupt VC operations and prevent cross-border trade

Informed by the SWOT analysis, the sustainability assessments, the VC map, and stakeholder interests as reflected during consultations, an overall objective for the upgrading strategy is developed with stakeholders in the form of **a vision statement** as follows:

"By 2032, United Republic of Tanzania will have strengthened its position as a main producer/exporter of Lake Tanganyika sprat, sardine, and perch thanks to enhanced value-addition in a sustainable value chain based upon sustainably managed fisheries resources, which will generate increased income and remunerative employment for both women and men and increase the value chain's resilience."

The upgrading strategy to achieve the vision is summarised in the diagram below.



Source: The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

The Theory of Change to achieve the above vision is based upon new market opportunities that have arisen due to an improved supply of electricity for cold chain facilities around the lake and improved access to large urban markets in other areas of United Republic of Tanzania (e.g. Dar es Salaam, Tunduma, Mbeya) due to improved road connectivity. Currently *dagaa* is dried and perch is smoked as a means of stopping the fish rotting, not to add value. Also, most of the fish are consumed locally or exported to other countries around the lake as those markets are more accessible by boat, than urban centres in United Republic of Tanzania by road transport. However, due to the artisanal structure of the value chain (thousands of small value chain actors carrying out thousands of uncoordinated transactions), new market opportunities thanks to the improved road connectivity and electricity supply remain unexploited.

Enabling structural change and improved conduct within the value chain will require the adoption of improved processing and cold chain techniques and improved coordination between value chain stakeholders. Improved processing technologies have been identified (see section 4.3.1). Once suppliers of improved processing equipment have been confirmed, financial products such as group loans developed with banks allowing processors to purchase the equipment, and training on technologies and standards provided, processors will be enabled to produce higher quality dried dagaa and smoked perch which sell for a 30 percent premium.

Three strategically located landing sites will be upgraded and provided with cold chain facilities such as ice making, cold stores, blast freezers and refrigerated transport. Wholesalers will use the cold chain facilities on a user-fee basis, allowing the sale of fresh/frozen perch in large urban markets such as Mbeya, where they also fetch a 30 percent premium, compared to selling at the lake.

Making the important 'market linkages' between fishers, processors and buyers requires improved coordination. Groups of fishers and processors will be established to aggregate produce and link with traders who supply high-value markets locally or in other large urban centres where customers are willing to pay a price premium for higher-quality products. Through capacity building and training, partnerships will be facilitated between value chain stakeholders to adopt improved business models and improve coordination.

Processing is the least profitable segment of the value chain (USD 591 profit per processor/year and 4 percent RoS) and is largely carried out by women. Therefore, additional attention will be paid to gender constraints and opportunities allowing the increased participation of women and increased share of direct value captured by women. To this end, leadership trainings for women, awareness raising on gender equity, and a gender study will be conducted to support the design and implementation of upgrading activities in a gender sensitive manner.

Sustainability of fish stocks is a significant threat to the value chain. Fisheries legislation will be revised based on updated data coming from a lake-wide assessment of stocks, a lake-wide frame survey, and catch assessment surveys. Along with better enforcement to improve compliance, this will lead to catch rates being maintained at sustainable levels to improve the sustainability of fish stock.

The upgrading strategy consists of **four key elements**, which aims to holistically improve the (economic, social, and environmental) sustainability performance of the VC, as below.

1. **VC actors adopting improved processing and cold chain techniques** will improve the quality of the fish and increase value added received by processors, in particular women.

2**. VC actors adopting improved business models to supply high-value markets** will improve coordination along the value chain, enabling the high-quality fish to reach the high-value markets in the main urban centres of United Republic of Tanzania.

3**. Increased participation by women** in the VC to ensure that women can capture a fair share of the value-added generated from the VC (social sustainability).

4. **Increased compliance with fisheries legislation**, which are revised/updated based on regularly updated data and whose enforcement are enhanced thanks to the strengthening of co-management and MCS mechanisms, will be crucial to ensure the responsible use (exploitation) of fisheries resources to maintain a sustainable level of the resources in the long run (environmental sustainability).

It is expected that the upgrading strategy will support nearly 4 000 and 7 000 beneficiaries to adopt improved techniques by 2025 and by 2032 respectively. The table below shows the main economic, social and environmental impact indicators. Direct value-added of the VC increases from USD 81 million in 2021 to USD 91 million in 2032, a 12 percent increase and combined profits of all VC core actors increases from USD 51 million to USD 63 million (24 percent). In addition to the economic indicators, the average income of processors (who are mostly women) will increase by 42 percent, the immature catch will reduce from 50 percent to 10 percent and CPUE/year will remain much the same but for less days in a year to allowing stocks to recover.

Item	**2021 baseline**	**2025 - with upgrading**	**2032 - with upgrading**
Economic indicators			
Direct value-added of the value chain	USD 81 million/year	USD 85 million/year	USD 91 million/year
Combined profits of all VC core actors	USD 51 million/year	USD 57 million/year	USD 63 million/year
Social indicators			
Average processor income	USD 591/year	USD 716/year	USD 840/year
Share of direct value added captured by women	17%	18%	18.5%
Environmental indicators			
Share of immature sprat, sardine, and perch in total catch	Approximately 50%	35%	10%
Catch per unit effort (CPUE)	46 kg per boat per day for 216 days per year	46 kg per boat per day for 216 days per year	61 kg per boat per day for 162 days per year

The total budget for the upgrading strategy is just over USD 9.7 million and summarized in the table below. Forty-three percent of the budget is for infrastructure (upgrading three landing sites) and will be sourced from Government. FISH4ACP will provide USD 1.6 million towards the budget (17 percent), mostly for training and equipment.

In USD	**Financing sources**				**Total**
Type of investments	FISH4ACP	LATAFIMA	LTA/ Governments/ Donors	Private sector	**Totals by type of investments**
Equipment	405 000	95 000	197 400	2 240 000	2 937 400
Facilitation	282 000	75 000			357 000
Infrastructure			4 200 000		4 200 000
Studies / Technical assistance	315 000	235 000	988 000		1 538 000
Training	616 000	10 000	60 000		686 000
Totals by funding source	**1 618 000**	**415 000**	**5 445 400**	**2 240 000**	**9 718 400**

1 Introduction

1.1 Background and objective

This report was developed under the FISH4ACP programme, an initiative of the Organization of African, Caribbean and Pacific States (OACPS) to support sustainable fisheries and aquaculture development. FISH4ACP is a value chain (VC) development programme implemented by the Food and Agriculture Organization of the United Nations (FAO) with funding from the European Union. Adopting a holistic approach to sustainability, FISH4ACP seeks to promote investments into fisheries and aquaculture value chains with the goal of stimulating inclusive growth, poverty reduction and improving food and nutrition security, while at the same time ensuring the sustainability of marine and aquatic resources. FISH4ACP aims to achieve the sustainable development of aquatic product value chains through five outcomes:

i) Improved stakeholder understanding of the value chain and participative development of a value chain upgrading strategy
ii) Increased micro, small and medium-sized enterprises (MSMEs) economic performance;
iii) Improved inclusiveness and social sustainability throughout the value chain;
iv) Enhanced management of natural resources and consideration for climate change; and
v) Facilitated MSMEs access to finance and investment.

FISH4ACP is a five-year programme (2020 – 2024) implemented in 12 countries in Africa, the Caribbean, and the Pacific (ACP). Twelve value chains (one per country) were competitively selected from over 70 proposals for programme implementation[2]. The year 2020 of the programme was devoted primarily to the development of the methodological tools and approaches to be used by the FISH4ACP project as a whole and to mobilisation in the 12 countries. The year 2021 of the programme has been used to conduct value chain analyses and the development of value chain upgrading strategies in the 12 countries. These upgrading strategies will be implemented in the years 2022 – 2024 of the programme. This report was developed in this context and thus presents an outcome of the work conducted in the United Republic of Tanzania in 2021.

FISH4ACP in the Lake Tanganyika in United Republic of Tanzania

[2] These 12 value chains are: the mahi-mahi VC in the Dominican Republic; the Atlantic seabob VC in Guyana; the oyster VC in Senegal; the farmed tilapia VC in Cote d'Ivoire; the farmed catfish VC in Nigeria; the Lake Tanganyika sardine, sprat and lates VC in United Republic of Tanzania; the farmed tilapia VC in Zimbabwe; the shrimp VC in Cameroon; the pelagics VC in Sao Tome and Principle; oyster in The Gambia, small lake pelagics in Zambia, and the purse seine tuna VC in the Republic of the Marshall Islands.

The Lake Tanganyika sprat, sardine, and perch[3] value chain was proposed by the Tanzanian Ministry of Livestock and Fisheries (MLF) and then selected for FISH4ACP implementation due to its potential to improve nutrition and food security, as well as empowering women and reducing environmental and health problems. In the MLF's proposal, improving fish processing to reduce post-harvest losses and increasing regional exports were identified as a key intervention area. This value chain assessment report was developed in response to the country request and aims to provide an in-depth understanding of the VC's performance as well as its constraints and opportunities, based on which a strategy for upgrading the VC will be identified.

1.2 Methodology

In the context of the FISH4ACP Programme, FAO has joined forces with the European Commission (EC), the OACPS and Agrinatura[4], to develop a VC analysis (VCA) and development approach based on FAO's Sustainable Food Value Chain (SFVC) and Agrinatura's Value Chain Analysis for Development (VCA4D) methodologies (FAO, 2014; Agrinatura, 2017). The FISH4ACP methodology, applicable across all countries included in the project, has four main components: functional analysis; sustainability assessment; upgrading strategy development; and implementation planning (actions and investments). The approach is highly participatory, involving value chain stakeholders from the public and private sector from the outset in order to ensure national ownership of all four components, thereby increasing the likelihood of success of the project interventions.

The **functional analysis** looks at the current structure of the VC, the dynamics that explain how and why this structure is changing, and the capacities and incentives that drive behaviours of VC actors. It starts with the identification of end-market opportunities, as the economic performance of the VC is ultimately determined by its ability to capture value in an end-market. Based on the in-depth analysis of a wide range of primary and secondary data[5], the functional analysis presents a detailed VC map and systematically analyses the nature of the various VC elements across four layers, namely: (1) actors in the core VC, (2) input and service providers, (3) the societal environment, and (4) the natural environment). This analysis includes the constraints and opportunities associated with the various VC elements and their linkages. The analysis is explicitly based on understanding the behaviour of the VC actors and the governance mechanisms that create incentives or disincentives for the observed behaviour. Through this in-depth and systemic approach, the functional analysis helps to identify the binding constraints in the VC and their root causes, as well as the

[3] The fish species in this value chain include sardine (*Limnothrissa miodon)* and sprat (*Stolothrissa tanganicae)*, both of which are called "dagaa" in local language, and perch *(Lates stappersii)*, called "mgebuka" in local language.
[4] Agrinatura is a European Alliance on Agricultural Knowledge for Development, an entity established jointly by European Research and Education organisations
[5] See FISH4ACP: Practical guidance for analysis, strategy and design, 2020, as well as Annexes 1 and 2 in this report.

leverage points (points of maximum impact) that will critically inform the development of an upgrading strategy that will bring about the desired economic, social and environmental impacts.

The **sustainability assessment** then uses a range of quantitative and qualitative indicators to measure the performance of the value chain in terms of its economic, social and environmental dimensions. This assessment includes: six economic sustainability domains (i.e. profitability, employment, value added, effects on the national economy, international competitiveness, and value for end-consumers); six social sustainability domains (i.e. inclusiveness, gender equality, food and nutrition security, decent employment social and cultural capital, and institutional strength); and seven environmental sustainability domains (i.e. climate impact, water footprint, fish stock sustainability, biodiversity and ecosystems, animal health and welfare, toxicity and pollution, and food loss and waste). The sustainability assessment identifies sustainability hotspots, which help to determine which opportunities should be pursued for upgrading, alongside government priorities and private sector ambitions.

Resilience assessment refers to how resilient the VC is to shocks such as economic crises, wars, floods and disease pandemics. Resilience assessment contributes towards the sustainability heat map and covers 'structural' (redundancy, diversity, connectivity) and 'behavioural' (collaboration and governance, learning and adaptation, participation and inclusion) domains.

The **upgrading strategy development**, the next step in the approach, starts with the development of a common vision based on the findings from the functional analysis and sustainability assessment. With facilitation by the project, VC stakeholders themselves develop this common vision, along with an associated set of targets for where to take the VC over a given time-period. This vision and these targets are then used to devise an upgrading strategy. This upgrading strategy aims to address the binding constraints, sustainability hotspots and their root causes and builds on the strengths and opportunities in the VC, as identified in the functional analysis and sustainability assessment. Various upgrading options are proposed in three categories: upgraded business models (elements), upgraded governance (linkages) and upgraded enabling environment (organizations, infrastructure, institutions, socio-cultural elements). These upgrading options are either derived from global best practices adapted to the situation at hand, or represent unique solutions prepared by experts in the particular upgrading area. The validity of these solutions typically needs to be assessed during the early stages of the action plan implementation. A holistic approach to sustainability is included throughout this vision and strategy development process in order not to overlook any potential adverse impacts of the proposed upgrading interventions.

The **implementation planning**, as the final step in this process, translates the upgrading strategy into action and investment plans to be implemented during years two-five of the

FISH4ACP project. The plans detail a sequence of activities that need to be conducted and investments that need to be made in order to implement the identified upgrading strategy. To ensure the sustainability of FISH4ACP's interventions, both the development of the plans (as part of this report development) and their implementation require the application of a facilitation approach, which facilitates local stakeholders' active participation and encourages stakeholders to take on their roles and to develop a sense of ownership of the development of the VC.

In United Republic of Tanzania, the conduct of the VCA effectively followed the FISH4ACP methodology, with some necessary adaptations to the standardized questionnaire templates, which were adapted to the specific contexts of the VC and the national/local situations. Secondary research (desk research) was first undertaken, followed by intensive primary data collection efforts conducted in three regions around Lake Tanganyika (i.e. Kigoma, Rukwa and Katavi) and two other regions in United Republic of Tanzania (i.e. Mbeya, Dar es Salaam). Four kinds of actor interviews were carried out, focusing on issues related to the functional, sustainability (economic, social, and environmental) and resilience analysis of the VC[6]. In addition, various other data collection methods were also used – ranging from key informant interviews (e.g. with input/service providers, banks, ministry officials, experts, groups/associations) to focus group discussions and surveys with VC actors and their workers[7]. The conduct of primary data collection was undertaken by the project's national partner - Tanzania Fisheries Research Institute (TAFIRI) – in close consultation and coordination with FAO (i.e. VCA team and Project Management Unit – PMU). VC stakeholders were engaged throughout, from the outset of the project to the development of the VC upgrading strategy. Stakeholder engagement efforts were primarily made through the organization of multi-stakeholder inception and validation meetings. Due to various travel restrictions imposed by the COVID-19 pandemic, these meetings were conducted using a hybrid format, involving a strong in-person component, where local participants were gathered physically, but providing for virtual participation by the international team and other international stakeholders from outside of United Republic of Tanzania.

1.3 Brief history and overview of the value chain

Lake Tanganyika (see map in Figure 65) covers 32 600km^2 and is the world's second largest lake by volume. The lake has territorial waters within the Democratic Republic of Congo, Burundi, Zambia and Tanzania, which claims approximately 13 400km^2, or 41 percent of the lake as its domain (LTA, 2020).

[6] These interviews herein are referred to as "functional (actor) interviews", ""economic (actor) interviews", "social (actor) interviews", and "environmental (actor) interviews".
[7] More details about the sample sizes used for primary data collection are provided in Annex 2 Table .

Pelagic fish live in open water, neither close to bottom or near the shore of marine or inland waters. According to Petit and Shipton (2012), the most important small pelagics are all native and include the Lake Tanganyika sprat (*Stolothrissa tanganicae*) and Lake Tanganyika sardine (*Limnothrissa miodon*), both known locally as '*Dagaa*'. The larger Sleek Lates (*Lates stappersii*), or perch, known locally as '*Migebuka*' also lives in the pelagic zone and feeds on the sprat and sardine. The Lake Tanganyika sprat, sardine and perch comprise 85 percent of the catch from the lake (MLF, 2019b).

Within Tanzania, Lake Tanganyika is the second most important lake for inland fisheries after Lake Victoria, with Lake Tanganyika producing 62 000 tonnes of fish and Lake Victoria producing 247 000 tonnes of fish in 2018 (MLF, 2018). Traditional fishing for subsistence was predominant in Lake Tanganyika until the 1950s, when Greek fishermen introduced commercial purse seine fishing in the off-shore waters of Burundi, which later expanded to other parts of the lake, including Tanzanian, as mentioned by Katonda and Kalangali in Coenen (1994). However, industrial fishing declined after the 1970's due to excess capacity and has since been replaced with small-scale fishing (Van der Knaap, Katonda and De Graaf, 2014; Molsa, 2008).

The use of beach seine, lift nets and ring nets by small-scale fishers quickly gained popularity during the 1960s-1970s, and the number of small-scale fishing units steadily increased, as mentioned by Katonda and Kalangali in Coenen (1994) and Mölsä (2008). Petit and Shipton (2012) also noted that during the second half of the 1980s outboard engines became widespread and the use of larger 'Apollo' catamarans allowed small-scale fishermen to operate further offshore. Now small-scale fishing dominates across the lake (Molsa, 2008; (Van der Knaap, Katonda and De Graaf, 2014)

Small-scale fishing efforts have intensified since the 1960s and 1970s, as reflected through a rise in the numbers of fishers, fishing vessels, and fishing units across the lake (Sarvala *et al.*, 2006), including the Tanzanian part, as stated by Katonda and Kalangali in Coenen (1994). Increased catches led to increased regional trade and the need for processing, such as drying or smoking, for preservation purposes. However, post-harvest losses due to poor fish handling facilities and techniques are high (African Development Fund, 2004; Onyango, 2016).

Increased fishing efforts, both legal and illegal, led to huge increases in total lake-wide catches until the mid-1990s, after which the total annual production and total harvest underwent a significant decline due to over exploitation (Sarvala *et al.*, 2006; Van der Knaap, 2018). However, recent catch data collected by the Ministry of Livestock and Fisheries (MLF) between 2016 and 2019 have shown a significant increase in production for the Lake Tanganyika sprat, sardine and perch. Over exploitation persists despite various initiatives, such as the establishment of the Lake Tanganyika Authority (LTA) in 2008, which aims at

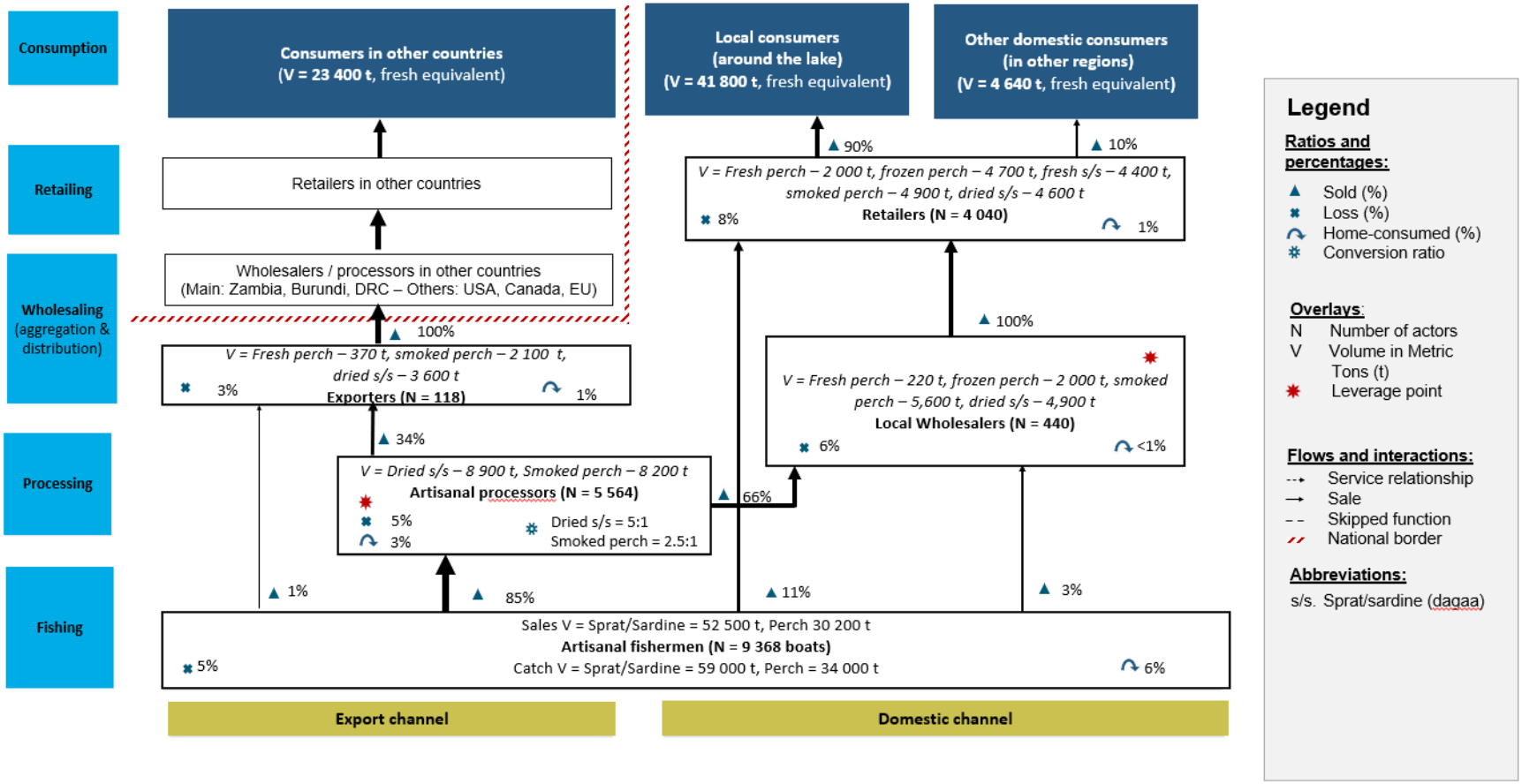
curbing illegal, unreported and unregulated (IUU) and unsustainable fishing activities (Van der Knaap, 2018).

2 Functional analysis

2.1 VC mapping

VC mapping (Figure 1) shows the flow of product from production to consumption; indicating actors, functions, linkages and main channels. In the absence of up-to-date and consistent secondary data, the number of boats is assumed to be the same as the LTA Frame Survey of 2011. Catch Per Unit Effort (CPUE) was then estimated based on data collected from the survey with fishers, conducted as part of this study. For plank boats CPUE was 40kg and for small catamarans CPUE was 70kg. It was then assumed each boat went fishing 216 times a year.

FIGURE 1. LAKE TANGANYIKA SPRAT, SARDINE AND PERCH VALUE CHAIN IN UNITED REPUBLIC OF TANZANIA (2021)



Note: The percentages sold, lost, and home-consumed are calculated in fresh equivalent weight.
Source: Fish4ACP

There are two market channels in the Value Chain (VC) for Lake Tanganyika sprat, sardine and perch. The largest is the domestic channel which accounts for 64 percent of the total fish catch (fresh equivalent) supplying local communities around the Tanzanian lakeside and other regions in United Republic of Tanzania. The export market channel accounts for 36 percent of the total fish catch and mainly supplies the neighbouring countries of Democratic Republic of the Congo, Burundi and Zambia.

All the fish are caught by small-scale fishers who are predominantly men, and approximately 85 percent of their total catch is sold to local small-scale processors who are predominantly women. The fish are processed into smoked perch or dried sprat and sardine, called *'dagaa'* in the local vernacular. Wholesalers, exporters and retailers purchase the remainder. In addition to processing carried out by small-scale processors, all actor types may carry out some fish processing, mainly for preservation purposes to prevent losses. Processors sell 66 percent of their product to wholesalers and 34 percent to exporters.

Consumers prefer to buy perch fresh for cooking at home. Since there have been significant improvements in the supply of electricity, perch is also sold frozen on the domestic market and now accounts for 4 700 tonnes of retail sales, more than twice the volume of fresh fish. However, due to the still limited availability of refrigerated transport and storage, smoked perch still accounts for 70 percent of total perch sales (fresh equivalent), mainly to other regions of United Republic of Tanzania and export markets.

As Lake Tanganyika sprat and sardine are smaller, they tend to deteriorate quicker, so are dried as soon as possible after landing. Due to this very little sprat and sardine is sold fresh. Also, freezing sprat and sardine affects quality so it is not a popular means of preservation.

Considering the large number and central role of small-scale processors with the value chain, they are the core actor with the most potential as a leverage point, especially for reducing fish losses and improving product quality.

Small-scale Fishers

There are approximately 9 000 fishing boats in Tanzanian Lake Tanganyika, a third of which are catamarans with lift-nets for catching Lake Tanganyika sprat and sardine and two-thirds plank boats with hook and line for catching perch (LTA, 2012). Some of the same fishers catch both perch and sprat/sardine either through changing fishing practices based upon fish seasons or as by-catch. Also, a small number of fishers own more than one boat and most of the boats also employ crew.

Total annual catches are 59 000 tonnes of fresh Lake Tanganyika sprat and sardine and 34 000 tonnes of fresh perch. Fishers use approximately six percent of the catch for home consumption and losses are estimated at five percent. Although actual fish losses are low,

there are price reductions due to deterioration of quality. Fishers also avoid losses by processing any fish not sold immediately at landing.

Small-scale Processors

There are an estimated 5 500 processor businesses based upon the LTA Frame Survey count in 2011, divided by the average number of workers estimated from primary data collection.[8] Smoking is most often done with firewood in ovens with a processing ratio of 2.5kg of fresh perch to 1kg of smoked perch. Drying is most often done under sunlight with a processing ratio of 5kg fresh sprat/sardine to 1kg dried sprat/sardine.

Many processors process both perch and sprat/sardine. In total, processors produce 8 900 tonnes of dried sprat/sardine and 8 200 tonnes smoked perch a year. Approximately five percent of product is lost, and three percent is home consumed.

Wholesalers

There are an estimated 440 wholesalers with some selling both perch and sprat/sardine. In total, wholesalers sell approximately 220 tonnes fresh perch, 5 600 tonnes smoked perch, 2 000 tonnes frozen perch and 4 900 tonnes dried sprat/sardine to local retailers around the lake (90 percent) and retailers in other regions of United Republic of Tanzania (10 percent). Home consumption accounts for one percent of the VC products procured by wholesalers, but losses are an average six percent.

Exporters

There are an estimated 118 exporters with most selling both perch and sprat/sardine. In total, exporters sell approximately 370 tonnes of fresh perch, 2 100 tonnes of smoked perch, and 3 600 tonnes dried sprat/sardine to wholesalers and processors in neighbouring countries such as Burundi, Democratic Republic of the Congo and Zambia. Around one percent of the VC products procured by exporters is home consumed, and three percent is lost, mainly due to damage during transport.

Retailers

There are approximately 4 040 retailers (LTA, 2012) along the Tanzanian lakeshore and in other regions of Tanzania selling a total of 2 000 tonnes of fresh perch, 4 700 tonnes of frozen perch, 4 400 tonnes of fresh sprat/sardine, 4 600 tonnes of dried sprat/sardine and 4 900 tonnes of smoked perch. Ninety percent of fish are sold to consumers around the lake and ten percent to consumers in other regions of Tanzania such as Dar es Salaam, Mbeya and

[8] 11,127 processors recorded in LTA Frame Survey with each business employing one worker

Tabora. Approximately one percent of the VC products procured by retailers is home consumed, and eight percent is lost due mainly to lack of cold storage.

The VC is characterised by a relatively large number of small-scale actors, typical of an artisanal-based industry. As such, fishing or processing technologies remain low cost and basic and there has not been any significant investment in downstream value chain activities, such as storage or transport, to improve efficiencies or profitability.

2.2 End-market analysis

2.2.1 Domestic consumption

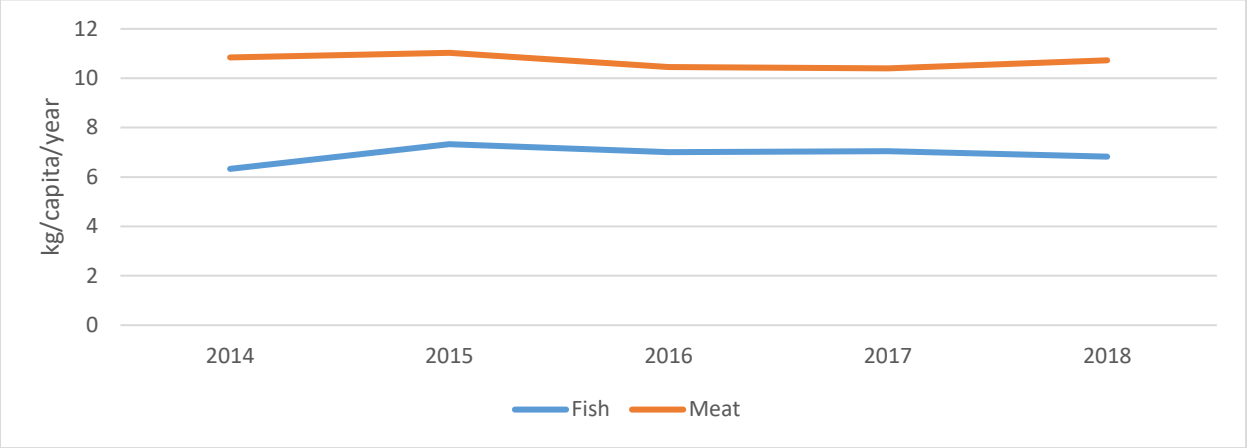
Domestic consumption of fish

The average fish consumption per capita in United Republic of Tanzania is around 7.8kg/year during the period 2015 – 2019 (MLF, 2019b), representing over 80 percent of the African average, which is 9.4kg according to Breuil & Grima (2014). However, it must be noted the consumption of fishery products is much higher in coastal regions, Zanzibar, as well as around the shores of Lake Tanganyika and Lake Victoria (Breuil & Grima, 2014).

Figure 2 shows fish and meat consumption has remained constant between 2014 and 2018, even though national fisheries output increased from nearly 360 000 tonnes in 2000, to over 390 000 tonnes in 2018 and national imports of fish (mostly frozen mackerel from China, Japan and Korea) increased from nearly 6 000 tonnes in the year 2010 to over 12 000 tonnes in 2018 (FAO FishStatJ and ITC, 2018a). Exports of fish over the same period also decreased slightly by 573 tonnes (FAO FishStatJ). One possible explanation for per capita fish consumption remaining constant when production and net imports were increasing is due to an increase in population in the last two decades, which is projected to continue in the future, implying increasing future demand for fish.[9]

[9] The World Bank estimates the Tanzanian population increased from 33.5 million in 2000 to 59.7 million in 2020 (a 78 percent rise), and is projected to reach over 79 million in 2030 and over 90 million in 2035 (https://data.worldbank.org/indicator/SP.POP.TOTL?locations=TZ; https://databank.worldbank.org/source/population-estimates-and-projections).

FIGURE 2. FISH AND MEAT CONSUMPTION IN UNITED REPUBLIC OF TANZANIA (KG/PER CAPITA/YEAR)



Source: FAOStatJ

Domestic consumption of Lake Tanganyika sprat, sardine and perch

Based on the data from the consumer survey conducted in 2021 as part of this VC report[10], the current total domestic yearly consumption of Lake Tanganyika sprat, sardine and perch, in fresh (wet) weight equivalent, is about 46 400 tonnes, or around two-thirds of the total volume of end-products (in fresh equivalent) destined to domestic and export markets. According to the consumer survey, approximately 90 percent of the sprat, sardine and perch consumed is prepared and eaten at home and 75 percent of households buy their fish in local markets, with others buying direct from fishers at landing sites.

[10] There were 122 consumers included in the survey. Of this, 89 are from the regions around the Lake and 33 from Dar es Salaam.

FIGURE 3. SMOKED PERCH ON DISPLAY IN A RETAIL MARKET

Source: ©TAFIRI

The largest domestic markets (accounting for around 90 percent of total domestic consumption) are the regions around Lake Tanganyika, where sprat, sardine, and perch play a relatively important role in the local diets as compared to other regions in United Republic of Tanzania. Sprat, sardine, and perch are also consumed in other regions in United Republic of Tanzania; but the consumption is restricted by limited and unreliable supply, which is in turn due to poor storage during transport, lack of specialized transport vehicles (e.g. refrigerated trucks), coupled with poor road and rail infrastructure (although already improved compared to the past) (Onyango, 2016; Interviews with VC actors and experts, 2021). The main sprat, sardine, and perch products on the markets vary across locations. Specifically, on local markets around the lake, sprat, sardine, and perch are sold both in fresh and processed forms (e.g. smoked perch, fried/boiled perch, fried/roasted dagaa). Some fresh Lake Tanganyika sprat and sardine is bought fresh for cooking at home by households or by retailers (small restaurants) close to the lake, however the majority is dried by processors. Meanwhile, on other domestic markets away from the lake (e.g. Mbeya, Dar es Salaam), the most common products are dried sprat/sardine, smoked perch, and frozen perch.

Interviews with VC actors and other key informants (such as trade experts, market leaders) indicate a generally increasing trend in the demand for sprat, sardine, and perch products in the last five years on domestic market, largely thanks to the population increase in United Republic of Tanzania. Notably, the demand for fresh/frozen sprat, sardine, and perch of

urban consumers living in locations further away from the lake (such as Mbeya, Dar es Salaam) has experienced relatively fast increases. This can be largely attributed to recent improvements in electricity supply, road infrastructure, and packaging/storage methods, which make these fisheries products more available and accessible to the population in these locations. At the same time, it is also indicated that in the three regions around the lake, fishers, processors, and retailers still have difficulties in finding more profitable markets despite the demand increase. Therefore, it is of strategic importance to facilitate better linkages between VC actors and the buyers on domestic market in locations outside of the lake (e.g. urban centres in Dar es Salaam, Mbeya, Dodoma) to better capture the increasing and unmet demand on these markets.

Of the three VC fish species, perch is the most preferred (as indicated by approximately 78 percent of the surveyed consumers), and is also a more important source of animal protein for Tanzanian households than sprat and sardine (with around two-thirds of the surveyed consumers indicating that their households use perch as a main[11] source of animal protein, whereas only 3 percent and 13 percent indicating so with sardine and sprat). This is largely due to the relatively high prices of sprat and sardine as compared to perch. The high prices of sprat and sardine (or *dagaa*) from Lake Tanganyika, in turn, is because these fish are believed to be high-quality (sometimes even luxury) products (Interviews with VC actors and MLF officers, 2021), as opposed to the *dagaa* from Lake Victoria which is traditionally considered as rather low-value fish and often used for animal feed (Kolding *et al.*, 2019). These consumer perception and preference represent a competitive advantage of Lake Tanganyika sprat and sardine; but at the same time, make these fish products less affordable for a broader group of domestic consumers.

As for perch, between fresh and smoked perch, fresh perch is preferred and thanks to recent improvements in electricity supply, perch is currently also sold frozen. Nonetheless, currently the majority of perch is still smoked for preservation before being sold on local markets or transported to other markets. In the future, with consumer preference for perch and further improvements in electricity and road infrastructure, there may be more opportunities for supplying more frozen perch to the markets.

According to the consumer survey, if Lake Tanganyika sprat, sardine or perch is unavailable or too expensive, they are most commonly substituted with beans/legumes, beef, vegetables, eggs, and chicken. Other fish products are also used, most commonly the fish from Lake Victoria (e.g. Lake Victoria sardine - *Rastrineobola argentea)* and other water bodies in United Republic of Tanzania, and the Giant Cichlid (*Boulengerochromis microlepis*), tilapia or catfish from Lake Tanganyika.

[11] This means perch contribute 50 percent or more to the household's total animal protein intake.

According to functional interviews with VC actors and consumer surveys, on domestic markets, buyer requirements – be it consumers' or traders' – usually differ across buyers. There is no uniformity in buyer requirements and there are hardly any specific quality standards that domestic buyers require, but just mainly general norms. Most commonly, fish quality is decided based on size (the bigger, the better). For fresh fish, quality implies freshness and appearance (not spoiled, rigor mortis is still present, reddish gills, transparent eyes, and a silvery colour). The quality for smoked perch is defined as having a golden yellow colour and dried sprat/sardine should not be contaminated by sand and have the stomach intact. Food quality standards on domestic markets exists (e.g. Tanzania Bureau of Standards (TBS) standards), but their implementation is largely lacking, which in turn poses challenges for VC actors to access higher-value markets (e.g. urban areas, supermarkets) which require higher quality products. Nevertheless, good quality fish (judged based on general norms rather than official standards) can be priced twice as much as poor quality ones. For instance, Table 1 shows the prices of different dried sprat/sardine products, with rack dried sprat/sardine fetching considerably higher prices thanks to their higher quality. This implies an opportunity for increasing income for VC actors thanks to improving the quality of fish products.

TABLE 1. PRICES OF DRIED SPRAT/SARDINE PRODUCTS (AVERAGE ACROSS ALL REGIONS)

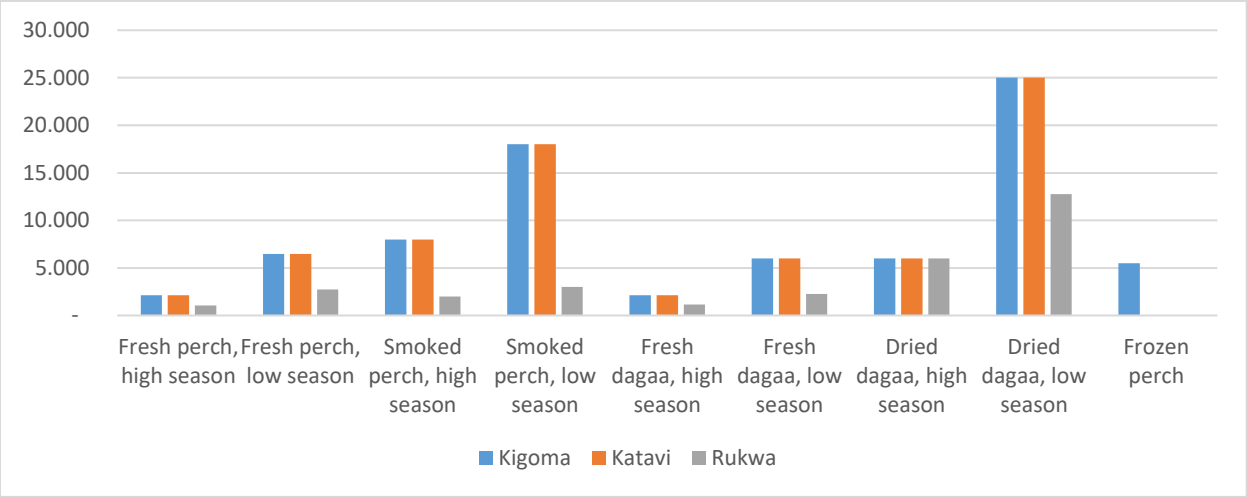
	Low season sale price per kg	High season sale price per kg
Rack dried sprat/sardine	15 000 – 30 000 TZS	6 000 - 10 000 TZS
Ground dried sprat/sardine	10 000 TZS	

Note: Exchange rate USD 1 = TZS 2 315. Source: Interviews with VC actors, 2021.

Figure 4 provides an overview of the average retail prices for different Lake Tanganyika sprat, sardine and perch products in high and low seasons in three regions around the lake – Kigoma, Rukwa and Katavi. Not reflected in the figure are the average fish prices in other domestic markets far from the lake (e.g. Dar es Salaam, Mbeya), which are two to three times higher than the those around the lake for fresh/frozen perch and dried dagaa[12] (Interview with VC actors, 2021).

[12] For instance, in Dar es Salaam, the price of dried dagaa in Dar es Salaam is TZS 38 000/kg; and the price of frozen perch is TZS 9 500/kg (Economic interview with retailers, 2021).

FIGURE 4. AVERAGE RETAIL PRICES OF SPRAT/SARDINE AND PERCH IN KIGOMA, RUKWA AND KATAVI IN 2021 (TZS/KG)



Notes: (1) Dagaa refers to sprat and sardine. The prices of these two species are grouped together because they are often mixed together when sold. (2) Exchange rate USD 1 = TZS 2 315.
Source: Own compilation of data collected from consultation with Fisheries Officers, economic interviews with retailers, and focus group discussion with traders conducted in 2021.

For all products, their prices on domestic market largely fluctuate between low and high seasons as fish availability dictates the prices. It must be noted that the months of low and high seasons differ between regions and fish species (see more in section 2.3.1.1). Additionally, prices also vary between the north and south of the lake, with prices in Kigoma and Katavi being largely the same and higher and having larger fluctuations than those in Rukwa. The lower prices and lower price fluctuations in Rukwa are mainly due to two reasons: (1) higher availability of perch throughout the year in the southern part of the lake leads to lower and more stable perch price in Rukwa; (2) lower consumer preference for sprat and sardine in the southern part explains the lower prices of sprat and sardine prices as well as the smaller impacts of fish availability on fish prices in Rukwa (as sprat and sardine are not highly preferred by southern consumers, their availability does not affect consumers' demand, and thus fish prices, as largely as in the north).

Seasonal price fluctuations due to unstable availability of fish in the lake make it difficult for consumers to plan their purchase and for fishers, processors, and traders to plan and conduct their activities at a profit. This implies the need to improve the stability of fish supply to support consumption, especially in urban markets which offer considerably higher prices. In addition, seasonal fluctuations also present an opportunity for fishers, processors, and traders to improve their practices to enhance their supply of fish products in low season to better capture the benefits of high prices in low season.

2.2.2 Export markets

Due to Tanzanian Lake Tanganyika's proximity and shared borders with Democratic Republic of the Congo, Burundi and Zambia; coupled with the long distance and poor transport linkages to large urban centres in United Republic of Tanzania itself, the regional market (i.e. neighbouring countries around the lake) has traditionally played an important role for sprat, sardine and perch from Lake Tanganyika. Tanzania is a net exporter for Lake Tanganyika sprat, sardine, and perch, whereas all the neighbouring countries around Lake Tanganyika are net importers (Kolding *et al.*, 2019).

The size of the regional market for fish in general of four countries around Lake Tanganyika was estimated at around 1.2 million tonnes as of 2004, which was not satisfied by domestic production and imports (African Development Fund, 2004). According to Onyango (2016), Democratic Republic of the Congo is the biggest market (it is estimated that 67 percent of the Lake Tanganyika fish in Tanzania is exported there), followed by Burundi (around 30 percent) and Zambia (2 percent). Traders often travel to the processing/landing sites in United Republic of Tanzania to buy; and wealthy traders from Democratic Republic of the Congo are key players, able to purchase large quantities of product and influence prices. Regional demand is indicated to have increased in the last 5-10 years due to population increases (interviews with VC actors, trade experts, market leaders in 2021) and increased awareness of the nutritional value of small fishes (Kolding *et al.*, 2019). Additionally, interviewed market leaders (who are traders) also indicated the demand from other neighbouring countries not adjacent to the lake (e.g. Malawi) has been increasing and is expected to further increase in the future as the population continues to grow and as electricity and road infrastructure will be further improved.

FIGURE 5. SMOKED PERCH PACKED READY FOR TRANSPORT TO DEMOCRATIC REPUBLIC OF THE CONGO

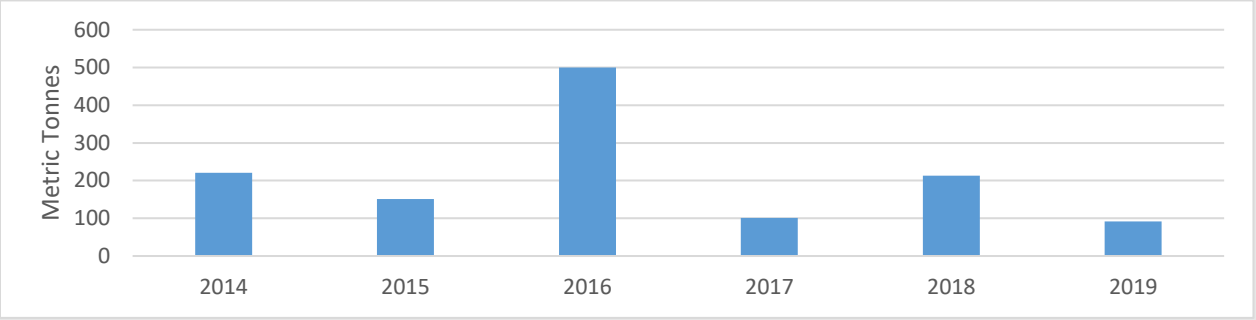
©TAFIRI

FIGURE 6. DRIED DAGAA BEING PACKED READY FOR TRANSPORT

©TAFIRI

MLF (2019b) statistics state 92 tonnes of dried sprat/sardine worth TZS 1 740 million (over USD 754 000) and 32 tonnes of smoked perch worth TZS 269 million (over USD 116 000) were exported from Lake Tanganyika in United Republic of Tanzania in 2019. Figure 7 shows exports of dried sprat and sardine between 2014 and 2019 using MLF (2019b) data, which averages between 100 and 200 tonnes/year, disregarding the spike in 2016.

FIGURE 7: DRIED SPRAT/SARDINE EXPORTS 2014 – 2019 (MT)



Source: MLF (2019b)

However, primary data collected as part of this value chain study estimated 370 tonnes of fresh perch, 2 100 tonnes of smoked perch and 3 600 tonnes of dried sprat and sardine (or around 23 400 tonnes of perch, sprat and sardine in fresh equivalent weight altogether) were exported in 2021. The huge differences between MLF official statistics and own estimates based on primary data can be attributed to the prevalence of illegal and unrecorded fish trade around the lake.[13] Petit and Shipton (2012) estimated approximately 30 percent of the fish exported from Kigoma is illegally exported and thus, unrecorded. Interviews with fisheries officers and local government authorities in 2021 re-confirmed the prevalence of unrecorded trade, which is done not only by traders but also by fishers who sell fish to foreign buyers directly on the lake. A possible reason for this situation is the export levy, or royalty, which is charged on fish exports (i.e. USD 0.50/kg for dried sprat/sardine, USD 0.30/kg for fresh perch and USD 0.20/kg for smoked perch in 2020[14]). Although these royalties have been reduced in 2020, they still make up a high proportion of fish price, and thus, avoiding them is the most likely motivating factor for unreported or illegal exports.

The prices of sprat, sardine and perch products on regional export markets vary across countries, depending on the quality of the products entering each country market. The Democratic Republic of the Congo market is often associated with lower prices and is less quality conscious, while the markets in Burundi, Zambia, Malawi, and Rwanda often offer higher prices as they also demand higher quality products (Interviews with market leaders and experts). Understanding these price and quality differences is therefore of strategic

[13] This may also be due to a possible underestimate of domestic consumption in areas in United Republic of Tanzania far away from the lake due to the difficulties in obtaining this estimate.
[14] The Fisheries (Amendment) Regulations, 2020, p.49.

relevance for the upgrading of the Lake Tanganyika sprat, sardine, and perch in United Republic of Tanzania.

Secondary data (e.g. Onyango, 2016) and interviews with traders and fisheries officers in 2021 suggest that there is a small amount of Lake Tanganyika sprat, sardine and perch being exported to outside of Africa, such as the USA, India, Canada, and the European Union. Interviewed exporters also indicated to pay export license and export royalty when exporting Lake Tanganyika fish to markets outside of Africa. However, the recorded export amount to these markets is extremely negligible (less than 0.0005 percent of the exported Lake Tanganyika fish according to Onyango, 2016), and the exports are most often done without any formal agreements between sellers and foreign buyers (Interviews with exporters, 2021), and most of the fish are exported as "gifts" (Expert interviews, 2021).

2.2.3 Market opportunities and requirements

There are several end-markets of the Lake Tanganyika sprat, sardine, and perch from United Republic of Tanzania, including domestic and export markets inside and outside Africa. However, the domestic markets and the markets in neighbouring countries are of most strategic importance to the Lake Tanganyika sprat, sardine, and perch value chain in United Republic of Tanzania, given the untapped and increasing demand on these markets and the potential for the value chain to better capture this demand.

On the domestic market, three regions around the lake (i.e. Kigoma, Rukwa, Katavi) will remain important end-markets in the future, given that they are currently the largest markets for the VC products and that the demand there is expected to continue increasing. There are uncaptured opportunities on higher-value domestic urban markets in locations away from the lake (such as Mbeya, Dar es Salaam, Dodoma), where demand exists but remains unmet due to either the unavailability or the unreliable supply of quality VC products, which are in turn due to various value chain constraints (to be discussed later in this report). A similar situation is observed on higher-value export markets in neighbouring countries. It is, therefore, of strategic relevance for the value chain to better capture these opportunities thanks to improving product quality and availability. Particularly, given consumer preference for perch and the abundance of perch in the southern part of the lake, there are opportunities for developing the fresh/frozen perch supply chain targeting the export market in Zambia. Smoked products are popular in Democratic Republic of the Congo, Burundi, and Zambia. As for dried sprat and sardine from Lake Tanganyika which have a reputation as high-quality products, the target markets would be urban consumers on domestic markets and the higher-value markets in neighbouring countries, such as Burundi, Zambia, Rwanda, and Malawi.

However, these opportunities can only be realized if the value chain is upgraded to meet the quality standards/requirements on the higher-value (and more demanding) urban and export markets and if linkages to these markets are established and maintained.

2.3 Analyses of the value chain elements

The elements of the VC are analysed at four layers: (1) the actors in the core VC; (2) the input suppliers and service providers in the extended VC; (3) the societal enabling environment; and (4) the natural environment. The latter two layers look at how the environment influences the VC.

2.3.1 Actors in the core value chain (layer 1)

The core actors in the value chain are those that are shown in the VC map (Figure 1). Five VC actor types have been identified – small-scale fishers, small-scale processors, wholesalers, exporters and retailers.

2.3.1.1 Fishers

According to MLF data (MLF, 2019b), total catch of Lake Tanganyika sprat, sardine, and perch increased by 85 percent between 2016 and 2019, due to increased fishing effort.

Manini, cited in the Fisheries Management Plan prepared by Reynolds (Reynolds, 1999) stated catch compositions varied by location. Sprat/sardine are more common in the north of the lake and perch more common in the south. Catches are also said to be generally higher in the more productive southern part of the lake (MLF, 2019b) Productivity of the lake is autochthonous (relies on an abundance of plankton). Intensive upwelling events (as a result of strong southeast trade winds) start to occur in the southern part of the lake (Plisnier et al 1999), which causes the southern part to be more productive than the northern part. In addition, both CPUE, number of fishers and number of fishing units (especially ring nets) are generally higher in the southern part of the lake.

FIGURE 8 LIFT NET CANOES AND DAGAA DRYING ON RAISED RACKS

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Fishing seasons vary according to the area of the lake and species. From the VC survey, indicative high season catches per boat are 100kg per trip for sprat/sardine and 80kg for perch.[15] For the low season, the volumes are 10kg for sprat/sardine and 20kg for perch. Table 2 provides a summary of fishing seasons in different areas of the lake.

TABLE 2. HIGH SEASONS FOR PERCH, SPRAT AND SARDINE

	Kigoma	Katavi	Rukwa
Perch	March - April	March - May	September – May
Sprat/Sardine	July - December	July - September	July - September

Note: Other months not indicated in the table are low seasons.
Source: Consultations with Fisheries Officers, 2021.

The high season also coincides with the rainy season when higher volumes of fish are landed and processing conditions are more difficult. The low season coincides with the dry season when there are also strong winds. Losses at fishing stage appear to be minimal, although deterioration of quality on the boat can lead to a lower price upon landing.

[15] A trip is usually for one night

FIGURE 9 FISHERS AND THEIR CANOES AT A LANDING SITE

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Based upon data collected as part of this study, approximately 95 percent of fishers are male with over 70 percent having completed primary school education but 60 percent are interested in fishing related training. Over 50 percent of fishers have 10 or more years of fishing experience and nearly 80 percent do not belong to any association or organization such as Beach Management Units (BMU) to which some fishers (a minority of all fishers) are members. Many rely on fellow fishers for information or have no access to technical information. Many do not use banking services and 80 percent do not have bank accounts. Although fishing is the main economic activity, some fishers also engage in farming.

Kolding, J. et al (2019) explain the two most common small-scale fishing methods – night fishing with lights and nets for sprat/sardines and day fishing with hook and line for perch. Fishers use planked boats or catamarans (two canoes joined by wooden poles), whilst subsistence fishers use dug-out canoes. Outboard engines, sail and paddle are the forms of propulsion. The most common fishing gears used are lift-nets (used on catamarans), ring-nets, hook and line and beach seines. Other gears include gill-nets, scoop-nets, traps and mosquito-nets. Fishing activity is influenced by weather and the lunar cycle. Lift nets are used at night for sprat and sardine. A crew of 6 to 11 use lights to draw the fish over the net. Lift nets range from 55 m to 100m opening circumference. Fishing is dictated by the lunar cycle and is not practiced during full moon periods. Ring nets are between 120 to 180 metres in length and used to encircle the fish. Permitted for use 1km and more from the lake shore, they are used both day and night (with lights) to catch both sprat/sardine and perch. Large canoes are operated by a crew of 12 to 18 and small search boats used to find the fish, accompany the main canoe.

FIGURE 10 LIFT NET FISHERS

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Hook and line fishing is carried out by one to three fishers per canoe. Hooks of size 9-13 are tied to a 200m length of monofilament line. The first 50 meters are used from around 6am then as it gets later and lighter the fishing depth is increased to 200 meters as fish descend into deeper water. Hook and line gear is cheap yet not as effective as ring-nets in terms of volume of catch and effort. Hooks are either baited or un-baited.

FIGURE 11. LIFT NET FISHING TAKES PLACE AT NIGHT SO CANOES CAN BE SEEN AT LANDING SITES DURING THE DAY

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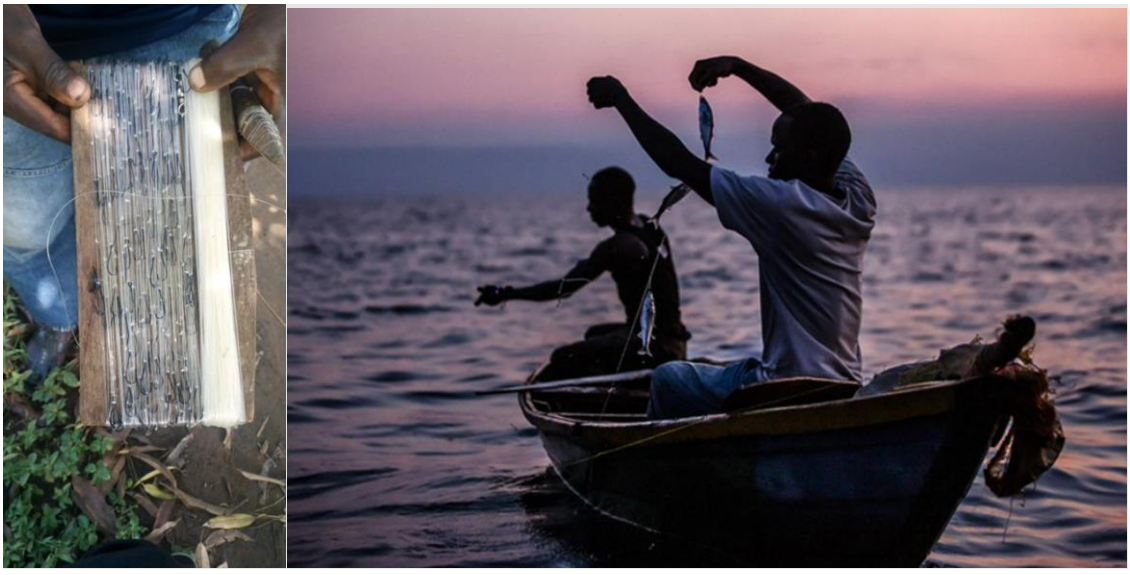
FIGURE 12 PERCH FISHING



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Investment costs are associated with wooden boats (locally made), fishing nets, lights, hooks and outboard engines, batteries for charging solar lights and wooden fish boxes. Key

operating costs are boat fuel (52 percent), crew food (13 percent) and outboard engine and boat repair (10 percent).

On-board handling is poor due to vessel design, lack of skills and knowledge as well as access to equipment and ice. Some use wooden boxes for storing the catch on-board while other fishers place the catch in the bottom of the canoe. The lower ambient temperatures experienced during the night and early morning are beneficial in terms of maintaining fish quality and fishing trips tend to be relatively short in order to avoid severe quality deterioration prior to landing. Catches are sold at landing sites to processors, traders and agents. Large sprat *(Karumba)* over 90 mm in length and large perch fetch a premium price. After the fish are sold and the overhead costs deducted the remainder is divided equally between owner and crew. When catches are good the crew can also be given fresh fish as part payment.

Van der Knaap (2018) describes how the number of fishers and boats doubled between 1995 and 2011 leading to fish catches reducing by up to 30 percent owing to the heightened fishing intensity and increased IUU fishing. Van der Knaap *et al.* (2014) also estimated fish catch per boat had reduced by at least half, significantly reducing fisher incomes. Reduced catches and changes to catch composition are most marked in the extreme northern and southern parts of the lake (LTA SAP, 2010).

FIGURE 13 FISHERS UNLOADING THE CATCH TO WOMEN PROCESSORS

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According to the VC assessment, fishers are switching from kerosene to cheaper, more effective solar lights. Catch per unit of effort (CPUE) continues to decrease and more fishers are switching to use ring net fishing. Ring nets are associated with the catch of juvenile (under size) fish. According to the VC assessment, CPUE is thought to have dropped 6 to 10-fold over the past 5 years. Undersize perch of 20cm (100 to 150 g) are common. Increasing numbers of fishing units and the increasing use of more efficient gear such as ring nets, in absence of effective fisheries management will have detrimental effects on sustainable fish production and the sustainability of the associated value chains.

FIGURE 14 PERCH FISHERS AND CATCH BEING LANDED

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FIGURE 15 BUCKET BEING USED TO MEASURE QUANTITY OF FRESH DAGAA

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According to Onyango (2016), the main problems voiced by fishers include robbery, insufficient capital, lack of high-tech fishing equipment, lack of processing and storage facilities and an unreliable market for the fish products. The consultation with VC actors (survey, interviews) in 2021 confirms these problems and in addition, identifies a myriad of other challenges the relevance of which varies according to the three regions:

- Fishing hampered by strong winds (especially in May/June)
- Poor and inaccessible roads from landing sites to markets
- Lack of stable supplies of fish and hence fluctuating prices
- Increases in operational costs as fishers move to offshore waters to follow fish
- Flooding of landing sites
- Piracy and the theft of fishing equipment
- Damaged or non-existent landing and market infrastructure
- Inability to reinvest in buying/hiring [new] gears and vessels, and other lost/damaged/stolen equipment.
- Reduced landings or unreliable fish supply
- Reduced fish price

Intervention options appear to be centred around:

- Strengthening fisheries management and improve efforts and measures to combat IUU
- Improve on-board handling of fish to maintain fish quality
- Improve access to higher value domestic and regional markets through the application of existing standards and certification
- Improve security on the lake to prevent piracy
- Stimulate value addition particularly by improving the quality of processed products and increasing sales to urban markets
- Improve access to finance for investment in fishing, fish trading and agriculture.

2.3.1.2 Processors

According to Reynolds (1999) the bulk of fish landed at most sites must be processed in some fashion in order to extend its shelf life for marketing purposes. According to the VC survey data, an average single processor produces 1.6 tonnes of dried sprat/sardine and 1.5 tonnes smoked perch per annum. Of the processors surveyed, 70 percent process smoked perch, 67 percent dried sprat/sardine and 35 percent process both products.

Data from the survey conducted under this study shows 78 percent of processors are female, mostly aged between 16 and 45 years old. The prevalence of women in the processing function of the VC, as seen from the survey, is well-recognized and supported by various past studies (e.g. African Development Fund, 2004; Breuil & Grima, 2014). Of the surveyed processors, about 86 percent have completed primary education and over 90 percent reside within the fishing community with 55 percent having over 10 years processing experience. About 60 percent of processors are dissatisfied or very dissatisfied with the fish they buy from fishers. A similar proportion find it difficult to sell the final product. Up to 80 percent of processors are not members of any association or organization. Most obtain technical and market information from either buyers or fellow processors but over 80 percent see a need for training in business management, processing or marketing. Approximately 84 percent do not have bank accounts and 70 percent have not registered their business. Processors also engage in agricultural activities. The main barrier to entry to processing is financial capital.

Lake Tanganyika sprat and sardine are typically sun dried. Fresh sprat/sardine are carried from the fish landing in the morning to the processing area in wooden boxes (of varying capacity) or in 20 litre buckets. The fish are spread on either raised drying racks or on fishing nets/canvas on the ground to dry. The VC assessment suggests that in the southern part of the lake, around 80 percent of processors still dry on the ground (note this not directly on the sand/ground, but processors often use obsolete fishing nets which is spread direct on the ground) and only 20 percent use raised or mobile racks (which are raised approximately 10 cm from the ground). The reason behind this is the lack of capital to buy materials to

construct raised or mobile racks and the lack of land/space to put up the racks (most of processors do not own land). Moreover, most processors in the south sell their products locally and in regional markets (Democratic Republic of the Congo, Burundi) where quality is not much emphasized. Higher fish catches and lack of improved handling facilities in the south also drives processors to dry fish on the ground.

FIGURE 16. PROCESSORS DRYING DAGAA ON RAISED RACKS

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FIGURE 17. DAGAA ARE ALSO DRIED ON PORTABLE WOODEN RACKS

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There is a greater use of drying racks in the northern part of the lake. Low catches in the north drives processors to use the available elevated racks to maintain fish quality. However,

in the periods of high catches, processors in the north are also forced to dry sprat/sardines on the ground because of the limited number of racks at landing sites.

The fish dry in one day, if conditions are sunny. Drying takes longer in the rainy season when the risk of quality deterioration is heightened. To speed up drying in the rainy season processors burn charcoal under drying racks. Mobile drying racks can be stacked and moved under cover during rains.

Perch are normally smoke dried, which is partially attributed to the lack of cold chains that are required to preserve fish fresh and/or chilled. Large fish are washed. The fish are formed into rings by inserting the tail through the head. The fish rings are threaded onto a long (3m) smoking stick. The sticks are then arranged on the smoking oven, which is typically a three walled raised structure with the front open. The fish are covered with iron sheets and wood is burnt under the fish to smoke and dry it. Smoking takes about four hours. After smoking the fish is removed and left to cool. A four-hour smoking time provides a storage life of weeks rather than months. Whilst longer smoked fish have a longer storage life, they are more prone to breakage/fragmentation during handling and distribution.

FIGURE 18 PROCESSORS PREPARING PERCH FOR SMOKING

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FIGURE 19 PERCH ARE SMOKED ON STICKS OR WIRE MESH

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FIGURE 20. WEAK COLD CHAIN FACILITIES MEAN PERCH ARE OFTEN SMOKED

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Processing activity is influenced by the fishing season and the volumes of fish caught and landed: low season equals less processing; high season means more processing.

Raw fish purchases account for 92 percent of total costs. The other main input is charcoal for smoking perch. Drying racks and storage can either be owned or rented.

FIGURE 21 DAGAA ARE ALSO DRIED USING CHARCOAL ESPECIALLY DURING THE RAINY SEASON

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In the Kigoma area, sun dried sprat/sardines are mostly sold by weight (kg) using spring balance weighing scale and mechanical weighing scale, in other areas they are sold by volume i.e. buckets (4 litre ≈1-1.5kg, 10 litre ≈2.5 kg and 20 litre ≈5 kg). Smoked perch are sold by counting the pieces (fish) of smoked fish. Processed products are sold by kg, soon after processing has finished, or products are stored for a short time before sale. Processed products should meet the minimum catch size limit and permits are required to transport processed products outside the fishing community.

FIGURE 22 PERCH ON WOODEN POLES BEING SMOKED

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First haul sprat/sardine (from the early catches of a fishing trip) is generally of low quality due to spoilage caused by the duration of time the fish is on board, most often without ice, after capture. Processed products will similarly be low quality. Low quality fresh sprat/sardine fetches a low price (almost half of the price of good quality). Drying sprat/sardine on the ground and on nets is associated with poor quality final products (contaminated with sand). Yellowing of sprat/sardine caused by oxidative rancidity of fats is also associated with low quality dried products. Low quality processed sprat/sardine fetch half the price of good quality product.

Smoked perch should ideally be a golden yellow in colour. Burning / blackening of smoked perch is very rare (less than 3 percent of the processors experience this). The loss due to quality downgrading might be 25 percent of a batch of smoked perch and the value of downgraded products is 25 percent of the price of good quality product. Losses occur due to prolonged storage of dry sprat/sardine (yellowing) and due to mould growth on perch. Smoked perch also breaks up (fragment) due to rough handling and transportation. Losses appear to be linked to low quality and loss in associated value. Physical losses, where fish are thrown away appear to be negligible.

There has been a decline in the supply of sprat/sardine since 2019 and low levels of capital hamper the ability to process and market large volumes of fish. The fish supply or availability of fish has reduced, and the number of processors increased. This has caused increased competition for fish for processing and a decline in income per processor. There has been an increased use of portable drying racks as well as demand for improved products and a shift away from low quality. The move towards producing good quality products should see an improvement in profit. Efforts to strengthen links to high value markets within United Republic of Tanzania, such as urban supermarkets as well as higher-value export markets in neighbouring countries (such as Rwanda), will complement the move to better quality, however, improving quality and increasing selling price may make fish less affordable to certain current consumers.

The VC survey data shows drying can be difficult during the rainy season (September to April). Drying racks are expensive and there is a lack of them. In addition, there is also the lack of land/space to put up the racks. Furthermore, flooding has disrupted processing in some locations. Processing facilities are rudimentary, and processors lack awareness of how to improve and to meet quality standards. Transportation costs are high, and in some locations, there is a reliance on water transport due to an absence of roads. Intermediary traders are said to manipulate prices to give undue advantage to wealthy traders from Democratic Republic of the Congo. Seasonal availability of fish and associated price fluctuations are highlighted as another challenge. As is the impact of COVID-19 which reduced trade to neighbouring countries. Additionally, fish smoking is affected by a scarcity of firewood.

Intervention options appear to be centred around:

- Explore the potential for better organization of women processors to improve advocacy and access to services, inputs and markets. This should consider links with the Tanzania Women in Fisheries Association (TAWFA)
- Capacity building in improved processing methods and quality standards, certification.
- Access to improved processing technology and improved or increased storage.
- Improve access to high value markets (domestic supermarkets and regional e.g. Rwanda).
- Stimulate value addition and job creation.
- Improve access to finance and support for investment in processing, fish trading and agriculture.

2.3.1.3 Wholesalers

Wholesalers are active in all three regions, usually operating from the main landing sites or marketplaces next to the lake and live locally. According to data collected as part of this study, most wholesalers are men aged between 16 and 45 years old and are comparatively more educated to at least primary level, with some completing secondary education. Most wholesalers have been operating for less than ten years with many previously working as farmers or fishers. After saving up enough capital as farmers or fishers, they then invested in fish wholesaling using their own funds and loans from family and friends. Wholesalers specialise in selling sprat, sardine and/or perch and generally do not trade in any other goods, or even fish species.

Wholesalers buy fresh sprat, sardine and perch from fishers at the landing sites or sundried sprat/sardine and smoked perch from processors. Purchases are made daily to accumulate large volumes in storage and are sourced from several suppliers who are paid in cash at the point of purchase. Prices are negotiated based upon size of the fish, quality of processing and cleanliness. According to economic data collected as part of this study, fish purchases account for 81 percent of wholesaler costs and is therefore a major determinant of profitability.

Wholesalers which buy fresh sprat, sardine and perch will either process the fish themselves or pay a processor on a service provider basis. There are also wholesalers who buy and sell fresh perch or buy fresh perch then freeze them. However, the bulk of wholesale trade is in smoked or frozen perch or dried sprat/sardine. The average wholesaler will sell about 29 tonnes of fish a year (Fish4ACP economic actor interviews, 2021).

In addition to aggregation, the main functions carried out by wholesalers are storage and transport. Storage is carried out to aggregate fish into marketable volumes and is usually short-term. As such, storage premises are usually just a dry room and around 15 square

metres in area, with the capacity to store 3 tonnes of fish. According to interviews carried out as part of this study, wholesalers frequently rent storage rather than owning it. Sundried sprat and sardine are often stored on polythene sheets on the floor or directly on to the floor, whilst smoked perch are stored on bamboo racks. Wholesalers trading fresh or frozen perch also require refrigerators or freezers.

Prior to transport, the wholesalers will pack the fish in medium (60kg) or large (120kg) boxes for perch, 85kg sacks for sundried sprat and sardine or large ice boxes for frozen perch. Most wholesalers are unaware of food safety and trading standards and as such don't implement any standards beyond traditional trading practices.

Wholesalers average one two tonne shipment a month. Most fish are transported by wholesalers to other regions by public bus and there are regular services to towns and cities such as Dar-es-Salaam, Mbeya and Tabora. Although transport only accounts for 2 percent of total costs, wholesalers estimate that most losses are due to broken dried fish or spoiled fresh and frozen fish during transport, which is usually between five and ten percent of sales. After the cost of the fish, transport represents the highest cost for wholesalers.

Other costs include labour and business fees. Very little full-time labour is employed by wholesalers. Most labour-time is undertaken by the business owner carrying out procurement and sales. Service-providing processors, packers, loaders and porters are just paid time-based fees when their services are required. Business fees include a trading licence and a council/market fee and amount to about TZS200 000 (USD 86) for an average wholesaler, less that one per cent of total costs.

Wholesalers along the Tanzanian lakeshore sell to other wholesalers in other areas such as Tabora, Mbeya and Dar-es-Salaam or to local retailers and are usually responsible for delivering the fish to the buyers via hired transport services. Verbal buying agreements are made over the phone and payments are made in cash on delivery or through mobile banking. Most wholesalers don't use formal financial services or even have bank accounts and usually self-finance their business start-up and operations from savings and loans from family and friends. This Is largely due to not being eligible for formal loans i.e. not meeting the borrowing requirements, or financial services not being available in their area. Nonetheless, many wholesalers state they would like to access loans if they were available.

Fish prices can more than double depending on season and availability. Wholesalers state demand is increasing for sundried sprat/sardine and smoked perch; however, competition has increased from wholesalers from other areas also buying direct from the landing sites. This is also exacerbated due to the downward trend in catches and availability of fresh fish from the lake. Whilst some wholesalers' turnover has decreased due to the decreased availability of fish to trade, wholesalers who have increased trade have done so through

growth strategies, such as increasing buying and storage capacity allowing them to buy larger amounts of fish at one time.

FIGURE 23 BLOCK ICE IS AVAILABLE FOR FISH PRESERVATION IN LIMITED QUANTITIES

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According to interviews carried out as part of this study, wholesalers stated there are opportunities to expand their business to supply additional towns in United Republic of Tanzania or start exporting. Profits could also be increased by improving fish quality through better storage, processing technologies and specialised transport services. Some were even considering vertical integration strategies to include fishing, to ensure the supply of fish for trading. Common constraints are transport infrastructure, reliable electricity supply and access to finance.

2.3.1.4 Exporters

Exporters are active in all three regions, usually operating from the main landing sites or marketplaces next to the lake and live locally. Main export destinations are Bujumbura in Burundi, Kalemie in Democratic Republic of the Congo and Mpulungu in Zambia (Onyango,

2016). According to data collected as part of this study, most exporters are men aged in their 40s and are comparatively well educated to at least primary level. Most exporters have been established for over ten years, with many previously working as domestic wholesalers. Exporting fish is judged to be more profitable than wholesaling domestically, however, it requires higher capital outlay, contacts in other countries and is inherently riskier. Exporters specialise in selling sprat, sardine and or perch and do not generally trade in any other goods, or even other fish species. Medium-sized exporters will export between 20 and 40 tonnes of Lake Tanganyika sprat, sardine and perch a year.

Exporters buy fresh sprat, sardine and perch from fishers at the landing sites or sundried sprat/sardine and smoked perch from processors. Purchases are made daily to accumulate large volumes in storage and are sourced from several suppliers who are paid in cash at the point of purchase. Prices are negotiated based upon size of the fish, quality of processing and cleanliness. Fish prices can vary considerably due to seasonal availability. Fish purchases account for 99 percent of total costs.

Exporters which buy fresh sprat, sardine and perch will either process the fish themselves or pay a processor on a service provider basis. There are also a small number of exporters who buy and sell fresh perch or buy fresh perch then freeze them.

FIGURE 24 AFTER PROCESSING DRIED DAGAA IS NORMALLY PACKED IN SACKS FOR ONWARD DISTRIBUTION

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In addition to aggregation, the main functions carried out by exporters are storage and transport. Storage and packaging activities are the same as for wholesalers. Transport is

commonly carried out by boat for exports and most exporters use the public ferries, rather than owning boats themselves.

According to economic data collected as part of this study, other costs include transport, labour and business fees. Very little full-time labour is employed by wholesalers. Most labour-time is undertaken by the business owner carrying out procurement and sales. Processors, packers, loaders and porters are just paid time-based fees when their services are required. Business fees include a trading licence, council/market fee and export royalty. Export royalties are high and charged at USD 0.2/kg is for fresh perch, USD 0.3/kg for dried perch, and USD 0.5/kg for dried sprat/sardine (MLF officials' interview, 2021).

Exporters make verbal buying agreements with foreign importers over the phone and payments are made in cash, on delivery. Most exporters don't use financial services or even have bank accounts and usually self-finance their business start-up and operations from savings and loans from family and friends. This is largely due to not being eligible for formal loans i.e. not meeting the borrowing requirements, or financial services not being available in their area. Nonetheless, many exporters did state they would like to access loans if they were available.

According to interviews carried out as part of this study, exporters state demand is increasing for sundried sprat/sardine and smoked perch, however, there is a downward trend in catches and availability of fresh fish from the lake. Exporters complain increased transport/fuel costs and export levies have reduced profits over recent years and common constraints are transport infrastructure, reliable electricity supply and access to finance. Nonetheless exporters see new opportunities to enter new markets beyond neighbouring countries and increase profits by improving fish quality through better storage, processing technologies and specialised transport services.

2.3.1.5 Retailers

Retailers include those along the Tanzanian shoreline selling fish to local housewives for home consumption, small restaurants selling cooked food for consumption and also retailers in other cities such as Dar-es-Salaam, Tabora and Mbeya in the central belt of United Republic of Tanzania. Cities in the north of United Republic of Tanzania are mainly supplied with fish from Mwanza port on Lake Victoria. According to data collected as part of this study, most retailers operate from small stalls in established market places and are women who have completed primary education. Many retailers established their businesses using their own funds and loans from family and friends and most own their own houses, with retailers in big cities also owning land. This could be due to the retailers around the lake only selling sprat, sardine and perch from Lake Tanganyika, whilst retailers in other cities also sell other fish such as catfish and tilapia from Lake Rukwa, Lake Victoria, Lake Nyasa, the Rufiji River and even marine fish from the Indian Ocean.

Retailers around the lake buy fresh and sundried sprat/sardine and fresh and smoked perch from fishers, processors or wholesalers on a daily basis, in cash, to sell in the local market. Most retailers rent small stalls in markets at a cost of TZS30 000/month (USD 12.94). Retailers buy from several suppliers depending on availability, quality and price.

City retailers in other regions buy sundried sprat/sardine and smoked or fresh perch from wholesalers at the lake, with whom they have established business relationships. City retailers place orders by telephone and usually order fresh fish weekly and processed fish monthly. The wholesalers arrange transport of the fish by train or truck to the city retailers and payments are often made using mobile banking.

FIGURE 25 MANY PROCESSED FISH RETAILERS ARE WOMEN

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FIGURE 26 FRESH PERCH IS POPULAR WITH CONSUMERS IN AND AROUND THE LAKE

©FAO/Hashim Muumin/FAO

Retail sales prices are determined by the cost price and fish purchases account for 98 percent of total costs. In addition to the cost of the fish, most of the costs related to retailing are rental payments for business premises and own labour costs.

Dried and smoked fish are stored in bamboo and wooden boxes, whilst fresh/frozen fish are stored in refrigerators/freezers. There is little knowledge, or implementation of, food safety standards amongst retailers. Retailers estimate losses to be around 8 percent (in terms of quantity loss) due to a lack of cold storage.[16]

[16] See more detailed calculations in Table 52 and Table 53 in Annex 5.

According to data collected as part of this study, a medium-sized retailer will sell about 5 tonnes of Lake Tanganyika sprat, sardine and perch a year. Due to decreasing availability of Lake Tanganyika sprat, sardine and perch and the large number of petty retailers, there does not appear to be many opportunities for increasing retailer income from just those products and increased incomes would mostly likely come from diversifying the retail of products beyond Lake Tanganyika sprat, sardine and perch.

2.3.2 Support providers and factor markets in the extended value chain (layer 2)

Value chain actors are supported by service providers, which play an essential role in facilitating the process from production to consumption. For this VC there are physical input suppliers, financial service providers, transport and storage service providers, and research, training and extension services. This section also includes an analysis of four factor markets: access to labor, access to energy and access to fishing grounds.

FIGURE 27 CANOES NEED TO BE MAINTAINED AND REPAIRED

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2.3.2.1 Physical input suppliers

Input sales are seasonal with higher sales and demand in the rainy season (December to May) when there is more fishing activity. There are several types of fishing boats that are used in Lake Tanganyika fisheries. Most of the boats or local fishing vessels (wooden type) that are used by fishermen in Kigoma are locally made in the famous landing sites such as Kibirizi, Kigodeko, Karago and Ujiji. For construction of dugout canoe the prices ranges from USD 350 – USD 500 and it takes three weeks to be completed while construction of fishing

vessels (up to 11m), price ranges from USD 1 100 to USD 2 000 and it takes 45 days to complete.

Suppliers of outboard engines (15 to 75HP) such as those used on Lake Tanganyika have a presence in United Republic of Tanzania and agents supply both engines and spare parts.

Fishing gear that has been reported in Lake Tanganyika (whole lake) are 34 408 including few illegal fishing nets (beach seines and ringnets). Sprat/sardine fishermen are using lift nets which are 1 409 in total based on fisheries frame survey of 2012 conducted in Lake Tanganyika while Migebuka fishers are using 23 319 gillnets for fishing perch species of the lake.

There are five registered shops in Kigoma selling nets, light batteries, ropes, boxes, drying frames and other fishing inputs although some fishing gears or materials are imported from Burundi. Wholesalers in Dar es Salaam supply various items in bulk. Some nets and rope are made in Dar es Salaam by Basil Industry & Company. Alternatively, inputs are imported. Fishing net (lift or ring net) prices range from USD 250/ piece to USD 500/ piece (1 piece = 100 x 7 yards of net, lift nets require 2 to 2.5 pieces (non-motorized vessels) 3.5 to 4 pieces (motorized vessels) and ring nets 7 to 12 pieces), while ropes costs USD 10 – USD 50 (per how long, meters) depending on thickness (in millimetre). The price of light batteries ranges from USD 80 to USD 100 (per battery) in Kigoma town while the wooden box that are normally used by fishers for carrying fish as well as selling their fish at landing sites ranges from USD 25 to USD 40. Black hooks are popular with Lake Tanganyika fishers. Other input suppliers selling fishing gear and accessories are found in Sumbawanga and Dar es Salaam.

So far there are no official prices for boat and nets repair since most of the fishers are doing maintenance themselves.

Input suppliers see opportunities to provide packaging and storage equipment for traders and processors e.g. plastic containers and ice boxes and GPS for fishers, security lights for boats, cold rooms / ice production and ice equipment, fish farming equipment.

FIGURE 28 SMOKED PERCH ARE PACKED INTO BASKETS AND THEN TRANSPORTED TO MARKETS

©FAO/Hashim Muumin

Small quantities of ice are produced. Production is hampered by the erratic and expensive electricity supply, water supply issues and poor maintenance of equipment. There may be scope to promote smaller affordable single phase on or off-grid ice machines.

Most of the processor inputs such as raised and mobile drying racks, smoking kilns, smoking sticks, firewood, charcoal, plastic sheets, buckets and basins are either made locally or locally acquired/sourced from materials locally available. However, the good quality or preferred mesh used to cover drying racks is only available in neighbouring Burundi, impeding adoption.

2.3.2.2 Financial service providers

Financial service providers providing commercial loans to small and medium enterprises, including businesses within the fisheries sector include CBRD Bank, Tanzania Agricultural Development Bank (TADB), National Microfinance Bank, National Bank of Commerce and the Tanzania Postal Bank (TPB). All the above banks follow the banking standards set by the Central Bank of Tanzania and are audited by them. Most have branches in Kigoma with some also having branches in Sumbawanga, therefore access is difficult for those living outside of regional capitals. However, mobile and internet banking services are now common, as long as there is internet access.

No banks offer loans specifically targeted at the fishing industry, but fishing businesses can access SME loans for operating costs or capital investment as long as they satisfy the general borrowing criteria. However, the TADB does provide value-chain financing for the agriculture sector and is interested in expanding to fisheries providing machinery and input loans.

Borrowing criteria usually includes having collateral, such as a land, to guarantee the loan and the business being registered with a Tax Identification Number as well as possessing a

trading licence. Previously loans have been used to purchase capital items such as boats and freezers. Insurance cover is also offered for fire and theft of boats and stock. Some of the above financial service providers also offer group loans of up to TZS 5 million (USD 2 160) per person which do not require collateral.

SME loans can be up to TZS 50 million (USD 150 925) repayable over three years, which is relatively short, with interest rates varying between 14 and 24 percent per annum, which is quite high for long-term capital borrowing. High interest rates and short repayment periods make borrowing money unviable for most businesses, hence the low uptake, even when they could satisfy the borrowing requirements such as collateral.

Banks do not consider fisheries as a high potential sector for lending, which explains the low level of penetration. As with the agriculture sector, rural fishers are difficult to reach and have a low density compared to urban businesses, increasing the cost to loan ratio. Fishers are also high risk as they are susceptible to external factors such as weather and it is not uncommon for fishers to default on loans due to their gear being confiscated for carrying out illegal fishing practices.

Informally, some wholesalers provide credit to fishers as a means of securing fish supplies. However, most fishers, processors and traders do not borrow money from banks and either finance their businesses from own savings or borrow money, with minimal or no charge, from family and friends.

2.3.2.3 Transport services

Most fish are transported domestically by public bus or exported by public ferry. Distances and public bus costs to markets in other regions are shown in Table 3. Approximate travel costs are based on an 85kg sack of dried sprat/sardine costing TZS1.65/kg/km (around USD 0.0007/kg/km).

TABLE 3: TRAVEL DISTANCE, TIME AND COST TO OTHER REGIONS IN UNITED REPUBLIC OF TANZANIA

Route	Distance (km)	Time (hours)	Cost for 85kg sack of dried sprat/sardine (TZS)
Kigoma to Dar-es-Salaam	1 445	20	202 661
Kigoma to Mbeya	860	15	120 615
Kigoma to Tabora	676	10	94 809
Katavi to Dar-es-Salaam	1 131	17	158 623
Katavi to Tabora	460	9	64 515
Katavi to Mbeya	643	7	90 181
Rukwa to Dar-es-Salaam	1 162	18	162 971
Rukwa to Tabora	631	9	88 498
Rukwa to Mbeya	348	5	48 807

Note: Exchange rate USD 1 = TZS 2 315
Source: Key informant interviews, 2021

The Tanzania Railways Corporation Central Line runs from Kigoma to Dar-es-Salaam via Dodoma, a distance of 1 254km. Three passenger services run every week, which are also used to transport fish from Kigoma to Dar-es-Salaam and the trip takes 40 hours. An 85 kg sack of dried sprat/sardine costs TZS 300/kg (or USD 0.13/kg) for the journey from Kigoma, or TZS 0.2/kg/km (USD 0.00009/kg/km).

The Marine Services Company of Tanzania is a Government-owned company operating three passenger and cargo ferries on Lake Tanganyika. The MV Liemba operates a weekly ferry between Kigoma and Mpulungu in Zambia and back again with a 200-tonne cargo capacity. The ferry also docks at Kasanga en-route. The MV Mwongozo sails between Kigoma and Bujumbura in Burundi (80 tonne cargo capacity) and the MV Sangara sails between Kigoma and Kalemie, Uvira and Baraka in the Democratic Republic of the Congo.

From Ikola port in Katavi region the ferry to Kalemie in Democratic Republic of the Congo takes two days and costs USD 20 for an 85 kg sack of dried sprat/sardine and the ferry to Bujumbura in Burundi takes four days costs USD 50 for an 85 kg sack of dried sprat/sardine. As the ferries don't have special storage facilities for fish, most losses occurred to exporters are due to broken dried fish or spoiled fresh/frozen fish encountered during transport, which is around three percent in terms of quantity.[17]

There are three airports close to Lake Tanganyika mainly linking Kigoma, Mpanda and Sumbawanga to Dar-es-Salaam with air services operated by Air Tanzania Company Limited. Kigoma airport also operates flights to Bujumbura in Burundi. However, Lake Tanganyika sprat, sardine and perch are not transported by plane, due to the high cost of TZS 8 000/kg (USD 3.5/kg).

[17] See more detailed calculations in Table 52 and Table 53 in Annex 5.

Although transport represents a comparatively small proportion of costs, much of the losses in the VC are made during transport as the public buses and ferries are not equipped for transporting fish, especially fresh or frozen fish. Wholesalers estimate that most losses are due to broken dried fish or spoiled fresh and frozen fish during transport, which is usually between five and ten per cent.

2.3.2.4 Storage services

Wholesalers and exporters are the main users of storage. Only Kibirizi landing site in Kigoma has chilled storage facilities available for rent. As with the limited access to refrigerated transport, the lack of cold storage adds to increased losses. The lack of cold storage and refrigerated transport also continues the reliance on traditional preservation techniques, such as smoking and drying, and prevents development of fresh or frozen fish markets.

2.3.2.5 Research, training and extension services

There are three main research institutions involved in the Lake Tanganyika sprat, sardine, and perch VC in United Republic of Tanzania, namely: the Tanzania Fisheries Research Institute (TAFIRI) which has a centre at Kigoma, the Department of Fisheries Sciences and Aquaculture of the University of Dar es Salaam, and the Department of Food Science and Technology of the Sokoine University of Agriculture (expert and MLF official interviews in 2021). Although these institutions have developed strong collaboration with regional and international research institutions, they face various challenges, ranging from the lack of finance to the lack of qualified and motivated human resources and the lack of adequate equipment, facilities and infrastructure (such as computers, means for transportation and communication) for data collection and analysis (African Development Fund, 2004; MLF, 2021b). These challenges the institutions from effectively carrying out their mandated tasks.

The provision of training and extension in the VC is mostly handled by the MLF through its network of Fisheries Officers, who provide VC actors with training and technical assistance on fisheries management, conflict management, and improved fishing, post-harvest handling and processing techniques. Like research institutions, training and extension offices also face difficulties in terms of financial shortages, exacerbated by the remoteness of some outreach areas coupled with poor infrastructure, such as roads (interview with MLF officials, 2021). Despite these challenges, the support and services provided by Fisheries Officers are largely considered as helpful and beneficial by VC actors. During the interviews conducted in 2021, VC actors shared to “have learned a lot from the government officers”. For instance, fishers have learned proper fishing techniques, and processors, wholesalers, and retailers have obtained new skills on using modern stoves and storage techniques to improve quality thanks to MLF trainings.

Training is also provided by the Fisheries Extension Training Agency (FETA) Centres in Kigoma and Mwanza. Both Centres deliver certificates and diplomas in fishing and related activities

such as fish processing, quality assurance and marketing; marine and refrigeration engineering; safety at sea; master fisherman; and environmental and coastal resources management.

2.3.2.6 Factor Markets

Access to labour

Labour for fishing and processing is available around the lake. Most of the labour is part-time, therefore workers move between employers and also engage in agricultural work. Fisher labourers tend to learn their skills on-the-job and have not received any formal training.

Although there is a legal minimum wage of TZS 100 000/month (USD 43.20/month) or TZS 3 847/day (USD 1.66/day) for agricultural workers (Employment and Labour Relations Act, 2004), the actual average monthly wage for a fisher worker is estimated at TZS 150 000. Fisher crew are paid a proportion of the catch; therefore income can vary considerably depending on the season, weather, fish prices and luck. According to interviews carried out as part of this survey, there is no shortage of local labour and Burundi and Democratic Republic of the Congo are also sources of cheap labour.

Access to energy

The Tanzania Electric Supply Company Limited (TANESCO), a parastatal regulated by the Ministry of Energy and Mines, is responsible for providing main grid power. Approximately 80 percent of the lake-side villages are connected to the main grid (Interview with MLF officials, 2021); however the electricity supply, although improved as compared to previous years, is considered weak and unreliable and VC actors indicated to also use diesel generators as backup (Interview with VC actors, 2021). Nevertheless, improved access to electricity– either through main grid or through generators - has allowed for increased freezer usage and supply of frozen fish. As for the rate, industries are charged TZS195 (USD0.08) per KiloWatt Hour (kWH) which is higher than Zambia but cheaper than Burundi, whilst electricity is not available around the lake in Democratic Republic of the Congo (Interview with electricity supplier).

Access to fishing waters

Access to the lake and fishing effort is not limited and anyone can carry out fishing on Lake Tanganyika as long as their boat is registered with District Council and fishing and crew licences are paid for. The Fisheries Act states restrictions on fishing methods but not on volumes caught. Therefore, the number of fishers and volume of fish harvested is limitless and the fishing grounds are essentially 'open access'.

Access to land

In United Republic of Tanzania, all land belongs to the public, but is vested in the President as trustee for and on behalf of all citizens. Response from VC actors indicated that land is accessible to all citizens irrespective of the gender and socio-economic status in the community. For VC actors, access to land is often obtained through inheriting from parents or through renting and leasing.[18] While national (formal) laws guarantee women's acquisition of land, customary land laws continue to discriminate against women as village councils, guided by customary laws, allocate land to heads of households who are usually men. The issue of access to land is of particular relevance to processors who need land to dry/smoke fish. Many processors reside outside of fish landing site areas and travel to the lakeshore every day to process fish. This group do not own land and therefore have difficulties in building their own drying racks. They may rent drying racks from people who own the land close to the lakeshore or rent an area of land close to the lakeshore to process fish using portable drying racks. Renting land/racks and investing in portable racks implies additional costs for processors, especially when they want to adopt better practices, such as using drying racks as opposed to drying fish on the ground.

2.3.3 The societal enabling environment (layer 3)

2.3.3.1 Institutional elements

National policies and regulations

Compared to other countries around Lake Tanganyika, United Republic of Tanzania has a relatively developed national fisheries-related regulatory and policy framework, which governs the fisheries activities in the Tanzanian side of the Lake Tanganyika (AU-IBAR, 2016). Fisheries operations on the mainland, including the Lake Tanganyika regions, are governed by the **National Fisheries Policy of 2015**, the **Fisheries Act of 2003** and the **Fisheries Regulations of 2009**, which was amended in 2020 (see Table 40 in Annex 3 for more details). While the Fisheries Act broadly outlines the overarching framework to regulate the sector, the Fisheries Regulations provide more specific details on the measures on the control and governance of fishing, fish processing and trading. Additionally, United Republic of Tanzania recently (in March 2021) launched its **National Plan of Action for the implementation of**

[18] In Tanzania, all land belongs to the public, but is vested in the President as trustee for and on behalf of all citizens. For planned areas (e.g. in towns or cities), people are given a lease for 33 years or so, which can be inherited from one generation to another by changing ownership to family member (s) through special arrangements. For areas which is not planned, there is this right of occupancy through customary ownership which is also inherited to family member (s) but if Government wants to develop the area, the owner can be compensated or special arrangement can be made through Local Government authority (Tanzania Land Act 1999, Tanzania Village Land Act 1999, Tanzania Urban Planning Act 2007).

the Voluntary guidelines for securing sustainable small-scale fisheries in the context of food security and poverty eradication (NOPA-SSF guidelines), which aims to provide a framework that would enhance small-scale fisheries', both men and women, contribution to food security and nutrition (MLF, 2021a). Acknowledging the gender-specific challenges facing women in fisheries, the action includes output and activities that specifically focus on supporting women. In addition, United Republic of Tanzania is in the process of developing its **Fisheries Sector Master Plan (FSMP) for 2021 – 2036**, which will be the second national master plan (replacing the first one which was phased out in 2015) to provide a strategic framework for long-term management and sustainable development of the fisheries sector (MLF, 2021b).

Licensing is a major regulatory measure aimed to ensure sustainable utilization and management of fisheries resources and products. According to the Fisheries Act 2003[19], there are licences for the conduct of fishing, collecting, and trading of fish and fish products (different license fees for different fish species), as well as licences for fishing boats/vessels to be used in fishing operations. All fishing vessels must be registered and re-registered annually, either at central (national) level (for vessels longer than 11 m) or at the district level (for vessels shorter than 11m). Whilst the central and local fisheries administration is expected to keep a registry of fishing craft and fishers as well as other operators, in practice, this is not properly done and thus, there is no good record of the numbers of granted licences (MLF official interviews, 2021). Information exchange between fisheries administration offices at the district and central (national) level is weak (Breuil & Grima, 2014). Additionally, the licensing mechanism is suggested to be used for government revenue generation (see section 3.1.4 on the VC's impacts on public funds) rather than as an effective control measure (LTA Interview, 2021). According to Petit and Shipton (2012), 78 percent of the Tanzanian vessels recorded during the Frame Survey 2011 were unregistered. During the consultations in 2021, while the majority of the interviewed actors[20] are reported to have valid licences and all the fishers are reported to register their boats annually, the interviews with MLF officials suggested a different picture, which is that in the VC, there may be around 50 percent of fishing vessels operating without licences (although this is only backed by officials' estimates as updated data appear to be unavailable). Additionally, there are many traders who operate rather informally and do not register their businesses. Given the small number of actor interviews conducted in 2021, the prevalence of informal VC operations as observed during field visits, and findings from expert interviews, it is prudent to note that the number of unregistered vessels is high, and that the number of VC actors who do not register their businesses is also high.

[19] Fisheries Act (2003), Part II.
[20] 29 interviews with VC actors, focusing on issues related to social sustainability.

The Fisheries Act 2003 also describes other licenses required and fees to be paid such as a **fish export licence** and **export royalty** charges for exporters. Specifically, exporters must possess an export licence which costs USD 250/year for sprat/sardine and USD 400/year for perch. In addition, all the fish that enter the (domestic or export) market must have a **health or sanitary certificate** issued by the fish inspectors (e.g. Public Health Officer). This inspection follows the standard for dried and salted fish established by the Tanzania Bureau of Standards (TBS) which is in line with the East African Standard under the East African Community. The standard specifies requirements for moisture content, microbiological and contaminant limits, packaging, and labelling. However, TBS standard is required by laws only for exported fish products, while on it is not required on domestic markets. Export health/sanitary certificates are issued by the Quality and Control Officer from the Fisheries Department and Fisheries Resource Protection Units located in Kigoma and Buhingu (Kigoma Region), Ikola (Katavi Region) and Kipili, Kasanga and Kasesya (Rukwa Region). The interviews with VC actors show that these measures are applied: interviewed actors are reported to pay the required fees, and safety inspections are generally carried out regularly by fisheries offices as well as public health officers, with the frequencies of inspection ranging from daily to once a month. However, in many interview locations in Katavi and Kigoma, it was indicated that the inspections are carried out rather randomly or even rarely. This implies the health/sanitary standards for fish are not well-implemented across lake regions. A main reason is that compliance with quality standards is generally not required by buyers of fish products, and thus, VC actors have little incentives to apply the standards. According to a previous report by MALF (Ministry of Agriculture, Livestock and Fisheries, 2016), the implementation of Sanitary and Phyto-Sanitary standards for fish products on domestic market and export market in the region (e.g. to Democratic Republic of the Congo, Burundi, Zambia) are less well-regulated than fish exports to the European Union, where consumers/buyers have more stringent quality requirements.

Of great relevance to the VC is a range of measures under the Fisheries Act 2003 focusing on **fishing activities**. These include measures in terms of fishing areas (or protected breeding/spawning areas), protection of immature fish species (by stipulating the minimum capture sizes), and prohibition of destructive fishing gears and fishing methods (see details in Table 41 in Annex 3). However, a gap in the current regulations (e.g. Fisheries Act 2003, Fisheries Regulations 2009) regarding fishing in Lake Tanganyika is that there are virtually no mentions of any limits to the number of fishing (access) licenses that can be issues (per year) and how much quantity of fish can be captured (per year).[21] The fisheries on the lake are thus essentially open access (Breuil & Grima, 2014).

The VC actors interviewed in 2021 during the conduct of this VCA generally expressed a positive attitude towards the policies and regulations governing their activities. Most actors

[21] Meanwhile, in the Fisheries Regulations 2009 (e.g. Subdivision 2 in Division 2 in Part 2, Schedule 5, Schedule 6), there are provisions on the maximum number of licenses and catch limit by access license holders for specific fish species, which do not include the VC commodities.

indicated that they found the regulatory environment "supportive" of their operations (e.g. "they allow us to do business", "licensing is good [...] to do business in lawful manner", "it takes a day to register the business"). Meanwhile, the actors also expressed several concerns regarding the cost of fishing and trading licenses (e.g. 100 000 TZS/year, or USD 43/year, as indicated by a retailers) and the cost of export license and export royalties (USD 0.2/kg for fresh perch, USD 0.3/kg for dried perch, and USD 0.5/kg for dried sprat/sardine), which, although have been reduced according to the Fisheries Regulations 2020, are still considered as high for VC actors. Among fishers particularly, a shared concern is that the regulations regarding the gear size are not reflective of the perch size. These concerns represent areas for potential improvements in the policy and regulatory framework to make it more conducive for the business along the VC.

In addition, the enforcement of the regulations prohibiting illegal, unreported, and unregulated (IUU) fishing on the Lake is found to be weak and ineffective, which in turn contributes to the prevalence of the use of illegal, prohibited gears on the lake (Onyango, 2016; Van der Knaap, 2018, Expert and MLF official interviews, 2021) and thus, detrimental impacts on the fisheries resources in the Lake (e.g. increased catch of undersized/immature fish, reduced fish stocks). Table 4 provides an overview of the numbers and shares of illegal gears in Tanzania according to the Frame Survey 2011 and Petit and Shipton (2012):

TABLE 4. USE OF ILLEGAL GEARS IN UNITED REPUBLIC OF TANZANIA IN 2011

Type of gears	Number of illegal gears	Share of illegal gears
Lift net*	483	25.5%
Gill net*	8 487	26.7%
Ring net*	30	4.7%
Beach seines**	66	3.7%

Note: * refers to the shares of illegal gears in the total number of gears of the respective gear type that are used in Tanzanian part of the Lake. Some types of lift nets, gill nets and ring nets are illegal.

** refers to the share of beach seines used in United Republic of Tanzania in the total number of beach seines used in the whole Lake. Beach seines are prohibited in all four countries, so 100 percent of beach seines used are illegal.

Source: Petit and Shipton (2012).

The ineffectiveness of IUU regulatory enforcement is due to various reasons, including the lack of finance (national funds) and human resources (both in terms of number and technical skills) for the conduct of monitoring, control and surveillance (MCS) missions, the inaccessibility of some areas along the Lake, coupled with fishers' limited financial resources and means of livelihoods and their lack of awareness about conservation (Expert and official interviews, 2021). This finding from consultations reconfirms past research's findings, for example from the AU-IBAR (2016) report, which specifies that the Doria Unit – the unit inside the Fisheries Department in charge of MCS - had only six staff and one vessel; but was

responsible for patrolling a coastline of nearly 670km and over 200 landing sites in 2016. Due to its limited resources, the Unit's operations are restricted to Kigoma and the MCS activities in the southern districts are conducted in collaboration with the police. However, neither the Fisheries Department personnel nor the police received proper MCS training.

Apart from fisheries-related regulations, there are environmental policies and regulations that also provide guidance to the management of fisheries resources in United Republic of Tanzania. These include the National Environmental Policy (1997) and the Environmental Management Act (EMA) no.20 (2004), and the National Water Policy (2002). These policies and regulations are also elaborated in Table 40 in Annex 3.

Regional institutions, frameworks, and agreements

The four riparian countries surrounding Lake Tanganyika manage fisheries activities on the lake largely separately, but with an increasing level of joint administration and coordination (Lowe *et al.*, 2019). The key legal framework guiding the regional management and development of fisheries sector in the lake is the "**Convention on the Sustainable Management of lake Tanganyika**" (herein referred to as "the Convention"), which was signed by four riparian countries in 2003 and ratified in 2007 (AU-IBAR, 2016). As part of the implementation of the Convention, the Lake Tanganyika Authority (LTA) was established in 2008 to act as an overarching management body of the whole lake (Petit and Shipton, 2012).

In addition to the establishment of the LTA, a **Strategic Action Plan (SAP)** was also devised in 2000 and then updated in 2012 to support the implementation of the Convention. The latest SAP lays out six areas of strategic actions targeting six objectives that the four riparian countries hope to achieve by 2035. These strategic action areas include: (i) adaptation to climate change impacts, (ii) development of sustainable fisheries, (iii) sustainable land management, (iv) protection, restoration and management of critical habitats, (v) control and prevention of biological invasions, and (vi) pollution reduction and water quality improvement (LTA Secretariat, 2012).

According to an assessment report done by the AU-IBAR in 2016, various regional initiatives have been taken to facilitate the implementation of SAP. To name a few, these include the Lake Tanganyika Research (LTR) project under which a **Framework Fisheries Management Plan (FFMP)** was developed, a regional programme – the Lake Tanganyika Regional Integrated Management and Development Programme (LTRIMDP) – coordinated by the LTA Secretariat, and the development of the Regional Plan of Action for the Management of Fishing Capacity on Lake Tanganyika. The FFPM, in particular, was updated in 2012 under the

PRODAP project and the revised FFPM was approved in the LTA Conference of Ministers in February 2020.[22]

Despite these efforts, **the integration of the provisions of the Convention and the SAP into national policy frameworks of the four riparian countries has been weak**, with only a few of the required provisions are incorporated in national laws of the four countries (LTA, 2020). To some extent, this implies the management of fisheries resources of the lake was not a government priority[23] (van der Knaap, 2013). Additionally, although harmonization of national fisheries legislations is considered, it has not been effectively implemented (van der Knaap, 2013; AU-IBAR, 2016; LTA, 2020). For instance, with the few Convention provisions that are incorporated in national laws, their contents vary significantly across four countries (LTA, 2020). See Table 42 in Annex 3, which provides an overview of the legal measures regarding the Lake Tanganyika sprat, sardine and perch which vary across the four countries around the lake.

Furthermore, **the coordination between the four riparian countries around Lake Tanganyika is also found to be weak**. In terms of MCS, there have been various measures set by law and put in implementation in the Lake Tanganyika, including the Tanzanian part of the Lake (as discussed above), such as mesh size restrictions, protected areas, closed seasons, catch assessment, use of surveillance boats and patrols (AU-IBAR, 2016; LTA interview, 2021). However, these measures are not implemented regularly (but only on an ad hoc basis) and effectively across the Lake due to the lack of coordination between riparian countries, for example in terms of harmonizing the closing seasons to prevent fishers in one country from migrating to another country's part during the closing seasons in their home country. Additionally, according to a recent study conducted under the Lake Tanganyika Fisheries Management project (LATAFIMA, 2021), a major challenge facing fisheries management in all four countries around the lake is the weak compliance with fisheries laws and regulations; for instance, the use of illegal gears persists despite various MCS and confiscation efforts by authorities, and the capture of immature fish is prevalent everywhere despite its prohibition. Although legislations provide for consultations between administrators and local representatives of the fishing communities, the level of local participation in fisheries management and decision-making has been minimal (LATAFIMA, 2021).

Interviews with MLF Fisheries officers and experts (e.g. from LTA) indicate that another key challenge facing the development of fisheries policies and regulations in Lake Tanganyika is

[22] https://www.thegef.org/sites/default/files/web-documents/10388_MFA_PIF.pdf.

[23] It should also be noted that two of the countries surrounding the lake went through periods of civil unrest during the 1990s, and all four countries surrounding the lake had to deal to internally and internationally displaced people (van der Knaap, 2013).

the lack of updated and precise data about fish stock, fishing efforts, and catch assessment at the lake-wide level. The last lake-wide fish stock assessment [24] was conducted during 1994-1999, and the last frame survey[25] and catch assessment survey[26] were conducted in 2011 (Interviews with LTA, MLF, and FAO expert, 2021). Since then, there has been neither formal nor informal lake-wide stock assessment and frame survey of the Lake Tanganyika sprat/sardine and perch carried out. This makes it difficult to assess the stock status and fishing pressure, and thus, to develop policies/regulations related to the sustainable management of fisheries resources. Additionally, many social and environmental changes happened in the fisheries on the lake in the last two decades (e.g. civil unrest, climate change), but little attention has been paid to improving/updating the management of fisheries resources and activities (van der Knaap, 2013).

In a recent effort to rationalize fishing activities in Lake Tanganyika, in December 2021, four riparian countries signed a **Regional Charter for measures for the sustainable management of fisheries in Lake Tanganyika and its basin**. The Charter provides provision for the joint adoption of various specific measures to manage fisheries resources and regulate fishing efforts, including minimum catch sizes, mesh sizes for fishing nets, illegal fishing gears and techniques, areas where fishing is prohibited, closed fishing season by all riparian countries from 15 May to 15 August, and minimum distance from shore for the use of certain nets (see Table 43 in Annex 3 for a summary of main provisions). It is stipulated that the measures adopted by the Charter shall come into effect three months after signature by the parties, i.e. starting from April 2022. While all these measures are supported by sound analysis and consultations with leading experts (e.g. LATAFIMA, 2021), their execution, particularly regarding the article on a 3-month closing season, would require tremendous efforts and commitment from all four countries around the Lake to guide and support fishing communities to comply with the laws, especially given the prevalence of poverty among the riparian population and the absence of alternative income-generation activities which are widely considered as major reasons for the use of illegal fishing practices in the lake.

In addition to participation in regional fisheries bodies, United Republic of Tanzania is a member of the Sub-Committee for Development and Management of the Fisheries of Lake Tanganyika (under the Committee for Inland Fisheries and Aquaculture of Africa (CIFAA),

[24] The fish stock assessment was implemented by FAO, with funding from FINNIDA (the Finnish International Development Agency), using the Lake Tanganyika Explorer vessel to undertake hydro acoustic surveys on the lake.
[25] The frame survey, which aimed to collect data about fishing efforts, was jointly undertaken by four countries (Burundi, Democratic Republic of the Congo, Tanzania, and Zambia), the LTA and FAO within the framework of the Lake Tanganyika Regional Integrated Development Programme (PRODAP) funded by the African Development Bank (AfDB).
[26] A catch assessment survey (CAS), focusing on catch volumes, was conducted using the fishing units in the frame survey to calculate fish harvest.

which has the objective of coordinating inland fisheries research and development in the regions surrounding Lake Tanganyika (AU-IBAR, 2016). Various meetings have taken place under the umbrella of the Sub-Committee to discuss issues such as fish stock management, statistics, fisheries regulations, fish processing and trade; but the implementation of the recommendations from these meetings still lacks the effective coordination among countries in the region (AU-IBAR, 2016).

In terms of regional trade, United Republic of Tanzania is a member of two regional trade agreements (RTAs) – the East African Community (EAC) and the Southern African Development Community (SADC) (Walkenhorst, 2000). With an aim to promote and harmonize regional trade, the EAC has been working on the improvement of roads and market infrastructure and harmonization of Sanitary and Phytosanitary Standard (SPS); and traded goods between country members of the EAC and SADC enjoy preferential conditions such as tariff rates lower than the MFN rates (Walkenhorst, 2005). The Southern African Development Community (SADC) Free Trade Area (FTA) aims to eliminate tariffs between member countries. However, whilst United Republic of Tanzania is a member of SADC, Burundi is not and whereas Democratic Republic of the Congo is a member it does not participate in the SADC FTA. Regarding Non-Tariff Barriers to Trade, the SADC Protocol on Trade (2005) states that its Sanitary and Phyto-Sanitary (SPS) requirements are based on the World Trade Organisation's Agreement on the Application of SPS Measures. A problem with the multiple RTAs is that there are overlaps between them, leading to the inconsistency of some tariff schedules in different RTAs and thus, potential conflicts in the application of different agreements (Walkenhorst, 2005). Consequently, for member countries such as Tanzania, the country will have to choose one agreement over the other to avoid contradicting trade conditions, which is already the case of its withdrawal from COMESA in 2000 (Walkenhorst, 2005).

2.3.3.2 Organisations and cooperation

National organizations

In United Republic of Tanzania, there is a range of ministries and government organizations responsible for or involved in the management and development of the fisheries sector. **At the national level**, the Ministry of Livestock and Fisheries (MLF) is the main ministry mandated with the formulation and implementation of fisheries policies as well as the sustainable management and development of the fisheries sector (MLF, 2020b). Additionally, the Tanzania Shipping Agencies Cooperation (TASAC) is in charge of boat safety inspection and safety training on the Lake. There are five other ministries and governmental offices who also provide oversight of the sector, namely the Ministry of Industry and Trade (MIT)[27], the Ministry of Health (MoH)[28], the Minister of State in the Vice President's Office for Union Affairs and Environment, the Ministry of Regional Administration and Local Government (TAMISEMI), and the Ministry of Foreign Affairs and East African Cooperation (interviews with experts and ministry officials). **At the regional level** (Lake Tanganyika region in United Republic of Tanzania), fisheries field administration is linked to local government structures and is under the direct supervision of local authorities (Local Government Authorities – LAGs). Specifically, the regional/municipal governments, which include Kigoma Fisheries Office (the main office for Lake Tanganyika), Regional Administration Offices, and the village authorities (village chairpersons) are responsible for the implementation of national fisheries policies at the regional and village levels, for fisheries conflict resolution, for monitoring, control and surveillance (MCS), for fisheries management plan development in collaboration with the Beach Management Units (BMUs – see discussion below), and for monitoring and evaluation of BMUs' performance (Onyango, 2016; Interviews with MLF officials and BMU leaders in 2021). More details about these organizations and their respective roles are provided in Table 44 in Annex 3.

Apart from the organizations directly involved in the oversight and management of the fisheries sector (as above), there are various other organizations who provide support to the sector and/or the broader enabling environment for the sector's development, including:

- Water supply and management: Ministry of Water, Regional Water Authorities (e.g. Kigoma Ujiji Water and Sanitation Authority - KUWASA)
- Infrastructural developments: Ministry of Public Works, Tanzania Rural and Urban Roads Agency (TARURA)
- Energy supply: Tanzania Electricity Supply Company Limited (TANESCO)
- Telecommunications: Tanzania Telecommunications Corporation (TTCL)

[27] Particularly, the Tanzania Bureau of Standards (TBS) and the Business Registration and Licensing Agency (BRELA)
[28] Particularly, the Tanzania Medicines and Medical Devices Authority (TMDA), formerly known as the Tanzania Food and Drugs Authority (TFDA) (https://www.tmda.go.tz/pages/tfda-profile).

- Tax collection: Tanzania Revenue Authority (TRA)
- Labour: Occupational Health and Safety Authority (OSHA)

Stakeholder consultations (interviews, surveys, focus group discussion) in 2021 show that most VC actors have a positive perception of the government organizations managing and/or overseeing the VC, indicating that the work done by these organizations is supportive of the improvement and sustainability of the VC and their livelihoods, and is helpful to prevent the violation of laws, to ensure and improve the quality of VC products, and to formalize the VC operations. The actors generally have good and collaborative relationships with government officials; but there are some reported cases of corrupted officials, which undermine their trust in the government. Particularly, for many fishers, the roles of TASAC (Tanzania Shipping Agencies Cooperation) are not fully understood, and thus, TASAC's relevance is not fully justified to them[29].

Beach Management Units (BMUs)

In Tanzania, the BMUs have been promoted and institutionalized through the Fisheries Act 2003 and the Fisheries Regulations 2009, which recognize BMUs as an organization to co-manage fisheries resources together with the government (IOC, 2014). Fisheries co-management entails the BMUs' sensitizing the community on sustainable fisheries, licensing and registration of fishers and fishing boats, and MCS activities to prevent IUU practices and environmental damage (Breuil and Grima, 2014; interviews with BMU leaders, 2021). Despite its potential to improve fisheries management, the effectiveness of this co-management system has been low, particularly in the Tanganyika region, where there were only 74 BMUs (of which 52 are active) to control 239 landing sites[30] as of now (Pers. Comm. with Fisheries Officers, 2022), as compared to Lake Victoria region with over 500 BMUs (Breuil and Grima, 2014). The table below shows the distribution of the BMUs across three regions in Lake Tanganyika in United Republic of Tanzania.

[29] Many interviewed fishers see "no good accountability" for the amount of fee they must pay TASAC, and thus, are "skeptical" about the role and relevance of TASAC.

[30] These locations are called "landing sites" but they do not have any facilities, and are used purely as a place for landings.

TABLE 5. NUMBER OF BMUS IN LAKE TANGANYIKA IN UNITED REPUBLIC OF TANZANIA (2022)

Region	Number of BMUs	Total
Kigoma	• 4 in Kigoma municipal (one in Katonga, one in Kibirizi, one in Kigodeko, and one in Ujiji) • 6 in Kigoma district	10
Katavi	• 23 in Uvinza district • 7 in Tanganyika district	30
Rukwa	• 11 in Kalambo • 23 in Nkasi	34
Total		**74**
Of which, active BMUs		**52**

Source: Pers. Comm. with Fisheries Officers, March 2022

The limited effectiveness of the BMUs and fisheries co-management are due to various reasons, mainly including the lack of finance and human resource capacity (Breuil and Grima, 2014; Interviews with LTA and TNC, 2021). According to a study conducted by The Nature Conservancy in 2021, the costs of running/management BMUs in Kigoma and Katavi regions are most often paid by donor support (e.g. NGOs) and the government (e.g. Fisheries Offices) (Wilson *et al.*, 2020). While this implies the strong reliance of BMUs on public funds, it should also be noted that sometimes BMUs' operational costs are paid for by private companies (Wilson *et al.*, 2020), which implies private sources of funding for BMUs exist and thus, opportunities to improve the funding mechanism for BMUs using both public and private funds. Besides, from the interviews with BMUs, it was shared that a practical challenge for BMUs in conducting patrols and controls against illegal fishing is due to the nature of their roles and membership. Fishers, who are the target of patrol and control activities, usually make up a large part of BMU membership. Some fisher members in the interviewed BMUs were arrested during patrols and then, decided to withdraw their BMU membership, which effectively reduced the BMUs' human resource capacity to conduct patrol and control missions.

Apart from co-management of fisheries resources, BMUs are also expected to provide and facilitate support for its members in terms of access to finance, access to plots in landing sites, access to physical inputs (such as fishing gears and nets) and services (such as technical and market information), conflict resolution, and other supports such as coping with shocks (e.g. floods) and protection against thefts (interviews with BMU leaders and VC actors, 2021). In the regions around Lake Tanganyika, most of these expected roles of the BMUs are actually practiced and many interviewed VC actors indicated to have benefited from the BMUs' support, especially in terms of conflict resolution (between buyers and sellers of fish products and inputs), access to finance and inputs (when BMU members put together their money to collectively pay certain investment costs, or support each other through lending

and borrowing money), and protection from thefts (interviews with BMU leaders and VC actors, 2021). The BMUs in the Lake Tanganyika region, therefore, appear to be more effective as an organization, or mechanism, for mutual support between community members than as an organization for co-management of fisheries resources.

Schools and health care facilities

In the Lake Tanganyika region in Tanzania, schools, and health centres are among the top priorities needed by the local population (African Development Fund, 2004). Schools are scarce, leading to high percentages of the population having limited access to education. In the surveys conducted with fishers, processors and their workers around the Lake in 2021, only 1-2 percent of the respondents have attended secondary schools, but none of them completed secondary education; and for over 70 percent of the surveyed respondents, the highest educational level is completed primary school. Among the surveyed, processors (mostly women) appear to have lower educational levels than fishers and workers (most of whom are male fishing workers). This implies around the Lake regions; women tend to have more limited access to education than men. Community health centres are also scarce around the lake, resulting a big proportion of the population being prone to diseases such as water-borne diseases and malaria (e.g. in 2016, over 80 percent of the households surveyed by Hess *et al.* (2017) had family members who had had malaria in the last 12 months (Hess *et al.*, 2017)). This low level of the population's wellbeing due to the lack of basic facilities has negative implications for the VC, which is operated by and relies on the participation of the local communities.

Development projects and support

There have been numerous past and ongoing efforts aiming at improving the sustainable management and conservation of fisheries resources in the Lake Tanganyika region while at the same time, improving the wellbeing of local communities. Various projects on fisheries resources, biodiversity, pollution control and environmental management have been conducted before the establishment of the LTA, such as the Lake Tanganyika Research Project (LTR) and the Lake Tanganyika Biodiversity Project (LTBP) during the 1990s-early 2000s. The LTA has also carried out the Frame Survey in 2011, the Transboundary Diagnostic Analysis of the lake, and the Lake Tanganyika Regional Integrated Management and Development Programme (LTRIMDP)) (AU-IBAR, 2016). Table Table 6 summarizes the recent and ongoing projects that have the most relevance to the current situation of the VC in Lake Tanganyika in United Republic of Tanzania and their implications for FISH4ACP project.

TABLE 6. PROJECTS OF RELEVANCE TO THE LAKE TANGANYIKA SPRAT, SARDINE AND PERCH VALUE CHAIN IN UNITED REPUBLIC OF TANZANIA

Project title	Lead implementer	Status	Short description/ Focus	Relevance to VC and FISH4ACP project
LATAFIMA - Lake Tanganyika Fisheries Management	FAO and LTA	Ongoing	LATAFIMA is a project under the ECOFISH programme, funded by the European Union. The project aims to support the enhancement of sustainable fisheries, fisheries governance, and the enabling environment (institutions) of fisheries in the Lake Tanganyika region, covering four countries surrounding the Lake.[1]	FISH4ACP and LATAFIMA are complementary. While LATAFIMA focuses on fisheries management in the whole Lake region, FISH4ACP adopts a value chain approach that studies the VC in the Tanzanian part of the Lake and the VC's enabling environment, which includes regional fisheries management.
Tuungane	The Nature Conservancy (TNC)	Ongoing (since 2012)	A population, health, and environment (PHE) project addressing the connection between people, their health and environment in the Greater Mahale Ecosystem (GME) - part of Lake Tanganyika basin covering 44 villages in Kigoma and Katavi regions in United Republic of Tanzania. The project has reached 110 000+ people so far.[2]	There are various potential areas for collaboration related to VC development (e.g. fishing, processing, governance, enabling environment). Two projects may collaborate on sharing data and findings (including development of business plans) and on capacity building for VC actors.
LATAWAMA - Lake Tanganyika Water Management	Enabel	Ongoing (since 2020)	The project, funded by the European Union, focuses on provision of capacity building and support to the LTA on lake water quality management, wastewater management, and water sanitation. The objective is to improve the sustainable management and quality control of cross-border water in the Lake Tanganyika basin.[3]	Water quality has a direct link to fish production and other organism (phytoplankton and zooplankton) in the Lake.

Lake Tanganyika Regional Integrated Development Programme (PRODAP)	Vice President Office, and MLF (Tanzania)	Past (up to 2015)	The (AfDB supported) project aimed to support fishery development, protect the lake environment, and reduce the poverty of the riparian communities. It included four components: institutional capacity building, fisheries development and environmental protection, infrastructural rehabilitation and local development, and project development.[4]	FISH4ACP may build on PRODAP's work, especially on infrastructure development (e.g. landing sites, fish processing facilities, storage facilities) and trainings on fish handling and processing methods.
Reduction of greenhouse gases and post-harvest loss	TAFIRI and MATIS	Past (2015 – 2017)	The project, funded by the Nordic Development Fund (NDF), introduced improved fish smoking and drying units and methods to reduce deforestation and improve food security. The introduced technique is based on smoking and drying fish in an integrated unit, which uses around 80% less firewood than traditional smoking methods. The geographical focus was Lake Tanganyika in Tanzania.[5]	The integrated fish smoking and drying model may be adopted/adapted under FISH4ACP, based on further assessment of the feasibility and impacts of this model, including the current adoption by VC actors.

Source: [1] Consultations with FAO and EU, 2021. [2] TNC (2019), and consultations with TNC in 2021.

[3] https://www.enabel.be/content/lake-tanganyika-water-management-project.

[4] Consultation, TAFIRI, 2021. [5] https://www.nordicclimatefacility.com/info/8049.

2.3.3.3 Infrastructural elements

Fish handling facilities (e.g. landing sites, marketplaces, storage)

It is well-acknowledged in past studies and research that fish handling facilities around Lake Tanganyika are few and poorly equipped (African Development Fund, 2004; Onyango, 2016). Interviews and focus group discussions with the VC stakeholders in 2021 confirmed the same findings. Around the Lake, there are just a few landing sites, such as those in Kigoma (e.g. Kibirizi and Muyobozi landing sites), Katavi (Ikola) and Rukwa (Kipili and Kasanga landing

sites). However, these landing sites are insufficiently equipped and lack the necessary infrastructure to ensure and support efficient handling of fish, such as clean water management, wastewater treatment, and accessible roads. In addition, many landing sites were submerged by lake water in 2021 (see photos) due to floods as most of these landing sites have been built within lake buffer zone (60m from highest water mark), and most facilities there were destroyed/damaged. Furthermore, there is a serious lack of marketplaces, with most interviewed locations (e.g. Katonga (Kigoma), Kasanga (Rukwa), Kibirizi (Kigoma), Kalungu (Mbeya) having no proper marketplaces, and just a few locations such as Muyobozi (Kigoma) and Kirando (Rukwa) having some market facilities. Storage facilities at marketplaces and landing sites are seriously lacking. Almost all interviewed VC actors, from fishers to retailers, face difficulties in preserving their fresh and processed fish products due to the lack of storage facilities, resulting in fish spoilage and wastage. Improvement in fish handling facilities – from landing sites to storage facilities, therefore, are one of the needs most often cited by VC actors, experts, and MLF officials during the interviews.

FIGURE 29. A SUBMERGED LANDING SITE IN KASANGA, RUKWA IN LATE APRIL 2021

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Transport infrastructure

The Lake Tanganyika region in Tanzania has very limited road infrastructure[31] (African Development Fund, 2004). Although some improvements have been made in the last 5-10 years and roads are now accessible to some areas, most areas around the Lake still lack such infrastructure (Interviews with MLF officials, 2021). Table 7 shows the numbers of trunk roads (connecting to other regions) and regional roads (within a region) in Kigoma, Katavi and Rukwa regions, with paved roads making up less than half of all the roads in three regions and over 90 percent of the internal/regional roads are unpaved.

TABLE 7. ROAD NETWORKS IN KIGOMA, KATAVI AND RUKWA REGIONS (AS OF FEB 2020)

	Number of trunk roads		Number of regional roads	
	Paved (share in total in region, %)	Unpaved	Paved (share in total in region, %)	Unpaved
Kigoma	269 (41%)	391	0 (0%)	716
Katavi	118 (25%)	356	25 (3%)	693
Rukwa	294 (72%)	117	77 (9%)	755

Source: https://www.tanroads.go.tz/road-networks/regional.

While Kigoma is considered a central hub of the Lake region as it has port, railway, and airport connections, the regional tarmac road connections are relatively better in Rukwa and Katavi, as suggested by focus group discussions with VC actors and interviews with MLF officials. Nevertheless, the road conditions around the Lake largely need to be improved to ensure reliable transport and accessibility throughout the year. As indicated by a wholesaler and an exporter in Ikola in Katavi region, during rainy seasons, transportation is greatly disrupted due to the poor quality of roads[32], preventing VC products from reaching the markets. In terms of railway connections, although there is a railway link between Kigoma and Dar es Salaam (via Dodoma), the railway transportation takes a long time (usually 2 days to transport fish from Kigoma to Dar es Salaam) and is "not reliable" (often delayed), which can result in up to 40 percent loss of fresh fish quantity during transportation (interview with a retailer in Dar es Salaam, 2021). The lack of transportation infrastructure not only limits the marketability of the fish and increases the distribution costs but also restrains various VC upgrading activities because the required inputs, such as ice and freezers for better storage of fish, are often too difficult or too expensive to access (African Development Fund, 2004; Actor interviews, 2021).

[31] See Figure 66- Figure 68 in Annex 1 for the maps of road networks in Kigoma, Rukwa and Katavi regions. See Figure 69 for the map of roads, railways, and airport networks in United Republic of Tanzania.

[32] "In rainy seasons, most of the truck owners afraid to bring their trucks to Ikola because the roads are rough" (Interview with a wholesaler in Ikola, Katavi, 2021).

Other basic facilities (water supply, electricity, telecommunication)

The Lake Tanganyika region in Tanzania is largely short of basic amenities. In terms of **electricity**, Kigoma region is currently supplied by three isolated diesel power plants at Kigoma town, Kasulu and Kibondo (AfDB, 2018; expert interviews, 2021). Meanwhile, there is one diesel generator in Katavi region and electricity supply for Rukwa is imported from Zambia (Pers., Comm., TAFIRI, 2021). According to interviews with MLF officials, the power supply by existing power plants has improved in the past 5-10 years, power cuts are much fewer than in the past, and currently around 80 percent of the riparian villages have access to electricity. However, interviews with VC actors and input/service providers suggest the instability of power supply, with still frequent load shedding and power cuts, is still a pressing issue. This lack and unreliable supply of electricity poses great challenges to the operations of VC actors (e.g. using freezers and cooler boxes to preserve fresh fish, using electric stoves for processing) and support service providers (e.g. ice production).

In terms of **water**, in most of the villages around the Lake Tanganyika in Tanzania, drinking water points and latrines are few and the local communities often directly use the lake water for their domestic needs (African Development Fund, 2004). As a result, water-borne diseases such as cholera, typhoid, intestinal worms, diarrhoea, and infections in the eye, ear and skin are prevalent among the riparian communities (African Development Fund, 2004; Hess *et al.*, 2017). Interviews with VC stakeholders also confirm the lack of water supply, with the majority of respondents reporting that they use lake water for their VC activities (including making ice and cleaning fish and working tools) while tap water is also used but not as often, and that clean water supply is generally insufficient.

VC stakeholders are reported to have relatively good access to means and networks of **information and communication technology** (**ICT)**, as compared to electricity and water. All the interviewed VC actors, from fishers to retailers, perceive existing means of telecommunication are affordable for them and supportive for their operations. For instance, mobile phones are reported to have helped fishers to obtain market information and to have helped wholesalers, exporters, and retailers to pay for the raw material supplies and to get payment from buyers using mobile banking. This presents an opportunity for various VC upgrading options that can be built on ICT means, such as improved provision of extension and finance provision as well as more efficient input purchase and output marketing based on mobile platforms.

2.3.3.4 Socio-cultural elements

Traditional knowledge and cultural norms

According to Bulengela *et al.* (2019), in the Lake Tanganyika region of Tanzania, fishing activities are strongly influenced by the local traditional knowledge, such as navigation and

weather forecasting, and cultural beliefs. The traditional knowledge that the local fishing community has accumulated over generations is crucial in guiding their fishing activities. According to the interviewed fishers, most of the fishing methods they currently use are inherited from previous generations, except for a few new technologies such as the use of solar lamps for fishing and monofilament nets (Freemaya). Inside the fishing community in Lake Tanganyika, this traditional knowledge is blended with the community's spiritual beliefs in the value of and relationship between natural resources and fishing. It is believed that a breach of beliefs "would make the spirits angry and even punish the entire society" (Bulengela *et al.*, 2019).

Local traditions and customs are found to have provided the local community with guidance on how they should behave in life and at work, which in turn, has had positive impacts on the VC in terms of social sustainability. For instance, despite VC actors' lack of understanding of formal anti-discrimination rules[33], incidences of discrimination in the VC are generally rare because the local customs and traditions do not allow such practices. Additionally, the major religions in the region (i.e. Christianity and Islam), which advocate for good deeds, are suggested to have shaped the characters of local people and motivates them to conduct good and trustful businesses (Consultation with VC stakeholders, 2021).

However, there exists socio-cultural gender norms which disadvantage women. For instance, women are not allowed to get into fishing boats because that will bring bad luck. It is largely due to such a cultural norm that there is hardly any participation of women in fishing crew, although this situation is also believed to be due to the nature of the fishing job (which is physically demanding) and due to women's preference for processing and retailing job (which entail lighter tasks) (Interviews with VC actors and MLF officers, 2021). According to interviews with gender/social experts, socio-cultural norms are indicated to dictate the roles women should play at home and in the community and the kinds of jobs that they should do. The main roles for women are mother and wife, taking care of household chores. Besides, fisheries businesses are often associated with social issues (such as sex for fish, to be discussed in section 3.2.2), and thus discouraging women from entering these businesses. Thanks to good examples of strong women who are successful in fisheries, the social attitudes towards women in fisheries have been gradually improved; but there still exist strong social norms that disadvantage women.

Social/cultural norms and traditional diets are found to support the consumption of the VC commodities. As already mentioned in Section 2.2, for the residents in three regions around Lake Tanganyika, fish is an important part of their diets, regardless of economic status (rich or poor) (Consultation with VC stakeholders, 2021). Among the three VC commodities, perch

[33] Many of the interviewed VC actors indicated they know that there are anti-discrimination laws, but they do not know what the laws are exactly about.

is of particular importance as it constitutes over 50 percent of the household intake of animal protein in two-thirds of the households surveyed in 2021. For both local people about the Lake and Tanzanians in other parts of the country, the *dagaa* (sprat and sardine) from Lake Tanganyika is believed to be high-quality products (Interviews with VC actors and MLF officers, 2021), as opposed to the *dagaa* from Lake Victoria which is traditionally considered as rather low-value fish and often used for animal feed (Kolding *et al.*, 2019).

Thefts/crimes and political stability

According to interviews with VC actors and Fisheries Officers, thefts and crimes are more common in Kigoma than in other regions around the Lake, which is thought to be largely due to political instability in neighbouring states such as Democratic Republic of the Congo and Burundi. This situation has caused negative impacts on VC actors, for example fishers had to buy all the working tools (e.g. outboard engines, boats, nets) again after their tools got stolen. There are virtually no insurance products covering losses from thefts that are available and accessible to VC actors, and thus, all these losses are borne by the actors.

The analysis of the societal enabling environment, as described above, reveals the following opportunities for VC upgrading:

- National and regional fisheries policies/regulations are already in place; but need to be improved based on updated data about fish stock and fishing pressure. National and regional organizations (e.g. ministries, BMUs, LTA) are also already in place to support sustainable fisheries management. However, there is a lack of adequate monitoring and enforcement of laws and regulations, especially those related to licensing and illegal fishing, which is largely due to limited financial and human resources of implementing organizations (e.g. ministries, BMUs) coupled with fishers' limited financial and livelihoods means and their lack of awareness about conservation. This implies an opportunity for FISH4ACP to strengthen the capacity for the ministry staff and BMUs on sustainable fisheries management, including designing and/or facilitating the mechanisms to support the ministries and BMUs to have access to the capital necessary for the effective execution of their mandates.
- VC actors have relatively good access to means and networks of information and communication technology (ICT), which some actors use to obtain information and make payments. This presents an opportunity for the provision of extension and facilitation of access to markets and finance built on ICT means.
- There are several other projects which also operate (or operated) in the Lake Tanganyika region, which have direct or indirect links to FISH4ACP. Synergies should be sought with these projects.
- There is a need for more sensitization on gender equality to tackle gender norms that disadvantage women.

2.3.4 The natural environment (layer 4)

2.3.4.1 Fisheries resources

Lake Tanganyika is the second largest fishing ground in Africa and is a rich biodiversity ecosystem consisting of over 2 000 plant and animal species (African Development Fund, 2004). It's a home to over 2 000 fish species among which 600 are endemic (Coulter, 1991; Allison *et al.*, 2000; Snoeks, 2000). The largest fish biomass in the lake is dominated by six endemic small pelagic species, including two clupeids - the Lake Tanganyika sprat (*Stolothrissa tanganicae*) and Lake Tanganyika sardine (*Limnothrissa miodon*) and four types of Lates species, including the predator Sleek Lates or perch (*Lates stappersii*) (Breuil & Grima, 2014; AU-IBAR, 2016). The sardine species, like their marine relatives, are small, numerous, short-lived and highly fecund. The small pelagic fish species of Lake Tanganyika especially, *sardine* and *sprat* are abundant and omnipresent in the lake and have been fished for many years.

However, certain commercial fisheries have reported significant declines in catch per unit effort (CPUE) of close to 90 percent (World Bank, 2020). It has been reported that, between 1995 and 2011, the total fish stock has decreased by 25 percent. The annual fish production in Lake Tanganyika in 2012 was estimated at around 110 000 to 120 000 tonnes, which is around 30 percent lower than the estimates in the 1990s, which were between 165 000 and 200 000 tonnes per year (Van der Knaap, 2018). Even though this estimation still needs to be verified and updated, it concurs with the general observations by the fishers that fish production of the lake has declined over time (Van der Knaap, 2018). This is in addition to the 2011 frame survey that showed declining trends in fish harvests of most species, with the fishing capacity (i.e. the number of fishers, the number of fishing vessels and the number of fishing gears, methods and boats) having doubled and the catch per unit of effort (CPUE) having decreased tremendously (World Bank, 2020). Tanganyika fisheries operate under an essentially open access regime where everyone is free to fish and a proper lake wide fish stock assessment is missing to date.

The capacity to undertake monitoring control and surveillance (MCS) operations across the region is constrained by several key factors such as lack of financial resources, equipment and patrol platforms, insufficient numbers of MCS personnel and a lack of coordination between the riparian countries (see also Petit & Shrimpton, 2015; Onyango 2016). There is also lack of reliable fisheries stock information and/or data to inform fisheries management decisions.

2.3.4.2 Climate and Climate Change

According to Mgana et al (2019), wind speed, moonlight and distance from the shore affect fish catch. During high winds, rough water surface affects the beaming angle of light and

refractions are more likely to happen. If the drifting speed is too high, fish may not stay with the lamp light. Moonlight counteracts the artificial lamp light and makes it less likely that fish congregate around artificial lamps placed close to the fishing nets, so fishers generally do not fish during full moon. According to Bulengela *et al.* (2019), there is a positive correlation between the intensity of the wind and the productivity of the fish population in the lake. As the regional wind intensity has been decreasing since the 1990s, the lake's fish productivity has also decreased. According to scientists, this is partly because less intense winds contribute to the "reduced mixing" and the decrease in "deep water nutrient upwelling and entrainment into surface waters" of the lake, thereby decreasing the food and nutrient available for fish and thus, fish productivity. As for the local fishing communities, while they cannot scientifically explain the relationship between the winds and fish availability, from their practical experience accumulated over the years, they have also noticed that when the winds are strong, they can have better catch.

Bulengela *et al.* (2019) also report similar perceptions among fishers about the link between rainfall and fish availability. As the local fishers notice there have been decreases in rainfall since the early 2000s, they also notice decreases in fish availability and the success of their catches. As the fishers explain, this association is due to two reasons: (i) the rain brings new, fresh water to the lake, making fish to come up to "enjoy the new water", and (ii) more rain contributes to more abundant food for fish because rainwater carries into the lake organic materials eroded from the surrounding areas that are food for fish.

Like winds and rainfall, the waves in the lake affect the movement of food for fish. As the fishermen interviewed by Bulengela *et al.* (2019) put it, "as the food move, fish moves as well". As such, these natural elements – winds, rainfall, and waves – contribute to fish movement or migration to the upper or deeper levels of the lake.

Lake Tanganyika is permanently stratified and according to Edmond *et al.* (1993) seasonal mixing within the lake doesn't extend beyond depths of 150 m. The mixing is known to mainly occur as the wind driven upwelling in the north and south of the lake though, to some extent there are also upwellings and down wellings elsewhere in the lake. The upwellings increase the lake's productivity (Plisnier *et al.*, 1999; Plisnier *et al.*, 2009) which increases the production of the clupeids.

Lake Tanganyika ecosystem is very sensitive to changes in climatic conditions (especially temperatures and winds) which have been recorded to have implications on its productivity, in addition to its hydrodynamic states (World Bank, 2018). Temperatures in Lake Tanganyika's waters have increased by 0.2 C° at 1 000 m in depth, in part because of reduced cool marginal inflows, while water surface temperatures have increased by about 1.3 C° (World Bank, 2018) which has affected the lake's aquatic resources. For example, the World Bank (2018) highlights that research undertaken on Lake Tanganyika has revealed that the

variability in the fish population is not only because of overfishing but also the natural warming and cooling cycles of the lake. The AU-IBAR (2016) and Bulengela *et al.* (2019), further report that climate change – particularly in terms of declining wind speeds and rising temperature—is a main contributor to the decline of fish production and fish catches in Lake Tanganyika. Climate warming and intensifying stratification have most likely reduced potential fishery production, due to the depressed algal production and shrunk in the oxygenated benthic habitat, helping to explain possible declines in fish catches (Cohen *et al.*, 2016). This is further acknowledged by Karenge and Kolding (1995a and b) and Jul-Larsen *et al.* (2003) that small pelagic fish species fluctuate strongly in response to changing climate-driven environmental conditions following their trophic proximity to the primary base of the food web. Climate change associated scenarios, drought to be specific, has caused changes in the rural economy within in the Lake Tanganyika basin which has resulted into high exploitation pressure on the pelagic fisheries resources (Kimirei *et al.*, 2008) of Lake Tanganyika.

The water level of Lake Tanganyika has been rising over years, due to climate change, causing floods and affecting 1 828 km of shoreline, destruction of homes and infrastructure, disappearance of beaches, and destruction of vegetation[34]. Fishing activities have neither been spared as many fishing villages and landing sites have been submerged. For example, according to information collected during the environment interviews conducted by FISH4ACP project in late April 2021 on the Tanzanian side of the lake, it was found that some landing sites like Kasanga in Rukwa region were completely submerged and fishers had limited spaces to dry their fish, in addition to an ice production factory that was forced to close down due to the floods.

2.3.4.3 Lake water and ecology

Lake Tanganyika is renowned for its unique richness of aquatic biodiversity and its shores are variable in their topography, and the different types of near-shore habitats alternate along its long coastline which has shaped the distribution of different flora and fauna. The lake accommodates more than 2,000 plant and animal species, close to half being endemic to the basin (African Development Fund, 2004; Allison *et al.*, 2000). Among others, it supports a multitude range of cichlid and clupeid fish species in the region. The near-shore habitats of the lake support the sleek lates, Lake Tanganyika sardine, and sprat (Ainsworth *et al.*, 2021).

According to Plisnier (1997) catches of sprat in the south of the lake declined due to less favourable conditions for reproduction, increased predation and fishing. Catches in the

[34] https://storyteller.iom.int/stories/burundi-how-rising-lake-tanganyika-triggers-urgent-humanitarian-needs

south are mainly seasonal (during the upwelling season) and hence catches are influenced by upwelling

The abundance of perch is linked to water transparency. The clearer the water, the easier it is for these fish to hunt other fish. Hence this species is more abundant in clearer water areas of the lake. Therefore, an improved understanding of regional climate linked to limnological and fisheries changes, may provide a method of forecasting fisheries yields for the main pelagic species of Lake Tanganyika. It's been also reported that increases in sprat abundance is related to local increases in zooplankton abundance. Thus, a limitation in zooplankton abundance due to the deteriorating environmental quality of Lake Tanganyika has impacted on the abundance of sprat as well as other larval and juvenile clupeids that feed essentially on copepod zooplankton (Mannini *et al.*, 1996; Sarvala *et al.*, 2002; Isumbisho *et al.*, 2004; 2006).

The water and the ecology of Lake Tanganyika are under increasing stresses coming from the urban, industrial and agricultural developments taking place in the lake's basin and littoral zone. Across the riparian areas in four countries bordering the lake, various types of solid and untreated liquid waste are discharged to the lake, including industrial waste from plants (e.g. TANESCO Power Station and the thermal plant in Kigoma, industrial refrigeration plant in Mpulungu) and mining companies, fuel and oil spills from major ports, pesticide residues from agriculture and other agricultural and livestock waste, and human waste (African Development Fund, 2004; AU-IBAR, 2016). In addition, in regions surrounding the lake, there have been increases in soil erosion, deforestation and wetland destruction due to the unsustainable practices adopted by the riparian communities (AU-IBAR, 2016), which coupled with the increasing untreated waste discharged to the lake has caused eutrophication and subsequently affected the lake's aquatic organisms' health leading to biodiversity loss (AU-IBAR, 2016; Bulengela *et al.*, 2019), reduction in fish stocks and diversity as well as the destruction of benthic habitats and critical fish spawning areas.

Lake Tanganyika is experiencing an invasion with the water hyacinth (*Eichhornia crassipes*) that has become a major invasive weed on the lake. It entered Lake Tanganyika about 20 years ago. It's a serious threat to the lake's aquatic ecosystem, affecting water quality and fish stocks. The extensive and tightly packed mats of the water hyacinth reduce the secchi disk visibility (an indication of water clarity) and further create underneath anoxic conditions that impair environmental quality for biodiversity maintenance, fish spawning grounds and nurseries of young fish, inshore feeding zones, and refuges for fish. The water hyacinth mats are a preferred breeding sites for the *Biomphalaria* snail, an alternative host for Schistosomiasis (bilharzia), as well as the malaria vector. These have got health implications on fishing communities of Lake Tanganyika, including those directly involved in the sardine, sprat and the perch value chain.

The small pelagic fish species *(sprat and sardine)* play a crucial role in the modified ecosystem of Lake Tanganyika. They utilize zooplankton and feed on surface insects; they are heavily preyed on by birds and fish, such as Lake Tanganyika perch, African Catfish (*Clarias gariepinus)* and Semuntundu (*Bagrus docmak)* (Coulter *et al*., 1991; O'Reilly *et al*., 2001). This keeps the ecosystem function of the lake moving. The abundance of Lake Tanganyika sprat is positively correlated to plankton biomass, while water transparency, depth of the mixed layer and oxygenated water appear to be important drivers for the abundance of perch (Bodiguel and Breuil, 2015). According to Bodiguel and Breuil (2015), increases in Lake Tanganyika sprat is related to local increases in zooplankton abundance.

2.4 Governance analysis (linkages)

2.4.1 Vertical linkages

As discussed in section 2.1, **VC actors at different functions are linked to each other through various connections**, with different VC actor types buying and selling from each other (e.g. fishers sell to not only processors but also wholesalers, exporters, and retailers; wholesalers buy from fishers and processors, and sell to other wholesalers and retailers). **These diverse connections, however, are highly informal and not well-coordinated**. Most VC actors operate individually instead of in coordination with their buyers or suppliers (e.g. fishers go fishing without knowing how much quantity is needed by their potential buyers). The transactions in the VC are mostly conducted through spot market transactions and verbal contracts (agreements), with spot market transactions being the more common form (Interviews with VC actors, 2021). In the conducted interviews, many fishers and processors shared that they face difficulties in finding markets or buyers due to "declining markets" and "having just a few buyers", while many processors, wholesalers, exporters, and retailers described the challenges in procuring VC materials/products due to "decreases in supply sources and quantities". These findings reveal missing links between the supply and demand of sprat, sardine, and perch products along the VC. This represents a potential need for the project to provide support in improving the connections between suppliers and markets, as also indicated by the VC actors.

While the lack of coordination and the missing links between suppliers and buyers are the constraints facing VC actors in general, for those actors who are connected to markets or sources of raw material procurement, they mostly perceive their relationships with buyers or suppliers as "trustful", "fruitful", "collaborative", and "good and fair" (interviews with VC actors, 2021). This mutual trust partially explains why for these actors, there is no need for written contracts for the exchange of VC products. **The transactions are based on trust**, which is typically built over a long time and is based on the experiences and perceptions from both sides that the agreed prices are largely fair, the payments are made on time, the supply is delivered as agreed, and there is hardly any incidence of cheating (Interviews with

VC actors, 2021). In some cases, the exchange goes beyond the simple buying-selling relationship to also covers sharing of market information, the provision of advanced inputs by buyers to sellers (e.g. 90 percent of the payment to fishers is made in cash, and 10 percent in the form of inputs (e.g. nets) provided by buyers) and/or the provision of VC products in advance of full payment (e.g. payments for fish are made in instalments, after all the fish are delivered to buyers). Payments are made mainly in cash paid during the conduct of spot transactions; but when there is a high level of trust between buyers and sellers, payments are also made through mobile banking transactions (e.g. M-Pesa) and/or in the forms of advanced inputs or advanced VC products, as described above. The existence of relatively sophisticated relationships and payment mechanisms based on mutual trust between VC actors, albeit not as common as pure buying-selling relationships using cash, is a strength in the VC that future interventions under FISH4ACP could build on.

With their relationships built on mutual trust, the interviewed VC actors generally indicated that there are no conflicts between them and their suppliers and buyers, although sometimes problems arise due to fish products not being delivered by the sellers (e.g. fishers), or are delivered but having low quality. In such cases, the conflicts are often effectively resolved through the BMUs, village leaders, or market leaders.

2.4.2 Horizontal linkages

Interviews with VC actors suggest that **horizontal coordination between the actors exists along the VC, but the share of VC actors belonging to any unions or associations is low**. There are different forms of group formation at each function along the VC, including relatively formal[35] groups (such as unions, cooperatives (including SACCOs - savings and credit cooperatives), and associations) and relatively informal ones (such as self-help groups at village level, groups of fellow actors or friends). However, the survey with fishers conducted in 2021 show that around 80 percent of the surveyed fishers and processors do not belong to any associations or organizations.

A list of the various types of groups between VC actors, as recorded during field work for primary data collection, is provided in Table 45 Table in Annex 2. In United Republic of Tanzania, these various terms for groups (e.g. union, cooperative, association) are often used interchangeably to describe a grouping of people coming together for a purpose (Interview with cooperative experts, 2021). Some groups' membership only includes a particular actor type (such as a union of fishers or processors), while some other groups have mixed membership (such as a fisher union that also includes traders, or a trader association that includes wholesalers, exporters, and retailers). The BMUs, as discussed in section 2.3.3.2, can be considered as a kind of groups with mixed membership, consisting of people living in

[35] These groups are considered more formal than other groups included in this analysis. However, being "formal", in this context, does not necessarily mean the groups are legally/officially registered.

a fishing community, and usually include fishers as well as other VC stakeholders. Additionally, actor interviews indicate some female actors are members of women groups, or unions, of fish processors and traders, for example the Tanzania Women Fish workers Association (TAWFA) which was established in 2019.[36] Regardless of group name and membership, the groups indicated through actor interviews are typically formed to collectively protect and advocate for the rights of group members, to coordinate and collaborate in investing in inputs and in selling products, and to provide mutual support to each other in terms of information sharing and lending/borrowing money in times of need. Particularly, women groups have a great potential to tackle gender-based constraints and to provide technical and financial support specifically targeting women (MLF, 2019a).

Specifically, grouping appears to be a means for VC actors to collectively present their challenges and suggestions for changes to the leadership in their villages and landing sites as well as to government officials. Such requests or suggestions are typically related to the regulatory aspects (such as requirements in fish trade, the costs of business licences and tax/levy rates), some of which have been accepted by the authority (such as a reduction in business license cost upon the request by an association of traders in Mbeya).

Additionally, there are various forms of collaborations and mutual support between group members along the VC. Those fishers, processors, wholesalers, exporters, and retailers who are part of a particular group often share costs of buying inputs (e.g. processing facilities, freezers) and services (e.g. transport), coordinate in setting fish prices when selling to traders, and share information about production (techniques, models) and marketing (where to sell, at which price), and support each other through group lending and borrowing. The exchange between group members is a channel for information, training, and extension, which in some cases appear to be more effective than public extension. Similarly, lending from within the group is a main source of financial support for many VC actors. As shared by the actors, this informal form of lending is strongly preferred than formal lending from banks, which is offered at high interest rates and difficult to access.

Group representation is generally considered by VC actors as fair and inclusive, considering differences between members such as in terms of gender and age. In most of the relatively formal groups (e.g. unions, SACCOs, associations), it is suggested that all members' views are collected, group leaders are elected through fair election, and there are regulations governing the operation of the groups.

The existing level of horizontal linkages between VC actors represents a strength in the VC that FISH4ACP could build on, for instance through using existing groups as an entry point

[36] TAWFA was launched in April 2019, with the support of a FAO project on the Voluntary Guidelines for securing sustainable small-scale fisheries in the context of food security and poverty eradication (SSF guidelines) in Tanzania (MLF, 2019a).

for the provision of technical and financial support. There are, however, various challenges associated with grouping that have resulted in the large share of VC actors who do not belong to any (rather formal) groups such as associations or unions. These include: (i) weak governance in some existing groups (there are a few reported cases of lack of fairness between group leaders and members, and in some other cases, group leaders are considered as too "soft" or lenient on some members), (ii) undermined trust between group members because some members fail to pay the loans advanced by the group, (iii) lack of technical capacity among group members (learning from each other is helpful, but additional training from Fisheries Officers is needed), and (iv) non-existence of any forms of groups in some interview locations due to the lack of trust and/or social conflicts between VC actors and due to the lack of understanding about the benefits of grouping and how to form into groups. These challenges should be taken into consideration for any interventions employing working with groups to be successful.

2.4.3 Factors that influence governance

Market Power

In the Lake Tanganyika sprat, sardine, and perch VC in United Republic of Tanzania, most VC actors are indicated to have a "medium-level" share of the market, just like their competitors, with the exception of a few traders from the Democratic Republic of the Congo who were suggested to be able to buy a large quantity (up to three-quarters) of the fish supply and thus, can influence the price and market (Interviews with VC actors, 2021). Interviews and focus groups discussions with VC actors in 2021 suggest that prices are negotiated and agreed between buyers and sellers mainly based on supply-demand relations. In many cases, prices are set by the sellers (for instance, fishers set the price of the fresh fish when selling to processors and traders, processors set the prices of the processed fish they sell to traders). Meanwhile, in other cases, the buyers (e.g. processors and traders) provide cash advances to fishers and in return, set the prices of fish they buy from fishers. Regardless of who sets the prices, the prices are generally considered as "fair" for both the seller and the buyer, which largely explains why there are few reported conflicts during transactions between VC actors. That said, focus group discussion with processors suggested that middlemen (traders) sometimes manipulate fish prices to give undue advantage to the wealthy traders from Democratic Republic of the Congo.

For those who wish to participate in the VC, there are virtually no barriers to entry, and everyone can participate in any activities along the VC, albeit under different roles, e.g. as business owners (for fishing, processing and trading) if having access to finance, or as workers if otherwise. Mainly due to the nature of fishing tasks (which are physically demanding and relatively risky as compared to onshore jobs) and some gender stereotypes that disadvantage women as opposed to men (e.g. women being a part of the fishing crew

may be considered as bringing bad luck), women hardly participate in the fishing crew. However, this does not mean they are fully excluded from fishing activities. In fact, there are businesswomen who own fishing boats and hire fishing crew to conduct fishing activities, some of whom were interviewed during the field work conducted in 2021. The number of women owning fishing businesses, however, is suggested to be much lower than that of men (Interviews with VC actors, 2021). Meanwhile, women actively participate in other VC segments, namely processing, wholesaling, and retailing, with processing mainly dominated by women (see more in section 3.2.2).

Trust

As described above, along the VC, there is a generally a good level of mutual trust between VC actors, men and women alike, which enables the various vertical and horizontal linkages between the actors. While such linkages – built on trust over the years - have allowed for various forms of fruitful collaborations, there are still challenges in building and maintaining trust. Regarding **vertical linkages**, there are reported incidences of cheating and unreliable supply, for instance when the seller (e.g. fishers) receives the payment from a buyer but ends up selling the fish to another buyer. From the conducted interviews, it appears that most of these trust-related issues involve fishers' failing to fulfil their promises, while few issues are observed with other VC actors. Regarding **horizontal linkages**, while many VC actors have trust in each other and consider collaboration as necessary for their businesses, many other actors distrust their competitors and perceive any forms of grouping and collaboration "would not work". The interviewed fishers expressed this distrust towards the ring net fishers, who they believe to have destroyed fish breeding areas and thus, their fishing grounds. As for processors and traders, some of the interviewed mentioned some level of distrust towards the foreign traders from Democratic Republic of the Congo and Zambia, who they perceived as "wealthy traders" who buy a large share of the fish on the market, thereby leaving them with little fish to process and/or trade. At the same time, these same processors and traders often expressed their trust in other local processors and traders from within United Republic of Tanzania, indicating that they are willing to collaborate with these fellow actors, provided that such collaborations are fair and beneficial for them.

Social capital

Social capital is found to have positive impacts on VC linkages and governance. While some of the interviewed VC actors have inherited their VC-related businesses from their parents or relatives, some other actors have borrowed money from their families, relatives, and friends (many of whom are also VC actors) to start the business and to deal with the financial challenges they face when operating the business. These social networks – built on family

relations and friendship - lay a good foundation for the establishment and strengthening of vertical and horizontal linkages between VC actors and between the actors and their communities.

Additionally, there is a sense of patriotism observed during the actor interviews. Obeying the laws and working with others in the community to promote good practices (and prevent illegal practices) as well as mutual trust and support within the community are indicated to be ways of expressing and practicing patriotism. This socio-cultural aspect may have influenced the incentives for VC actors to perform certain behaviours, including collaboration with other actors and other people in their communities.

Formal and informal rules

In the Lake Tanganyika sprat, sardine, and perch VC in United Republic of Tanzania, the nature of linkages and governance mechanisms between VC actors are influenced more strongly by the informal rules (e.g. social or customary norms) than formal ones (e.g. national policies and regulations). For instance, the use of written contracts in the VC – either for the exchange of goods or service, or for the hiring of workers – is rare, which reflects the norm within the local communities that written contracts are not common, and "serve no purpose" because the transactions are largely "based on trust". The resolution of conflicts between VC actors is also mostly done at the village level (involving either the village leader, market leader or BMU leader), and is rarely brought up to the local government or the police because this is considered as "not very effective". Local traditions, customs and religions are found to have provided the local community with guidance on how they should behave in life and at work, as well as how they should interact with other people. Such traditions, customs, and religions call for good practices such as non-discrimination, supporting each other, doing good deeds, no cheating, and so on. These customary norms and social values enable and create incentives for VC actors to engage in certain activities and with other people, and thus, influence their linkages with other actors in the VC.

3 Sustainability assessment

In this section, the analysis shifts from the structural and behavioural dimensions of the VC to its performance in terms of economic, social and environmental impacts.

3.1 Economic analysis (Economic Snapshot)

The economic analysis focuses on the actor level and value chain-level contributions to economic growth. It contains six main domains: 1. Profitability (financial analysis) 2. Employment 3. Value added 4. Effects in the national economy 5. International

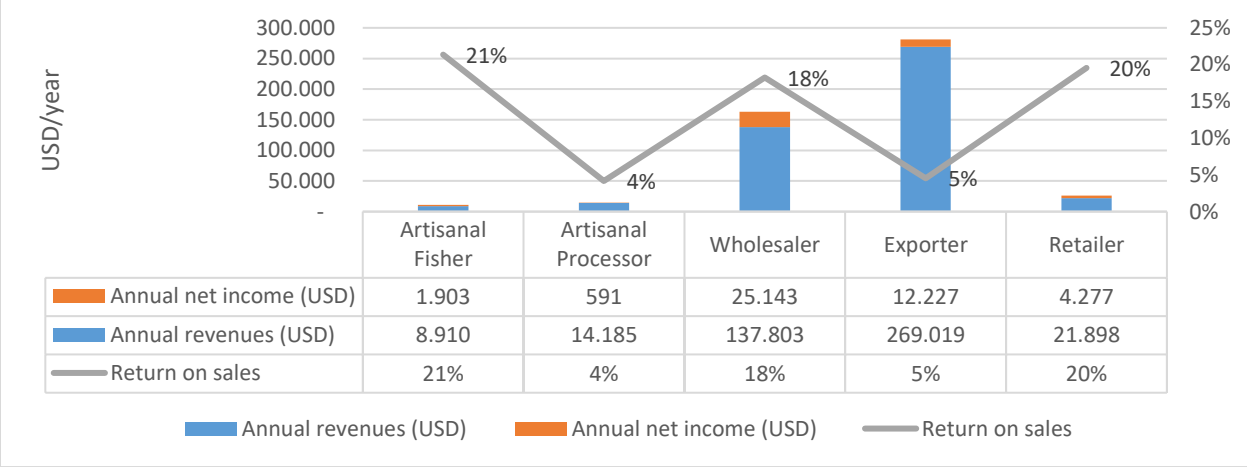
competitiveness 6. Value for end-consumers. Each domain presents a number of sustainability impact indicators which are later summarized in to a 'sustainability heat map' in Table 15.

The economic analysis is based upon primary data collected through detailed interviews with at least five actors for each actor type. The financial data is then formatted into an operating account to assess profitability, employment and value-added. The operating accounts of each actor type are averaged to give indicators for each segment of the value chain, then multiplied by the total number of actors by actor type in the VC to provide indicators at the VC and national level. The limited but detailed data has also been cross-referenced through wider but less detailed focus group discussions, key informant interviews and surveys.

3.1.1 Profitability

Figure 30 summarises annual revenues, net income, and return on sales (RoS) for core actor types at the VC level and shows which actors capture more of the profit.

FIGURE 30. PROFITABILITY OF TYPICAL, INDIVIDUAL VC ACTORS IN THE LAKE TANGANYIKA SPRAT, SARDINE AND PERCH VALUE CHAIN (2021)



	Artisanal Fisher	Artisanal Processor	Wholesaler	Exporter	Retailer
Annual net income (USD)	1.903	591	25.143	12.227	4.277
Annual revenues (USD)	8.910	14.185	137.803	269.019	21.898
Return on sales	21%	4%	18%	5%	20%

Note: Exchange rate: 1 USD = TZS 2 315.
Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Net Income at Actor Level (for business owners)

Figure 30 shows that the net income of **a typical (average) individual VC actor**, for all core actor types, is higher than the poverty line (USD 493/year)[37] and more than the minimum wage (USD 518/year).[38] Processors are the only VC actor to receive an average income lower

[37] World Bank
[38] Section 19 of the Employment and Labour Relations Act, 2004 of United Republic of Tanzania

than the average GNI per capita (USD 1 080/year).[39] Wholesalers receive the highest income, at just over USD 25 000/year.

At **the VC segment level**, the small-scale fisher, processor, and retailer segments all generate a revenue of about USD 80 million each, with wholesalers and exporter segments generating less. Net income per year is greatest for the segments of small-scale fishers and retailers at just over USD 17 million each and lowest for the segment of small-scale processors at just over USD 3 million.

Return on sales

Figure 30 shows Return on Sales (RoS) is highest for small-scale fishers (21 percent) and lowest for processors (4 percent). RoS shows the mark-up added to the costs of production and is a measure of efficiency. For small-scale fishers, this indicates that the price of fish is higher than the costs of catching them, however for processors this indicates the price of processed fish is not much more than the cost of buying fresh fish plus processing costs. For all core actor types, except processors and exporters, a typical (average) VC actor has a RoS above the Tanzania bank lending rate of 17 percent, indicating the activity still provides positive financial returns even if the funding has to be borrowed from the bank.[40]

Return on Investment

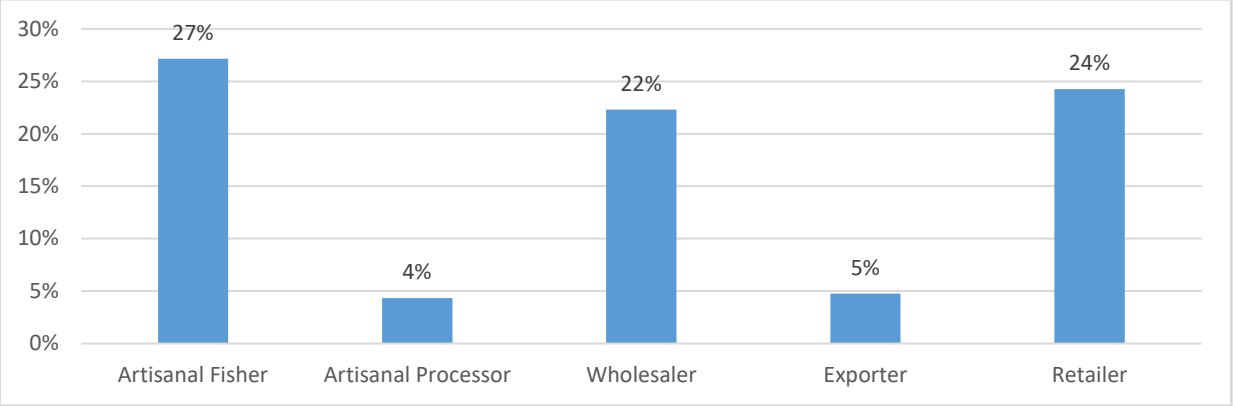
Figure 31 below shows Return on Investment (RoI), which is a similar picture to RoS. For all core actor types, except processors and exporters, a typical (average) VC actor has a RoI above the United Republic of Tanzania bank lending rate of 17 percent, indicating the activity still provides positive financial returns even if the funding has to be borrowed from the bank.[41]

[39] World Bank

[40] United Republic of Tanzania bank lending rate (World Bank, 2020)

[41] United Republic of Tanzania bank lending rate (World Bank, 2020)

FIGURE 31. RETURN ON INVESTMENT (%) OF TYPICAL VC ACTORS

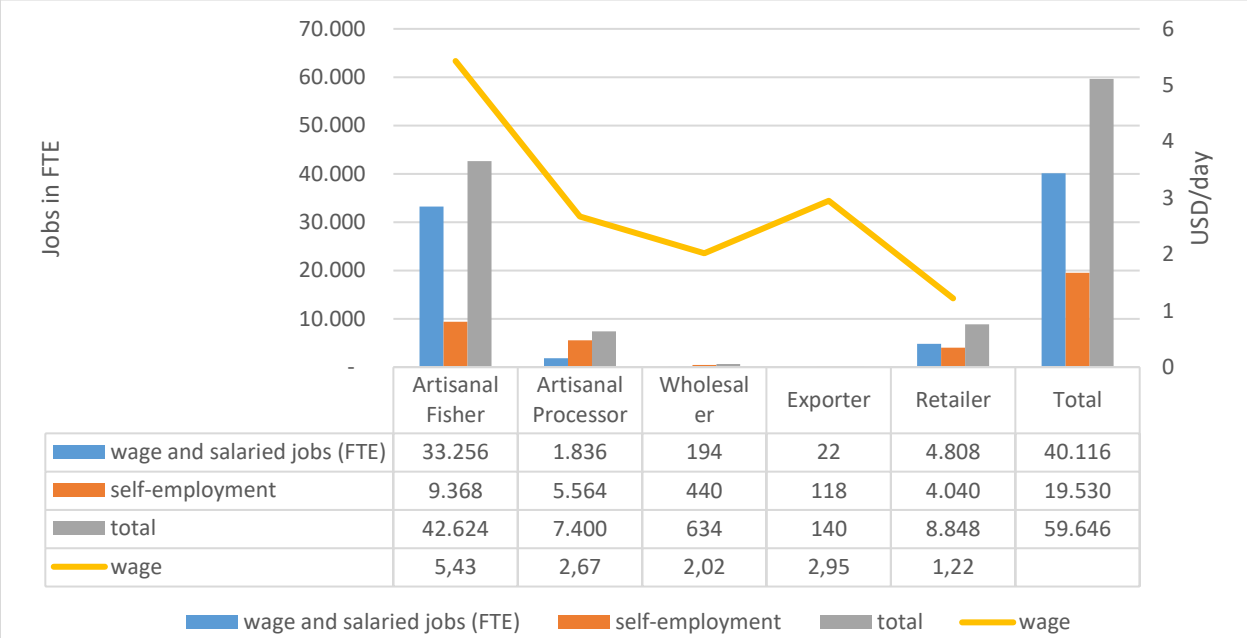


Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

3.1.2 Employment

Figure 32 summarises employment by functional level and actor type. Wage and salaried jobs include hired workers and family members who receive salaries. Self-employed are the business owners who draw an income from the operating profit of the business, rather than a salary. Fishers create the most employment through hired jobs (33 256 jobs in FTE) due to the necessity for boat crews. When considering average wages for both self-employed and hired workers, wages are also considerably higher for fisher workers (USD 5.43/day) than for other employment. Wholesalers and exporters provide least employment and retailers provide the lowest average wages which are below the world bank poverty line and Tanzanian minimum wage (i.e. USD 1.66/day).

FIGURE 32: EMPLOYMENT BY FUNCTIONAL LEVEL AND ACTOR TYPE



	Artisanal Fisher	Artisanal Processor	Wholesaler	Exporter	Retailer	Total
wage and salaried jobs (FTE)	33.256	1.836	194	22	4.808	40.116
self-employment	9.368	5.564	440	118	4.040	19.530
total	42.624	7.400	634	140	8.848	59.646
wage	5,43	2,67	2,02	2,95	1,22	

Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Number of wage and salaried jobs in FTE

Figure 33 shows the VC employs a total of 40 116 jobs in full-time equivalents, including hired labour and family labour. Due to the prevalence of part-time employment, the number of jobs in FTE is only 30 percent the total number of workers engaged in the VC (133 429 persons). Small-scale fishers account for 83 percent of FTE jobs due to the number of crew required to operate each boat. Wholesalers and exporters account for least number of jobs in FTE as most of their labour is part-time for storage and transport purposes only.

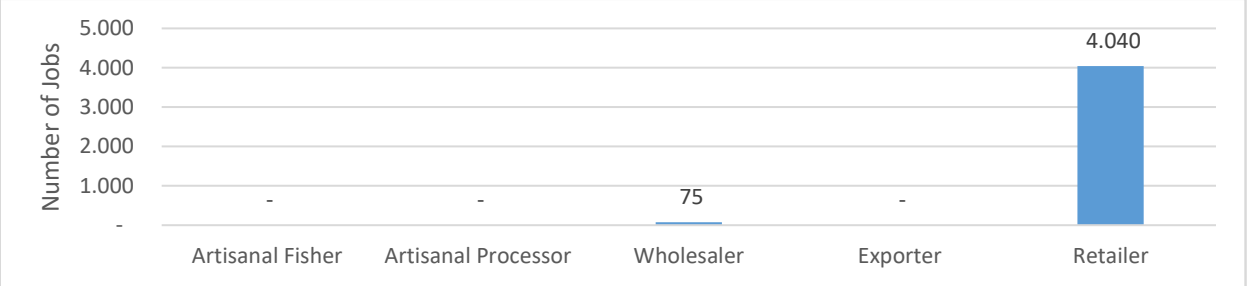
FIGURE 33: NUMBER OF WAGE AND SALARIED JOBS IN FTE BY ACTOR TYPE

Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Number of full-time jobs

Figure 34 shows the number of 'actual' full-time jobs in the VC is only 4 115, which represents only 10 percent of jobs in FTE and 98 percent of these are in the retail segment of the value chain. Based upon the total number of retailers, this indicates that all retailers on average employ one staff on a full-time basis. Meanwhile, fishers, processors, wholesalers and exporters are mostly employed part-time and seasonally and will have other jobs, or income generating activities, such as farming.

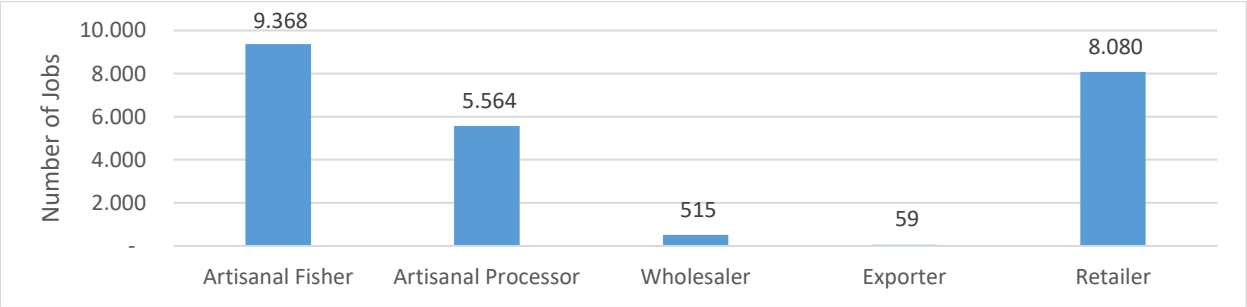
FIGURE 34: NUMBER OF FULL-TIME JOBS



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

However, if the business owners who take profits instead of wages are added to the number of full-time jobs, the level of engagement in fishing and processing increases considerably, whereas the number of full-time jobs in wholesaling and export remains low.

FIGURE 35: NUMBER OF FULL-TIME JOBS INCLUDING BUSINESS OWNERS



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Number of wage/salaried hired jobs

Figure 36 shows the total number of hired jobs in FTE is 34 157 jobs or 85 percent of the number of wage and salaried jobs in FTE (i.e. 40 116 FTE jobs). As expected, fisher workers account for the majority (92 percent) of hired jobs in FTE, due to the need for boat crews.

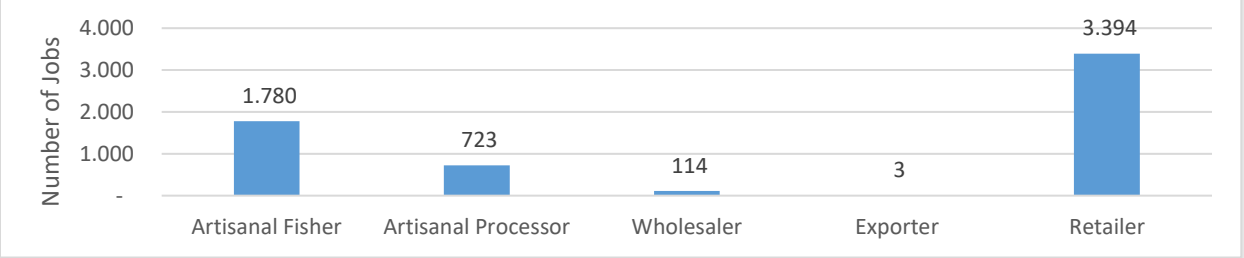
FIGURE 36: NUMBER OF HIRED JOBS IN FTE

Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Number of wage/salaried family labour jobs

Figure 37 shows the number of family jobs in FTE is 6 014 jobs or 15 percent of the total number of jobs in FTE. Retailers account for the majority (56 percent) of family jobs in FTE.

FIGURE 37: NUMBER OF FAMILY JOBS IN FTE

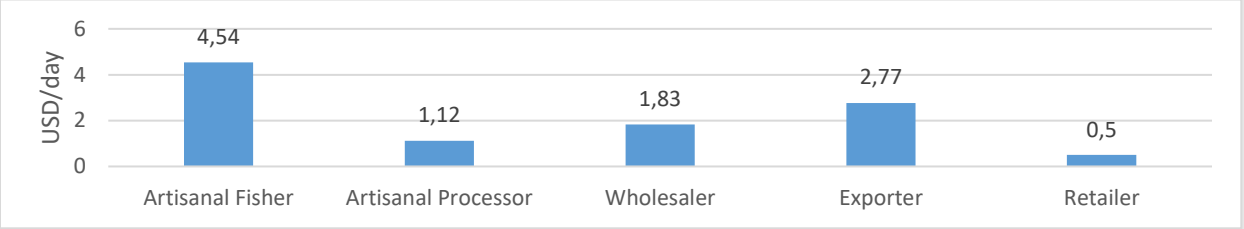


Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Average gross wage paid to hired workers

Figure 38 shows the average gross wage paid to hired workers.[42] Small-scale fisher workers receive the highest daily pay (USD 4.54), followed by exporter workers and wholesaler workers. Small-scale processor workers and retailer workers receive below the minimum wage of USD 1.66/day and poverty line of USD 1.35/day. Boat crews are paid based on a share of the catch and are paid higher due to the skills required and risks undertaken. Other hired labour in the value chain are generally unskilled labour, such as packers and porters, which is reflected in the lower wages paid.

FIGURE 38: AVERAGE GROSS WAGES PAID TO HIRED WORKERS (USD/DAY)

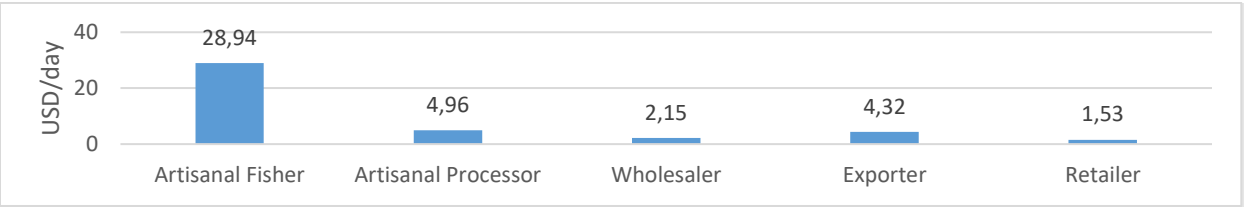


Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Average gross wage paid to family labour

Figure 39 shows the average gross wage paid to family labour and follows the same pattern as for hired labour, except all wages are higher. Small-scale fishers receive the highest income at USD 28.94/day and all other actor types receive above the minimum wage apart from retailers (who earn USD 1.53/day).

FIGURE 39: AVERAGE GROSS WAGES PAID TO FAMILY LABOUR (USD/DAY)



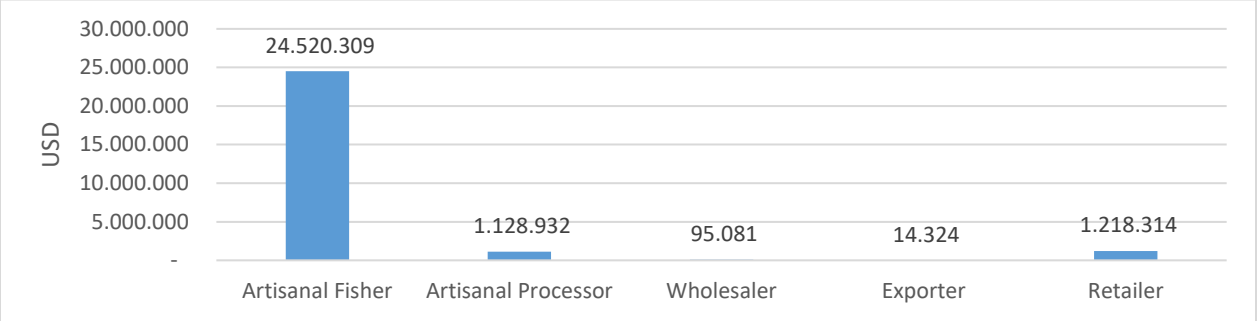
Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Total value of net wages

Figure 40 shows total value of net wages paid to salaried hired and family labour in the VC is nearly USD 27 million, with fisher workers accounting for 90 percent of the total net wages.

[42] Note that this differs from the average wages paid to family labour and hired workers as discussed in Figure 32.

FIGURE 40: TOTAL VALUE OF NET WAGES (USD)

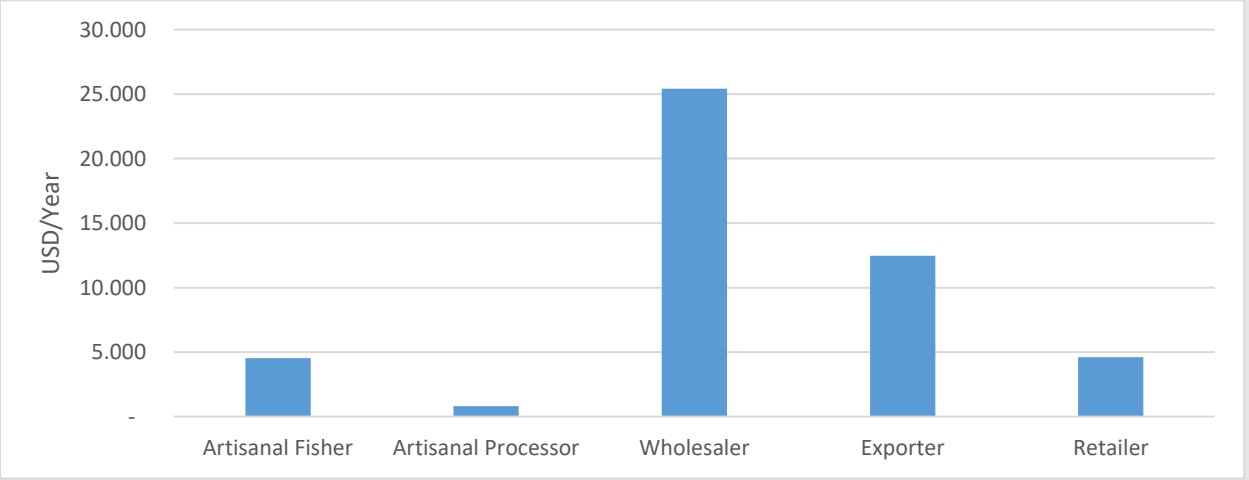


Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

3.1.3 Value added

According to FISH4ACP methodology, direct value-added equals the sum of gross operating profit (before paying taxes to the government) and labour cost (wages and salaries for workers). Figure 41 shows direct value-added at the individual actor level, with wholesalers providing the most and processors the least value-addition of all actor types.

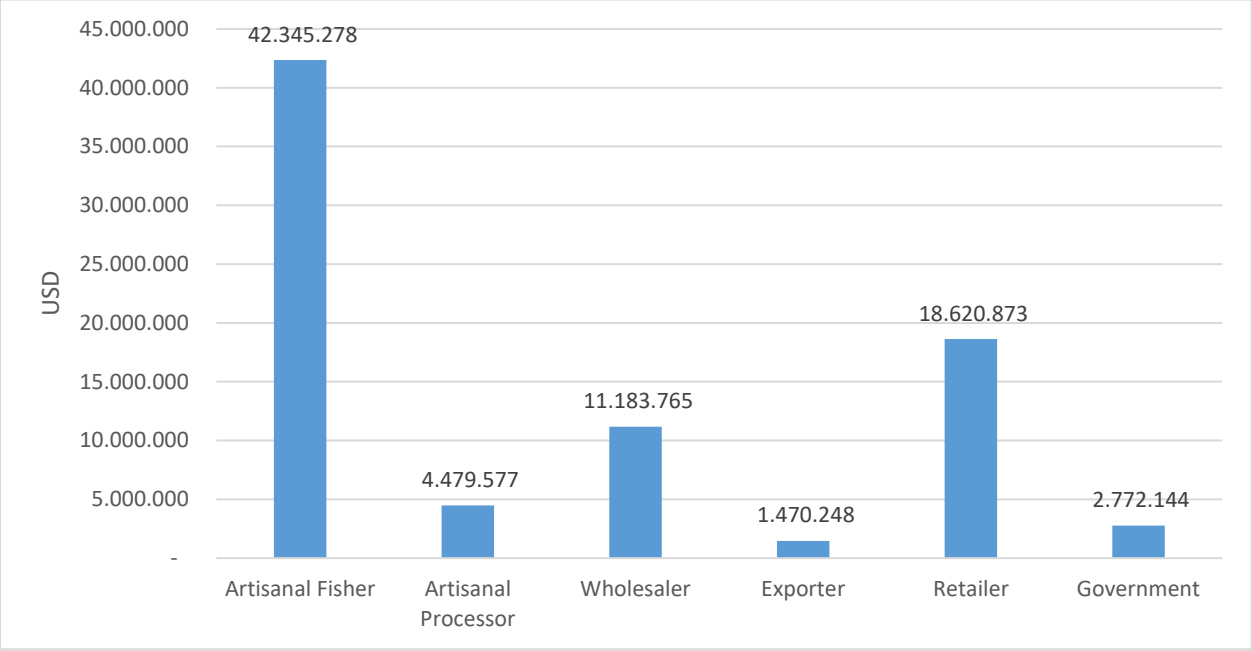
FIGURE 41: DIRECT VALUE-ADDED AT ACTOR LEVEL



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Figure 42 shows direct value added at the functional level of the value chain. Total direct value added of the whole VC is nearly USD 81 million/year. Due to the larger number of fishers, that segment of the value chain contributes the most (52 percent) to value addition overall. Overall direct value added is high at 63 percent of output (USD 128 million).

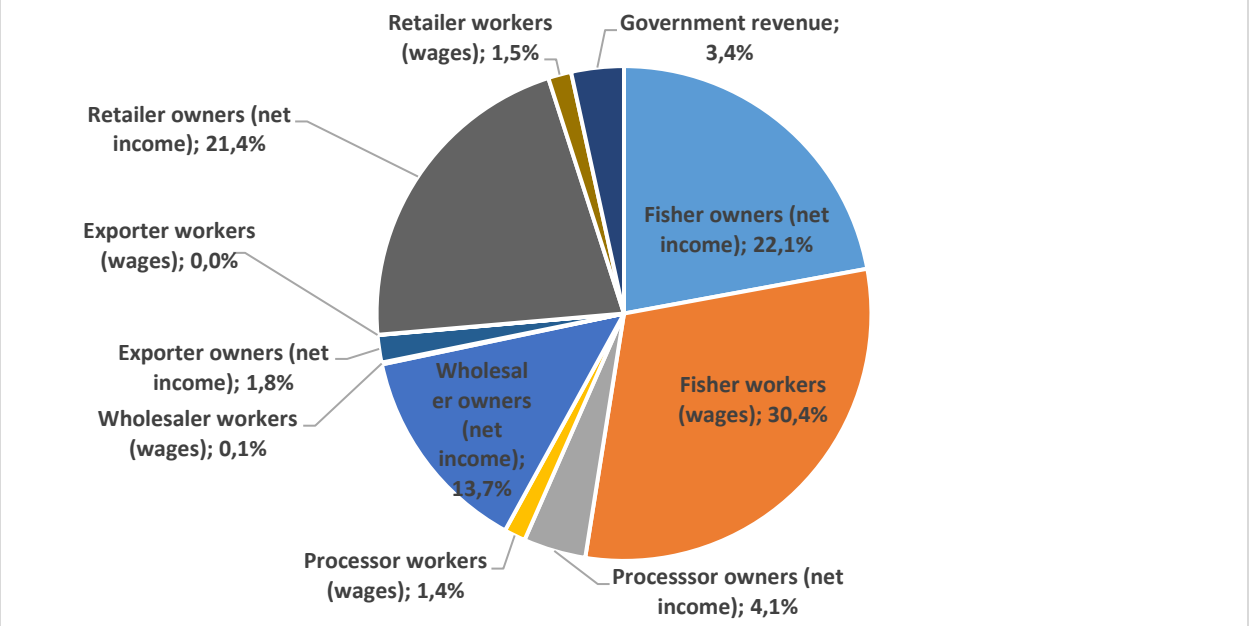
FIGURE 42: DIRECT VALUE-ADDED AT THE FUNCTIONAL LEVEL



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Figure 43 shows the distribution of value added amongst core actor types and their workers at the value chain level. Most of the direct value added generated in the VC is captured by fisher worker wages (30 percent) and fisher owners (22 percent) in the form of their net profits. All other workers only capture about two percent of value added.

FIGURE 43: DIRECT VALUE-ADDED DISTRIBUTION



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

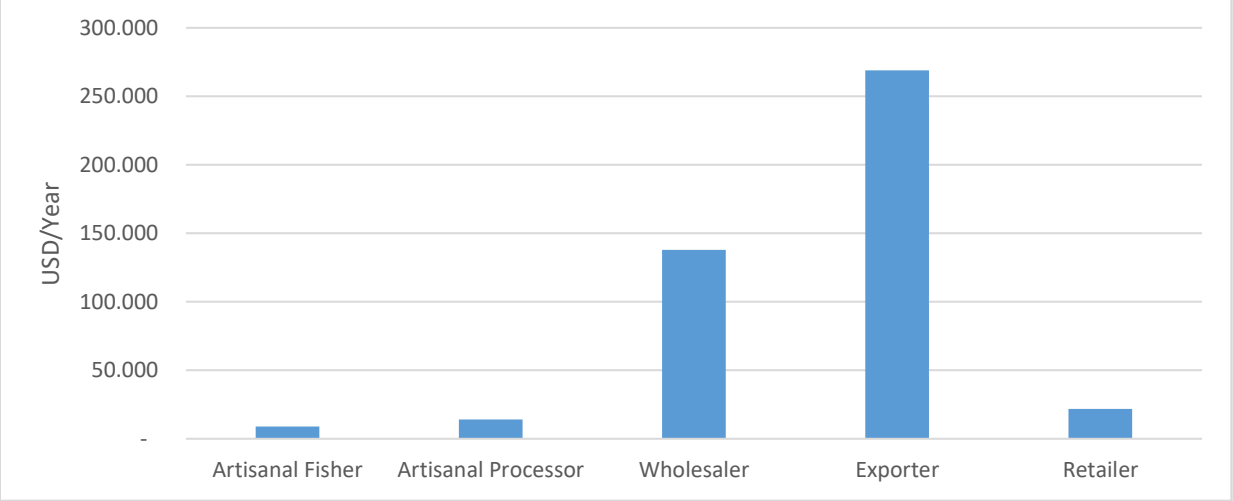
As no other cost items represent 20 percent or more of total costs, indirect value-added has not been calculated and direct value-added is the same as total value-added.

Total value of output

At the overall VC level, output is nearly USD 347 140 355.

Figure 44 shows output by individual VC actors across all actor types. Exporters produce the highest amount of output at nearly USD 270 000.

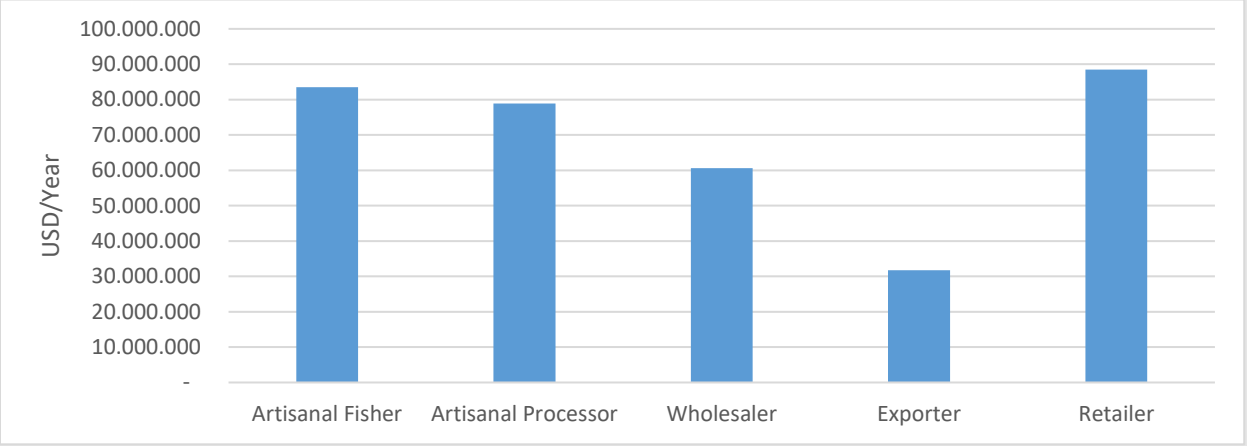
FIGURE 44: AVERAGE OUTPUT BY INDIVIDUAL VC ACTORS



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Figure 45 shows the value of output by actor types at the functional level. At functional level, output by actor types is reversed due to the inversely proportional number of actors. Fishers, processors and retailers all produce around USD 80 000 000 per year, whilst wholesalers and exporters produce USD 60 000 000 and USD 32 000 000 per year respectively.

FIGURE 45: VALUE OF OUTPUT BY ACTOR TYPES



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

3.1.4 Effects in the national economy

Based upon economic analysis carried out as part of this survey, total value-added for the VC is nearly USD 81 million/year, or over TZS 187 billion, at an exchange rate of TZS 2 315 / USD.

Contribution to GDP

According to the National Bureau of Statistics, total GDP in 2020 was TZS 148 522 billion (USD 64.2 billion), therefore the total value-added of the VC contributed 0.13 percent towards total GDP. Although this is not a significant contribution to national GDP, it is an important source of income and employment for the lake-side communities.

Contribution to Agriculture GDP

According to World Bank OECD national accounts data; agriculture, forestry, and fisheries GDP was valued at USD 16.7 billion in 2020, therefore the total value-added of the VC contributed 0.48 percent towards agriculture GDP. This is insignificant and is unlikely to change in the future as crops and livestock are the main contributors to agriculture GDP.

Contribution to Fisheries GDP

Based upon MLF data in 2017, current fisheries GDP is estimated at TZS 18 billion (USD 7.8 billion). Therefore, the total value-added of the VC contributed 1 percent towards fisheries GDP. As stated in Section 2.2.1, Lake Victoria sardine and Nile Perch account for 50 percent of fisheries output, dwarfing the contribution of Lake Tanganyika sprat, sardine and perch.

Net impact on the balance of trade

As there are only exports of the VC and no imports, the net impact on the balance of trade is positive

Rate of integration

As the VC has no imported consumables, the VC is 100 percent integrated into the national economy.

Net impact on public funds

Based upon economic data collected as part of this study, the VC pays a total of USD 2 616 849 in fees (boat and crew licences, processing licences, trading licences, market fees and export royalties) and USD153 898 in taxes (from operating profit). From interviews carried out, none of the VC actors received any direct subsidies, therefore the net impact on public funds is plus USD 2 770 746.

Contribution to national budget

The national budget for the year 2019/2020 was USD 15.14 billion (TZS 34.88 trillion). The VC contributes nearly USD 2.8 million towards the national budget through fees, licenses and taxes, which is less than one percent of the national budget.

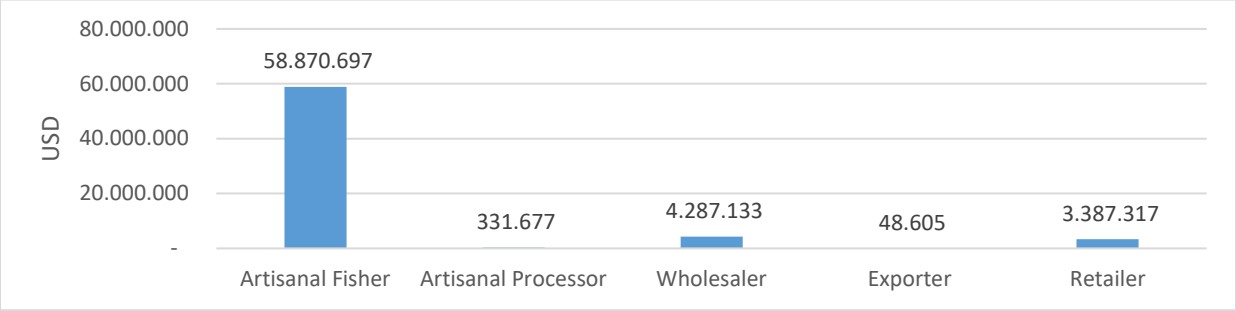
Contribution to the line ministry budget

The fisheries budget for the financial year 2020/21 was TZS33 billion (USD14 254 860). The VC contributes nearly USD 2.8 million through fees, licenses and taxes, or 19 percent towards the ministry budget.

Private investment

Figure 46 shows private investment, which is the combined value of all fixed assets at purchase, by actor type. Total investment is nearly USD 67 million with 88 percent of investment made by fishers. The majority of fisher investment is in boats, engines and fishing gear, which are the main fixed assets in the VC.

FIGURE 46: PRIVATE INVESTMENT IN THE VC



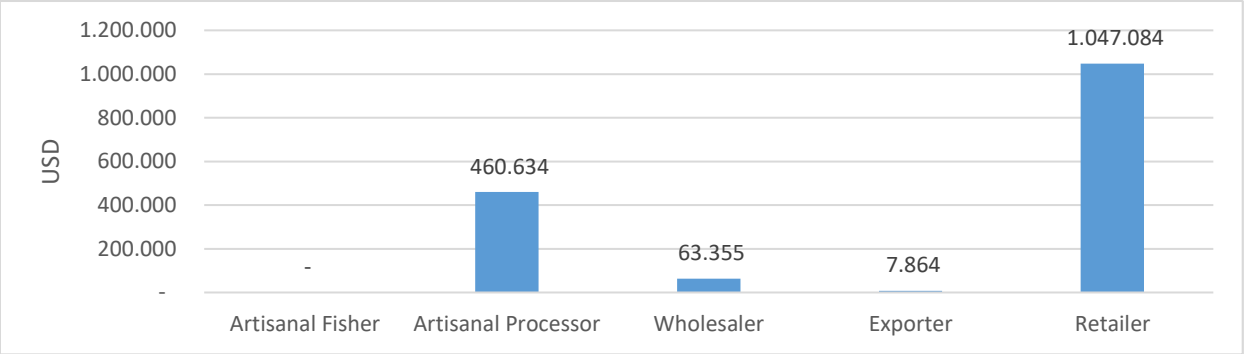
Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Investment borrowing

Data on borrowing was collected from a small sample of economic interviews, so does not represent the wider value chain. It is assumed there will be representatives of all actor types who have borrowed money, formally or informally, to fund their businesses.

Figure 47 shows approximately USD 1 500 000 of investment comes from formal and informal loans. From the small sample of economic interviews carried out as part of this study, no fishers had taken out loans, so no information is available for this indicator. All other actor types did, with retailers accounting for 66 percent of loans. All loans were for less than a year and taken to finance working capital, not investment. Total borrowing for the VC only accounts for two percent of total VC investment. Most VC actors interviewed as part of this study did not take out loans but financed their businesses through own savings.

FIGURE 47: INVESTMENT BORROWING IN THE VC

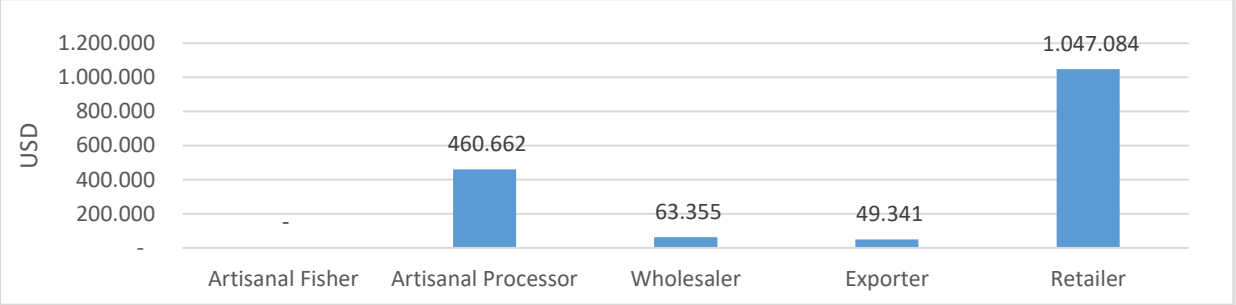


Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Total borrowing

Figure 48 shows total borrowing in a year based upon outstanding loans by actor type and covers formal and informal loans for investment and working capital. Total borrowing for all actor types is just over USD 1.6 million with retailers accounting for 67 percent of all borrowing.

FIGURE 48: TOTAL BORROWING IN THE VC

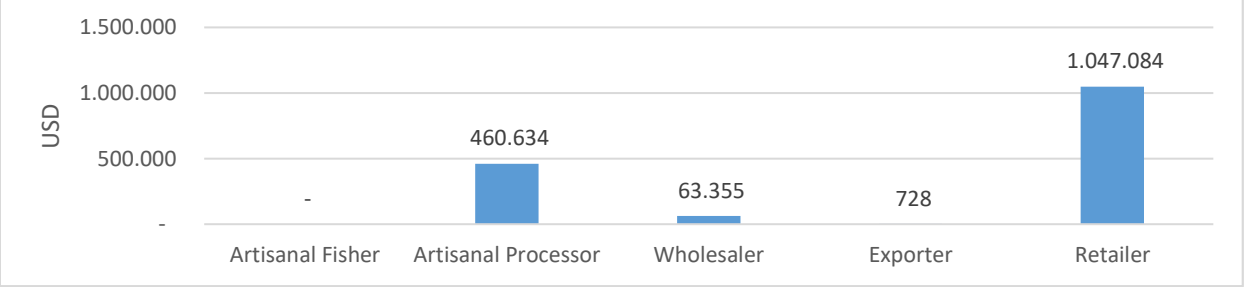


Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Formal borrowing

Figure 49 shows the amount of borrowing that comes from formal loans. As expected, retailers have borrowed the most from formal lenders such as the NMB Bank. As a total, formal borrowing accounts for USD 1.57 million, which is 99.5 percent of total investment borrowing.

FIGURE 49: FORMAL BORROWING IN THE VC



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

3.1.5 International competitiveness

Lake Tanganyika sprat, sardine and perch are exported to other countries around the lake but none are imported. However, for the purpose of comparing international

competitiveness, the import parity price for fresh perch from Zambia has been calculated in Table 8 below.

TABLE 8: IMPORT PARITY PRICE FOR LAKE TANGANYIKA PERCH

Item	USD/kg	USD/kg
Wholesale price of fresh perch in Mpulungu, Zambia	1.11	
Transport cost to Kigoma, Tanzania	0.23	
Export permit, health certificate, customs etc	0.17	
Import Parity Price Sub-total		1.51
Wholesale price of fresh perch in Kigoma, Tanzania		1.08
Nominal Protection Coefficient (NPC)		0.7

Note: Exchange rate USD 1 = TZS 2 315

Source: Fish4ACP analysis, August 2021

As seen in Table 8, the wholesale prices of perch in the respective countries are similar, however, once the costs of importing from Zambia are added, the Zambian fish becomes more expensive with an import parity price of USD1.51/kg, compared to a domestic price of USD1.08/kg. Therefore, the Lake Tanganyika perch from Tanzania is internationally competitive with a NPC of 0.7.

3.1.6 Value for end-consumers (domestic)

Consumer price benefit surplus

As seen in Table 8, Lake Tanganyika perch consumers in Tanzania pay similar prices to consumers in Zambia. However, when compared to the import parity price, consumers in Tanzania enjoy a price benefit surplus of USD0.43/kg (28 percent less than import parity price).

Number of annual food safety violations recorded in the VC

According to the interviews with MLF officials (2021), no records are kept for food safety violations. However, interviews with VC actors and other key informants (e.g. experts, officials) suggest that food safety and quality in the VC need to be improved.

Consumer evaluations of the different fish products

Table 9 evaluates perch and sprat/sardine according to five characteristics. Consumers scored perch positive for all attributes, whereas sprat/sardine scored neutral for all attributes apart from price, which scored very negative. As sprat/sardine is mostly consumed

after drying, the cost can be as high as TZS 24 000/kg, compared to TZS 8 000/kg for smoked perch.

TABLE 9: EVALUATION OF CONSUMER PREFERENCES FOR THE VC FISH

Product Characteristic	1 (very neg)	2 (neg)	3 (neutral)	4 (pos)	5 (very pos)
Taste					
Perch				**x**	
Sprat/sardine			**x**		
Price					
Perch				**x**	
Sprat/sardine	**x**				
Quality					
Perch				**x**	
Sprat/sardine			**x**		
Convenience					
Perch				**x**	
Sprat/sardine			**x**		
Nutritional Value					
Perch				**x**	
Sprat/sardine			**x**		

Source: FISH4ACP Consumer Survey, May 2021

Consumer preference relative to the five most direct substitute food products and prices relative to the four most direct substitute food products

Table 10 shows the VC fish ranked with substitute foods according to preferred taste. Beef was included as the most common non-fish protein substitute and prices have also been included. Sprat and sardine is the most expensive fish but only ranks fourth in taste preference. Emperor Cichlid is the most preferred fish for taste and is the second most expensive. Perch is the second most preferred fish for taste but is cheaper than four of the other substitutes. Catfish and Lake Victoria sardine rank low for taste preference and are also the cheapest substitutes.

TABLE 10: COMPARATIVE TASTE PREFERENCE AND PRICES FOR SUBSTITUTE PRODUCTS

Fish	Taste preference	Price (TZS/kg)
Giant Cichlid (*Boulengerochromis microlepis*)	1	15 000
Perch (*Lates stappersii*)	2	6 852
Tilapia (*Oreochromis tanganicae*)	3	8 000
Sprat/sardine (*Stolothrissa tanganicae/Limnothrissa miodon*)	4	16 000
Beef	5	7 000
Catfish (*Clarias gariepinus*)	6	4 000
Lake Victoria sardine (*Rastrineobola argentea*)	7	6 000

Note: Exchange rate USD 1 = TZS 2 315. Source: Fish4ACP Key Informant Interview

There is some correlation between taste preference and price. However, sprat/sardine is an anomaly as it is the most expensive fish but only ranked fourth for taste preference. This may indicate that although demand is not so high locally, it is in high demand elsewhere such as export markets, which drives the price up. By comparison perch is more preferred for taste but is cheaper, which may indicate a high supply locally.

3.1.7 Economic analysis overview

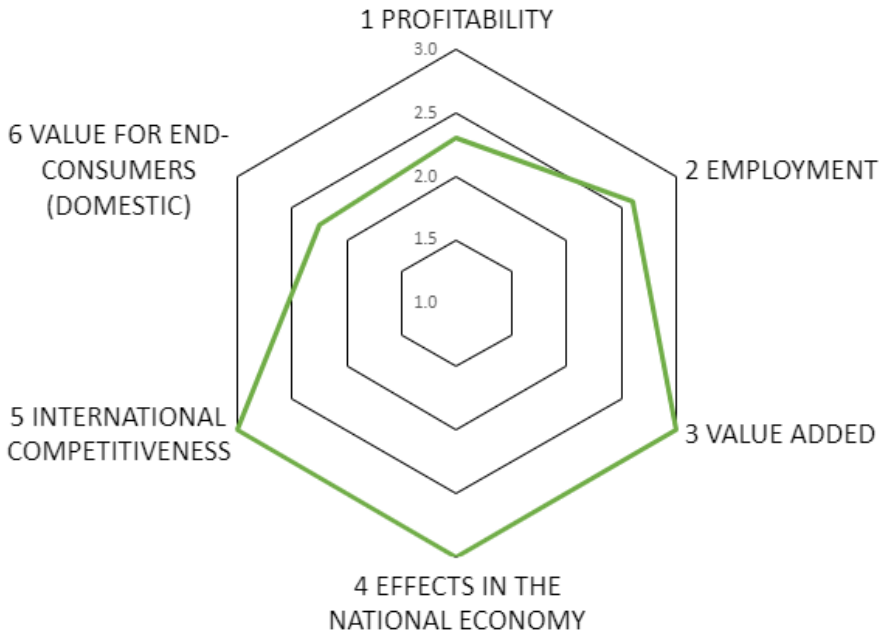
Based on the analytical assessment of economic performance as discussed above, and using the FISH4ACP economic picture tool, an overview of economic performance for the sprat, sardine and perch value chain is provided in Table 11Table 11 and Figure 50 below. A score in the range 1 – 3 (with 1 being "highly concerning" (red), 2 being "concerning" (yellow), and 3 being "not concerning" (green)) is given to each sub-domain of the six economic sustainability domains (i.e. profitability, employment, value added, effects in the national economy, international competitiveness, and value for end-consumers).

TABLE 11. ECONOMIC SUSTAINABILITY PERFORMANCE SCORES FOR THE VALUE CHAIN

1 PROFITABILITY		
Net income	3	Not concerning
Trend in net income	1	Highly concerning
Return on sales	2	Concerning
Return on investment	3	Not concerning (except processors)
Average	**2.3**	**Concerning**
2 EMPLOYMENT		
Number of jobs in FTE	2	Concerning
Number of fulltime jobs	2	Concerning
Number of wage labour jobs	3	Not concerning
Number of family/self-employed jobs	3	Not concerning
Average wage for hired workers	2	Concerning
Average wage proxy family labour	3	Not concerning (except retailers)
Total value of net wages	3	Not concerning
Average	**2.6**	**Concerning**
3 VALUE ADDED		
Direct value added at VC level	3	Not concerning
Total value added	3	Not concerning
Average	**3.0**	**Not concerning**
4 EFFECTS IN THE NATIONAL ECONOMY		
Contribution to trade balance	3	Not concerning
Rate of integration	3	Not concerning
Public finances impact	3	Not concerning
Contribution to investment	3	Not concerning
Average	**3**	**Not concerning**
5 INTERNATIONAL COMPETITIVENESS		
International competitiveness	3	Not concerning
6 VALUE FOR END-CONSUMERS (DOMESTIC)		
Food safety violations	2	Concerning
Consumer evaluation	3	Not concerning
Consumer preference	2	Concerning
Price relative to substitutes	2	Concerning
Average	**2.3**	**Concerning**

Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

FIGURE 50. ECONOMIC SUSTAINABILITY PERFORMANCE SCORES FOR THE VALUE CHAIN



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Key issues, recommendations, risks, and mitigating measures flowing from the assessment of performance are provided in Table 12.

TABLE 12. KEY ISSUES, RECOMMENDATIONS, RISKS, AND MITIGATING MEASURES – ECONOMIC SUSTAINABILITY

Key issues	Main recommendations
• Low profitability for processors and retailers and apart from fishers, the number of full-time remunerative jobs in the VC is low. • Returns on processing are very low, when compared to selling fresh or frozen fish and considering processing ratios. • Fish quality first starts deteriorating in the boat which can have a large impact on prices received all along the VC. • Comparatively high level of losses for wholesalers and exporters during transport and comparatively high level of losses for retailers during storage. • Fresh perch are preferred over all other fish except Emperor Cichlid for taste and are cheaper than many substitutes but a large proportion has to be smoked for preservation purposes. • In Rukwa, more fish are available and prices are lower.	• Improve processing technology to increase cost efficiency and quality e.g. electric dryers, smoking kilns. • Promote the use of ice in fishing boats. • Invest in cold storage and refrigerated transport to reduce losses for wholesalers, exporters and retailers. • Develop fresh and frozen perch market including processing into fillets and steaks. • Improve transport and market linkages from Rukwa to Zambia, Kigoma or other distribution centres in United Republic of Tanzania.
Main risks	**Mitigating measures**
• Reduced availability of fish from the lake. • The VC is a minor contributor to GDP, so is less likely to attract public investment.	• Improve sustainable fisheries management, including licenses and quotas. • Promote private investment in the VC and increase availability of formal borrowing

3.2 Social analysis (Social Profile)

3.2.1 Inclusiveness

Wage and employment distribution

Lake Tanganyika fishery is an important source of employment and income to many people within the basin. As discussed in section 3.1.2, it is estimated that there are over 130 000 people employed as wage and salaried labour in the VC, either as family labour or hired labour, and additionally over 19 000 self-employed business owners. However, due to the

prevalence of parttime employment, there are just over 40 000 wage and salaried jobs for workers in FTE terms, making up around one-third of the total number of jobs. Across all VC functions, most of the wage and salaried jobs are for hired labour; but family labour also contributes to the businesses. In terms of hired labour, over 90 percent of FTE hired jobs are generated by the fishing function, followed by around 4 percent by the retailing function and 3 percent by the processing function (calculated based on Figure 36Figure 36). Family labour is most common in the retailing and processing functions, making up 70 percent and 38 percent of the total numbers of FTE jobs in each function respectively (calculated based on Figure 36 and Figure 37). This distribution of hired and family labour is reflective of the gender distribution between VC functions, with women playing dominant roles in the processing function and active roles in the retailing function while other VC functions are dominated by men and have little to no involvement by women. The relatively low level of participation by women (as well as the elderly and disabled) in the VC as compared to men can be explained partially by the nature of many VC tasks which are physically demanding and most of the time requires spending the night in the boat and partially by the social-cultural norms restricting women, such as it is a taboo for women to go to the waters.

In terms of wages, female workers generally get lower daily pay than male workers in the VC. The women employed to work in retailing and processing as hired workers are among the lowest-paid workers in the VC, earning on average USD 0.5 to USD 1.12 per day(which is below the minimum wage of USD 1.66/day and the poverty line of USD 1.35/day) as opposed to the hired fishing workers and exporting workers who are male and earn USD 4.54 and USD 2.77 per day on average (see Figure 32). While VC actors, and even the workers, often attributed these wage differences to the differences in the nature of the tasks conducted by men and women (e.g. fishing is heavier and riskier than processing), the generally low level of wages for female workers is concerning.

Value added distribution

As shown from Figure 43 in section 3.1.3, almost all (nearly 90 percent) of the direct value-added generated in the VC is captured by fishing workers (30 percent), fishers (22 percent), retailers (21 percent) and wholesaler (14 percent). The relatively high shares of direct value-added captured by fishers and fishing workers are due to the higher level of profitability (return on sales) of fishing as compared to other VC functions and the high share of fishing workers in total employment. By contrast, processors and processing workers capture negligible shares of direct value-added (4 percent and 1 percent respectively), which is largely because processing is the least profitable function along the VC. This situation is concerning, as it shows women can capture very little benefit from the VC.

Additionally, government's share of direct value-added is low (3 percent). This reflects the informal nature of VC operations, with various taxes/fees (e.g. such as vessel license fees, fishing fees, fish trading fees, fish export levies, fines and permits of various sorts) not properly collected, leading to inadequate funds to properly manage the fisheries.

Poverty and vulnerability

Surveys with workers, processors, and fishers (with 128 workers engaged in different VC activities, 57 processors, and 55 fishers) show that workers and processors are from poorer households as compared to fishers, with nearly 80 percent of the workers and 60 percent of the processors indicated that their household income is TZS 200 000 (USD 86) or less per month as compared to 30 percent of fishers. Nevertheless, given the big household sizes (average 6-8 people), the economic situation of VC actors (including fishers) and workers is generally poor. Within the Lake Tanganyika region poverty can be measured by examining whether income earned by fisheries stakeholders can meet the basic needs required for maintaining a minimum standard of living. Furthermore, the retailing and the processing hired workers (mainly women) earn on average below the national minimum wage, which implies they may even be more economically vulnerable than other VC actors and workers. As a result, the majority (60 percent) of the surveyed workers and some interviewed VC actors reported to engage in other income generating activities such as dealing with other fish species, or engaging in farming or livestock production, or small shop businesses to earn additional incomes. According to VC actors and workers, this diversification of sources of income and livelihoods has contributed to reducing their levels of poverty and vulnerability, especially in the event of shocks.

Discrimination

Interview with VC actors revealed the existence of national policies and regulations prohibiting discrimination in the workplaces or employment.[43] Many actors also think that the laws are respected or enforced; but none of them could mention the specific regulation or policy. In addition, the VC actors do not have formal business level standards; but do have informal standards at their workplaces regarding non-discrimination of anyone seeking employment (such as giving opportunity to both men and women). However, they did indicate that there are some VC activities such as participation in fishing crews which are considered as not suited to women and elderly people because of its tedious or of physically demanding nature.

[43] Social interviews with VC actors, 2021

3.2.2 Gender equality

Women´s economic involvement

In the VC, women are mostly engaged in post-harvest activities (e.g. processing which is dominated by women [44], or retailing where women seem to have somewhat equal participation as men). Women are not part of any fishing crew, and there are very few women owning fishing boats. These are due to various reasons, including the social norms that fishing is a male business, the physically demanding nature of fishing tasks, as well as the difficulties facing women in accessing finance to buy boats and gears as opposed to men. In addition, much fewer women than men are employed as workers along the VC. In the survey of workers employed to work at different functions along the VC, nearly 80 percent are men. Interviews with VC actors also indicate a tendency to hire male rather than female workers across all VC functions, except for processing which involves relatively light tasks as compared to other functions. Of over 133 000 family labour and hired workers (people) employed to work in the VC as wage and salaried workers, it is estimated that just around 23 percent (or nearly 31 000) are women paid to do processing and retailing tasks. [45] Additionally, as their employment is mostly part-time, women' share in the total number of wage and salaried jobs in FTE terms is even lower, estimated to be around 10.5 percent for processing and retailing tasks (calculated based on Figure 32). In addition to their relatively low involvement in VC activities, women also get lower pay than men because their jobs are often considered lighter or easier than men's (as discussed in section 3.2.1).

When considering self-employment, women comprise nearly 40 percent of all the business owners along the VC, mostly as owners of processing businesses and some as owners of retailing businesses[46]. However, as processors' profitability level is the lowest among VC actors, the share of direct value added from the VC that is captured by women is low, i.e. around 17 percent, in the forms of profits (for female processor and retailer business owners) and wages for female processing and retailing workers.

Despite their relatively low levels of participation in and benefits from the VC, the interviewed female actors and workers generally perceive that they are not discriminated against when participating in the VC. While it may be considered reasonable that lighter tasks have lower pay, the fact that women generally get paid lower than men in the VC raises a concern that there may be some (rather discrete) form of discrimination against women, which women themselves are not fully aware of. During interviews, VC actors reported few incidences of

[44] Almost all processors and their workers are women. Around half of retailers and their workers are women.
[45] Almost all processing workers are female, and around half of retailing workers are female.
[46] Almost all processors are women, and around half of retailers are women.

potential discrimination at their workplaces, mostly about fishing crews refusing to pay back the cash that female traders or processors advance to them.

Expert interviews indicate women's important roles in the fisheries in the lake are usually unrecognized. Although women are not part of fishing crew, the fishing activities (by men) are heavily supported by women who provide logistical or financial support to fishing trips, for example through pre-financing some costs or providing food for fishing crew. As all these support arrangements are informal and not legally binding, these women also run the risk of not getting paid by fishers, as is the case often reported in interviews with female processors. Additionally, many women help to mobilize fishers to register for fishing licenses and support the payment of fishing licenses. When it comes to processing, women play a dominant role, thereby also taking most of the risks associated with processing (such as fish spoilage due to rain or poor storage). At home, women are responsible for household chores, taking care of the family when their fisher-husbands go fishing. All these activities undertaken by women are crucial to the functional of the value chain; but women do not receive proportionate recognition for their participation.

Notably, there are indications of sexual harassment/exploitation in the VC, whereby female processors can only obtain fish or get back the money they advance to fishers in exchange for having sex or other forms of sexual relationships with fishers. This sexual exploitation was indicated by only a few female processors included in the interviews conducted under FISH4ACP, but it was probably because this is a sensitive issue that women often hesitate to mention. Concerns about sexual exploitation and the consequences of this issue, such as vulnerability to HIV/AIDS, are shared by a social development officer in Kigoma who was also interviewed under FISH4ACP. At the national level, fishers and communities in landing sites are identified as high-risk groups that are highly vulnerable to HIV/AIDS (Ministry of Health, Community development, Gender, Elderly and Children, 2017). While sexual exploitation of women is a well-recognized social issue in other regions, such as Lake Victoria, the prevalence of this issue in Lake Tanganyika is less well-studied. It is, therefore, important to conduct a more in-depth study to obtain better understanding of this topic, as well as other social constraints in the Lake Tanganyika sprat, sardine, and perch value chain.

Gendered division of labour

Societal traditions have restricted women equal participation in sprat, sardine, and perch value chain activities. Although there are no reports of gender discrimination in business licensing or registrations (as licenses are issued to anybody who meet the legal requirements), women's participation in the VC – either as business owners or workers – is restricted to post-harvest activities; and women are not actively engaged in fish harvesting (as men do). Even in post-harvest activities, women also do not spend much time as men do in their harvest activities. Instead, women are found to spend much more time than men on performing household chores (such as cleaning the house, cooking, cloth washing, water

fetching, farming and looking after the children), which are traditionally considered as entirely women's responsibilities. On the other hand, men are indicated to only engage in bush clearing. Gender stereotypes sometimes also impede women from getting equal pay as men when performing similar jobs. For example, women claimed that men get the higher wages as they do for carrying bucket or boxes of dagaa and perch.

Gendered access to productive resources

The national land policy as well as other legislative documents calls for equal opportunity for all gender in accessing resources. However, according to many women interviewed under the conduct of the VC analysis, this is not the case. These female respondents indicated that they do not have ownership over land as men do. Traditionally, land has been owned and controlled by men, and the transition to ensure equal opportunity on land ownership is slow. This, in turn, prevents women from having access to formal financial services which require ownership of assets (e.g. land) to be provided as collaterals. Due to the lack of access to formal credits, women are more often involved in informal saving schemes, as opposed to men whose participation in these informal groups is low. In terms of non-financial services, it is also suggested from interviews that there are few women having access to these services.

Women´s decision-making and leadership

Women have limited roles in decision making and leadership in the sprat, sardine, and perch value chain in Lake Tanganyika. In many decision-making organs like BMUs, the number of women is generally low with majority of them holding lower positions than male members. In addition, nearly 60 percent of women who were interviewed during workers survey indicated that their husbands make unilateral decisions on how to spend household income. This may imply that women are also not involved in making decisions related to the purchase and/or utilization of assets by the family.

3.2.3 Food and nutrition security

Availability of food

Annual statistics report of 2019 by the MLF documents that fish provides around 30 percent of the animal protein consumption in United Republic of Tanzania. In the regions around Lake Tanganyika, fish contribution is even higher, with the consumer survey in 2021 indicating that perch constitutes over 50 percent of the household animal protein intake in two-thirds of the surveyed households.[47] However, discussion with experts revealed that fish production from Lake Tanganyika does not meet the national demand.[48] The availability of Lake Tanganyika sprat, sardine and perch varies largely between the three regions around

[47] Meanwhile, the contributions of sprat and sardine are smaller. Specifically, sprat is indicated to contribute up to 25 percent of household animal protein intake in nearly 90 percent of the interviewees, while sardine had the least contribution (up to 5 percent contribution in over 80 percent of the interviewees).

[48] MLF official interview, 2021

the lake and other regions in United Republic of Tanzania. Around the lake, sprat, sardine, and perch are largely available throughout the year, as indicated by around 60 percent of the surveyed consumers. However, this view is not held by the surveyed consumers outside of the lake region, who perceive the supply of these fish products is inconsistent throughout the year. This may be largely attributed to poor road transport network to and from Lake Tanganyika region. Also, when the Lake Tanganyika sprat, sardine and perch harvest becomes low, traders tend to avoid transporting the products to other Regions.

Accessibility to food

Over 90 percent of all the surveyed consumers (in regions around the lake and in Dar es Salaam) indicated to consume sprat, sardine, and perch. However, despite being available in the regions around the lake, the prices of these fish products, especially sprat and sardine, are considered high for low income earners and thus unaffordable (or inaccessible) to them.[49] Particularly sprat and sardine are priced relatively high as compared to perch, which may largely explain why among the surveyed consumers, around two-thirds indicated that their households use perch as a main[50] source of animal protein, whereas only 3 percent and 13 percent of the consumers indicated so with sardine and sprat.

Utilization of food

Around 98 percent of the surveyed consumers indicated to consume sprat, sardine, and perch; and nearly 90 percent indicated that they consume the fish at home. Most (60 to 80 percent) of the surveyed consumers find it convenient to prepare sprat and perch, while the opposite applies to sardine, with around 70 percent of the surveyed consumers finding it inconvenient to prepare this fish. Further consultations with fisheries experts and consumers revealed that the dominant methods of preparing fish (sprat, sardine, and perch) are frying and smoking, which are somewhat unhealthy as they involve using a lot of oil and producing harmful substances. Additionally, from the consumer survey, it appears that the nutritional benefits of sprat and sardine are not well-acknowledged by the consumers, with consumers, on average, being neutral about the health and nutrition benefits of these fish. This is different from perch, which was largely perceived by the survey consumers as healthy and nutritious (as discussed in section 3.1.6). These findings imply there may be a need for more educational and awareness raising programs to introduce the consumers to the nutritional benefits of the small fish such as sprat and sardine as well as methods to prepare these fish products in a healthier manner.

[49] Interview with quality control and fisheries resources market expert 2021

[50] This means perch contribute 50 percent or more to the household's total animal protein intake.

Stability

The prices of Lake Tanganyika sprat, sardine and perch products have steadily increased over the years but also fluctuate between seasons, depending on availability. Specifically, the prices of sprat, sardine, and perch – in both fresh and processed forms - in low season are two to three times higher than those in high season in Kigoma and Katavi regions. Fluctuations in Rukwa region are much less pronounced as catches do not vary as much between seasons.

3.2.4 Decent employment

Respect of labour rights

The United Republic of Tanzania constitution of 1977 and amendment of 1984 and the Employment and Labour Relations Act of 2004 and the amendment of 2006 provides for labour rights, including rights of employees for collective bargaining through trade unions. Focus group discussion with workers across all VC activities, however, revealed the lack of trade unions along the VC. Nevertheless, 60 percent of workers indicated that their employers do not restrict them from collaborating with other workers. On average, the male workers in the VC work for 8 to 10 hours/day for 5 days/week, as compared to 6 hours/day for 5 days/week for women. These working hours are thus generally in line with legal working hours postulated in the Employment and Labour Relation Act No.8 of 2006 article 19(2), which is 5 days a week and 9 hours a day, or 45 hours a week. It was also noted from the focus group discussion with both male and female workers that women are the ones who deal with household chores such as cleaning, cooking, and taking care of young children. They also get involved in non-value chain related economic activities especially small-scale farming. In terms of contracts, none of the workers have written contracts, as indicated from the worker survey and actor interviews conducted in 2021. The absence of written contracts in the VC indicates the highly informal nature of the VC operations. In addition, the worker survey reveals concerns regarding safety at the workplaces, with workers indicating that they are not provided with basic safety equipment as lifejackets, aprons, gumboots, and gloves while conducting their tasks.

Child and forced labour

Interviews with VC actors and social experts revealed a low level of child employment in the chain activities. Although 25 percent of the VC actors indicated to sometimes use family labour, including children (under 14 years old) in their activities, this engagement is not considered as employment as the tasks are light duties and done after normal school hours. In addition, there were no sight of child labour during field visits, as also reported by 60 percent of the surveyed workers. However, 5 percent of the workers (out of the 128

interviewed) reported to have experienced forced labour at their workplaces[51], for instance the employer "just care about money" and thus, can force them to work even if they do not feel good or if the conditions are not suitable to do so (e.g. fishing workers are forced to go fishing even in bad weather conditions).

Job safety and security

There are agencies responsible for health and safety standards monitoring at workplaces[52]. However, interviews with VC actors revealed that these agencies are more concerned with food safety issues, with only Tanzania Shipping Agency (TASAC) being more concerned with the safety of fishing boats and crews/the workers. Consultations with VC workers indicated there are hardly any life-threatening injuries or accidents at their workplaces, except those working in the fish harvest sector who experience heavy storms. No deaths have been reported during interviews; but VC actors workers indicated to suffer from moderate illnesses (e.g. back pain, chest pain, headache) that they claimed to be due to their VC related activities. Results on employment turnover shows that male employees stay longer in jobs compared to female ones (91 percent of interviewed men have spent more than 10 years, as compared to 53 percent of the women interviewed).

Job attractiveness

Survey results show that over 40 percent of the workers in VC activities are dissatisfied with the terms and conditions under which they are employed to work. In addition, around two-thirds of the surveyed workers consider the wages they get to be unfair and uncompetitive compared to the work they do. Notably, from the focus group discussion with workers, it is revealed that the workers' perception of unfair remuneration is mostly associated with the way incomes/profits are shared between the workers and their employers (the business owners), rather than between the workers themselves (e.g. women as compared to men workers). In addition, the use of technologies to reduce manual work is generally low, with the only evident use of relatively new technologies reported by fishers[53] other activities are still manually conducted. Despite these shortcomings of existing employment opportunities in the VC, interviews with VC actors suggest that the interest in working in the VC has been increasing, including among youths, for various reasons. These include: (i) VC-related businesses are often passed on to the next generations, and many youths believe fishery business can be successful; and (ii) people are interested in any income-generating activities because there is a general lack of employment opportunities in the lake regions, which in turn is partially attributed to the low level of education among the local communities.

[51] Forced labour is defined as "all work or service which is exacted from any person under the threat of a penalty and for which the person has not offered himself or herself voluntarily"

[52] For instance, Tanzania Shipping Agency (TASAC); Fisheries department, Health and environment department of local level councils

[53] Such as the use of motorized boats in fish harvesting.

3.2.5 Social and cultural capital

Collective action

There is hardly any formal collective bargaining by the VC actors. However, there exist rather informal groups that share information about resources, advocate for their rights and lobby for changes. Through these groupings, VC actors have been able to negotiate with the government about reducing some levies on fishery product. For example, the interviewed actors indicated that they successfully negotiated for a reduction of royalty charged on fish exports for a kilogram of sprat from USD 1/kg to USD 0.3/kg. In addition, fishers can now use a fishing license obtained from one district for fishing across regions in the lake, as opposed to the previous situation where license was district specific.

Coordination of transaction

The results from functional analysis interviews indicated that over 80 percent of the interviewed VC actors do business with their customers through spot market transaction with the remaining indicating to also have verbal contracts with buyers. In addition, over 70 percent of the interviewed VC actors indicated to have good access to markets with high demand for sprat, sardine, and perch products both within the lake regions and beyond. In the meantime, many other actors indicated that they face difficulties in finding markets and customers and that their markets have been declining. This is the case of over 30 percent of the surveyed small-scale fishers. As already described in section 2.4.1, there is a good level of collaboration between VC actors and their customers and input/service providers (vertical linkages).[54] These relationships and collaborations are centred around sharing costs of production/processing and transportation of products, sharing technical (production/processing) and market information, and sometimes advancing payments (provided by buyers to sellers) or products (provided by sellers to buyers). The interviewed VC actors generally consider the relationship as trustworthy and collaborative, except for the few actors who indicated to have experienced issues related to products not being delivered or having low quality from their suppliers.

Social cohesion

Nearly 70 percent of the VC actors who responded to social sustainability questions[55] indicated to periodically contribute to decision and policy making processes that affect the VC, while over 30 percent do not contribute to decision making at all. In addition, few actors believe that VC-related policies are drafted in a participatory manner because the frequent use of representatives in decision making is not effective in reaching out to majority of people as some of these representatives do not disseminate information to the wider fisher communities. As already mentioned in section 2.4 on vertical and horizontal linkages, there

[54] Based on social actor interviews and focus group discussions.

[55] 29 VC actors were interviewed using this set of questions which focuses on social sustainability issues.

is a good level of networking and information sharing between VC actors. These relationships range from sharing marketing information, lobbying on changes in levies and licenses, to lending money and advancing of products or payments. In addition, VC actors reported to have good collaboration with public sectors with whom they interact with.

Cultural traditions

The VC has strengthened positive aspects of the sociocultural norms, while at the same time contributing to the improvement of other sociocultural aspects and to the transition from traditional methods to improved methods that are more effective and ensure better quality products. Over 50 percent of the interviewed VC actors perceive the VC as supportive of traditional beliefs, knowledge, and practices. For example, fishers think that the use of traditional boats enhances their traditional beliefs while small-scale processor's view fish smoking as a traditional processing method that portrays community culture. Smoking is also considered important to adding flavour to perch. Meanwhile, according to actor interviews, the VC is considered to have positive impacts on gender equity in the riparian communities as it challenges the traditional gender norms that fisheries-related jobs are merely for men and that women's main role is to take care of the family and household chores. Women are now actively engaged in post-harvest activities in the VC and a few also owning fish boats. This was not experienced before. In addition, VC-related activities have provided youths with job opportunities. The processing of sprat, sardine and perch has helped improve the shelf-life of these products; but general consumer perception (based on consumer survey) is that there are still moderate concerns about the safety and quality of these products, mainly due to the poor traditional processing methods for sprat and sardine (especially sand drying). These concerns seem to have driven up the demand for higher-quality products in recent years, as suggested by VC actors. [56] This increased demand, in turn, creates incentives for VC actors to adopt improved fish processing methods. However, there are still very few processors using improved technology (which is due to various constraints as discussed in previous sections in the report).

3.2.6 Institutional strength

Policy and regulations

Fisheries management in United Republic of Tanzania, including Lake Tanganyika fishery is through the Fisheries Policy of 2015, Fisheries Acts No. 22 of 2003, Fisheries Regulations of 2009 and its amendment of 2020 (as already discussed in section 2.3.3.1). Over 50 percent of the VC actors participating in the social actor interviews reported that these policies or legislative frameworks are supportive of their business because they provide a mechanism for licensing VC-related activities and describe the requirements and rules for doing

[56] Functional analysis actor interviews, 2021

businesses. In terms of compliance with policies and regulations, while all (100 percent) small-scale fishers participating in the social actor interviews reported to have fishing licenses, interviews with MLF officials suggest that the number of fishers operating without licenses can be around 50 percent. Additionally, just over 20 percent of the interviewed small-scale processors claimed to have license. The implementation of licensing regulations, therefore, is considered as generally ineffective. Apart from licensing compliance, consultations with MLF officials also reveal that there still exists some weaknesses in implementing other parts of the regulations, partly due to financial constraints and inadequate staff.[57]

Access to finance

Survey and actor interviews results indicated that access to financial institutions is still a challenge to VC actors, with just over 20 percent of the interviewed fishers and 45 percent of all the interviewed VC actors reported to have bank accounts.[58] However, VC actors appear to have much better access to mobile banking services. For instance, nearly one-third of the interviewed fishers who do not have any bank account indicated that they save their money in mobile bank services. Instead of obtaining financial resources from financial institutions, VC actors are able to generate funds from their own savings and friends, as well as from informal savings and credit schemes around the landing sites. Those VC actors with bank accounts can access bank loans, but just few of them choose to do so due to the high interest rates and complicated lending procedures associated with bank loans. Interviews with financial service providers revealed that their loans are automatically insured to cover any risk that may occur with defaulting. Moreover, they also require the borrower to present a collateral, and they also visit the place where the house or land pledged as security is located. Some informal savings groups also have mechanisms for ensuring that loans advanced to members are paid back through having weekly meetings where members repay back the loans. In addition, they form collateral groups of five members for quick monitoring of loans.

Access to natural resources

The National Land Policy focuses on promoting a secure land tenure system, encouraging the optimal use of land and the facilitation of broad-based socio-economic development without endangering the ecological balance of the environment. In United Republic of Tanzania, all land belongs to the public, but is vested in the President as trustee for and on behalf of all citizens. Response from VC actors indicated that land is accessible to all citizens irrespective of the gender and socio-economic status in the community. For VC actors, access to land for drying dagaa is obtained through using their own land or through renting and leasing while access to water or fisheries resources is through licensing. The cost for renting

[57] Key informant interview with Ministry officials

[58] Banks where fishers have accounts are National Microfinance Bank (NMB) and Cooperative and Rural Development Bank (CRDB)

is based on landlord and tenant agreement, which is in line with the land policy.[59] Renting cost averaging between TZS 210 000 to TZS 300 000 /year (USD 91 – USD 130/year) is within the reach of many tenants. In addition, part 4.2.6 (1) of the policy guarantees women to acquisition through purchase and distribution by state. However, under customary land law, village councils are guided by customs and have continued to discriminate against women by allocating land to heads of households who are usually men. The issue of access to land is of particular relevance to processors who need land to dry/smoke fish. Especially for the many processors who reside outside of the fish landing site areas and travel to the lakeshore every day to process fish, it is difficult to dry fish on the racks because they must rent drying racks or use portable racks. Consequently, lack of access to land contributes to the prevalence of drying fish on the ground.

Fishers also require a license to access fisheries resources. It should be noted that before being granted access, fishers must obtain approval by the BMUs that their fishing activities is not contravening the fisheries regulations (e.g. not using illegal fishing gears). Other actors such as traders also access fish and fishery products through trading license.

Access to information

Access to information is key to providing necessary tools for resource management. However, in the case of the Lake Tanganyika sprat, sardine, and perch VC, there is a general lack of important fisheries information such as fishing effort and capacity. Findings shows that these data were collected in 1990s and 2011 respectively.

In terms of sources of information accessible to VC actors, the interviewed actors shared to receive technical information (e.g. for fishing, processing) from different sources. For example, 60 percent of the interviewed VC actors[60] access technical information from fisheries extension officers while the remaining 40 percent from fellow actors, customers, and family members. This is different from surveyed respondents (55 fishers and 57 processors) where the majority indicated to receive technical information from fellow actors. In terms of market information, customers and fellow actors are the main source of information for the VC actors, as indicated by around 60-70 percent of the surveyed fishers and processors. While fisheries extension officers were suggested to offer market information to around one-quarter of the surveyed processors, they are not active among fishers, with almost all surveyed fishers indicating they receive market information from other sources. Other potential sources of market information (such as NGOs, media, BMUs) are rarely used.

[59] In the National Land Policy, part 4.1.1 (1) (c) states that ´the rights and interest of citizens in land shall not be taken without due process of law´ and (d) calls for full, fair and prompt compensation when land occupied by an individual is taken for other purposes.

[60] 29 actors were interviewed on issues related to social sustainability.

However, a large (nearly 40 percent) share of the surveyed fishers indicated that they did not receive technical information, and for processors, over 10 percent of the surveyed indicated so. As for market information, around 5-10 percent of the surveyed fishers and processors indicated that they did not receive market information. Furthermore, there is general feeling among the VC actors that the information they received is not sufficient for them to effectively conduct their VC activities. In the surveys, over 60 percent of the fishers and over 80 percent of the processors stated that they need further training. This implies concerns related to the technical trainings currently provided, as well as a need for further training on improved fishing and processing skills and methods.

3.2.7 Social analysis overview

Based on the analytical assessment of social performance as discussed above, and using the FISH4ACP social profiling tool, an overview of social performance for the sprat, sardine and perch value chain is provided in Table 13 and Figure 51Figure 51 below. A score in the range 1 – 5 (with 1 being "highly concerning" and 5 being "not concerning")[61] is given to each sub-domain of the six social sustainability domains (i.e. inclusiveness; gender equality; food security, safety and nutrition; decent employment; social and cultural capital; and institutional strength).

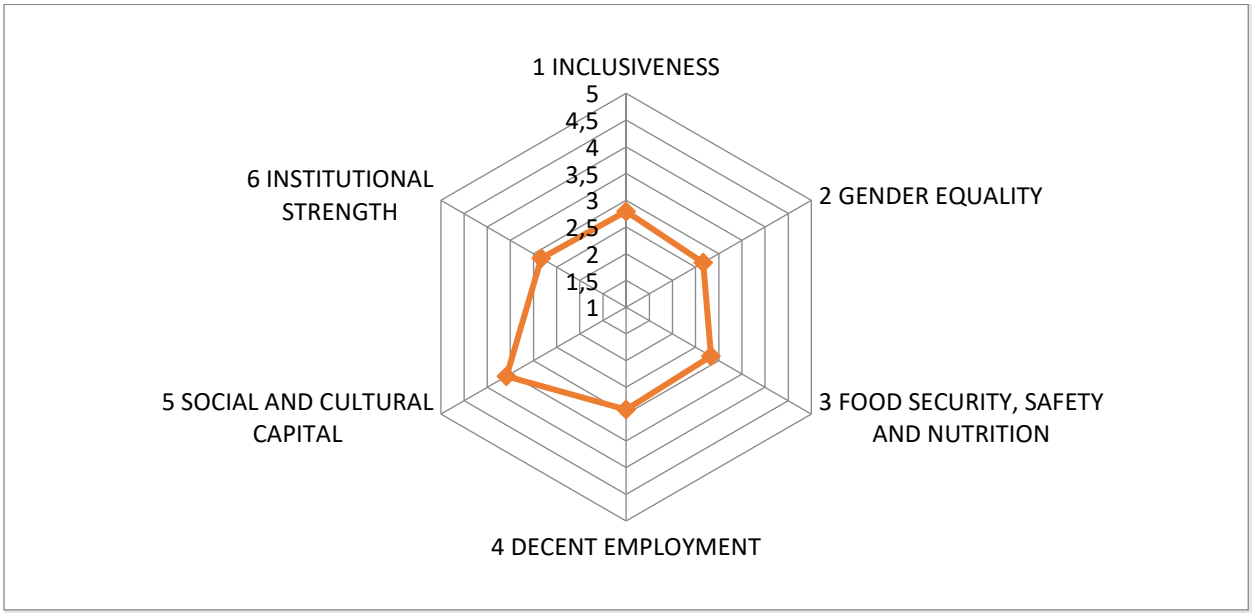
[61] The score range (1 – 5) refers to: very concerning (< 1.5, and has red color), concerning (≥1.5 and <2.5, orange color), moderate concerns (≥2.5 and < 3.5, yellow color), minor concerns (≥3.5 and < 4.5, light green color), and no concerns (≥4.5, dark green color).

TABLE 13. SOCIAL SUSTAINABILITY PERFORMANCE SCORES FOR THE VALUE CHAIN

1 INCLUSIVENESS		
1.1 Wages and employment distribution	2.67	Moderate concerns
1.2 Value added distribution	2.50	Moderate concerns
1.3 Poverty and vulnerability	3.33	Moderate concerns
1.4 Discrimination	2.67	Moderate concerns
Average	**2.79**	**Moderate concerns**
2 GENDER EQUALITY		
2.1 Women's economic involvement	2.33	Concerning
2.2 Gendered division of labour	2.33	Concerning
2.3 Gendered access to productive resources	2.33	Concerning
2.4 Women's decision-making and leadership	3.33	Moderate concerns
Average	**2.58**	**Moderate concerns**
3 FOOD SECURITY, SAFETY AND NUTRITION		
3.1 Availability of Food	2.33	Concerning
3.2 Accessibility of food	3.00	Moderate concerns
3.3 Utilisation of food (nutrition, safety)	3.33	Moderate concerns
3.4 Stability of food (trends)	2.67	Moderate concerns
Average	**2.83**	**Moderate concerns**
4 DECENT EMPLOYMENT		
4.1 Respect of labour rights	2.67	Moderate concerns
4.2 Child and forced labour	4.00	Minor concerns
4.3 Job safety and security	2.33	Concerning
4.4 Job attractiveness	2.67	Moderate concerns
Average	**2.92**	**Moderate concerns**
5 SOCIAL AND CULTURAL CAPITAL		
5.1 Collective Action (horizontal linkages)	3.00	Moderate concerns
5.2 Coordination of transactions (vertical linkages)	3.67	Minor concerns
5.3 Social Cohesion	4.00	Minor concerns
5.4 Cultural Traditions	3.67	Minor concerns
Average	**3.58**	**Minor concerns**
6 INSTITUTIONAL STRENGTH		
6.1 Policy, regulations, and standards	3.33	Moderate concerns
6.2 Access to finance	2.33	Concerning
6.3 Access to natural resources	3.00	Moderate concerns
6.4 Access to information	2.67	Moderate concerns
Average	**2.83**	**Moderate concerns**

Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

FIGURE 51. SOCIAL SUSTAINABILITY PERFORMANCE SCORES FOR THE VALUE CHAIN



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Key issues, recommendations, risks, and mitigating measures flowing from the assessment of performance are provided in Table 14.

TABLE 14. KEY ISSUES, RECOMMENDATIONS, RISKS, AND MITIGATING MEASURES – SOCIAL SUSTAINABILITY

Key issues	Main recommendations
• Unequal income among VC actors and workers, especially between men and women • Unequal division of roles between men and women • Limited number of women holding decision making positions • Unstable supply of fish throughout the year and in different regions in United Republic of Tanzania • Absence of formal work contracts • Absence of health and safety standards for VC workers • Women having limited access to land • Lack of access to financial services by both male and female actors in the VC	• Sensitization on gender equality would be necessary to tackle gender norms that disadvantage women. • There is a need to put up mechanisms to improve on the contracts or agreements between boat owners and fishing crew as well as between fishers and traders/agents. • There is need for Non-Governmental Organizations (NGOs) and Community Based Organizations (CBOs) working in the fishing communities to create awareness to fishers on the importance of enrolling in social protection schemes. • Education and training on entrepreneurial skills is also required by many youths and women • Improvement of the VC's efficiency to improve the stability of supply • Suitable financing mechanisms with conditions reflective of the fishery should be instituted to enable fishers acquire required fishing gears and expand their business. • Special measures (e.g. social protection) and platforms/organizations (e.g. TAWFA) should be created, established, or strengthened to cater for challenges faced by women in the fishery
Main risks	**Mitigating measures**
• The lake has huge potential but lack of proper facilities for handling and processing fish could hinder the economic importance of the fishery as well the livelihood of the dependent communities • Additional benefits from improving the VC may benefit men, if women's involvement in the VC is not improved.	• Need to have in place specific fisheries management plan for Lake Tanganyika to address the VC challenges. • While the nature of some VC tasks may not be suitable for women (for instance fishing during the night), many other tasks are. However, even for those jobs that are suitable for women, employers still tend to prefer employing men. Improving women's involvement in these tasks can help them to capture more benefits from the VC.

3.3 Environmental analysis (Ecological Footprint)

3.3.1 Climate Impact

Different fuel types like wood, gas, diesel, are used, for powering both fishing, processing and transportation vessels directly used by VC actors in the VC. In addition, there is also an indirect use of fuels through VC actors' use of electricity and ice, which also results in CO_2 emissions

Electricity use: According to interviews with VC actors, the electricity used for VC related activities comes from hydro, solar and use of generators—with most electricity used for the VC related activities coming from the national grid operated by the Tanzania Electric Supply Company (TANESCO). Rukwa region uses electric power imported from Zambia (which is hydro-powered) while Katavi and Kigoma have power generated by government owned diesel-powered generators. The quantity of electricity used in the value chain was found to be 0.18 KWh/kg of the end product, which is sustainable (i.e. when electricity use is or lower than 0.2 kWh/kg of end product).

The share of clean renewable energy use, especially solar and hydroelectric power for the VC activities is estimated at 80 percent of the total energy used in the VC (see Figure 52 of solar panels used by fishers). This high share of clean renewable energy in the total energy use is thanks to several reasons: (i) processing activities heavily rely on sun-drying (not electrical drying), (ii) the use of freezers and ice during storage and transportation is still relatively limited, and hence, limited electricity use (while transporting/storing dried and smoked fish does not require electricity), and (iii) the energy used in Rukwa region is imported from Zambia, which is hydro-powered (Interviews with VC actors and TAFIRI expert, 2021). Nevertheless, it should be noted that this estimate of the share of clean renewable energy in the total energy use can be over-estimated due to the lack of data (some respondents could not answer how much electricity they use for their VC activities). Field visits show that solar-powered freezers are not available in most regions, and solar equipment (e.g. solar panel) is relatively expensive. Therefore, when VC actors need to use electricity, they mostly turn to diesel and/or petrol-powered generators. Electricity consumption in the value chain has increased over the last couple of years following an increase of people storming landing sites on Lake Tanganyika to get engaged in the fishing related activities. This is in addition to an increase in the use of freezers as well as other cold storage facilities for fish storage and ice production, since majority of traders are aware of the use of ice to avoid fish post-harvest loss and spoilage.

FIGURE 52. SOLAR ENERGY USED TO CHARGE THE BATTERIES THAT POWER THE LIGHTS USED DURING NIGHT FISHING

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Fuel consumption: During interviews with the VC actors, the type of fuel used for VC related activities include diesel, petrol, kerosene, wood, and charcoal. Petrol and/or diesel is used to fuel boat engines for transporting fishers to and from the fishing grounds as well as transporting fresh or processed sprat, sardine, or perch to local and regional markets. Diesel is occasionally used to run generators used by ice production plants and to charge the batteries used to power lamps used as a source of light during fishing whereas wood and charcoal are normally used for fish smoking, mainly perch. Meanwhile, kerosene is normally used for pressure lamps used for light attraction during *dagaa* fishing. However, there has been a shift away from use of Kerosene (see also Mgana *et al.*, 2019), following the adoption of LED lamp technology on Lake Tanganyika. Though the long-term environmental impacts of using LED batteries are harder to discern, a reduction in greenhouse gas emissions may be realized on a long-term scale.

Previously, the majority of the fishers were using generators as a source of energy for their fishing lamps. However, the use of generators was later minimized and currently fishers are using solar-powered lamps instead. The use of fuel in the VC has increased over years following an increase in people engaged in fisheries activities as well as fuel becoming more accessible. The increased distance from the shore to the furthest fishing grounds on the lake (due to a reduction in onshore catches), has made fishers increase on their fuel input, which has not only increased the cost of investment but also to increased emissions leading to climate change.

The use of wood and charcoal to smoke fish, especially perch, has contributed to deforestation of catchment forests. This concurs the report by the African Development Fund (2014) regarding the proliferation of deforestation, for wood fuel as source of energy, for fish smoking as well as in the surrounding areas of Lake Tanganyika. It should be noted

that fish processors do not use energy efficient stoves and end up using a lot of wood—posing a considerable threat to the ecological footprint (environmental sustainability) and hence climate change (see also Reynolds & Mölsä, 2000).

The hotspot classification using the FISH4ACP environmental sustainability tool reveals that the fuel consumption in the VC is high i.e. 47.64 MJ/kg of the end product. While this could be attributed to high fuel consumption in case of limited fish stocks, it should also be noted that the fuel consumption indicated by the VC actors could have been overestimated, due to their poor record-keeping, since some could hardly establish the exact amount of fuel consumed specifically for VC related activities.

GHG emissions: There are potential contributions to GHG emissions in the VC that stem from land use change, especially from deforestation for wood used for fish smoking, making canoes and fish storage boxes as well as poles fused in the fishing operations. The high fossil fuel dependency for Tilley lamps, fishing vessels, generation of electricity used in some areas around Lake Tanganyika by diesel powered generators as well as high dependency on wood for fish smoking is the most significant source of emissions from the VC. This is in addition to the GHGs emitted by cars and motorcycles used for transporting fish and fisheries related products as well as HP engines used in fishing.

However, the GHG emissions are not that much concerning when considered in the context of United Republic of Tanzania's total and per capita contributions to global carbon emissions or when compared to the carbon footprints of most other fisheries and land-based production of animal protein. It's also important to note that most catch of the small pelagic fish (Sprat and Sardine) of Lake Tanganyika is simply sun-dried which is the most environmentally friendly and energy-efficient processing technology with low carbon dioxide (CO_2)-emission.

Using the FISH4ACP environment sustainability tool, the carbon footprint was estimated to be 3.61 kg CO_2 equivalent per kilogram of end-product, which is considered unsustainable (between 2-4 kg CO_2 equivalent per of end product). This is mostly due to the high amounts of fuel used per kg of the end product as well as high dependency on fossil fuels recorded during the survey. However, whereas the rating according to FISH4ACP methodology shows that the carbon footprint of core VC actors is unsustainable, this might not be a full reflection of what happens in the VC especially when it comes to fuel consumption as most of the figures that were reported seemed to be overestimated following the poor record keeping practices by the VC actors.

3.3.2 Water footprint

Water and ice consumption: According to the FISH4ACP methodology, the water consumption in the VC is considered as sustainable. In the VC, the water consumption is below 1 cubic meters /kg of end-product, ice consumption is below 1 kg/kg of end product, and water supply comes from the common water sources (Lake, groundwater, streams and rivers). The sources provide quality and sufficient water that is freely accessible to the majority of VC stakeholders, with some areas around Lake Tanganyika further supplied with tap water by the Government of United Republic of Tanzania through Rural Water and Sanitation Agency (RUWASA)—at largely affordable prices (1 000 TZS/month or USD 0.43/month). Water is used in cooking, ice production as well as cleaning of boats, fish, pressure lamps, buckets and wooden boxes used to store the catch. Landing sites with ice production factories include Kibirizi (Kigoma Region), Ikola (Katavi Region), and Kasanga (Rukwa Region), although no ice production activities are taking place at the Kasanga site which is currently submerged). The remaining landing sites on Lake Tanganyika have no ice production factories, with some individuals using deep freezers to produce ice used for value chain related activities.

Water pollution & wastewater treatment: There are sources of water pollution in the value chain emanating from fishing and VC related activities. This is because of human defecation (both on land and directly into the lake during fishing), oil/fuel spills from continuous running of outboard engines, kerosene from pressure lamps and plastic dumping into the lake and other water sources, and organic pollution from fish waste etc. (Patterson G. & Makin J., 1997). There is sewage dumping on Lake Tanganyika from communal septic systems from cities (Niyoyitungiye, 2020) under the VC such as Kalemie, Uvira (from the Democratic Republic of the Congo side of the Lake), Bujumbura (from the Burundi side of the lake), and Kigoma (United Republic of Tanzania). This is affecting the fish stocks and biodiversity and destroying important fish spawning areas.

Wastewater treatment is an unsustainable practice in the value chain. Over 78.4 percent of the VC actors responding to the environmental interviews reported having no measures in place as regards to wastewater treatment before discharging it into the environment. This is attributed to the limited knowledge and awareness that wastewater needs to be treated before it can be discharged as well limited and/or absence of centralized wastewater treatment facilities at different fish landing sites around Lake Tanganyika. It was also found that, though water treatment standards exist through the Environment Management Act of 2004, these are hardly monitored and/or enforced. Most of the fishing boats are locally made and have no toilets and wastewater treatment facilities thus fishers and boat passengers directly urinate and defecate in the lake and pollute water. This in addition to inadequate toilet facilities at various fish landing sites, further increase the pollution burden of the lake and the surrounding environments. This concurs with findings of Mataba (2015) who

reported that in most villages around Lake Tanganyika drinking water points and latrines are virtually non-existent and the communities directly use the lake water for their domestic needs.

3.3.3 Fish stock sustainability

Stock status and stock dynamics: Interviews with VC actors and other key informants (e.g. MLF officials, experts) indicated that the sprat, sardine, and perch stocks must be declining following an overtime reduction in fish catches observed by the fishers. In addition, juvenile perch, sprat and sardine are observed in fish landing sites as well as local markets and are suggested to constitute a high (probably around 50 percent, according to interviews conducted with MLF experts)[62] share of the overall catch of these three species in the lake. This implies recruitment overfishing is taking place, thus causing detrimental impacts on fish stock sustainability. However, there has been neither formal nor informal stock assessment of the Lake Tanganyika sprat/sardine (Dagaa) and perch (Mgebuka) carried out in recent years, which makes it difficult to assess the stock status and thus, sustainably manage fisheries resources. It is thus suggested that an assessment of the fish stock should be conducted to inform decision and policy making.

Fishing pressure: There has been increasing fishing capacity (effort) in Lake Tanganyika — both legal and illegal fishing, partially resulting from the open access nature of the fisheries in the lake and United Republic of Tanzania in general (see section 2.3.3.1). This has led to increased competition for the available fisheries resources leading to overexploitation of the resources and declining returns for all participants. The fishing pressure on sprat, sardine and perch is concerning, with the current fishing effort gradually leading to overfishing as incidences of declining fish catches over time have been observed.

Illegal fishing activities, such as fishing in prohibited areas and use of illegal fishing gears, are negatively affecting the stock dynamics of Lake Tanganyika Dagaa (sprat/sardine) and perch (Mgebuka). There are places on Lake Tanganyika where illegal gears (e.g. beach seines, cast nets, monofilament nets, which altogether make up 2-5 percent of all gears) are still being used (see also Breuil and Grima, 2014). This has resulted in recruitment overfishing (because these nets do not discriminate between mature and immature fish), and thus, has contributed to a reduction in fish stocks below the maximum sustainable yield (Van der Knaap, 2018). As already discussed in section 2.3.3.1, incidences of illegal fishing are still

[62] Precise and recent estimates of the share of juvenile sprat, sardine and perch in total fish catch are not available. However, existing studies (e.g. Mannini, 1998b; Kimirei and Mgaya, 2006; Mölsä et al, 2008; LATAFIMA, 2021) and field observations in 2021 concur that juvenile content (judged based on mean lengths) in catches is high, implying heavy exploitation of juveniles, especially for perch. For instance, in the northern waters, juvenile perch (Lates stappersii) accounted for most of the captured perch (Mannini, 1998b).

common, partially due to the limited capacity in enforcing fish management laws and conducting periodic monitoring, control and surveillance. Furthermore, the fact that Lake Tanganyika is shared with other regional countries poses additional challenges in implementing harmonized polices to safeguard the lake due to different priorities and implementation approaches by each of the countries that shares the lake.

Depending on the fishing method, the catch of perch on Lake Tanganyika is an all-year round activity. Harvested more offshore (at distant fishing ground) and mainly targeted during the wet season, perch is fished both day and night while sardine and sprat are only fished at night—except during moonlight nights. Some years ago, fishers could get desirable catches close to the shore but this has since changed over time, due to a reduction in catches. This has reportedly forced fishers to always go further offshore where catches are known to be promising for them to recover their investments, which is, nonetheless, a costly venture. Most of the fishing vessels lack cooling and/or freezing facilities, so fishing is limited by both time and distance and fishers at times continue to fish in the same grounds, thereby causing local overfishing of the fish stocks.

3.3.4 Biodiversity and ecosystems

Impacts on associated species/stocks: Un-targeted (by-catch) fish species are reportedly caught as a result of the value chain activities—though this has been inadequately reported in quantitative terms. There are no specific measures exercised by the fishers to reduce the catch of untargeted species. The non-targeted fish species make up about 2 percent of the overall catch of all fishers interviewed on environmental issues, and mainly include big latids (perch), shrimps, tilapia, cichlids (*Boulengerochromis microlepis* (The Emperor cichlid), *Xenotilapia flavipinnis* (Yellow sand cichlid) and *Bathybates)* and Catfish (*Clarias gariepinus*) which are caught mostly with beach seines, ring and lift nets. This concurs with Ngatunga (1992) cited in Kimirei *et al.* (2008) that reports a decline in big Lates species of Lake Tanganyika which is partly attributed to beach seining. The untargeted catch is either used for home consumption or sold to vendors or whole sellers who take them to market. The use of solar modified lamps with wide coverage of lamination attracts a lot of nocturnal fish (clupeids) which are harvested in large numbers. A study conducted by Mgana *et al.* (2019) to assess the primary effect of the use of battery-powered LED lighting systems to attract fish, primarily sprat and sardine in Lake Tanganyika, revealed that, although rarely, nearshore demersal fish species (mainly cichlids), sponges and pelagic shrimp were found in the fish catches.

Impact on Endangered, Threatened and Protected (ETP) species: ETP species are reportedly captured in the fish catches, though under very rare circumstances—with the majority of fishers reportedly not even aware of the existence of such species in Lake

Tanganyika. The ETP species that are reportedly caught are *Tropheus duboisi* (White-Spotted Cichlid), *Neolamprologus leloupi*—an ornamental cichlid fish with two colour morphs (white and yellow)—and *Byrconaethiops boulengeri* (Soga), *Xenotilapia burtoni* (caught especially in ring nets or illegally operated lift nets—that are operated in river mouths and shallow waters with rocky or muddy habitats.). The white-spotted cichlid has reportedly become endangered because of being heavily exploited (TAFIRI, 2013 cited in the Framework Fisheries Management Plan II for the Transboundary Fishery Resources of Lake Tanganyika). There are no specific measures (e.g. appropriate net and mesh sizes, bycatch reduction devices, sorting out, excluder devise, escape windows, choices of fishing area/depth/season etc.) exercised by the fishers to reduce the catch of ETP species, and their presence is, therefore, likely to be jeopardized as a result of VC activities. In addition, some VC activities, such as fishing and processing, are suggested to have contributed to deforestation due to VC stakeholders' cutting down trees to obtain soft and hard woods to smoke perch or make canoes. This has contributed to damaged or destroyed natural habitats of the ETP species living in the forest (e.g. chimpanzees).

Status of vulnerable ecosystems: According to key informant interviews with MLF experts, the vulnerable ecosystems estimated to be affected by the VC related activities are a) terrestrial-forest and vegetation which have been affected by cutting down of trees for fish processing and canoe making, and b) the aquatic environment that is affected by destructive fishing gears and methods. The effect is quite concerning, though no comprehensive assessment has been done, with the harm estimated between 10-15 percent for both terrestrial and aquatic ecosystems based on the observation of the occurrence of tree cutting and the use of destructive fishing gears. Illegal fishing activities like fishing in prohibited areas, including fish nurseries in the littoral ecosystems, and using illegal and non-selective fishing gears like beach seines, mosquito nets, and ring nets affects the ecosystem and stock dynamics of Lake Tanganyika dagaa (sprat/sardine) and perch (Mgebuka), and are further a threat to ecosystems. Most notably, these fishing practices destroy cichlid nests including *Boulengerochromis microlepis* (Hannu, 2008; Kimirei *et al.*, 2008) and target the juveniles of Bigeye lates (*Lates mariae,* commonly known as Sangala) which are abundant in the littoral zone as well as negatively impact the benthic environment. In addition, the catch of young Cichlids, such as the Haplochromines, deprives predators of a high-value food source (Petit and Shipton, 2012). This is in addition to findings by Kimirei and Mgaya (2006) who observed that sometimes codends of <6 mm stretched mesh size are used in fishing of perch (*Lates Stappersii)* and due to their unselective nature they have resulted in heavy exploitation of its juveniles.

Though widely used, ring nets remain controversial on Lake Tanganyika. They are reportedly used to fish both during day and night time yet they are supposed to only be used at night

and in not less than 1000m range from the shoreline, island or peninsula. More fishers are resorting to ring net fishing than other fishing methods, as the gear can also be used to fish nearshore. Their use during day is probably to catch other fish species instead of dagaa (which is only caught at night) and hence seen as destructive to the inshore stocks and negatively impact the benthic environment. However, ring nets end up catching very small juveniles of dagaa and perch, because they are operated in bays or near shore and other presumed nursery habitats. This has been associated to the overall decline of catch in recent years. Ring nets are supposed to be used in depths of more than 50 metres, but fishers are non-compliant—with adherence to this regulation further makes it difficult to enforce (see also Breuil and Grima., 2014) on the lake by the authorities.

Deforestation is being experienced due to the use of both soft and hard woods for perch smoking and canoe making, which is threatening the biodiversity within the surrounding areas of Lake Tanganyika. This is subsequently contributing to various environmental problems such as soil erosion, siltation and sedimentation that seriously affect the lake Tanganyika's biodiversity as lake sediments limit the penetration of light, thereby affecting the trophic system as well as destroying critical habitats for various fish species in the lake.

Furthermore, most of the baskets used in fish value chain related activities are made from particular bamboo species (*Oxytenanthera abyssinica*), which though still widespread, their over exploitation could eventually threaten their survival. Hard wood species (e.g. *Pericopsis angolensis* locally known as Mbanga, *Brachystegia spiciformis* locally known as miombo) are mostly preferred for fish smoking since they burn for long time compared to soft wood species (*Parinari excelsa, Hymenocardia acida, Parinari curatelli;* all locally known as Mbura), threatening their survival. Hard wood is also reportedly known to generate large amount of burning charcoal. Though still known to be abundant, such heavy pressure is threatening their survival. *Pterocarpusangolensis* locally known as Mninga and *Ptecarpus tessmannii* locally known as Mpilipili are facing extinction following their over exploitation, especially for canoe making, along the shores of Lake Tanganyika.

3.3.5 Animal health and welfare

Appropriate animal husbandry and handling: Ring nets, lift nets, as well as hand lines with multiple hooks are commonly used to fish the Lake Tanganyika sprat, sardine and/or perch, which are then left to die on their own. Following the FISH4ACP environment tool, the current practices for slaughtering (killing) the fish in the VC are considered as unsustainable because no WOAH approved slaughter techniques (like percussive stunning, spiking, free bullet, electrical stunning, semi-dry electrical stunning etc.) were found to be applied and fishers normally leave the fish to die on their own—which the fishers on Lake Tanganyika take not to be cruel. However, it is important to note that perch die as they try to back out their gills

or fins out of the nets (set by the fishers). Others struggle desperately in the sharp mesh that they bleed to death. Those that are ripped out of the fishing gears alive are deprived of oxygen and held in boats, which at times contain chilling ice. All these should be considered to be cruel. However, given the small-scale nature of the fishery as well as the small size of the VC species, especially sprat and sardine which cannot be slaughtered one by one and are captured in large quantities at a time and must be removed out of the nets into holding containers onboard as quickly as possible, the current practices should not be judged to be cruel as the WOAH approved slaughter techniques are not feasible and/or applicable.

There are no documented cases of sprat, sardine and/or perch diseases outbreaks on Lake Tanganyika. However, there are fish deaths that usually occurs once a year due to a major up-welling event, nevertheless the deaths do not happen every year.

3.3.6 Toxicity and pollution

There is a growing level of pollution of the Lake Tanganyika aquatic ecosystems, which is ultimately changing the natural productivity of the lake. Pollution at different stages of the VC not only have negative implications for flora and fauna but also for human health.

Organic (fish) waste pollution: The level of organic waste pollution in the VC is very concerning with less than 60 percent of VC actors interviewed in environmental interviews found to have controlled disposal of organic solid waste. In addition, only 35 percent of the actors are found to reuse the organic solid waste at the core VC level.

Cleaning of fish at the landing sites generates wastewater containing scales, blood and other fish related materials which are either disposed directly into the lake or onto land of waste disposable points away from the lake. Water saturation of the woven plastic sacks containing dagaa, especially during rough weather, in addition to delays in fish landing at the shoreline results in gradual fish deterioration generating fish waste. The spoiled dagaa and/or perch is sorted out and treated differently. The partially spoilt catches are sold at low prices to processors for human consumption or animal feeds while the extremely spoilt dagaa and/or perch are at times buried on the ground, an act which infrequently happens. Sacks of rotten and/or spoiled dagaa are also reportedly thrown into the lake during the extremely rough weather to lighten the boats. This is always either during fishing and/or water transportation of sundried dagaa to various market destination, leading to localized organic water pollution.

Standards on wastewater treatment are outlined in the Environmental Management Act 2004 of Tanzania, in addition to the general local bylaws, providing guidance on general environmental cleanliness. However, these are hardly enforced and/or complied with. Some fishing communities on Lake Tanganyika have local wastewater seepage sinks, which are

built and covered with stones for local wastewater treatment at a family and/or community level. However, these are rarely used.

Air pollution: The VC related activities were reported by over 81 percent of the actors interviewed in the environmental interviews to contribute to air pollution with 83.3 percent of the actors found not to have measures in place to minimize air pollution. Air pollution is a result of smoke generated from the smoking of the perch; outboard engines used in fishing as well as the use of generators as a source of electricity for value chain related activities. These activities raise both social and environmental concerns as they not only contribute to climate change but also pose significant health threats to VC actors and communities living in the surroundings. The leaking of refrigerants (e.g. R22 and T404A) from the refrigerators and/or deep freezers used to preserve fish (when handled and used by unqualified people) is also highlighted as a potential source of air pollution in the value chain. According to key informant interviews conducted with ice producers, ice production plants and/or facilities (I.e. R22—a block ice machine—and R404A—a flake ice machine, though very few exist in Lake Tanganyika regions), are also reportedly a source of air pollution in the VC with a GHG effect. This is through leakage and/or escape of coolants and emission of greenhouse gases like R-404A, a pseudo-a zeotropic mixed refrigerant, especially following the breakdown of freezers. There is a need to raise more awareness in ice plant operators in ensuring proper maintenance of the ice making machines, in addition to strengthening appropriate enforcement of laws and regulations against air pollution.

National standards on air pollution, as highlighted in the National Environment Management Act 2004, are only partially in place and there does not appear to be any regular monitoring of air pollution. There is limited awareness as regards to the existence of air pollution standards—with over 52.4 percent of the interviewed VC actors reportedly not aware of them. There is thus a need to educate the population with regard to the existing air pollution laws and how they can be enforced.

Plastic and other inorganic waste pollution: Plastic pollution is concerning in the VC. The proportion of interviewed VC actors found to reuse and/or reduce plastic and other inorganic wastes was found to be low at 34 percent. Even though nearly 80 percent of the interviewed VC actors claimed to have controlled disposal of plastic and/or other inorganic solid waste, it is highly common that plastics are littered at various landing sites, thrown on dry land or municipal waste disposable pits while others are lost in the lake, though at times its burnt and/or sold for recycling. The main sources of plastic waste in the VC include obsolete main sail (that are made up of woven plastic sacks that are used as packaging materials), plastic canvas/sheets, empty salt sachets, water bottles and buckets, small thin plastic bags, cello tape used to wrap magazine when packing fish as well as plastic fishing floaters which always get lost in the process of fishing. The main source of other inorganic solid wastes in the VC

includes outdated fishing nets, worn out engines, ropes and batteries. These have most times created poor working environment in addition to being harmful to people's health. Communities on Lake Tanganyika are fond of re-using some of the plastic bags following the government's instruction on the use of reusable shopping bags, but this is not enough to offset all the plastic waste generated due to the value chain activities.

Chemical use: There are some concerns associated with the use of chemicals in the value chain, though VC actors mentioned not to use any harmful chemicals during the environment interviews. A few VC actors shared to use salt to process and preserve sprat, sardine or perch. Detergents are occasionally used to clean up the materials used for daily VC activities. Chlorine, which is used in perch processing for cleanliness, can find its way into the lake if not handled properly, which in turn could result in fish kills and some people can be affected with higher chlorine concentration. Additionally, the use of mosquito nets for fishing is a widespread, frequent, and commonly accepted practice along Lake Tanganyika (McLean et al, 2014). In addition, insecticides used to treat bed nets, such as permethrin, are known to be toxic to aquatic life. Permethrin is moderately soluble in water, creating the possibility that fishing with bed nets could lead to leaching of this chemical into the lake, and subsequent damage to surrounding fish. These nets are further used in fish processing (drying the fish) and in addition to the poor hygiene conditions at processing sites, this is likely to cumulate to health risks for consumers. Communities should therefore be sensitized to avoid this kind of practice and responsible stakeholders should improve the monitoring and enforcement of chemical regulations.

3.3.7 Food loss and waste

Food loss: The assessment of food loss in the value chain considers the loss at fishing, processing, wholesale, exporting functions and aims to estimate what share of production does not reach the retail level. Though found not seriously concerning, value chain actors experience commodity losses (estimated at a total of 16 percent in fresh equivalent weight across the entire VC[63]) during both fishing and post-harvest handling (processing, packaging, storage, and transportation). Tight packaging makes some highly dried sprat and sardine and over-smoked perch to break, both during packaging and transportation. The poor road infrastructure connecting certain fish landing sites and markets around Lake Tanganyika is also highlighted to contribute to fish commodity loss by delaying their delivery to the markets. This is in addition to unexpected engine break downs during the fishing process that delays fish landing leading to spoilage, especially for sprat and sardine. In certain places, there is no electricity or an unreliable electricity supply to facilitate the production of ice to use onboard during fishing and further fish preservation on landing. Saturation of the woven

[63] See detailed calculations in Table 52 and Table 53 in Annex 5.

plastic sack with water, occasionally generate fish loss as spoiled sprat and sardine need to be sorted out and treated differently.

Food waste: Food waste (waste of sprat, sardine, and perch products) is defined as the share of production not reaching the retail or consumption levels. Functional interviews with retailers suggest that food waste is a concern at the retailing function; but the severity of food waste differs between retailers and those retailers in regions far from the lake tend to experience higher share of food waste, which is largely due to difficulties and delays in transporting fish from the lake to retail markets coupled with poor storage facilities during transportation. Specifically, the percentages of sprat, sardine or perch products that get spoiled (or wasted) during storage and transportation largely vary between retailers, with some retailers reported less than 5 percent of their products get wasted, while some other retailers indicated 20 – 40 percent and some others claimed up to 60 percent especially during rainy season. At the consumption function, over 95 percent of the surveyed consumers and their households do not throw away any sprat, sardine, or perch products that they purchase. Food waste, therefore, does not appear to be a concern at the consumption function.

3.3.8 Environmental analysis overview

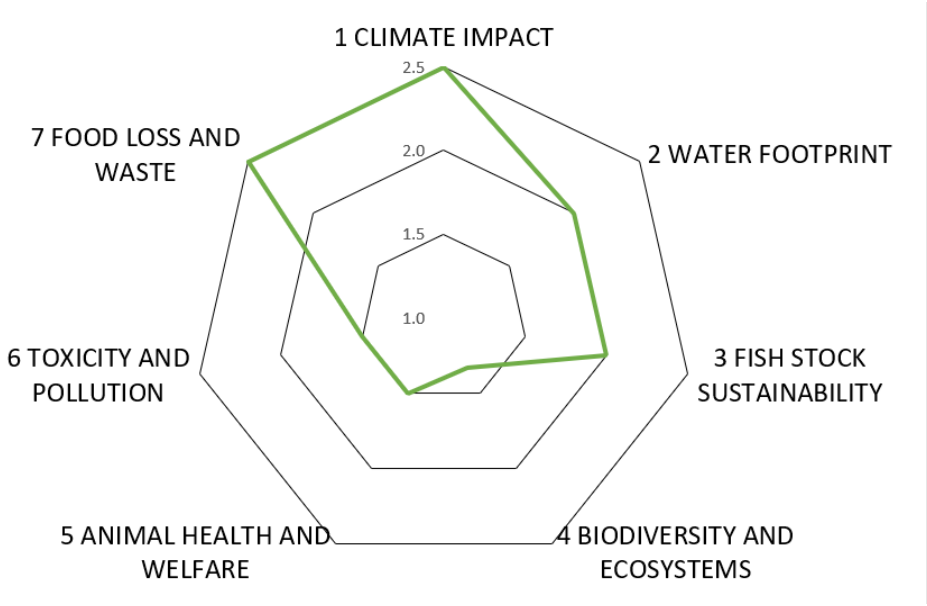
Based on the analytical assessment of environmental performance as discussed above and using the FISH4ACP environmental assessment tool (which uses a score range of (1-3), with 1 being “highly concerning” (red colour), 2 being “concerning” (yellow), 3 being “not concerning” (green)), a summary of performance for the Lake Tanganyika sprat, sardine and perch VC is provided Table 15 and Figure 53 below.

TABLE 15. ENVIRONMENTAL SUSTAINABILITY PERFORMANCE SCORES FOR THE VALUE CHAIN

1 CLIMATE IMPACT		
1.1 Electricity use	3.0	Not concerning
1.2 Fuel consumption	2.0	Concerning
1.3 Carbon footprint	2.0	Concerning
1.4 Renewable clean energy use	3.0	Not concerning
AVERAGE	2.5	Not concerning
2 WATER FOOTPRINT		
2.1 Water and ice consumption	3.0	Not concerning
2.2 Water pollution and wastewater treatment	1.0	Highly concerning
AVERAGE	2.0	Concerning
3 FISH STOCK SUSTAINABILITY		
3.1 Stock status and stock dynamics	2.0	Concerning
3.2 Fishing pressure	2.0	Concerning
AVERAGE	2.0	Concerning
4 BIODIVERSITY AND ECOSYSTEMS		
4.1 Impact on associated species	1.0	Highly concerning
4.2 Status of vulnerable ecosystems	2.0	Concerning
4.3 Status of ETP species	1.0	Highly concerning
AVERAGE	1.3	Highly concerning
5 ANIMAL HEALTH AND WELFARE		
5.1 Application of biosecurity measures	2.0	Concerning
5.2 Appropriate animal husbandry and handling	1.0	Highly concerning
AVERAGE	1.5	Highly concerning
6 TOXICITY AND POLLUTION		
6.2 Responsible use drugs and chemicals	2.0	Concerning
6.3 Air pollution	1.0	Highly concerning
6.4 Inorganic solid waste pollution	2.0	Concerning
6.5 Organic solid waste pollution	1.0	Highly concerning
AVERAGE	1.5	Highly concerning
7 FOOD LOSS AND WASTE		
7.1 Food loss	2.0	Concerning
7.2 Food waste	3.0	Not concerning
AVERAGE	2.5	Not concerning

Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

FIGURE 53. ENVIRONMENTAL SUSTAINABILITY PERFORMANCE SCORES FOR THE VALUE CHAIN



Source: Sendall, A., Duong, G., Ward, A., Mushabe, M., Muumin, H., Luomba, J., Mwakiluma, Y., Khamis, K., and Mwaka, I. 2022. The Lake Tanganyika sprat, sardine and perch value chain in United Republic of Tanzania: Analysis and design report. Rome, FAO.

Key issues, recommendations, and risks of the potential VC upgrading strategy, flowing from the assessment of performance are provided in Table 16.

TABLE 16. KEY ISSUES, RECOMMENDATIONS, RISKS, AND MITIGATING MEASURES – ENVIRONMENTAL SUSTAINABILITY

Key issues	Main recommendations
• Heavy dependence on fossil fuel (especially diesel and petrol); • High dependency on fuel wood for fish smoking; • Impact of VC actors on biodiversity and ecosystems is concerning. Fishing vessels do not have measures in place to mitigate impacts on ETP and associated species; • Lack of adequate monitoring and enforcement of laws and regulations related to illegal fishing, water pollution and air pollution; • Limited facilities to handle waste water and organic pollutants generated from VC; • Limited awareness of VC actors as regards to problems associated with over fishing, water pollution and air pollution; • Lack of proper fisheries management plan and regular formal stock assessments which is limiting information on the stock status	• Solar power or other renewable energy use need to be promoted (see also Mgana *et al.*, 2019)—with areas not supplied with power connected. Given the considerable number of units on the lake, this may require developing charging systems that can be as effective in the rainy season when cloud cover is common. Meanwhile, the disposal of the lead-acid batteries being used by fishermen to power their lamps needs to be followed up as improper disposal could lead to environmental pollution, with negative implications on the fisheries resources and human health. • Reforestation programmes be promoted to restore degraded forests; • Promote the use of energy efficient and saving stoves (fish smoking kilns); • Improved monitoring and enforcement of environmental and fisheries management laws and standards. Many fish that are landed are below size at maturity, there are no limits to effort, and modifications to approved gears allows them to be destructive. Thus, factors such as regulation and/or enforcement of size limits, mesh size, and total effort remain critically important for management of harvest and fish stocks; • Put measures in place to avoid catch of ETP species and sensitize fishers; • Regular stock assessments, including for bycatch species, and hydro acoustic surveys be conducted and estimate the stock levels to help further management decisions. With limited control over the catch of undersized fish and no measures in place to control the catch of the un-target fish species, it is important for the fisheries enforcement authorities to provide guidelines and more awareness to various stakeholder along the take, including those in the fish markets about the negative effect of exploiting undersized as well as non- targeted fish species. The impacts associated with the sprat and sardine fishing

	activities on the biodiversity of the non-targeted species need to be fully documented. • More awareness, capacity building and enforcement of appropriate waste management strategies (construction of toilets, reuse of some wastes, recycling of some wastes such as plastics etc.) need to be popularized. Proper waste disposable facilities need to be availed both at village and/or municipal levels. • Controls on the quality of fuel imported, including its maximum sulfur content, would help mitigate to some extent the negative impacts of emissions from the fishing vessels and other fuel consuming activities in the VC.
Main risks	Mitigating measures
• Lack of formal stock assessments for by-catch and ETP Species • Risk of air and water pollution (Both organic and inorganic • Risk of food loss	• Undertake a formal stock assessment • Increase awareness, build capacity, and enforce appropriate waste management strategies • Promote appropriate post harvesting harvest handling practices.

3.4 Resilience analysis

3.4.1 Main relevant shocks

According to secondary research and interviews with VC stakeholders, in the Lake Tanganyika sprat, sardine, and perch VC in United Republic of Tanzania, there are four types of shocks, as listed below, that are considered most relevant based on their **likelihoods of occurrence** (or re-occurrence) and the (potential) **severity** of their impacts.

- Environmental shock: Heavy rain resulting in flooding in landing sites, processing sites and marketplaces
- Environmental shock: Climate change, characterized by stronger wind and changing conditions in the Lake (as also discussed in section 2.3.4.2).
- Social shock: Political instability in the neighbouring countries (e.g. Democratic Republic of the Congo and Burundi) disrupted fish exports.
- Health shock: COVID-19 pandemic resulting in declined markets.

3.4.2 Resilience of the VC to shocks

Following the FISH4ACP methodology, the VC's resilience to shocks is assessed based on six domains: redundancy, diversity, connectivity, collaboration, and governance, learning and

adaptation, and participation and inclusion. A summary of a qualitative assessment of these domains is provided in Table 17.

TABLE 17. RESILIENCE ASSESSMENT OF THE VC

Resilience domains		
Structural resilience domains		
Redundancy	Diversity	Connectivity
Behavioural resilience domains		
Collaboration and governance	Learning and adaptation	Participation and inclusion

Hotspot classification		
Not concerning	Concerning	Highly concerning

Note: **Structural domains** evaluate the presence and nature of certain structural elements that may contribute to resilient value chains. **Behavioural domains** refer to how actors and other stakeholders' behavioural patterns interact in ways that may contribute to resilient value chains (FISH4ACP methodological guide, 2021, Internal project document).

Redundancy: According to the conducted actor interviews, **VC actors are unable to retain any stocks** as buffer inventories to prepare for shocks due to various reasons, including: (i) the nature of their activities (the catch quantities are difficult to predict), (ii) the nature of the VC products (they are easily perishable goods), (iii) the lack of proper handling and storage facilities, inputs and equipment (such as cold storage and ice), (iv) the lack of knowledge about proper fish handling and processing techniques, and (v) limited financial resources to maintain some level of excess capacity. Consequently, in the event of shocks that disrupt the supply of fish (such as heavy rain and strong winds preventing fishers from going fishing), almost all VC actors do not have any stocks to sustain their operations, and it took them weeks to months to re-stock and resume the business.

Diversity: **The level of diversity in the VC is extremely low**. Although there are several end markets for the VC products, most of the markets outside of the three regions around the Lake (Kigoma, Rukwa, Katavi) often quickly become unreachable for VC actors in the event of shocks that disrupt the movements to and from the Lake (such as in case of COVID-19 and floods). Due to the limited processing and other value-addition options currently adopted along the VC (which are mostly traditional methods largely relying on weather patterns), there is only a small range of VC product offerings. These products are either highly perishable (fresh fish), or easy to degrade in terms of quality (smoked or dried fish), especially given the limited and improper storage equipment and facilities that VC actors currently use or have access to. Furthermore, while there is a large number of actors and support service providers in the VC, their activities, operational scales, as well as production and marketing processes are largely similar at each VC function and for each type of input/service provision.

This overall low level of diversity implies there is little capacity for the VC to resist to shocks because when a shock hits, almost all the actors (at certain VC functions) and/or all the support service providers (of certain types of input/service) would suffer from similar impact, and thus, the whole VC will be affected as none of the actors or service providers could sustain their normal business operations.

Connectivity: **The level of connectivity in the VC is low.** There are connections of various kinds between VC actors and stakeholders, but many of these connections are informal (without registration, contracts, or any formalization processes) and can be easily disrupted in the event of shocks. Specifically, there are various organizational and social linkages between VC actors and other stakeholders, for instance the grouping of VC actors (e.g. associations, unions) and the collaboration between VC actors and their communities (e.g. BMUs). These connections are based on long-established relationships and/or social (personal) networks (such as family relationships and friendship), which are expected to hold up in case of a shock. However, given the limited financial and technical resources of VC actors and other members in their groups or networks, these social linkages are often insufficient to support VC actors to recover from shocks (Interviews with VC actors, 2021). The connections between VC actors and input and output markets are relatively weak, mainly characterized by spot market transactions and verbal arrangements and thus, are susceptible to collapse when a shock disrupts the VC. During interviews, being disconnected to markets is the most common impact that VC actors indicated in case of a shock. In addition, existing infrastructure (such as roads, marketplaces, electricity grids) within three regions around the Lake is underdeveloped, resulting in low level of connectivity with other regions in United Republic of Tanzania and in neighbouring countries. This situation worsens considerably in the event of shocks such as heavy flooding, which largely hinders transportation to and from the Lake regions.

Collaboration and governance: There are various forms of collaboration between VC actors and stakeholders, ranging from exchange of information to cost sharing and coordination in the conduct of VC activities. Such collaborations exist between VC actors at the same function (horizontal linkages) as well as between VC actors and their suppliers and buyers (vertical linkages). However, the (vertical) collaborations between VC actors and their suppliers and buyers, although based on trust and are largely considered as “trustful” and “collaborative” in normal time, appear to be highly vulnerable in the time of shocks and in many cases, quickly cease to exist. During interviews, the most cited impacts of shocks that VC actors share to have experienced are damaged relationships with customers and losing customers due to increasing fish prices and decreasing fish supply quantities. Meanwhile, horizontal linkages, characterized by various forms of group formation and mutual support/collaboration, are often based on a more solid ground (i.e. family relationships and friendship) and can offer some level support to VC actors in coping with shocks. However, as

mentioned in the point on "Connectivity" above, such horizontal support and collaboration are often ineffective in dealing with shocks. Furthermore, in some cases, there are a number of challenges facing the formation, operation, and sustainability of these groups due to the lack of trust between VC actors and the (perceived) lack of transparency and/or fairness in terms of group governance (Interviews with VC actors, 2021). For these reasons, the majority of VC actors (e.g. around 80 percent of the surveyed fishers and processors) do not belong to any groups (e.g. association). There are collaborative relationships between VC actors and their support service providers as well as between VC actors and various government organizations. However, these collaborations, albeit considered as "good" and "fruitful" in normal time, are virtually non-existent when it comes to dealing with the impacts of shocks, and VC actors largely cope with the impacts of shocks on their own, without any support from other stakeholders (Interviews with VC actors, 2021).

Learning and adaptation: The level of learning and adaptation[64] in the VC is extremely low. Along the VC, **there is a very low level of technology and innovation adoption** by VC actors, with most actors using traditional methods and techniques in conducting their VC activities. Adoption of modern technologies is desirable for VC actors; but the unavailability and high costs of modern equipment/inputs, coupled with limited financial and technical capacities of VC actors, effectively prevent them from applying these technologies. Using largely traditional methods and facing constraints in adapting/improving their techniques, VC actors struggle to deal with the impacts of shocks and to prepare for future shocks. None of the VC actors makes any preparation for future shocks, mainly because they do not have the means and resources to do so.

Participation and inclusion: There is a high level of participation and inclusion in the VC. Everyone can engage in VC activities if she/he can or wishes to, and group representation among VC actors is largely considered as fair. However, given the largely small-scale nature of VC actors, this high level of participation and inclusion does not necessarily contribute to a high level of resilience in the VC. It is because almost every actor is highly vulnerable to shocks, and thus, any risk or loss sharing mechanisms among these actors would potentially be ineffective in supporting them to recover (when they are all heavily hit by shocks). As indicated from interviews, VC actors are not connected to any shock response or recovery support mechanisms, either among the actors themselves or provided by other stakeholders (e.g. government organizations). Although research has been conducted on how to enhance

[64] This refers to "the levels of flexibility and innovation on the VC, in particular with respect to past shocks. It assesses how the value chain is gradually strengthening or weakening its ability to absorb, adapt and transform, and if the distance to tipping points is shrinking or growing" (FISH4ACP methodological guide, 2021, Internal project document).

the resilience in the VC, no concrete action has been taken. This lack of support mechanisms (or VC actors' access to these mechanisms) further increases the vulnerability of VC actors.

3.4.3 Sustainability impact pathways of shocks

The impact pathways of the main relevant shocks in the VC, as mentioned in section 3.4.1, as well as the VC actors' strategies to cope with the impacts of these shocks are described below.

Environmental shock – Heavy rain: This is the most cited shocks by VC actors during interviews. Floods due to heavy rain were not a frequent occurrence in the Lake area in the past, but the floods experienced in the past 2-3 years were unprecedented and are expected to continue in the future. Flooding results in damaged and/or submerged landing sites, processing sites and marketplaces where VC actors operate (process and trade the fish), which in turn leads to reduced supply of fish products and increased prices. In addition, increased difficulties in transportation due to rainfall and flooding further reduce sales volumes. As reduced sales volume cannot be offset by the increases in fish prices, the profitability for all VC actors is reduced. For processors particularly, their revenues are reduced due to difficulties in sun-drying sprat and sardine and properly storing fish products to maintain quality. Reduced revenues and profits for fishers, processors, and traders implies reduced income for the workers employed by them (Interviews with VC actors and workers, 2021).

Environmental shock - Climate change: This is the second-most cited shock by VC actors during interviews. According to VC actors and expert consultations, climate change, characterised by stronger wind and changing conditions in the Lake, has resulted in reduced fish catches. Specifically, strong wind prevents fishers from going fishing and changing lake conditions is claimed to have adversely affected fish production in the Lake. Reduced catches result in reduced revenues for fishers. The revenues for processors and traders are also reduced due to the reduced supply of fish. Reduced revenues and profits for VC actors implies reduced income for the workers employed by them (Interviews with VC actors and workers, 2021).

Social shock - Political instability in the neighbouring countries: Some exporters mentioned the political instability in neighbouring countries (such as Democratic Republic of the Congo and Burundi) has caused difficulties in exporting VC products to these markets. Export markets disruptions leads to reduced revenues for exporters, which in turn results in reduced income for their workers (Interviews with exporters, 2021).

Health shock - COVID-19 pandemic: During interviews, the COVID-19 pandemic was mentioned as a main shock mainly by the traders (wholesalers, exporters, retailers), whereas for the fishers and processors, it does not appear to be a shock of great relevance. As

suggested by the interviews, the pandemic has disrupted the linkages between the traders in the VC and the national and regional markets. Particularly, COVID-19-related restrictions have led to increased border restrictions (on the sides of Democratic Republic of the Congo, Burundi, and Zambia) and hence, limited fish products (among other goods) from being exported to neighbouring countries. Inside United Republic of Tanzania, many customers stopped going to local markets, especially for eating out. Consequently, the number of customers of has reduced, and thus, also the sales volume and revenues of VC traders. Transportation costs have increased, which further reduced the profitability for traders. Some traders cease operating, either because of the lack of customers or because they were making loss. These impacts are felt relatively strongly with the retailers in other regions in United Republic of Tanzania (e.g. Dar es Salaam, Mbeya), wholesalers and exporters, as opposed to the retailers in the three regions around the Lake (i.e., Kigoma, Rukwa, Katavi).

Strategies to cope with the impacts of shocks: VC actors and their workers have little capacity to cope with these impacts. Neither do they receive any support to deal with the shocks or to prepare for future shocks. During interviews, some VC actors indicated that they tried several ways to cope with the impacts of shocks, for instance processors and traders reduced the quantity of the fish they purchased to minimize loss or tried to find alternative markets/locations to do business. However, none of these actions was effective in helping them recover from shocks (although they are "somewhat effective" to help actors minimize their losses). Most actors shared that they either could "do nothing" in the event of shocks, or could just try to accept the situation imposed by shocks (e.g. losing customers, making loss), or quit their businesses in the VC to change to other income-generating activities (such as agriculture or running small shops for food or clothes).

3.5 Sustainability heat map

A sustainability heat map Table 18 provides a synthesis of the economic, social and environmental sustainability assessment and the resilience analysis (see sections 3.1, 3.2, 3.3 and 3.4).

TABLE 18. THE LAKE TANGANYIKA SPRAT, SARDINE, AND PERCH SUSTAINABILITY HEAT MAP

Economic Sustainability	Social Sustainability	Environmental Sustainability
Net Income	Wage & employment distribution	Electricity use
Trend in net income	Value added distribution	Fuel Consumption
Return on Sales	Poverty and vulnerability	Carbon footprint
Return on investment	Discrimination	Renewable Clean Energy Use
No. of jobs in FTE	Women's economic involvement	Water and Ice Consumption
No. of fulltime jobs	Gendered division of labour	Water pollution & wastewater treatment
No. of wage labour jobs	Gendered access to productive resources	Stock status and stock dynamics

No. family/self-employed jobs	Women's decision-making and leadership	Fishing pressure
Average wage for hired workers	Availability of food	Impact on associated species
Average wage proxy family labour	Accessibility of food	Status of vulnerable ecosystems
Total value of net wages	Utilization of food	Status of ETP species
Direct value added at VC level	Stability of food	Application of biosecurity measures
Total value added	Respect of labour rights	Appropriate animal husbandry and handling
Contribution to trade balance	Child and forced labour	Responsible use of drugs and chemicals
Rate of integration	Job safety and security	Air pollution
Public finances impact	Job attractiveness	Inorganic solid waste pollution
Contribution to investment	Collective action	Organic solid waste pollution
International competitiveness	Coordination of transactions	Food loss
Food safety	Social cohesion	Food waste
Consumer evaluation	Cultural traditions	
Consumer preference	Policy, regulations, and standards	
Price relative to substitutes	Access to finance	
	Access to natural resources	
	Access to information	
Resilience		
Redundancy	Diversity	Connectivity
Collaboration and governance	Learning and adaptation	Participation and inclusion
Key		
Not concerning	**Concerning**	**Highly concerning**

Economic sustainability score[65]: 80%
Social sustainability score: 46%
Environmental sustainability score: 45%
Resilience score: 17%
Overall sustainability score: 54%
Number of highly concerning hotspots (red): 17

[65] According to the FISH4ACP methodological guide, "the (sustainability scores) indexes are calculated by adding up across sub-domains (1 for green, 0.5 for yellow, 0 for red) and dividing this by the number of subdomains, expressed as a percentage".

The main conclusions to be drawn from the heat map when viewed in totally are that the **overall sustainability performance of the VC is medium**, with overall sustainability score of just over 50 percent. Economic sustainability is the area where the VC demonstrates the best performance, while resilience is the weakest area. There are 17 hotspots (red or highly concerning areas) in terms of the VC's sustainability performance and resilience.

With respect to **economic sustainability**, overall performance of the VC is positive. The VC is profitable, although there is a downward trend in incomes as the supply of fish decreases. Value-added is concerning but is only just below sustainable levels of output. Effects on the national economy are positive as taxes and fees paid by VC actors are more than any subsidies received. However, the size of the VC is small compared to the size of the wider fisheries or agriculture sectors, so contributions to GDP are insignificant. Value for end consumers is concerning, especially for sprat and sardine, as it ranks low for taste preference and is significantly more expensive than other fish substitutes. The area of least sustainability is employment which is highly concerning due to the low number of full-time jobs and low wages for hired workers, with the exception of fisher crew.

The **social sustainability** performance of the VC is low, with over half of the social sustainability aspects being somewhat concerning, and six aspects being red/concerning. The most concerning social hotspots are related to the women and workers participating in the VC. Specifically, the levels of women's involvement in and benefits from the VC are low as compared to men's, which are largely attributed to the nature of many VC activities (which are physically demanding) coupled with gender norms disadvantaging women. As for workers, the complete absence of formal (written) contracts as well as the lack of occupational health and safety standards place workers in a particularly vulnerable situation due to the lack of job security and safety. Additionally, the supply of sprat, sardine, and perch is unstable throughout the year, particularly in regions away from Lake Tanganyika. This instability in supply has adversely affected the demand for sprat, sardine, and perch (and thus, profits for VC actors and workers), as well as consumers' access to these products.

In terms of **environmental sustainability**, the activities taking place inside and/or at different stages of the sprat, sardine and perch VC of Lake Tanganyika were found to have various negative effects on the wider lake environment. The use of fossil fuels (diesel & petrol) has increased over years, which in addition to the high dependence on wood for fish smoking is increasing the VC carbon footprint and hence climate change. Potential risks of water, air, organic and inorganic pollution emanating from fishing and VC related activities were also identified in the value chain. The fishing pressure on sprat, sardine and perch is concerning, with the use of illegal fishing gears found to be still taking place, contributing to overfishing and destroying ecosystems for the associated species. There has been neither formal nor informal fish stock assessment that has been carried out, which has made getting

information on the landed catches to further estimate the damage associated with the VC on the fish stocks more difficult. While the environmental situation across the lake and its catchment continues to deteriorate, it should be noted that the vastness of Lake Tanganyika, its mere physical dimensions help absorb and mitigate some environmental impacts to a certain degree. For example, the quality of water across the lake remains relatively good. Nonetheless, the existing trends in deforestation, sedimentation, general weakness in fisheries management, pollution, exacerbated by climate change impacts such flooding and soil erosion, if not carefully thought about and taken care of, will lead to an ever-increasing pace of the deterioration of environmental conditions and overall degradation of Lake Tanganyika and its surrounding areas.

When considering **resilience**, the VC performs extremely poorly. Four out of six domains are highly concerning, while the other two are concerning. The lack of resilience in the VC are mainly due to the small-scale nature of all the VC actors, coupled with their limited or lack of technical and financial resources and unfavourable conditions in the enabling environment (e.g. road, railway). These factors contribute to and/or result in the absence of any stocks/inventories of VC products, the low level of diversity in terms of markets and products, the limited connectivity with input and output markets, and the limited capabilities of VC actors to improve their practices/processes or to prepare for future shocks.

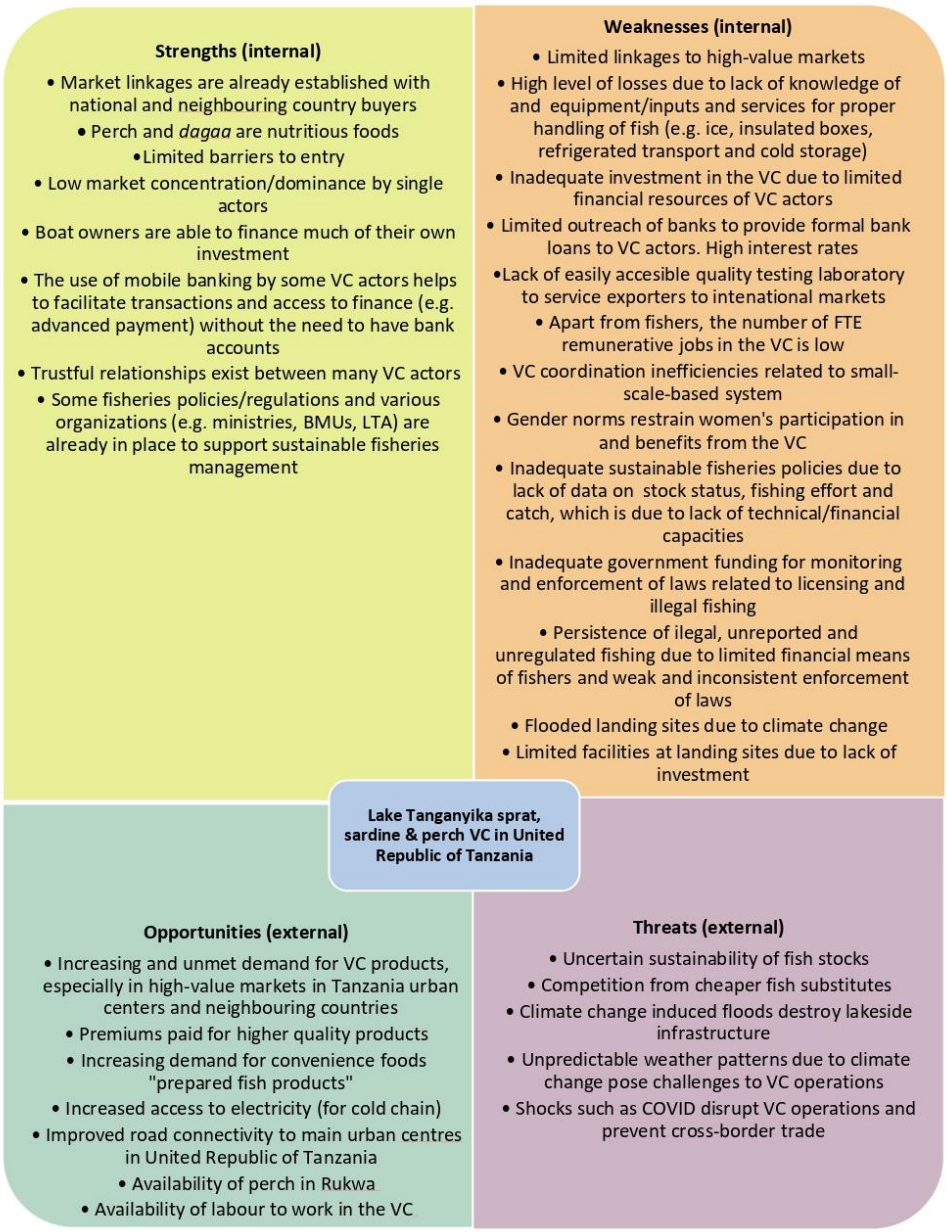
4 Upgrading strategy

This section of the report draws on the analysis presented in Sections 2 and 3 to develop an upgrading strategy for the Lake Tanganyika sprat, sardine and perch value chain in Lake Tanganyika. It starts with a strengths-weaknesses-opportunities-threats (SWOT) analysis to begin the process of moving from analytical complexity to strategic simplicity (sub-section 4.1). Informed by the SWOT analysis, the sustainability heat-map (see earlier, Table 18, the VC map (see earlier, Figure 1), and varied stakeholder interests as reflected during consultations, an overall objective for the upgrading strategy is developed in the form of a vision statement (co-developed with VC stakeholders based on the SWOT). The vision statement includes concrete targets and will be realized through four outcomes of an upgrading strategy, brought about by a range of activities and outputs which are presented graphically in a theory of change. Sub-section 4.3 presents assumptions about factors that will change under the upgrading strategy, and then business models, the enabling environment and governance arrangements under the baseline situation and following upgrading. Sub-section 4.4 builds on preceding sub-sections to develop an assessment of the sustainability impact the upgrading strategy it is expected to have.

4.1 SWOT analysis

Based upon the functional and sustainability analyses carried out previously, SWOT analysis has been performed as a first step towards identifying strategic options (See Figure 54Figure 54).

FIGURE 54. SWOT ANALYSIS OF THE VALUE CHAIN



Perch and dagaa are now recognised as nutritious foods. Other strengths of the value chain include the low barriers to entry and market concentration amongst the fisher segment, allowing innovation. Also, the Government recognizes the sustainability of fish stocks is a significant threat and have already instigated some policies, regulations and organisations to support sustainable fisheries management.

Due to the large proportion of the fish catch being processed, one main weakness in the value chain is the rudimentary post-harvest handling and processing techniques used for preserving fish, which are mainly due to the lack and high prices of inputs/equipment (e.g. drying racks), the lack of access to finance, and the lack of land to put up drying racks. Before the improved availability of electricity, the only means of preserving and extending the shelf-life of fish was by drying sprat/sardine and smoking perch. Traditional processing is small-scale and processing is the least profitable of all value-chain segments, providing the lowest incomes for business owners and wages for employees. As processing is mostly undertaken by women, this has a particular negative affect on women's income.

The second weakness in the value chain is its small-scale nature and lack of coordination between VC actors, which can be largely attributed to the lack of access to finance and the lack of technical/business capacity and skills of VC actors. Additionally, there is a lack of necessary support service (e.g. transport, cold storage) and infrastructure (e.g. roads) for connecting VC actors to more profitable markets. If linkages are to be made with higher-value markets, commercially viable business models will need to be developed and supported by improved services and infrastructure.

Another main weakness of the VC is the inequality between men and women. There are unequal division of roles and unequal incomes between women and men VC participants, which are partially due to the nature of the VC tasks (some of which are physically demanding) and partially due to social norms restricting women.

The main threat to the value chain is the sustainability of fish stocks due to the lack of formal fish stock assessments and inadequate monitoring and enforcement of fisheries laws and regulations. Considering the importance of the value chain for income, employment and nutrition around the lake, ensuring the sustainability of fish stocks is a priority.

The productivity of the value chain to create income and employment is a major strength and there are several opportunities based upon the increasing domestic consumer demand for fish, improved roads/access to markets and consumers willing to pay premiums for higher quality processed products. Also, fresh and frozen fish, particularly perch, provide the biggest profit margin between fisher and retailer. Improved access to electricity allows the introduction of better processing technology for processors (most of whom are female) and

the establishment of cold chains to supply the lucrative fresh/frozen fish market. This coupled with improved road connectivity allows increased access to a wider population.

Key **strategic recommendations** emerge from the SWOT as follows:

1. Improving the processing quality of dried sprat/sardine and smoked perch and increasing the supply of fresh and frozen fish, combined with facilitating market linkages and developing business models to enable higher-value products to reach higher-value markets.
2. Improving women's position in and benefits from the value chain.
3. Supporting sustainable fisheries management to ensure long-term viability of the value chain.

4.2 Vision, Upgrading strategy, and Theory of Change

A **shared and agreed vision** for the value chain that is considered achievable and realistic, following successful implementation of the upgrading strategy, has been developed together with stakeholders during the validation and action planning workshops. The shared vision for the Lake Tanganyika sprat, sardine and perch value chains is as follows:

"By 2032, United Republic of *Tanzania will have strengthened its position as a main producer/exporter of Lake Tanganyika sprat, sardine, and perch thanks to enhanced value-addition in a sustainable value chain based upon sustainably managed fisheries resources, which will generate increased income and remunerative employment for both women and men and increase the value chain's resilience*."

The vision is aligned with the National Fisheries Policy (2015) objective to "achieve sustainable fisheries that contribute to food security and nutrition, economic growth and improved wellbeing of fisheries stakeholders while conserving natural environment". This specifically includes fisheries infrastructure; utilization, processing and marketing of fish products. FISH4ACP supports the Fisheries Sector Master Plan (2021 – 2036) vison for "Sustainable management and development of the fisheries sector for improved services and high production", specifically Thematic area 1: Maintenance of the environment, ecological systems and associated biodiversity; Thematic area 2: Improved research, monitoring and a reporting system; Thematic area 3: Empowerment of fishers and fish workers; Thematic area 5: Compliance and enforcement of management measures; Thematic area 6 to develop fisheries infrastructure, and the cross-cutting thematic area to reduce post-harvest losses through improved fish handling .

The vision also supports the regional LTA Strategic Action Plan objective to develop sustainable fisheries and the Sustainable Framework Management Plan to promote sustainable livelihood and economic viability of the Lake Tanganyika fisheries. Furthermore, the vision supports three Sustainable Development Goals (SDG) goals of the United Nations, namely:

SDG 5: Achieve gender equality and empower all women and girls
SDG 8: Decent work and economic growth, and its goal to 'promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all'.
SDG 14: Life below water, and its goal to 'conserve and sustainable use the oceans, seas and marine resources for sustainable development'.

Theory of Change

The Theory of Change to achieve the above vision is based upon new market opportunities that have arisen due to an improved supply of electricity for cold chain facilities around the lake and improved access to large urban markets in other areas of United Republic of Tanzania (e.g. Dar es Salaam, Tunduma, Mbeya) due to improved road connectivity. Currently dagaa is dried and perch is smoked as a means of stopping the fish rotting, not to add value. Due to the prevalence of traditional (oftentimes unhygienic) processing and handling methods, the quality of dagaa and perch products is low or easily degraded, resulting in low selling prices, or lost quality/economic value[66] despite the relatively low level of quantity loss (i.e. 16 percent in fresh equivalent weight across the entire VC, as mentioned in section 3.3.7). Also, most of the fish are consumed locally or exported to other countries around the lake as those markets are more accessible by boat, than urban centres in United Republic of Tanzania by road transport. However, due to the artisanal structure of the value chain (thousands of small value chain actors carrying out thousands of uncoordinated transactions), new market opportunities thanks to the improved road connectivity and electricity supply remain unexploited.

Enabling structural change and improved conduct within the value chain will require the adoption of improved processing and cold chain techniques and improved coordination between value chain stakeholders. Improved processing technologies have been identified (see section 4.3.1). Once suppliers of improved processing equipment have been confirmed, financial products developed with banks allowing processors to purchase the equipment,

[66] For dried sprat and sardine smoked perch, the quality loss is largely due to the use of traditional practices such as drying on the ground instead of drying on racks, resulting in lower prices due to lower product quality (see Table 1 in section 2.2.1). For perch, the quality loss per kg of fresh perch is also in the form of the price of 1 kg of fresh perch sold as frozen (e.g. TZS 5 500/kg in Kigoma) minus the price of 1 kg of fresh perch being smoked (e.g. TZS 5 200/kg in Kigoma), or TZS 300 lost per kg due to the lack of cold chain (calculated based on Figure 4 in section 2.2.1 and the conversion rate fresh perch: smoked perch = 2.5:1).

and training on technologies and standards provided, processors will be enabled to produce higher quality dried dagaa and smoked perch which sell for a 30 percent premium.[67]

Three strategically located landing sites will be upgraded and provided with cold chain facilities such as ice making, cold stores, blast freezers and refrigerated transport. The landing sites will be publicly owned but could be managed under a public-private-partnership. Wholesalers will use the cold chain facilities on a user-fee basis, allowing the sale of fresh/frozen perch in large urban markets such as Mbeya, where they also fetch a 30 percent premium, compared to selling at the lake.[68]

Making the important 'market linkages' between fishers, processors and buyers requires improved coordination. Groups of fishers and processors will be established to aggregate produce and link with traders who supply high-value markets locally or in other large urban centres where customers are willing to pay a price premium for higher-quality products. Through capacity building and training, partnerships will be facilitated between value chain stakeholders to adopt improved business models and improve coordination.

Processing is the least profitable segment of the value chain and is largely carried out by women. Therefore, additional attention will be paid to gender constraints and opportunities allowing the increased participation of women and increased share of direct value captured by women. To this end, leadership trainings for women, awareness raising events on gender equity, and a gender study will be conducted to support the design and implementation of upgrading activities in a gender sensitive manner.

Sustainability of fish stocks is a significant threat to the value chain. Fisheries legislation will be revised based on updated data coming from a lake-wide assessment of stocks, a lake-wide frame survey, and catch assessment surveys. Along with better enforcement to improve compliance, this will lead to catch rates being maintained at sustainable levels to improve the sustainability of fish stock.

The proposed upgrading strategy consists of **four key elements**, which aims to holistically improve the (economic, social, and environmental) sustainability performance of the VC, as below.

1. **VC actors adopting improved processing and cold chain techniques** will improve the quality of the fish and increase value added received by processors, in particular women.

[67] Assumption made based on end-market analysis, Table 1.

[68] Assumption made based on end-market analysis, Figure 4.

2**. VC actors adopting improved business models to supply high-value markets** will improve coordination along the value chain, enabling the high-quality fish to reach the high-value markets in the main urban centres of United Republic of Tanzania.

3**. Increased participation by women** in the VC to ensure that women can capture a fair share of the value-added generated from the VC (social sustainability).

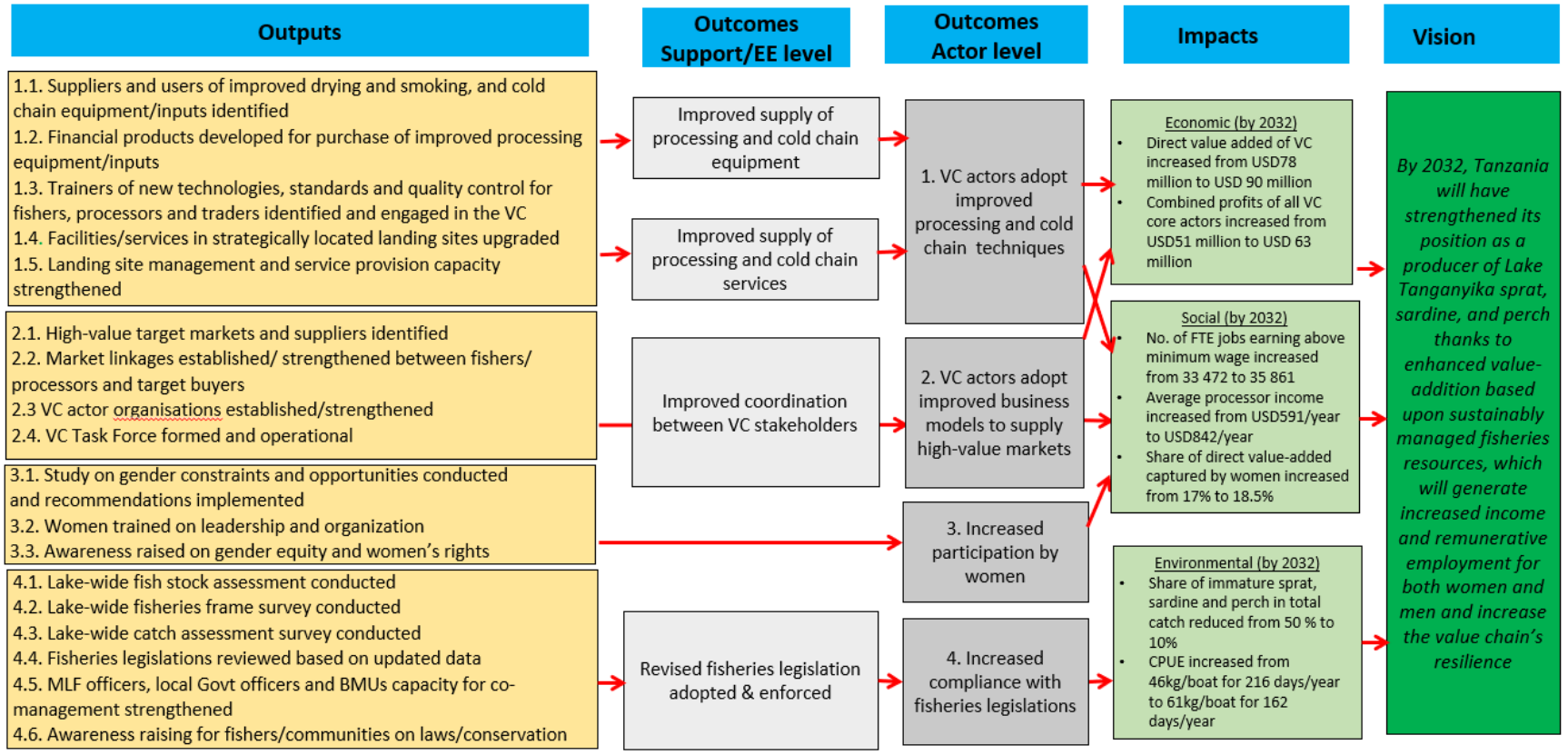
4. **Increased compliance with fisheries legislation**, which are revised/updated based on regularly updated data and whose enforcement are enhanced thanks to the strengthening of co-management and MCS mechanisms, will be crucial to ensure the responsible use (exploitation) of fisheries resources to maintain a sustainable level of the resources in the long run (environmental sustainability).

Progress towards realizing elements 1 and 2 should begin to be evident within approximately 2-3 years. Addressing gender-based constraints whose causes are most often deeply rooted social norms in the communities, element 3 would require long-term efforts and its results will take 3-5 years to be evident. Work in support of element 4 in the form of improved baseline data for sustainable fisheries management will take longer to become visible (+5 years) given the long-term nature of carrying out stock assessments.

A range of actions (e.g. studies, trainings) and investments by different stakeholders, including government, the private sector (core VC actors and service providers), the FISH4ACP project, and other donors (discussed in detail in Section 5), will produce outputs. These outputs will in turn bring about outcomes at the support/enabling environment level, which will in turn support the realization of the outcomes at actor level, and thereby the achievement of the vision.

The explanatory text above is presented graphically in the Theory of Change (ToC) overleaf. The ToC covers the whole upgrading strategy (whose implementation may go beyond the scope of FISH4ACP project) rather than being specific to the FISH4ACP project. Assumptions contained in the ToC are indicative and not linked directly to specific levels of the ToC (i.e. outputs, outcomes, etc) - the more detailed log frame for the upgrading strategy contains assumptions that are specific to different levels of the log frame.

FIGURE 55. THEORY OF CHANGE FOR THE OVERALL UPGRADING STRATEGY FOR THE VALUE CHAIN



4.3 Upgrading activities

Upgrading actions generally fall under three types of upgrading: upgrading business models; upgrading the enabling environment; and upgrading governance.

4.3.1 Upgraded business models

Upgrading business models includes improved technologies the value chain actors adopt to improve performance. For this value chain the upgraded business models include improved processing equipment and cold chain inputs.

4.3.1.1 Suppliers and users of improved drying and smoking, and cold chain equipment/inputs identified

Processing techniques and equipment have remained rudimentary, largely due to a lack of financial incentive for investing in processing equipment to produce a higher quality product. As such, improved processing equipment is not available at the lake. The Tables below compare current processing and cold chain practices with improved techniques according to six criteria. Analysis shows that when premium prices are paid for higher quality fish, as is now possible due to improved road connectivity to urban consumer markets, there is a financial benefit for investing in improved processing equipment.

Suppliers/fabricators will be identified depending on the location and the type of equipment and could include local fabricators, fishing gear suppliers at the lake or importers and distributors which can supply fishing gear suppliers at the lake.

Raised drying racks

Table 19 shows using raised drying racks requires significantly more investment than drying on the floor (TZS 3 million, or USD 1 296, for 125m^2 area to dry 500 kg of fresh sprat/sardine, assuming 1 m^2 is needed to dry 4kg of fresh fish), however, operating costs (working capital) remain the same. The raised drying racks tend to be permanent structures and therefore require land, which may be difficult for some processors. However, profit per square metre and profit per year (when also considering investment cost) is nearly triple that on raised racks, compared to ground drying as the dagaa is kept clean and receives a higher price.

TABLE 19: COST BENEFIT ANALYSIS OF RAISED DRYING RACKS (PER M^2 AND PER YEAR)

Sun Drying Racks	**Current Business Model** (Drying nets on the ground)	**Upgraded Business Model** (Raised metal-framed racks)
Investment required	Salvaged fishing nets: TZS 2 250/m^2. 125m^2 is needed to dry 500 kg of fish. The cost of 125m2 net = TZS 281 250.	Raised metal framed racks: TZS 29 075/m^2. 125m^2 is needed to dry 500 kg of fish. The cost of 125m2 rack = TZS 3 634 375.

	Assume a net can be used over 5 years. A typical processor processes 8 600 kg of fresh sprat/sardine a year.	Assume a rack can be used over 5 years. A typical processor processes 8 600 kg of fresh sprat/sardine a year.
Working capital required	**Per m2** 4kg of fresh sprat/sardine per 1 m^2. 4kg fresh sprat/sardine @TZS 2 700/kg = TZS 10 800/m^2 *Labour = TZS 62/m^2 Total = TZS 10 862/m^2 **Per year** 8 600 kg of sprat/sardine @TZS 2 700/kg = TZS 23 220 000. Labour = TZS 62/m2 * (8 600/4) = TZS 133 300 Total = TZS 23 353 300	**Per m2** 4kg of fresh sprat/sardine per 1 m^2. 4kg fresh sprat/sardine @TZS 2 700/kg = TZS 10 800/m^2 *Labour = TZS 62/m^2 Total = TZS10 862/m^2 **Per year** 8 600 kg of sprat/sardine @TZS 2 700/kg = TZS 23 220 000. Labour = TZS 62/m2 * (8 600/4) = TZS 133 300 Total = TZS 23 353 300
Profitability	**Per m2** 4kg of fresh sprat/sardine is processed into 0.8kg of dried sprat/sardine (conversion rate 0.2). Sales: 0.8kg dried dagaa @ TZS 16 241/kg = TZS 12 993 Profit = TZS 2 131/m^2 (before deducting investment cost) **Per year** 8 600 kg of fresh sprat/sardine is processed into 1 720 kg of dried sprat/sardine (conversion rate 0.2). Sales: 1 720 kg dried dagaa @ TZS16 241/kg = TZS 27 934 520/year Profit (before deducting investment cost) = TZS 4 581 220 Profit (after deducting investment cost) = TZS 4 581 220 – TZS 281 250/5 = **TZS 4 524 970**	**Per m2** 4kg of fresh sprat/sardine is processed into 0.8kg of dried sprat/sardine (conversion rate 0.2). **Sales: 0 .8kg dried dagaa @ TZS 21 113/kg = TZS 16 890 Profit = TZS 6 028/m^2 (before deducting investment cost) **Per year** 8 600 kg of fresh sprat/sardine is processed into 1 720 kg of dried sprat/sardine (conversion rate 0.2). Sales: 1 720 kg dried dagaa @ TZS 21 113/kg = TZS 36 314 360/year Profit (before deducting investment cost) = TZS 12 961 060 Profit (after deducting investment cost) = TZS 12 961 060 – TZS 3 634 375/5 = **TZS 12 234 185**
Effect upon employment	3 man-days per 500kg load	3 man-days per 500kg load
Environmental impact	None	None
Risk	Reliant on sunshine	Reliant on sunshine Requires land to erect permanent racks

* To dry 500kg of fresh fish takes 3 man-days @ TZS 2 596/day
** High quality dagaa receives a 30 percent price premium
Exchange rate: USD 1 = TZS 2 315

FIGURE 56 DAGAA DRIES QUICKLY ON RAISED DRYING RACKS AND IS SAND AND DIRT FREE HENCE OF A SUPERIOR QUALITY

©SmartFish/Ansen Ward

FIGURE 57 SIMPLE PACKAGING CAN ADD VALUE TO PROCESSED FISH PRODUCTS

©TAFIRI

Electric dryers

Table 20 shows a 500kg electric dryer with 500kg capacity per load costs TZS19 million (or USD 8 207), which is a large investment for an artisanal processor. Also, considering the average processor dries only around 40kg/day (or 8 600 kg/year), it would not be profitable for a single processor to invest in the dryer. Potential options to make the investment financially viable may include ten or more processors forming into a cooperative with a clear/effective management structure and hire a business professional to manage the operation of the dryer (this is linked to upgraded VC governance, discussed below), or an entrepreneur purchasing the dryer to provide drying service to processors (as a support service provider). A benefit of using electric dryer as opposed to current practices is that processors will obtain price premium for higher quality dried sprat/sardine, leading to

increased profit/year by nearly three times (see table below). In addition, the electric dryer requires less labour and takes only six hours to dry 500kg fish, compared to 12-18 hours sun-drying. It is also not reliant on sunny weather and can be worked throughout the year, day or night. However, there is a risk of electric power cuts preventing running the dryer.

TABLE 20: COST BENEFIT ANALYSIS OF ELECTRIC DRYERS (PER 500KG LOAD AND PER YEAR)

Electric Dryers	**Current Business Model** (drying nets on the ground)	**Upgraded Business Model** (electric dryer 500kg capacity per load)
Investment required	Salvaged fishing nets: TZS 2 250/m^2 125m^2 is needed to dry 500 kg of fish. The cost of 125m2 net = TZS 281 250. Assuming lifespan is 5 years, the annual depreciation cost is TZS 281 250 / 5 = TZS 56 250.	A locally made electric dryer with 500kg capacity per load costs TZS 19 000 000. A typical processor processes 8 600 kg of fresh sprat/sardine a year, or 8% of the dryer's annual capacity (i.e. 500kg *216 days/year = 108 000 kg/year). Assuming lifespan is 10 years, the annual depreciation cost of the dryer for a processor (if buying and sharing the machine with other processors) is 19 000 000 / 10 * 8% = TZS 152 000
Working capital required	**Per 500kg load** 500kg fresh sprat/sardine @ TZS 2 700/kg = TZS 1 350 000 Labour: 3 man-days @ TZS 2 596/day = TZS 7 788 Total = TZS 1 357 788 **Per year** 8 600 kg fresh sprat/sardine @ TZS 2 700/kg = TZS 23 220 000 Labour: 52 man-days to process 8 600 kg of fresh sprat/sardine. Labour cost: 52 man-days @ TZS 2 596/day = TZS 134 992 Total = TZS 23 354 992	**Per 500kg load** 500kg fresh sprat/sardine @ TZS 2 700/kg = TZS 1 350 000 Labour: 2 man-days @ TZS 2 596/day = TZS 5 192 *Energy: TZS 502 per 500kg load Total = TZS 1 355 694 **Per year** 8 600 kg fresh sprat/sardine @ TZS 2 700/kg = TZS 23 220 000 Labour: 34 man-days to process 8 600 kg of fresh sprat/sardine. Labour cost: 34 man-days @ TZS 2 596/day = TZS 88 264 Energy: 8 600kg / 500kg * TZS 502 = TZS 8 634 Total = TZS 23 316 898
Profitability	**Per 500kg load** 500kg of fresh sprat/sardine is processed into 100kg of dried sprat/sardine (conversion rate 0.2). Sales: 100kg dried dagaa @ TZS 16 241/kg = TZS 1 624 100	**Per 500kg load** 500kg of fresh sprat/sardine is processed into 100 kg of dried sprat/sardine (conversion rate 0.2). **Sales: 100 kg dried dagaa @ TZS 21 113/kg = TZS 2 111 300

	Profit (before deducting investment cost) = TZS 266 312 per 500kg load **Per year** 8 600 kg of fresh sprat/sardine is processed into 1 720 kg of dried sprat/sardine (conversion rate 0.2). Sales: 1 720 kg dried dagaa @ TZS 16 241/kg = TZS 27 934 520/year Profit (before deducting investment cost) = TZS 4 579 528/year Profit (after deducting investment cost) = TZS 4 579 528 – TZS 56 250 = **TZS 4 523 278/year**	Profit (before deducting investment cost) = TZS 755 606 per 500kg load **Per year** 8 600 kg of fresh sprat/sardine is processed into 1 720 kg of dried sprat/sardine (conversion rate 0.2). Sales: 1 720 kg dried dagaa @ TZS 21 113 /kg = TZS 36 314 360/year Profit (before deducting investment cost) = TZS 12 997 462/year Profit (after deducting investment cost) = TZS 12 997 462 – TZS 152 000 = **TZS 12 845 462/year**
Effect upon employment	3 man-days per 500kg load	2 man-days per 500kg load
Environmental impact	None	Use of electricity
Risk	Reliant on sunshine	Energy supply disruptions. Repairs and maintenance

* Energy = 450W/hour x 6 hours x TZS186/Kwh = TZS 502
** High quality dagaa receives a 30 percent price premium
Exchange rate: USD 1 = TZS 2 315

FIGURE 58 MECHANICAL FISH DRIERS ENABLE ROUND THE CLOCK PROCESSING

Source: https://fooddryingoven.com/drying-ideas/hot-air-fish-drying-machine.html

FIGURE 59 PACKAGING AND LABELLING IS AN IMPORTANT ASPECT OF VALUE ADDITION AND IMPROVING MARKET ACCESS

©FAO/TAFIRI

Chorkor smoking oven

The chorkor smoking oven is brick-walled and has a closed fire pit and smoking chamber. This allows better control of the smoking process to improve product quality, reduces the amount of firewood required per 500kg load by half, and increases an average processor's annual profit by over three times (Table 21).

FIGURE 60 CHORKOR OVENS HAVE PROVED TO BE A POPULAR IMPROVED SMOKING KILN

©SmartFish/Ansen Ward

TABLE 21: COST BENEFIT ANALYSIS OF A CHORKER SMOKING OVEN (PER 500 KG LOAD AND PER YEAR)

Chorker Smoking Oven	**Current Business Model** (traditional mud-walled smoking oven)	**Upgraded Business Model** (brick-walled smoking oven with improved fire chamber)
Investment required	3m * 2m * 1.2m oven = TZS 120 000 Assuming life span is 5 years, the annual depreciation cost is TZS 120 000 / 5 = TZS 24 000	2.2m * 1.1m * 0.6m oven = TZS 697 800 A typical processor processes 4 000 kg of fresh perch a year. Assuming life span is 5 years, the annual depreciation cost is TZS 697 800 / 5 = TZS 139 560
Working capital required	**Per 500 kg load** 500kg fresh perch @ TZS 1 300/kg = TZS 650 000 Labour: 2 man-days @ TZS 2 596/day = TZS 5 192 *Firewood = TZS 107 500 Total = TZS 762 692 **Per year** 4 000 kg fresh perch @ TZS 1 300/kg = TZS 5 200 000 Labour: 4000/500 * 2 man-days = 16 man-days Labour cost: 16 man days @TZS 2 596/day = TZS 41 536	**Per 500 kg load** 500 kg fresh perch @ TZS 1 690/kg = TZS 845 000 (assuming processors using improved ovens would also buy perch on ice) Labour: 2 man-days @ TZS2 596/day = TZS 5 192 **Firewood = TZS 53 750 Total = TZS 898 942 **Per year** 4 000 kg fresh perch @ TZS 1 690/kg = TZS 6,760,000 Labour: 4000/500 * 2 man-days = 16 man-days

	Firewood: 4000/500 * TZS 107 500 = TZS 860 000 Total = TZS 6 101 536	Labour: 16 man days @TZS 2 596/day = TZS 41 536 Firewood: 4000/500 * TZS 53 750 = TZS 430 000 Total = TZS 7 231 536
Profitability	**Per 500 kg load** 500kg of fresh perch is processed into 200kg of smoked perch (conversion rate 0.4). Sales: 200kg smoked perch @ TZS 4 000/kg = TZS 800 000 Profit (before deducting investment cost) = TZS 37 308 per 500kg load **Per year** 4 000 kg fresh perch is processed into 1 600 kg of smoked perch (conversion rate 0.4). Sales: 1 600 kg of smoked perch @ TZS 4 000/kg = TZS 6 400 000/year Profit (before deducting investment cost) = TZS 298 464/year Profit (after deducting investment cost) = TZS 298 464 – TZS 24 000 = **TZS 274 464/year**	**Per 500 kg load** 500kg of fresh perch is processed into 200kg of smoked perch (conversion rate 0.4). *** Sales: 200kg smoked perch @ TZS 5 200/kg = TZS 1 040 000 Profit (before deducting investment cost) = TZS 141 058 per 500kg load **Per year** 4 000 kg fresh perch is processed into 1 600 kg of smoked perch (conversion rate 0.4). Sales: 1 600 kg of smoked perch @ TZS 5 200/kg = TZS 8 320 000/year Profit (before deducting investment cost) = TZS 1 088 464/year Profit (after deducting investment cost) = TZS 1 088 464 – TZS 139 560 = **TZS 948 904/year**
Effect upon employment	2 man-days for 500kg load	2 man-days for 500kg load
Environmental impact	Uses firewood	Uses less firewood

* Use 1kg firewood to smoke 1kg fish @ TZS 215/kg
** Improved fire chamber uses 0.5kg firewood to smoke 1kg fish
*** High quality smoked perch receives 30 percent price premium
Exchange rate: USD 1 = TZS 2 315

FAO Thiaroye Technique (FTT) Ovens

The FTT oven includes further improvements to the chorker oven. The smoking and cooking of the fish are separated and the indirect smoking process reduces the levels of Polycyclic Aromatic Hydrocarbons to meet food safety requirements. Table 22 shows profits can be nearly three times higher using the improved smoking ovens as compared to current practices.

TABLE 22: COST BENEFIT ANALYSIS OF A FTT OVEN (PER 500 KG LOAD AND PER YEAR)

FTT Smoking Oven	Current Business Model (traditional mud-walled smoking oven)	Upgraded Business Model (brick-walled smoking oven with improved fire chamber)
Investment required	3m * 2m * 1.2m oven = TZS 120 000 Assuming life span is 5 years, the annual depreciation cost is TZS 120 000 / 5 = TZS 24 000	2.2m * 1.1m * 0.6m oven = TZS 1 860 800 A typical processor processes 4 000 kg of fresh perch a year. Assuming life span is 5 years, the annual depreciation cost is TZS 1 860 800 / 5 = TZS 372 160
Working capital required	**Per 500 kg load** 500kg fresh perch @ TZS 1 300/kg = TZS 650 000 Labour: 2 man-days @ TZS 2 596/day = TZS 5 192 *Firewood = TZS 107 500 Total = TZS 762 692 **Per year** 4 000 kg fresh perch @ TZS 1 300/kg = TZS 5 200 000 Labour: TZS 2 596/day * 16 man-days = TZS 41 536 *Firewood = TZS 107 500 * (4000/5) = TZS 860 000 Total = TZS 6 101 536	**Per 500 kg load** 500kg fresh perch @ TZS 1 690/kg = TZS 845 000 (assuming processors using improved ovens would also buy perch on iced) Labour: 2 man-days @ TZS 2 596/day = TZS 5 192 **Charcoal = TZS 50 750 Total = TZS 895 942 **Per year** 4 000 kg fresh perch @ TZS 1 690/kg = TZS 6 760 000 Labour: TZS 2 596/day * 16 man-days = TZS 41 536 **Charcoal = TZS 50 750 * (4000/5) = TZS 406 000 Total = TZS 7 207 536
Profitability	**Per 500 kg load** 500kg of fresh perch is processed into 200kg of smoked perch (conversion rate 0.4). Sales: 200kg smoked perch @ TZS 4 000/kg = TZS 800 000 Profit = TZS 37 308 per 500kg load **Per year** 4 000 kg fresh perch is processed into 1 600 kg of smoked perch (conversion rate 0.4). Sales: 1 600 kg of smoked perch @ TZS 4 000/kg = TZS 6 400 000/year	**Per 500 kg load** 500kg of fresh perch is processed into 200kg of smoked perch (conversion rate 0.4). *** Sales: 200kg smoked perch @ TZS 5 200/kg = TZS 1 040 000 Profit = TZS 114 058 per 500kg load **Per year** 4 000 kg fresh perch is processed into 1 600 kg of smoked perch (conversion rate 0.4). Sales: 1 600 kg of smoked perch @ TZS 5 200/kg = TZS 320 000/year

	Profit (before deducting investment cost) = TZS 298 464/year Profit (after deducting investment cost) = TZS 298 464 – TSZ 24 000 = **TZS 274 464/year**	Profit (before deducting investment cost) = TZS 1 112 464/year Profit (after deducting investment cost) = TZS 1 112 464 – TZS 372 160 = **TZS 740 304/year**
Effect upon employment	2 man-days for 500kg load	2 man-days for 500kg load
Environmental impact	Uses firewood	Uses less fuelwood
Risk		

* Use 1kg firewood to smoke 1kg fish @ TZS 215/kg
** Heat retaining bricks uses 0.25kg charcoal to smoke 1kg fish
*** High quality smoked perch receives a 30 percent price premium
Exchange rate: USD 1 = TZS 2 315

FIGURE 61 THE FTT IS AN IMPROVED FUEL-EFFICIENT SMOKING OVEN THAT PRODUCES GOOD QUALITY PRODUCTS

© FAO/Sia Kambou

Ice

When fishing, fishers usually store the caught fish in boxes or buckets on the boat. If fishing for long periods or the fishing grounds are a long way from the landing sites, this can lead to deterioration to fish quality. Insulated boxes that fit in to the boats have been designed that can hold ice and keep the fish fresh.

FIGURE 62 ICE IS AN IMPORTANT INPUT FOR IMPROVED FRESH FISH DISTRIBUTION

©SmartFish/Ansen Ward

Table 23 shows the costs of insulated ice boxes and ice are relatively expensive and availability is a problem if local ice making machines are not available. However, assuming fish price would increase due to the fish having better quality when being on ice, it could still be more profitable for fishers or traders to invest in using ice (increased profits as compared to current business model, without using ice). That said, for fishers to adopt this improved practice, it is important that they are connected to buyers (e.g. traders, consumers) who can pay higher prices for better quality fish (this is linked to upgraded VC governance, to be discussed below). Additional benefits of 'fresh'(iced) fish are shared all along the value chain, for instance it is essential to maintain freshness from the moment the fish is caught as processing poor-quality fresh fish results in poor-quality processed fish.

TABLE 23: COST BENEFIT ANALYSIS OF USING ICE BY FISHERS IN FISHING (PER YEAR)

Ice	Current Business Model (fish are not iced on board boats)	Upgraded Business Model (fish are kept in insulated ice boxes on board boats)
Investment required	One box can hold maximum around 60 kg. CPUE 46 kg/trip, of which 33% (or 15 kg) is perch. A boat needs 1 box per trip for perch. The boxes are used year-round. 1 Wooden box costs TZS 20 000 Assuming lifespan is 5 years, the annual depreciation cost is TZS 20 000 / 5 = TZS 4 000	One box can hold maximum around 60 kg. CPUE 46 kg/trip, of which 33% (or 15 kg) is perch. Ice is used for perch. A boat needs 2 boxes per trip (one box for ice, one box for fish on ice, and ice:fish ratio is 1:1). The boxes are used year-round. 2 insulated boxes @ TZS 150 000 = TZS 300 000 Assuming lifespan is 5 years, the annual depreciation cost is TZS 300 000 / 5 = TZS 60 000
Working capital required	None	**Per year (3 300 kg of perch/year)** Ice costs TZS 300/kg. For 15 kg of perch/trip, 15 kg of ice is needed. Ice cost/year= TZS 300 * 15 kg * 216 trips = TZS 972 000 *Additional boat fuel = TZS 165 000 Total = TZS 1 137 000
Profitability	**Per year (3 300 kg of perch/year)** Sales of fresh perch : 3 300 kg @ TZS 1 300/kg = TZS 4 290 000 Profit (before deducting investment cost) = TZS 4 290 000 Profit (after deducting investment cost) = TZS 4 290 000 – TZS 4 000 = **TZS 4 286 000/ year**	**Per year (3 300 kg of perch/year)** Sales of fresh perch: 3 300 kg @ TZS 1 690/kg = TZS 5 577 000 Profit (before deducting investment cost) = TZS 4 440 000 Profit (after deducting investment cost) = TZS 4 440 000 – TZS 60 000 = **TZS 4 380 000/ year**
Effect upon employment	None	None-
Environmental impact	None	Energy and water used to make ice
Risk		

* Additional boat fuel required due to carrying ice (heavier load)
** High quality fresh perch receives 30 percent price premium
Exchange rate: USD 1 = TZS 2 315

FIGURE 63 ICE IS IDEALLY USED AT ALL STAGES OF THE FRESH FISH VALUE CHAIN

Source: ©SmartFish/Ansen Ward

4.3.1.2 Financial products developed for purchase of improved processing equipment/inputs

Formal borrowing in the fisheries sector is low, due to the limited outreach of the banks and the capacity of small-scale fishers and processors to meet minimum buying criteria. However, if fishers and processors are to adopt the improved processing techniques, they are likely to require some form of credit.

FISH4ACP will work with the NGO African Rural and Agricultural Credit Association (AFRACA) to carry out an assessment of the market demand for financial services for the value chain and also assess financial policies and legal/regulatory frameworks to provide recommendations for investment, micro-finance, credit, and insurance products specifically for the value chain. Discussions with banks, such as the Tanzania Agriculture Development Bank (TADB) who are willing to provide loans, have already started.

Innovative financial products will be developed by FISH4ACP and financial service providers specifically for the fisheries sector that sustain the supply and purchase of improved processing equipment/inputs. These could include direct lending to individuals; direct lending to groups; leasing to individuals/groups; lending to equipment suppliers who then provide credit to processors.

4.3.1.3 Trainers of new technologies, standards and quality control for fishers, processors and traders identified and engaged in the VC

The provision of training and extension in the VC is mostly handled by the MLF through its network of Fisheries Officers but face challenges regarding funding and outreach. If adopting

new technologies, the processors will need training how to use them and also other skills such as standards and quality control, establishing business partnerships and forging market linkages.

For sustainability purposes, FISH4ACP will partner with Business Development Service (BDS) providers to provide this training, rather than delivering the training directly. A curriculum and training materials will be developed with the BDS provider which will then deliver the training.

4.3.1.4 Facilities in strategically located landing sites upgraded

Landing sites are insufficiently equipped and lack the necessary infrastructure to ensure and support the efficient handling of fish. Processing, handling and storage facilities are lacking and there are other issues such as clean water management, wastewater treatment, and accessible roads.

A scoping study will identify strategically located sites where fishers, processors and buyers can meet to trade, which could include Kibirizi, which is already well known in Kigoma, Ikola as it is the biggest landing site in Katavi and Kasanga in Rukwa as it is located close to the Zambian border. However, there are other factors such as risk of flooding that need to be considered.

Facilities required by fishers, processors and traders to produce good quality fish will be identified and is likely to include cold chain facilities – ice makers to supply ice on boats, cold room storage, blast freezers and refrigerated transport. These facilities will be available to hire on a user-fee basis to cover investment and maintenance costs.

4.3.1.5 Landing site management and service provision capacity strengthened

Increasing the capacity of the upgraded landing site management will ensure the upgraded facilities are sustainably managed. Currently landing sites offer few services and generate little income to finance maintenance or improvements. Various management models could be considered such as joint management with BMUs, direct management as a public service or even Public Private Partnerships.

Operating accounts of core VC actors under the current situation and the improved situation

Tables 24 to 27 compare the operating accounts of core actors under the current situation and the improved situation if they adopt the proposed technologies and techniques. Exporters are not included as the main target market is domestic. For fishers (Table 24), the main increase in costs is ice to keep the fish fresh on board the boats. There is also some added depreciation for the insulated boxes in which the iced fish will be kept. Due to the

increased quality of the fish, fishers receive a 30 percent higher price for their fish. Overall, this results in nearly a doubling of profits.

TABLE 24: UPGRADED OPERATING ACCOUNTS OF A TYPICAL FISHER

Fisher	Current scenario (TZS)	Improved scenario (TZS)
Total output value	20,626,000	26,813,800
Intermediate Inputs	8,130,750	10,309,350
Inputs from inside the chain	-	-
Inputs from outside the chain	8,130,750	10,309,350
Gross value added	12,495,250	16,504,450
Fixed capital consumption	2,030,976	2,090,974
Net value added	10,464,274	14,413,476
Other components	6,059,406	6,059,406
Profits/Losses	4,404,868	8,354,070

Exchange rate: USD 1 = TZS 2 315

Source: VCATool Analysis

Under the improved scenario processors (Table 25) smoke 50 percent less perch, as more are sold fresh or frozen by wholesalers due to the improved cold chain facilities, resulting in the need for slightly less labour. Although the costs of raw fish increase, due to improved quality as described above and the costs of processing increases due to the use of improved equipment and machinery, processors receive a 30 percent higher price for their dried dagaa and smoked perch[69], resulting in profits more than doubling. Under the improved scenario a processor dries 66 percent of dagaa on raised racks and the remaining 33 percent using an electric dryer. For smoking perch, the costs of using the 'chorker' oven are used, which are similar to the FTT oven.

TABLE 25: UPGRADED OPERATING ACCOUNTS OF A TYPICAL PROCESSOR

Processor	Current scenario (TZS)	Improved scenario (TZS)
Total output value	32,837,168	38,741,024
Intermediate Inputs	30,973,361	35,119,210
Inputs from inside the chain	28,502,000	33,689,500
Inputs from outside the chain	2,471,361	1,429,710
Gross value added	1,863,807	3,621,814
Fixed capital consumption	-	181,075
Net value added	1,863,807	3,440,739
Other components	496,379	465,227
Profits/Losses	1,367,428	2,975,512

Exchange rate: USD 1 = TZS 2 315

Source: VCATool Analysis

[69] Assumption made based on end-market analysis Table 1 and Figure 4.

Wholesalers (Table 26) are expected to sell nearly 40 percent more fresh or frozen perch in the urban centres of United Republic of Tanzania where retailers pay between 30 (Mbeya) and 70 (Dar es Salaam) percent more for fresh/frozen perch than in Kigoma (Economic actor interviews, 2021), as fresh perch are less available in those areas. Additional costs include the increased price of quality raw fish from fishers, additional ice or freezing costs, increased transport costs and slightly increased labour for handling the increased volume of fish. Overall, profits increases by nearly 30 percent.

TABLE 26: UPGRADED OPERATING ACCOUNTS OF A TYPICAL WHOLESALER

Wholesaler	Current scenario (TZS)	Improved scenario (TZS)
Total output value	319,014,196	415,342,572
Intermediate Inputs	258,374,742	337,867,406
Inputs from inside the chain	253,750,512	329,402,816
Inputs from outside the chain	4,624,230	8,464,590
Gross value added	60,639,454	77,475,166
Fixed capital consumption	1,797,597	1,797,597
Net value added	58,841,857	75,677,569
Other components	636,923	636,923
Profits/Losses	58,204,934	75,040,646

Exchange rate: USD 1 = TZS 2 315
Source: VCATool Analysis

Table 27 compares retailers at the lake and retailers in urban centres such as Mbeya, so is not a like for like comparison. Currently only 10 percent of fish is sold in urban centres to about 400 urban retailers. This is expected to rise to just over 800 urban retailers in 2025 and 1600 urban retailers in 2031.

TABLE 27: UPGRADED OPERATING ACCOUNTS OF A TYPICAL RETAILER

Retailer	Selling at the lake (TZS)	Selling in an urban centre (TZS)
Total output value	50,694,860	73,506,725
Intermediate Inputs	39,961,403	57,159,241
Inputs from inside the chain	39,297,268	53,970,606
Inputs from outside the chain	664,135	3,188,635
Gross value added	10,733,457	16,347,484
Fixed capital consumption	63,328	63,328
Net value added	10,670,129	16,284,156
Other components	769,518	811,206
Profits/Losses	9,900,611	15,472,950

Exchange rate: USD 1 = TZS 2 315
Source: VCATool Analysis

4.3.2 Upgraded enabling environment

The upgrading of the enabling environment of the VC would involve the socio-cultural improvements for the benefits of women and the improved design and enforcement of fisheries legislations.

4.3.2.1 Gender hotspots (and their root causes in social cultural elements) addressed

The upgrading strategy will help to address the gender hotspots in the VC[70] and bring about an improved socio-cultural enabling environment for women participants in the VC. Thanks to the conduct of an in-depth study on the constraints and opportunities for women in the value chain, the root causes of gender-based constraints, and thus, the opportunities/solutions to address them will be identified. These opportunities/solutions will be incorporated in other upgrading components (for instance, the training of fishers, processors and traders, and new financial products will have to be gender-sensitive), which will in turn enhance women's position and benefits. Additionally, experience from working with women, for instance from EMEDO (Environmental Management and Economic Development Organization) who supports the Tanzania Women Fish Workers Association (TAWFA)[71], shows that leadership and organization training for women and awareness raising on gender equity in fisheries communities could lead to transformational changes as women are made aware of their rights, are empowered with knowledge, and are organized to defend their rights collectively, and as the communities are sensitized to tackle the deeply rooted social norms that disadvantage women.

Improving the socio-cultural enabling environment requires long-term commitment and support from local actors and communities. Therefore, for sustainability purpose, while FISH4ACP will provide budget for relevant trainings and awareness raising events, the project will partner with existing training providers, rather than providing trainings directly, and all the sensitization activities will need to be led by the VC Task Force in coordination with local governments and other local partners.

4.3.2.2 Improved institutional enabling environment

The upgrading strategy will bring about an improved institutional enabling environment with fisheries legislations being revised based on updated data and the enforcement of fisheries policies and regulations being strengthened thanks to improved co-management and MCS capacities of the MLF and BMUs.

[70] The three hotspots are low level of women's economic involvement in the VC, unequal division of roles between men and women, and women's limited access to land (see section 3.2.2).

[71] TAWFA was launched in April 2019, with the support of a FAO project on the Voluntary Guidelines for securing sustainable small-scale fisheries in the context of food security and poverty eradication (SSF guidelines) in Tanzania (MLF, 2019a).

The **revision of fisheries legislation** will be informed by updated data coming from a lake-wide fish stock assessment, a lake-wide frame survey, and a lake-wide catch assessment survey (CAS). While a fish stock assessment focuses on stock status (and fisheries resource potential), a frame survey and a catch assessment survey focus on fishing pressure (and the extent of the exploitation of fisheries resource). Given their regional scope, the conduct of the assessment and surveys would be led by the LTA, with support from other VC stakeholders including ministries (MLF in Tanzania, other countries' government bodies), FISH4ACP and other projects/donors (e.g. LATAFIMA). Funding from LATAFIMA project has been secured for the implementation of the frame survey. Meanwhile, the conduct of fish stock assessment and CAS requires regularity (i.e. they should not be one-off efforts, but need to be carried out regularly to generate sufficient data to inform estimation and to understand trends over the years), and therefore, requires long-term commitment and funding. While CAS is relatively less demanding in terms of (financial and human) resources required, and thus, could/should be led by country governments (as is the case in United Republic of Tanzania, where e-CAS[72] has been used), a lake-wide fish stock assessment is expensive. Therefore, it is now a priority to engage partners/donors and agree on a mechanism to collaborate on the funding and implementation of the fish stock assessment. As the regional body overseeing fisheries management in the lake, the LTA is well-positioned to take the lead in this partner engagement process. FISH4ACP will provide budget to support the assessment design, partner engagement, and resource mobilization.

Fisheries legislations, at national and regional levels, will then need to be revised based on updated data. To this end, national laws must be harmonized with the Framework Fisheries Management Plan (FFMP) of Lake Tanganyika, which is the overarching sustainable management framework in the region. Additionally, there is a need to ensure coordination between four countries around the lake in the drafting, review, and implementation of fisheries policies, regulations, and measures. This coordination is of particular importance to prevent fishers from one country from migrating (drifting) to another country's part of the lake to avoid certain measures in their home country. The LTA, as an overarching management body of the whole lake, plays an essential role in facilitating and ensuring this harmonization between the national laws in four countries bordering the lake and between national laws and regional frameworks. FISH4ACP will provide support to this policy revision and harmonization process, particularly through capacity building and technical assistance to the LTA and the government where relevant.

In terms of **policy enforcement**, given the limited human and financial resources of government fisheries offices, it is necessary that the fishing communities, especially through BMUs, are involved in the management of fisheries resources. While the roles of BMUs in

[72] Traditional CAS use paper-based survey forms while e-CAS is in electronic format.

fisheries co-management and MCS are well-understood within fishing communities, a key challenge facing their execution is the lack of finance, particularly a viable financial mechanism to fund the operation of BMUs. Potential funding mechanisms may include but are not limited to: the government allocates additional funds to BMUs, fishing communities pull resources together to fund BMUs, landing site operators pay BMUs the fees for the use of landing site services, or a combination of these mechanisms. Additionally, there are potential business models to generate income for BMUs that could be explored and piloted, if proven to be relevant. More detailed feasibility study of the funding mechanisms (or business models) for the BMUs needs to be conducted to identify the most suitable mechanism(s)/models. Additionally, for co-management and MCS to work, it is also necessary to continue strengthening the capacity of BMUs in sensitizing and training fishers on fishing activities as well as in executing MCS activities. In turn, this would require training of the BMUs as well as demonstrations of resource management practices, to be led by the MLF. Some training and/or demonstration activities could be funded by FISH4ACP; but for sustainability reasons, this will have to be conducted in partnership with the MLF and other local partners.

4.3.3 Upgraded governance

Upgraded governance strives to improve the relationships between value chain stakeholders including core actors and support providers and create more efficient coordination along the value chain.

4.3.3.1 High-value target markets and suppliers identified

In Section 2.4 of the report, the governance analysis concluded the vertical linkages between VC actors are informal, not well coordinated and most transactions were 'spot' transactions. There were also few horizontal linkages between VC actors for collective business purposes.

This is typical of an artisanal-based system where thousands of small transactions are repeated on a daily and ad-hoc basis. This not only increases transaction costs but also undermines efforts to improve value chain efficiencies such as assured quality, predictable quantities and reduced waste. Fishers and processors are unsure of demand and prices and traders are unsure of quantities available and quality.

A scoping study to identify target markets (retailers) and buyers of high-quality processed fish and fresh/frozen fish will be carried out and could include wholesalers, exporters and also retailers. These buyers could be located around the lake, in urban centres within United Republic of Tanzania with good transport links to the lake, or neighbouring countries with good boat linkages to the landing sites. It is important the buyers are supplying a market segment willing to pay a premium for good quality fish and the buyer is willing to share some of that premium with fishers and processors and enter in to long-term partnership with those suppliers.

4.3.3.2 Market linkages established/ strengthened between fishers/processors and target buyers

To achieve the VC vision, the VC must become more commercial in its conduct. Market linkages will have to be made between fishers, processors and traders and if fishers and processors are to invest in improving quality, they must be assured they will receive adequate financial reward. Similarly, if traders are to sell to higher-value markets, they must be assured they are supplied with dependable quantities of the right quality product. Establishing market linkages, strengthening business models and improving governance will be required for both the processed fish and the fresh/frozen fish target markets.

The financial benefits of improved coordination along the value chain are summarized in Table 28, which compares the price of 'average quality' dried dagaa and fresh perch in Kigoma with Dar es Salaam.

TABLE 28: PROCESSED FISH PRICES IN KIGOMA AND DAR ES SALAAM

	Retail price Kigoma (TZS/kg)	Transport cost (TZS/kg)	Retail price Dar es Salaam (TZS/kg)	Net benefit (TZS/kg)
Dried sprat/sardine	TZS 24 000/kg	TZS 2 384/kg	TZS 38 000/kg	TZS 11 616/kg
Frozen perch	TZS 5 500/kg	TZS 2 384/kg plus TZS 210/kg ice	TZS 9 500/kg	TZS 1 406/kg

Note: Exchange rate: USD 1 = TZS 2 315

Source: Key Informant and actor interviews

As can be seen from Table 28, after deducting transport and related costs, additional profit can be earned from selling Lake Tanganyika sprat, sardine and perch in distant urban centres such as Dar es salaam. Prices quoted are for 'average' quality fish, therefore an additional premium is possible for higher quality fish.

4.3.3.3 VC actor organisations established/strengthened

Whilst the above action strengthened vertical linkages, horizontal linkages can also be strengthened to better engage with VC partners. There are very few fisher or processor organisations which perform a commercial role. The purpose of the groups is likely to revolve around the purchase, use and management of shared equipment such as processing machinery, cold stores and refrigerated transport to supply bulk contracts. Fishers and processors who want to work together to supply high-value markets and form business partnerships with those buyers will be identified and trained in organisational and management skills.

4.3.3.4 VC Task Force formed and operational

Currently, there is no agency or organisation responsible for coordination across the value chain. A VC task force will be established to assist FISH4ACP project during the planning phase, then provide guidance on strengthening the value chain during and after project implementation. Membership will include Relevant Government Institutions (MLF, TBS, NEMC), Fishers Union, Financial Institutions, Donors, specialised agencies (FAO, TNC), Research and Academic Institutions (TAFIRI, UDSM), Fish processors Union and LGA and they will meet every quarter.

In addition to discussing issues and guiding decision making on the sustainability of Lake Tanganyika fisheries, the VC Task Force will be included in the stock assessments and also monitoring implementation of the Fish4ACP upgrading strategy.

4.4 Anticipated sustainability impact

The sustainability impact revolves around three questions:

4.4.1 Will the strategy lead to the realization of the vision and deliver impact at scale?

Impact at scale is determined by the number of VC stakeholders adopting the improved technologies and entering business partnerships to sell fish for higher prices. Table 29 shows the number of project beneficiaries in 2025 and continuing to 2032. The baseline number of actors is taken from the value chain map. By 2025, with project support, it is expected 18 percent of value chain actors will have adopted the improved technologies, established business partnerships and increased profits as shown in the operating accounts above. The main leverage point upon which the number of adopters is based are processors i.e. if 18 percent of processors adopt the new technologies, they will need to buy fish from 18 percent of fishers and sell to 18 percent of wholesalers. A total of 1 000 processors are targeted for by 2025 which is the equivalent of 333 processors per region/landing site. By 2032, it is expected this will have increased to 36 percent through independent growth and adoption of the business models.

TABLE 29: NUMBER OF BENEFICIARIES ADOPTING IMPROVED TECHNOLOGIES

Adoption Rate (new adopters)	0%	18%		36%	
	Baseline	2025		2032	
VC Actors	Current No. VC Actors	Non-adopters	New Adopters	Non-adopters	New Adopters
Fishers	9 368	7 682	1 686	5 996	3 372
Processors	5 564	4 564	1 000	3 564	2 000
Wholesalers	440	361	79	282	158
Retailers	4 040	3 313	727	2 586	1 454
Exporters	118	118	-	118	-

Table 30 shows the increases in output and net value-added[73] for the value chain when the target number of beneficiaries adopt the improved technologies, enter business partnerships and sell fish for higher prices. The increases are based on the upgraded operating accounts presented in Tables 23 to 26. VC output increases from USD 340 million in 2022 to USD 378 million in 2032, a 10 percent increase. Net value-added increases from USD 78 million in 2022 to USD 90 million in 2032, a 15 percent increase.

TABLE 30: OUTPUT & VALUE ADDED FROM THE CORE VC (BASELINE, 2025 & 2032)

	Baseline (USD)	2025 (USD)	2032 (USD)
Total output value	343 236 219	360 758 872	378 281 525
Intermediate Inputs	256 462 129	267 964 453	279 466 777
Inputs from inside the chain	215 252 130	224 693 814	234 135 498
Inputs from outside the chain	41 209 999	43 270 639	45 331 279
Gross value added	86 774 090	92 794 419	98 814 748
Fixed capital consumption	8 674 348	8 796 388	8 918 427
Net value added	78 099 742	83 998 031	89 896 321
Other components	27 204 714	27 204 332	27 203 950
Profits/Losses	50 895 028	56 793 699	62 692 370

Source: VCATool Analysis

[73] The ***net value-added***, as showed in Table 30, is based on the FAO-VCA tool, and does not include the taxes/fees collected (captured) by the government. Differently, the ***direct value-added***, as showed in Table 31, is based on the FISH4ACP methodology and includes the taxes/fees collected by the government. This explains the differences between the values of value added obtained through two methods.

Table 31 shows the main economic, social and environmental impact indicators. In addition to the economic indicators described above the average income of processors (who are mostly women) will increase by 42 percent, the immature catch will reduce from 50 percent to 10 percent and CPUE/year will remain much the same but for less days in a year to allow stocks to recover.

TABLE 31: KEY ECONOMIC, SOCIAL, AND ENVIRONMENTAL PERFORMANCE INDICATORS UNDER CURRENT AND UPGRADED SITUATIONS (AGGREGATED AT VC LEVEL)

Item	2021 baseline	2025 - with upgrading	2032 - with upgrading
Economic indicators			
Direct value-added of the value chain	USD 81 million/year	USD 85 million/year	USD 91 million/year
Combined profits of all VC core actors	USD 51 million/year	USD 57 million/year	USD 63 million/year
Social indicators			
Average processor income	USD 591/year	USD 716/year	USD 840/year
Share of direct value added captured by women	17%	18%	18.5%
Environmental indicators			
Share of immature sprat, sardine, and perch in total catch	Approximately 50%	35%	10%
Catch per unit effort (CPUE)	46 kg per boat per day for 216 days per year	46 kg per boat per day for 216 days per year	61 kg per boat per day for 162 days per year

4.4.2 Will the strategy generate important positive or negative economic, social or environmental externalities?

Possible externalities of the upgrading strategy are summarized in Table 32. Most of the externalities are positive due to benefits accruing to non-VC core-actors, such as increased income for ancillary services. One negative externality is the possibility of reduced affordability and availability of dagaa for poorer lake-side consumers, if demand in other parts of United Republic of Tanzania increases. Environmental externalities are double-edged as there is a reduced use of fuelwood for processing but this is displaced by an increased use of electricity.

TABLE 32. POSSIBLE EXTERNALITIES OF THE UPGRADING STRATEGY

Item	Positive Externality	Negative Externality
Economic	• Increased income and employment for ancillary services e.g. transport, machinery fabricators	
Social	• VC actors who adopt improved food safety and quality standards can apply these skills and knowledge to other VCs and transfer the knowledge to others. • Improved landing site infrastructure and facilities will benefit not only VC actors but also the broader communities around the landing sites (e.g. marketplaces with better facilities and more resilient to floods, availability of inputs and services)	• Less fish available for consumption by poorer lake-side communities
Environmental	• The use of wood used for fish smoking, making canoes and fish storage boxes can be reduced thanks to adoption of improved smoking techniques by processors and increased knowledge and awareness of laws and conservation of fishers and fishing communities. These, in turn, contribute to reduction of GHG emission and deforestation.	• Increased use of electricity in cold chain may lead to increased GHG emission. However, this externality is unlikely to be a serious concern, given the current low level of cold chain use in the VC and potential GHG emission reduction thanks to improved smoking techniques.

4.4.3 Will the strategy increase the resilience of the VC?

The upgrading strategy is expected to strengthen the resilience of the value chain. This is assessed according to the six resilience domains, as shown in Table 33.

TABLE 33: POSSIBLE IMPACTS OF THE UPGRADING STRATEGY ON RESILIENCE

Item	Strengthened or weakened?
Redundancy	**Strengthened**: Improved availability and quality of the inputs and services required for proper handling, processing, and storage of VC products will enable VC actors to maintain higher levels of stock of fresh and processed fish, which as act as a buffer against shocks (such as flood, heavy rainfall) and fluctuations in supply (due to catch variations).
Diversity	**Strengthened**: By adopting improved techniques (i.e. drying, smoking, icing), VC actors will be able to ensure more stable provision of a range of product offerings, regardless of external factors such as weather patterns (e.g. rain) which currently largely influence the stability of supply. Additionally, enhanced linkages to buyers in urban centres will lead to increased market diversification and less dependency on certain markets/buyers, which helps to increase resilience to shocks.

Connectivity	**Strengthened**: Various upgrading activities related to organizational strengthening (e.g. supporting women groups, BMUs) will bring about stronger social linkages and networks between VC stakeholders. Additionally, improved infrastructure in landing sites (e.g. more resilient to floods) can help to maintain the transportation to and from the Lake in the event of shocks such as flooding. Altogether these will lead to increased level of VC connectivity.
Collaboration and governance	**Strengthened**: Various upgrading activities (e.g. facilitation of seller-buyer contracts, support group formation, training on organization, linkages to national/regional networks, strengthening co-management) will lead to more and strengthened horizontal and vertical linkages between VC stakeholders, which will in turn increase the level of collaboration and governance in the VC.
Learning and adaptation	**Strengthened**: Various upgrading activities aim at improving the availability, affordability, and quality of the inputs and services required for proper handling, processing, and storage of VC products, which will in turn lead to enhanced adoption of improved technologies by VC actors and increase their ability to resist to shocks as they are no longer fully dependent on traditional methods.
Participation and inclusion	**Strengthened**: With enhanced linkages to national and regional networks and associations as well as to buyers, VC actors will be better-connected to support/recovery mechanisms in the event of shocks.

5 Value Chain Development Plan

In this final section of the report, the upgrading strategy presented in Section 4 is translated into a VC development plan. This section includes four main components: (1) a logframe for the whole upgrading strategy, which will be used to monitor and evaluate the implementation and results of the strategy; (2) specification of the action and investment plans for sustainably developing the value chain. This also covers the whole set of activities all VC stakeholders will have to engage in, as well as those specifically by the FISH4ACP project; (3) a detailed FISH4ACP project design (i.e. the role of the project in the overall plan); and (4) a risk analysis which reflects on the risks that could prevent the achievement of the envisioned impact, and which develops associated mitigation strategies affecting both the overall and project-specific plans.

5.1 Overall log-frame of VC upgrading strategy

A log-frame for the VC upgrading is provided in Figure 64 below. Similar to the ToC, the logframe summaries the upgrading strategy and shows the causal linkages between outputs, outcomes and income. However, the logframe also includes monitoring and evaluation indicators to assess progress made against targets in 2025, when FISH4ACP support stops and 2032 when the shared vision for the value chain is expected to be achieved.

FIGURE 64. OVERALL LOGFRAME FOR VC UPGRADING

Impact	Impact indicator 1	2021 baseline		2025 target	2032 target	Assumptions/ Notes
By 2032, United Republic of *Tanzania will have strengthened its position as producer of Lake Tanganyika sprat, sardine, and perch thanks to enhanced value-addition based upon sustainably managed fisheries resources, which will generate increased income and remunerative employment for both women and men and increase the value chain's resilience*	Direct value added of value chain	USD 81 million	Planned	USD 85 million	USD 91 million	
			Achieved			
			MoV	Economic evaluation of core VC		
	Impact indicator 2	**2021 baseline**		**2025 target**	**2032 target**	
	Combined profits of all VC core actors	USD 51 million/year	Planned	USD 57 million/year	USD 63 million/year	
			Achieved			
			MoV	Economic evaluation of core VC		
	Impact indicator 3	**2021 baseline**		**2025 target**	**2032 target**	Almost all processors and their workers are women.
	Average processor income (USD/year)	591	Planned	716	840	
			Achieved			
			MoV	Economic evaluation of core VC		
	Impact indicator 4	**2021 baseline**		**2025 target**	**2032 target**	Almost all processors and their workers are women. Around half of retailers and their workers are women.
	Share of direct value added captured by women	17%*	Planned	18%*	18.5%*	
			Achieved			
			MoV	Economic evaluation of core VC		
	Impact indicator 5	**2021 baseline**		**2025 target**	**2032 target**	
	Share of immature	Approximately 50%	Planned	35%	10%	
			Achieved			

	sprat, sardine, and perch in total catch		MoV	Survey of catches and catch composition. Market studies.		
	Impact indicator 6	**2021 baseline**		**2025 target**	**2032 target**	* Total catch volume does not change compared to baseline. The number of fishing days will gradually decrease as management measures related to closing season are implemented. Overtime, less fishing pressure will help the stock to recover, leading to catch of bigger fish and thus, higher CPUE, in 2032.
	Catch per unit effort (CPUE)	46 kg per boat per day for 216 days per year	Planned	46 kg per boat per day for 216 days per year *	61 kg per boat per day for 162 days per year*	
			Achieved			
			MoV	Catch assessment surveys		
Outcome 1	**Outcome indicator 1 (actor level)**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
VC actors adopt improved processing and cold chain techniques	Number of processors adopting improved drying equipment	n/a (this indicator refers to number of processors adopting improved techniques due to the project's support, so it is n/a in baseline)	Planned	667*	1 334	Adoption of improved techniques and increased linkages to high-value markets will lead to increased income for processors. (*Based on catch composition 66% is dagaa, and based on the numbers of adopters in Table 29)
			Achieved			
			MoV	Equipment sales records		
	Number of processors adopting improved	n/a	Planned	333*	666	Adoption of improved techniques and increased linkages to high-value markets will lead to increased income for processors.
			Achieved			
			MoV	Equipment sales records		

	smoking equipment					(* Based on catch composition 33% is perch, and based on the numbers of adopters in Table 29)
	Number of VC actors (fishers and wholesalers) adopting cold chain services	n/a	Planned	1 765*	3 530	Adoption of improved techniques and increased linkages to high-value markets will lead to increased income for fishers and wholesalers. (* Based on number of fisher and wholesaler adopters in Table 29)
			Achieved			
			MoV	Landing site records		
	Outcome indicator 1 (support/EE level)	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
	Number of suppliers supplying improved equipment/inputs to VC actors	n/a	Planned	15*	15	Users are convinced of the benefits of investing in the new equipment/inputs and have access to credit to purchase improved equipment/inputs (*Assuming 5 suppliers per landing site, or a 50% success rate of Output 1.1)
			Achieved			
			MoV	Project records, survey		
	Number of loans made to core VC actors to purchase improved processing equipment/inputs	n/a	Planned	100*	200	Improved processing equipment/inputs are available to purchase (* 1 dry/smoke machine has capacity to process 100t/year. 1 processor processes 10t/year, so there will be 10 processors/machine. Expect 1 000 processors to adopt improved
			Achieved			
			MoV	Bank reports		

						techniques in 2025, so there will be 100 loans for 100 processor groups.
	Number of VC actors (fishers, processors and traders) trained by local trainers on improved processing and cold chain techniques	n/a	Planned	10 476 (of which 4 091 women)*	20 952 (of which 8 181 women)*	Improved equipment/inputs are available and users have finance to purchase them. (* Triple the number of adopters in Table 29. Almost all processors and around half of retailers are women.)
			Achieved			
			MoV	Training record. Survey with VC actors		
Output 1.1	**Output indicator 1.1**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Suppliers and users of improved drying and smoking, and cold chain equipment/inputs identified	Number of suppliers of improved equipment/inputs identified and engaged	n/a	Planned	30*	30*	Users have access to credit to purchase improved equipment/inputs (*Assuming 10 suppliers per landing site)
			Achieved			
			MoV	Project records, survey		
Output 1.2	**Output indicator 1.2**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Financial products developed for purchase of improved processing equipment/inputs	Number of financial products developed for purchase of improved processing equipment/inputs	n/a	Planned	2	2*	Improved processing equipment/inputs are available to purchase (* Assuming FISH4ACP will support banks to develop two loan products)
			Achieved			
			MoV	Bank reports		
Output 1.3	**Output indicator 1.3**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
		n/a	Planned	3*	3*	

Trainers of new technologies, standards and quality control for fishers, processors and traders identified and engaged in the VC	Number of training organizations identified and engaged		Achieved			Training is effective in building the technical capacity of VC actors. VC actors also have access to and can afford improved processing and cold chain techniques. (* Assuming one training organization for improved drying technologies, one for improved smoking technologies, and one for standards/quality control)
			MoV	BDS training records		
Output 1.4	**Output indicator 1.4**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Facilities/services in strategically located landing sites upgraded	Number of landing sites upgraded	0	Planned	3	3	Management capacity sufficient to maintain landing sites
			Achieved			
			MoV	Inspection reports		
Output 1.5	**Output indicator 1.5**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Landing site management and service provision capacity strengthened	Number of landing sites whose management is strengthened	0	Planned	3	3	Sufficient funding available to maintain landing sites and funds are used according to a sustainable landing site management plan
			Achieved			
			MoV	Management evaluation		
Outcome 2	**Outcome indicator 2**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
VC actors adopt improved business models to supply high-value markets	Number of new contracts between fishers/processor and buyers sustained for more than one cycle	n/a	Planned	100*	200	Consumers continue to pay premium prices for high-quality Lake Tanganyika sprat, sardine and perch (*Assumes 66% success rate of Output 2.2)
			Achieved			
			MoV	Project records, survey		

Output 2.1	**Output indicator 2.1**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
High-value target markets and suppliers identified	Number of retailers contacted in urban centres	0	Planned	800*	1 600	Urban centers are target high-value markets for VC products. Buyers and suppliers are able to agree business partnership deals (*Currently 10% fish off lake = 400 retailers. Plan to double sales to off-lake retailers by 2025)
			Achieved			
			MoV	Project records, survey		
Output 2.2	**Output indicator 2.2**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Market linkages facilitated between fishers/processors and target buyers	Number of business partnerships facilitated between fishers/processor and target buyers	0	Planned	150*	300	Premium prices for high-quality Lake Tanganyika sprat, sardine and perch continue to be paid (*Assumes 100 processor groups and 50 wholesalers)
			Achieved			
			MoV	Project records, survey with VC actors		
Output 2.3	**Output indicator 2.3**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
VC actor organisations established/strengthened	Number of organisations established/strengthened	0	Planned	100*	200	VC actor organisations establish business partnerships (* Example for a processing group - 1 dry/smoke machine has capacity to process 100t/year. 1 processor processes 10t/year, so there will be 10 processors/machine in each processing group)
			Achieved			
			MoV	Project records, survey		
Output 2.4	**Output indicator 2.4**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
		0	Planned	12*	44	

VC Task Force formed and operational	Number of VC Task Force meetings held		Achieved			VC Task Force supports private sector business needs (*Quarterly meetings)
			MoV	Minutes of meetings		
Outcome 3	**Outcome indicator 3**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Increased participation by women	Number of processors adopting improved processing techniques and linked to high-value markets	n/a	Planned	1 000*	2 000*	Adoption of improved techniques and linkages to high-value markets will lead to increased income for female processors. Almost all processors are women. (* Based on the numbers of adopters in Table 29. This is the sum of the targets of two indicators under Outcome 1 about adoption of improved drying and smoking techniques.)
			Achieved			
			MoV	Economic evaluation of core VC		
Output 3.1	**Output indicator 3.1**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Study on gender constraints and opportunities conducted and recommendations implemented	Study on gender constraints and opportunities	n/a	Planned	1	1	The findings and recommendations from the gender study will be incorporated in the design and execution of other upgrading strategies, which will help enhance women's benefits.
			Achieved			
			MoV	Gender study		
Output 3.2	**Output indicator 3.2**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Women trained on leadership and organization	Number of women receiving training on	n/a	Planned	1 364	2 727	Women are also empowered with organizational support and financial support. Sensitization on gender equity effectively contributes to addressing gender norms.
			Achieved			
			MoV	Training records		

	leadership and organization					(* Based on the numbers of processors and retailers adopting improved techniques in Table 29. Almost all processors and round half of retailers are women.)
Output 3.3	**Output indicator 3.3**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Awareness raised on gender equity and women's rights	Number of awareness events on gender equity and women's rights in the VC	n/a	Planned	12 events across 3 regions*	30 events across 3 regions*	Sensitization and awareness raising effectively contribute to increased awareness. Women are also empowered with knowledge and skills through training, organizational support, and financial support. (* 1 event per year per region, for 3 regions)
			Achieved			
			MoV	Brief report after each event. News/media articles		
	Number of people participating in awareness raising events	n/a	Planned	2 400 across 3 regions	6 000 across 3 regions	Sensitization and awareness raising effectively contribute to increased awareness. Women are also empowered with knowledge and skills through training, organizational support, and financial support. (*200 people/event, estimated based on the number of people at Kibirizi landing site (500 people/day))
			Achieved			
			MoV	Brief report after each event. News/media articles.		
Outcome 4	**Outcome indicator 4 (actor level)**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
	Proportion of fishing vessels	Approximately 50%	Planned	60%*	90%*	All four countries around the lake effectively implement the Framework
			Achieved			

Increased compliance with fisheries legislation	operating with licence		MoV	Reports/records by MLF and BMUs		Fisheries Management Plan (FFMP). Maintaining the sustainability of fisheries resources helps to ensure the achievement of outcomes 1 – 3 and the vision because all VC activities rely on a healthy fish stock. (* Expect gradual increase in compliance over the years, but full compliance will require longer time to achieve)
	Number of beach seines used	66 (in 2011)	Planned	40*	10*	
			Achieved			
			MoV	Reports/records by MLF and BMUs		
	Average proportion of illegal gears in total number of gears (lift net, gill net, ring net) used	19% (in 2011)	Planned	15%*	5%*	
			Achieved			
			MoV	Reports/records by MLF and BMUs		
	Outcome indicator 4 (support/EE level)	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
	Number of draft fisheries management measures reviewed using updated data that are endorsed by Tanzanian government	n/a	Planned	2*	5*	Government is committed to revising national regulations in line with the regional frameworks. Regulatory revision will be accompanied with strengthened enforcement (by MLF and BMUs) and livelihood supports for VC actors to comply with the policies/ measures. (*Assuming 50% approval rate of Output 4.4)
			Achieved			
			MoV	Endorsed revised measures		
Output 4.1	**Output indicator 4.1**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
	Number of lake-wide fish	0	Planned	0	2*	Once a stock assessment system in in place and national partners are
			Achieved			

Lake-wide fish stock assessment conducted	stock assessment conducted		MoV	Fish stock assessment reports		trained, four countries around the lake will continue conducting the fish stock assessment. Fisheries management legislations will be revised and enforcement mechanisms will be strengthened based on updated understanding of the stock status and dynamics. (* Expect to have 2 assessments in the next 10 years due to the high cost of the assessment)
Output 4.2	**Output indicator 4.2**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Lake-wide fisheries frame survey conducted	Number of lake-wide frame survey conducted	0	Planned	1*	2*	Once a frame survey system in in place and national partners are trained, four countries around the lake will continue conducting the fish stock assessment. Fisheries management legislations will be revised and enforcement mechanisms will be strengthened based on updated understanding of fishing efforts. (* 1 survey to be conducted under LATAFIMA. Expect to have another survey in the next 10 years.)
			Achieved			
			MoV	Frame survey reports		
Output 4.3	**Output indicator 4.3**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
	Number of lake-wide catch	0	Planned	2*	5*	Once a CAS system in in place and national partners are trained, four
			Achieved			

Lake-wide catch assessment survey conducted	assessment surveys conducted		MoV	Catch assessment survey annual reports		countries around the lake will continue conducting the fish stock assessment. Fisheries management legislations will be revised and enforcement mechanisms will be strengthened based on updated understanding of catch volume and composition. (* CAS is less expensive than stock assessment and frame survey per time of conduct, and thus, can be conducted more frequently)
Output 4.4	**Output indicator 4.4**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Fisheries legislations reviewed based on updated data	Number of Tanzania's specific fisheries management measures reviewed and proposals for revised measures drafted in line with the regional frameworks and based on updated data	n/a	Planned	4*	10*	Updated data are sufficient to support sound revision of fisheries legislations. Regulatory revision will be accompanied with strengthened enforcement (by MLF and BMUs) and livelihood supports for VC actors to comply with the policies/ measures.
			Achieved			
			MoV	Reviewed measures with proposals for revision drafted		

Output 4.5	**Output indicator 4.5**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
MLF officers, local government officers, and BMUs capacity for co-management strengthened	Number of BMUs patrolling at least once a week	23 BMUs across 3 regions*	Planned	33 BMUs across 3 regions*	50 BMUs across 3 regions*	Increased compliance with legislations requires strong co-management capacity. Availability of support for BMUs from the communities, government and donors. (* Baseline is estimated based on the number of BMUs currently supported by TNC and the number of their patrols per year (1 200 patrols by 23 BMUs). There is no information about other BMUs who are not supported by TNC. Targets for 2025 is based on FISH4ACP support for 10 BMUs, which is expected to be scaled up by 2032.)
			Achieved			
			MoV	BMU reports		
Output 4.6	**Output indicator 4.6**	**2021 baseline**		**2025 target**	**2032 target**	**Assumptions**
Awareness raised for fishers/ communities on laws/conservation	Number of awareness events	n/a	Planned	12 events across 3 regions*	30 events across 3 regions*	Sensitization and awareness raising effectively contribute to increased compliance with legislation. (*1 event per year per region, for 3 regions)
			Achieved			
			MoV	Brief report after each event. News/media articles		
	Number of people participating awareness raising events	n/a	Planned	2 400 across 3 regions*	6 000 across 3 regions*	Sensitization and awareness raising effectively contribute to increased compliance with legislation.
			Achieved			
			MoV	Brief report after each event. News/media articles		

						(*200 people/event, estimated based on the number of people at Kibirizi landing site (500 people/day))
	Number of fishers with increased understanding of fisheries conservation measures	n/a	Planned	1 600 across 3 regions*	4 000 across 3 regions*	Sensitization and awareness raising effectively contribute to increased compliance with legislation. (* Two-thirds of the participants)
			Achieved			
			MoV	Short survey of fishers		

5.2 Activities and investment tables

The VC development action table (Table 34) lists all the activities that need to be implemented by the VC stakeholders (both public and private) and by the FISH4ACP project (and possibly other development partners), to generate the outputs and outcomes that are needed to realize the vision. The table thus depicts the critical interplay between the FISH4ACP project and the VC stakeholders.

Following the summary table, information is provided for each activity on the key stakeholders involved, the costs/investments, the timing, along with a short activity description to aid with implementation. It should be noted that the level of investments identified in the section below is indicative and will have to be confirmed by the various parties involved.

TABLE 34. SUMMARY OF UPGRADING ACTIVITIES AND INVESTMENTS (IN USD)

In the table below:

- Activities to be funded by FISH4ACP are shaded in green
- Activities to be funded by private sector are shaded in orange
- Activities to be funded by the LTA/ governments/ donors are shaded in yellow
- Activities to be funded by the LATAFIMA are shaded in grey
- Activities to be funded from blended sources (FISH4ACP and other stakeholders) shaded in pink
- The * indicates the activities to be funded or co-funded by FISH4ACP

Outcome 1 – VC actors adopt improved processing and cold chain techniques		**Funding Source (lead/ support)**	**Total Costs (USD)**	**Type of Cost**	**Timing (start-finish)**
Outputs	**Activities**				
1.1. Suppliers and users of improved drying and smoking, and cold chain equipment/inputs identified	*1.1.1 Identify suppliers/fabricators of improved equipment/inputs with capacity and willingness to supply at the lake zone	FISH4ACP	5 000	Facilitation	Apr 2022 – Jun 2022
	*1.1.2. Identify processors, fishers and traders who want to adopt improved techniques to supply high-value markets	FISH4ACP	2 000 x 3 regions x 2 years = 12 000	Facilitation	Apr 2022 – Jun 2022
	*1.1.3 Pilot/demonstrate improved drying/smoking and cold chain equipment/inputs with suppliers and processors	FISH4ACP, Equipment/ input suppliers	10 000 x 3 region = 30 000	Equipment	May 2022 – Jun 2022
	1.1.4. Integrate improved processing equipment/inputs into the business models in activity 2.2.2	Private Sector	2 230 000	Equipment	Jun 2022 – Dec 2024
1.2. Financial products developed for purchase of improved processing	*1.2.1 With AFRACA and partner bank(s), develop financial products for VC operators	FISH4ACP/ AFRACA, Banks	30 000	Studies/ Technical assistance	Apr 2022 – Jun 2022
	*1.2.2 Integrate financial products into the	FISH4ACP	1 000 x 3 regions = 3 000	Facilitation	Jul 2022 -Aug 2022

equipment/ inputs	business model strategy in activity 2.2.2				
1.3. Trainers of new technologies, standards and quality control for fishers, processors and traders identified and engaged in the VC	*1.3.1. Identify Business Development Service (BDS) providers to provide training services	FISH4ACP, MLF	30 000	Facilitation	Apr 2022 – Jun 2022
	*1.3.2. Develop training materials with input suppliers and BDS providers	FISH4ACP, BDS providers, MLF	60 000	Studies/ Technical assistance	Jul 2022 – Dec 2022
	*1.3.3 Integrate training services into the business model strategy in activity 2.2.2	FISH4ACP	1 000 x 3 regions = 3 000	Facilitation	Jul 2022 – Dec 2022
1.4. Facilities in strategically located landing sites upgraded	*1.4.1 Carry out Scoping Study to identify strategic locations for landing sites and facilities/services required	FISH4ACP/ MLF, LGAs, Regional Government	30 000	Studies/ Technical assistance	Aug 2022 – Sep 2022
	*1.4.2 Prepare upgrading plan (for construction of facilities), and engage partners	FISH4ACP/ MLF, LGAs, Regional Government	30 000	Studies/ Technical assistance	Sep 2022 – Dec 2022
	1.4.3 Implement the upgrading plan	MLF, LGAs, Regional Government (infrastructure) FISH4ACP (equipment)	1 400 000 x 3 regions for infra, 100 000 x 3 regions for equipment	Infrastructure Equipment	Jan 2023 – Jun 2023
1.5. Landing site management and service provision capacity strengthened	*1.5.1 Develop best management/operational model for landing site (e.g. direct management by LGA or PPP) and assess management/operational capacity gaps	FISH4ACP	30 000	Studies/ Technical assistance	Sep 2022 – Dec 2022
	*1.5.2 Prepare and deliver programme of capacity building support for landing site management/operations	FISH4ACP, BDS providers	60 000	Training	Jan 2023 – Dec 2023
Outcome 2 - VC actors adopt improved business models to supply high-value markets					
Outputs	**Activities**				

2.1. High-value target markets and suppliers identified	*2.1.1 Carry out Scoping Study to identify target markets and buyers of high-quality processed fish on these markets	FISH4ACP	30 000	Studies/ Technical assistance	Apr 2022 – Jul 2022
2.2. Market linkages established/ strengthened b etween fishers/ processors and target buyers	*2.2.1 Facilitate match-making forums between fishers/processors and buyers	FISH4ACP, BDS providers	70 000	Facilitation	Apr 2022 – Dec 2023
	*2.2.2 Facilitate development of business models between suppliers and buyers of fish and provide support required to establish business models e.g. contracting, planning, finance, skills training (linked to activities 1.1.4, 1.2.2 and 1.3.3)	FISH4ACP, BDS providers	140 000	Training	Jun 2022 – Dec 2023
	*2.2.3 Facilitate provision of capacity building support required to grow business models	FISH4ACP, BDS providers	140 000	Training	Jun 2022 – Dec 2024
2.3. VC actor organisations established/str engthened	*2.3.1 Identify fishers, processors and retailers who want to form into groups or to improve their groups	FISH4ACP LGAs, MLF, BDS providers	2 000 x 3 regions x 2 years = 12 000	Facilitation	Apr 2022 – Jul 2022
	*2.3.2 Facilitate the development of business models for the operation and management of organizations/groups of fishers, processors and retailers	FISH4ACP, BDS providers	30 000	Studies/ Technical assistance	Jun 2022 – Dec 2022
	*2.3.3 Facilitate provision of capacity building support required to operationalize the groups (linked to activities 1.1.4, 1.2.2 and 1.3.3)	FISH4ACP, BDS providers	140 000	Training	Jun 2022 – Dec 2024
2.4. VC Task Force formed and operational	*2.4.1 Identify members, prepare ToR and source operating costs	FISH4ACP	-	Facilitation	Dec 2021

	2.4.2 Quarterly meetings held to review the progress of implementing the upgrading strategy and discuss issues on Lake Tanganyika fisheries	FISH4ACP	1 000/ meeting = 12 000	Facilitation	Jan 2022 - ongoing
Outcome 3 - Increased participation by women					
Outputs	**Activities**				
3.1. Study on gender constraints and opportunities conducted and recommendations implemented	*3.1.1. Complete a study on gender constraints to explore the root causes of the constraints and identify opportunities/solutions to address them	FISH4ACP	25 000	Studies/ Technical assistance	Apr 2022 – Oct 2022
	3.1.2. Implement recommendations from the gender study	VC Task Force, FISH4ACP	n/a	Facilitation	Nov 2022 - ongoing
3.2. Women trained in leadership and organization	*3.2.1. Train women on organization/collective action and how to form and manage groups	FISH4ACP/ Local partners (e.g. EMEDO)	20 000	Training	May 2022 – Feb 2025
	*3.2.2. Support linkages between local women groups and existing national and regional organizations/associations (e.g. TAWFA, AWFishNET)	FISH4ACP/ Local partners (e.g. EMEDO)	20 000	Facilitation	May 2022 – Feb 2025
	*3.2.3. Train women groups on women's rights, leadership, and communication	FISH4ACP/ Local partners (e.g. EMEDO)	20 000	Training	May 2022 – Feb 2025
3.3. Awareness raised on gender equity and women's rights	*3.3.1. Develop and disseminate communication products on gender equity and women's rights	VC Task Force, FISH4ACP/ Local partners (e.g. EMEDO)	10 000	Facilitation	Aug 2022 – Feb 2025
	*3.3.2. Conduct awareness raising/community events to advocate for gender equity and women's rights	VC Task Force, FISH4ACP/ Local partners (e.g. EMEDO)	10 000	Facilitation	Nov 2022 – Feb 2025
Outcome 4 - Increased compliance with fisheries legislation					
Outputs	**Activities**				

4.1. Lake-wide fish stock assessment conducted	*4.1.1. Conduct a pre-assessment study to prepare for and design the fish stock assessment	FISH4ACP, LATAFIMA/ LTA, country governments	30 000	Studies/ Technical assistance	Apr 2022 – Oct 2022
	*4.1.2. Engage partners and agree on a mechanism to collaborate on the funding and implementation of the fish stock assessment	LTA/ LATAFIMA, FISH4ACP	10 000	Facilitation	Oct 2022 – Apr 2023
	*4.1.3. Purchase equipment required for the implementation of the fish stock assessment	LTA, country governments/ Other donors	180 000	Equipment	May 2023 – Nov 2023
	*4.1.4. Train partners on stock assessment method/SOPs	FISH4ACP/ LTA, LATAFIMA	20 000	Training	Nov 2023 – Dec 2023
	4.1.5. Conduct lake wide (regional) fish stock assessment and finalize assessment report(s)	LTA, country governments	180 000 per time for whole lake x 2 times	Studies/ Technical assistance	Dec 2023 – ongoing
4.2. Lake-wide fisheries frame survey conducted	4.2.1. Design the frame survey and form the survey team	LATAFIMA/ LTA	n/a	Studies/ Technical assistance	Dec 2021 - Jan 2022
	4.2.2. Engage partners and agree on a mechanism to collaborate on the implementation of the frame survey	LTA, LATAFIMA	n/a	Facilitation	Feb 2022 – Apr 2022
	4.2.3. Train partners on frame survey method/SOPs	LATAFIMA	10 000	Training	May – Jul 2022
	4.2.4. Conduct a lake-wide (regional) frame survey and finalize frame survey report	LTA, country governments/ LATAFIMA	220 000/ year for whole lake x 2 times, with the first time funded by LATAFIMA	Studies/ Technical assistance	Jul 2022 – Nov 2022, then ongoing

4.3. Lake-wide catch assessment survey (CAS) conducted	4.3.1. Design the CAS and form the four national survey teams (based on frame survey's results)	LATAFIMA/ LTA	15 000	Studies/ Technical assistance	Oct 2022 – Dec 2022
	*4.3.2. Engage partners and agree on a mechanism to collaborate on the funding and implementation of the CAS	LATAFIMA, LTA, country governments/ FISH4ACP	5 000	Facilitation	Dec 2022 – Jan 2023
	*4.3.3. Purchase equipment required for the conduct of the CAS	LATAFIMA/ LTA, country governments	40 000	Equipment	Feb 2023 – Jun 2023
	*4.3.4. Train partners on CAS methods/SOPs	LATAFIMA, FISH4ACP	15 000	Training	Jun 2023 – Jul 2023
	4.3.5. Conduct CAS and finalize CAS reports	LTA, country governments	80 000/ year for whole lake x 5 times	Studies/ Technical assistance	Aug 2023 – ongoing
4.4. Fisheries legislations revised based on updated data	*4.4.1. Revise and update fisheries (national and regional) legislation	LTA, country governments/ LATAFIMA, FISH4ACP	10 000	Facilitation	Jan 2023 – ongoing
	4.4.2. Adopt revised fisheries legislation	LTA, country governments	n/a	Facilitation	ASAP
4.5. MLF officers, local government officers, and BMUs capacity for co-management and MCS strengthened	*4.5.1. Facilitate the establishment of BMUs in important locations where BMUs are now lacking	VC Task Force, FISH4ACP/ MLF, LGAs, TNC	15 000	Facilitation	Apr 2022 – ongoing
	4.5.2. Purchase MCS equipment for BMUs	TNC, FISH4ACP	56 000	Equipment	Jul 2022 – Feb 2025
	4.5.3. Support BMUs' operational costs	FISH4ACP, TNC	32 000	Equipment	Jul 2022 – Feb 2025
	*4.5.4. Train local government officers on fisheries legislation, sensitization methods, MCS practices (who can then train BMUs)	FISH4ACP, TNC, MLF, TAFIRI	15 000	Training	Jul 2022 – Feb 2025

	*4.5.5. Train BMUs on fisheries legislation, management skills, sensitization methods, MCS practices and use of MCS equipment	FISH4ACP, TNC, MLF, TAFIRI	90 000	Training	Aug 2022 – Feb 2025
	*4.5.6. Develop viable funding mechanism(s) or business models for BMU operations	FISH4ACP, TNC	28 000	Studies/ Technical assistance	Jun 2022 – Dec 2022
	*4.5.7. Implement BMU funding mechanism(s) or business models	VC Task Force, FISH4ACP/ TNC	40 000	Facilitation	Jan 2023 – ongoing
	*4.5.8. Support MLF offices/officers with equipment for surveillance	FISH4ACP, LATAFIMA	70 000	Equipment	Jul 2022 – Feb 2025
	*4.5.9. Train MLF officers on MCS practices	FISH4ACP	16 000	Training	Jul 2022 – Feb 2025
4.6. Awareness raised for fishers/ communities on laws and conservation	*4.6.1. Develop and disseminate communication products on conservation and fisheries legislation	VC Task Force, FISH4ACP/ MLF, TNC, LATAFIMA	80 000	Facilitation	Apr 2022 – ongoing
	*4.6.2. Conduct awareness raising activities/events on conservation and fisheries legislation	VC Task Force, LTA, MLF, LGAs/ FISH4ACP/ TNC, LATAFIMA	10 000	Facilitation	Jun 2022 – ongoing

In the descriptions below, the costs to implement specific activities are expected to be financed by the VC stakeholders identified in the line 'Stakeholders and catalysts involved'. The **costs to be potentially funded (or co-funded) by FISH4ACP are indicated with an *** under the line 'Costs and investments'.

Activity number and name: Activity 1.1.1 - Identify suppliers/fabricators of improved equipment/inputs with capacity and willingness to supply at the lake zone
Stakeholders or catalysts involved: FISH4ACP
Costs and investments: USD5 000*
Type of investment: Facilitation
Timing: April 2022 – June 2022
Description: Examples of improved processing equipment and inputs are provided in Section 4.3.1.1 above. It is expected the suppliers/fabricators will differ depending on the location and the type of equipment. For example, the raised drying racks could be sourced from local fabricators at the lake who can also source the salvaged fishing nets. The chorker and FTT smoking ovens could also be sourced from local fabricators who previously supplied TAFIRI or the Small Industrial Development Organisation (SIDO) which has a branch in Kigoma. The electric driers will more likely need to be imported and sold through local distributors at the lake. Much of this equipment could also be sourced from existing suppliers at Lake Victoria.

Discussions will be held with potential suppliers and fabricators to identify the best-case solution to providing the equipment on a sustainable basis. As credit may also be linked to the supply of processing equipment this will also be considered during the identification process and is described further under Activity 1.2.2 below.

Activity number and name: Activity 1.1.2 - Identify processors, fishers and traders who want to adopt improved techniques to supply high-value markets
Stakeholders or catalysts involved: FISH4ACP
Costs and investments: USD2 000 x 3 regions x 2 years = USD 12 000*
Type of investment: Facilitation
Timing: April 2022 – June 2022
Description: Whilst suppliers of the improved equipment are being sought; processors, fishers and traders who want to adopt the improved techniques will also be identified. This will take place through public meetings and be coordinated through the three landing sites and BMUs. The project strategy, expected benefits and requirements to participate in the project will be fully explained.

A list of interested processors, fishers and traders who want to adopt improved techniques to supply high-value markets will then be made and invited to the equipment demonstrations and match-making forums, described further below. This exercise will be carried out twice in the first two years of the project, to build up the number of beneficiaries from year one.

Activity number and name: Activity 1.1.3 - Pilot/demonstrate improved drying/smoking and cold chain equipment/inputs with suppliers and processors
Stakeholders or catalysts involved: FISH4ACP, Equipment/ input suppliers
Costs and investments: USD 10 000 x 3 region = USD 30 000*
Type of investment: Equipment
Timing: May 2022 – June 2022
Description: Once suppliers of the improved equipment, as described under Activity 1.1.1, have been identified; the improved processing equipment will be demonstrated at the landing sites selected for upgrading. The demonstrations will be carried out by the suppliers of the equipment, facilitating first point of contact for future sales.

Activity number and name: Activity 1.1.4 - Integrate improved processing equipment/inputs into the business models in activity 2.2.2
Stakeholders or catalysts involved: Private Sector
Costs and investments: USD 2 230 000
Type of investment: Equipment
Timing: June 2022 – December 2024
Description: A suite of integrated support services will be offered to the business models described under Activities 2.2.2 and 2.3.4 and one of those services will be access to improved equipment and inputs. Linked services will be access to finance to purchase the equipment and access to training.

Activity number and name: Activity 1.2.1 - With AFRACA and partner bank(s), develop financial products for VC operators
Stakeholders or catalysts involved: FISH4ACP in collaboration with AFRACA and banks
Costs and investments: USD 30 000*
Type of investment: Studies/ Technical assistance
Timing: April 2022 – June 2022
Description: A consultant will be recruited to develop financial products suitable for fishers, processors and traders in the Lake Tanganyika zone. Different models will be considered, for example, direct lending to individuals; direct lending to groups; leasing to individuals/groups; lending to equipment suppliers who then provide credit to processors.

This will be done in close collaboration with AFRACA, which has already carried out similar studies, and possible partner Banks to arrive at models and borrowing conditions acceptable to both borrowers and lenders.

Activity number and name: Activity 1.2.2 - Integrate financial products into the business model strategy in activity 2.2.2
Stakeholders or catalysts involved: FISH4ACP, Banks
Costs and investments: USD 1 000 x 3 regions = USD 3 000*
Type of investment: Facilitation
Timing: July 2022 – August 2022
Description: A suite of integrated support services will be offered to the business models described under Activities 2.2.2 and 2.3.4 and one of those services will be access to finance. Linked services will be access to improved equipment and inputs and access to training, for which finance may be required. As the cost of private sector investment in improved equipment is estimated to be USD 2 230 000, it is possible loans will be required up to this amount.

Activity number and name: Activity 1.3.1 - Identify Business Development Service (BDS) providers to provide training services.
Stakeholders or catalysts involved: FISH4ACP
Costs and investments: USD 30 000*
Type of investment: Facilitation
Timing: April 2022 – June 2022
Description: A 'Call for Proposals' will be made to identify possible BDS providers to supply training services. The Fisheries Extension Training Agency and local NGOs are possible providers. Public health fisheries inspectors, MLF Quality & Control Officers and Tanzanian Bureau of Standards will also be included for specific regulatory training.

Activity number and name: Activity 1.3.2 - Develop training materials with/by input suppliers and/or BDS providers
Stakeholders or catalysts involved: FISH4ACP, BDS providers, MLF, TAFIRI
Costs and investments: USD 60 000*
Type of investment: Studies/ Technical assistance
Timing: July 2022 – December 2022
Description: Technical assistance will be provided to support input suppliers and BDS providers develop training materials to train fishers, processors and traders. Although it is expected the equipment suppliers will provide training on how to use the equipment; additional training will be required in topics such as quality standards, food safety standards, packaging, storage, transport, business regulations and contract compliance.

Activity number and name: Activity 1.3.3 - Integrate training services into the business model strategy in activity 2.2.2
Stakeholders or catalysts involved: FISH4ACP in collaboration with MLF, TAFIRI and BDS partners
Costs and investments: USD 1 000 x 3 regions = USD 3 000*
Type of investment: Facilitation
Timing: July 2022 – December 2022
Description: A suite of integrated support services will be offered to the business models described under Activities 2.2.2 and 2.3.4 and one of those services will be access to training services. Linked services will be access to improved equipment and inputs and finance to purchase the equipment.

Activity number and name: Activity 1.4.1 - Carry out Scoping Study to identify strategic locations for landing sites and facilities/services required
Stakeholders or catalysts involved: FISH4ACP in collaboration with MLF, LGAs, Regional Government
Costs and investments: USD 30 000*
Type of investment: Studies/ Technical assistance
Timing: August 2022 – September 2022
Description: Technical Assistance will be recruited to identify strategic locations for landing sites and facilities/services required in coordination with MLF, LGAs and Regional Government. It is expected one landing site will be upgraded in each of the three regions. The landing sites are central to the implementation strategy as a venue for delivering support and need to be strategically located to attract fishers and processors and also connected by a good road network to buyers in target markets. Access to a stable supply of electricity and water are other important considerations, as well as risks such as flooding.

The facilities and services required at each landing site are likely to differ, depending on different species of fish caught and target markets. For example, in Rukwa there is likely to be more processing of fresh/frozen perch to supply the Zambia market. In Kigoma, there is likely to be more *dagaa* drying for the United Republic of Tanzania and Burundi market.

Activity number and name: Activity 1.4.2 - Prepare upgrading plan (for renovation of infrastructure and construction of facilities), and engage partners
Stakeholders or catalysts involved: FISH4ACP, MLF, LGAs, Regional Government
Costs and investments: USD 30 000*
Type of investment: Studies/ Technical assistance
Timing: September 2022 – December 2022
Description:

An upgrading plan will be prepared by recruited Technical Assistance to include the renovation of infrastructure and the purchase and installation of facilities to be financed by VC stakeholders, including FISH4ACP. The upgrading plan will also include a funding mechanism which specifies the partners involved and their roles in financing and implementing the plan. On condition the upgrading plan is agreed upon by involved partners, FISH4ACP will fund the provision of equipment such as commercial scale dryers and smokers, blast freezers, ice-making machines, cold rooms, processing and packing lines and refrigerated transport.

Activity number and name: Activity 1.4.3 - Implement the upgrading plan
Stakeholders or catalysts involved: MLF, LGAs, Regional Government, with support from FISH4ACP
Costs and investments: USD 1 500 000 x 3 regions = USD 4 500 000.
[USD 4 200 000 (Infrastructure) plus USD 300 000* (equipment)]
Type of investment: Infrastructure & equipment
Timing: September 2022 – December 2022
Description: The MLF and LGA will be responsible for implementing the upgrading plan. In addition to co-financing the upgrading plan, periodic monitoring of building works and expenditure will also be undertaken by FISH4ACP and FISH4ACP will provide technical support to the implementation of the upgrading plan as required/relevant.

Activity number and name: Activity 1.5.1 - Develop best management/operational model for landing site (e.g. direct management by LGA or PPP) and assess management/operational capacity gaps
Stakeholders or catalysts involved: FISH4ACP, in collaboration with MLF, LGAs, TAFIRI
Costs and investments: USD 30 000*
Type of investment: Studies/ Technical assistance
Timing: September 2022 – December 2022
Description: Technical Assistance will be recruited to develop the best management/operational model for each landing site, which will differ depending on the current institutional arrangements. Models could include direct management by the LGA, co-management with BMUs or a PPP. The TA will also assess management/operational capacity gaps that will need addressing to implement the improved management model.

Activity number and name: Activity 1.5.2 - Prepare and deliver programme of capacity building support for landing site management/operations
Stakeholders or catalysts involved: FISH4ACP
Costs and investments: USD 60 000*
Type of investment: Training
Timing: September 2022 – December 2022
Description: A key element to managing the landing sites will be effective management of the facilities and services to be provided by the landing sites, such as processing equipment. Service fees will be charged for using the facilities to cover costs and ensure their maintenance. A programme of capacity building will be provided to the landing site management teams, based on the assessment carried out under Activity 1.5.1

Activity number and name: Activity 2.1.1 - Carry out Scoping Study to identify target markets and buyers of high-quality processed fish on these markets
Stakeholders or catalysts involved: FISH4ACP
Costs and investments: USD 30 000*
Type of investment: Studies/ Technical assistance
Timing: March 2022 – May 2022
Description: Technical Assistance will be recruited to carry out a market study in the main urban centres of United Republic of Tanzania including Dar-es-Salaam, Mbeya, Tabora and Dodoma. The purpose of the study is to identify target buyers for high-quality dagaa, smoked perch and fresh/frozen perch and could include wholesalers, distributors and large retailers. Existing buying requirements, volumes and supply sources will also be explored. A list of interested buyers who wish to purchase high quality fish products from Lake Tanganyika will then be made to invite to the match-making forums, described further below.

Activity number and name: Activity 2.2.1 - Facilitate match-making forums between fishers/processors and buyers
Stakeholders or catalysts involved: FISH4ACP, BDS providers
Costs and investments: USD 70 000*
Type of investment: Facilitation
Timing: April 2022 – December 2022
Description: Match-making forums are facilitated in the 3 regions whereby fishers, processors and traders identified under Activity 1.1.2 and buyers identified under Activity 2.1.1 meet to discuss possible business partnerships regarding the supply of specific quantities of fish. This could take the form of buyers presenting their companies and buying requirements and each processor having a sales stand where they can exhibit their goods and meet with the potential buyers.

Activity number and name: Activity 2.2.2 - Facilitate development of business models between suppliers and buyers of fish and provide support required to establish business models e.g. contracting, planning, finance, skills training (linked to activities 1.1.4, 1.2.2 and 1.3.3)
Stakeholders or catalysts involved: FISH4ACP, BDS providers
Costs and investments: USD 140 000*
Type of investment: Training
Timing: June 2022 – December 2023
Description: Once potential partnerships are forged, the fishers, processors and buyers will be offered a suite of training to develop the business model and could include how to prepare a mutually acceptable contract, securing finance, production scheduling and meeting quality requirements. This activity is core to the upgrading strategy and integrates linkages with Activity 1.1.4 (improved processing machinery), Activity 1.2.2 (access to finance to purchase improved machinery) and Activity 1.3.3 (training services).

Activity number and name: Activity 2.2.3 - Facilitate provision of capacity building support required to grow business models
Stakeholders or catalysts involved: FISH4ACP, BDS providers
Costs and investments: USD 140 000*
Type of investment: Training
Timing: June 2022 – December 2024
Description: Once the business models are established and several business cycles have been completed, the business partnership will be reviewed to identify any further capacity building required, based upon shared and common priorities. The purpose of the second-tier capacity building is to 'grow' the business, compared to previously 'starting' the business. This type of capacity building could include further product development, packaging and marketing strategies to improve market penetration. Again, the delivery of the capacity building support would be provided by local Business Development Service (BDS) providers, to ensure continuity of support once Fish4ACP closes.

Activity number and name: Activity 2.3.1 - Identify fishers, processors and retailers who want to form into groups or to improve their groups
Stakeholders or catalysts involved: FISH4ACP, LGAs, MLF, BDS providers
Costs and investments: USD 2 000 x 3 regions x 2 years = USD 12 000*
Type of investment: Facilitation
Timing: April 2022 – July 2022
Description: Whilst the Activities 2.2 strengthened vertical linkages, horizontal linkages can also be strengthened to aggregate produce and better engage with VC partners. The groups will represent the 'functional' role of the VC actors i.e. fisher groups or processor groups and be commodity-based and market-oriented. Fishers and processors who want to work with other fishers or processors to supply high-value markets and form business partnerships

with those buyers will be identified from the list prepared under Activity 1.1.2. and also include established groups wishing to strengthen their capacity to form business partnerships. This exercise will be carried out twice in the first two years of the project, to build up the number of beneficiaries from year one.

Activity number and name: Activity 2.3.2 - Facilitate the development of business models for the operation and management of organizations/groups of fishers, processors and retailers
Stakeholders or catalysts involved: FISH4ACP, BDS providers
Costs and investments: USD 30 000*
Type of investment: Studies/ Technical assistance
Timing: June 2022 – December 2022
Description: Support will be provided to establish the structure of the group (e.g. informal association, cooperative, company), clarifying purpose and activities of the group and selecting a management team. The purpose of the groups are likely to revolve around shared equipment such as processing machinery, cold stores, refrigerated transport, therefore support will be provided in establishing operational procedures for managing these shared resources

Activity number and name: Activity 2.3.3 - Facilitate provision of capacity building support required to operationalise the groups (linked to activities 1.1.3, 1.2.3 and 1.3.3)
Stakeholders or catalysts involved: FISH4ACP, BDS providers
Costs and investments: USD 140 000*
Type of investment: Training
Timing: June 2022 – December 2024
Description: Once the groups have been established, they will be offered a suite of training to operationalize as a business unit and engage with other actors in the VC chain. This activity is core to the upgrading strategy and integrates linkages with Activity 1.1.4 (improved processing machinery), Activity 1.2.2 (access to finance to purchase improved machinery) and Activity 1.3.3 (business development services).

Activity number and name: Activity 2.4.1 - Identify members, prepare ToR and source operating costs
Stakeholders or catalysts involved: FISH4ACP
Costs and investments: 0
Type of investment:
Timing: December 2021
Description: Membership of the VC Task Force will include representatives from relevant Government Institutions (MLF, TBS, NEMC), Fishers Union, Financial Institutions, Donors (FAO, TNC), Research and Academic Institutions (TAFIRI, UDSM), Fish Processors Union and

LGA. FISH4ACP will facilitate development of a ToR for the VC Task Force and propose membership of a Secretariat to manage the VC Task Force. Membership will be voluntary and not require any costs, however, a small budget will be sourced to cover basic operating costs. Initially this will come from donations by projects such as FISH4ACP.

Activity number and name: Activity 2.4.2 - Quarterly meetings held to review the progress of implementing the upgrading strategy and discuss issues on Lake Tanganyika fisheries
Stakeholders or catalysts involved: VC Task Force
Costs and investments: USD 1 500 / meeting = USD 12 000*
Type of investment: Facilitation
Timing: January 2022 - ongoing
Description: VC Task Force meetings will be held quarterly to review the progress of implementing the upgrading strategy and to discuss the broader issues concerning Lake Tanganyika fisheries, such as sustainability and climate change.

Activity number and name: Activity 3.1.1 - Complete a study on gender constraints to explore the root causes of the constraints and identify opportunities/solutions to address them
Stakeholders or catalysts involved: FISH4ACP working with women groups, LGAs and other VC stakeholders
Costs and investments: USD 25 000*
Type of investment: Studies/ Technical assistance
Timing: April - October 2022
Description: This activity would involve the conduct of a study on the gender constraints in the VC to explore the root causes of the constraints and identify opportunities/solutions to address them. The study will build on the findings from this VC report as well as other past studies/information. Specifically, the study will focus on the social hotspots identified in this VC analysis, namely low level of women's economic involvement in the VC, unequal division of roles between men and women, and women's limited access to land. The aim of the study will be to identify a list of measures/solutions that VC actors and other stakeholders can take to improve gender equity in the VC.

Activity number and name: Activity 3.1.2 – Implement recommendations from the gender study
Stakeholders or catalysts involved: VC Task Force, with support from FISH4ACP and other partners
Costs and investments: n/a (subject to activity 3.1.1)
Type of investment: Facilitation
Timing: November 2022 - ongoing
Description: Based on the findings of the gender study (activity 3.1.1), VC stakeholders would make their own assessments as to whether adopting any of the recommended measures/solutions, especially from a financial/operational standpoint. The implementation of the recommendations will be led by the VC Task Force and will require collaboration and commitment of various VC stakeholders, including VC actors, their communities, the government, civil society, and development projects such as FISH4ACP. Some of the recommendations would be woven into other upgrading activities, for instance, the training of fishers, processors and traders will have to be gender-sensitive and incorporate the findings from the gender study to design trainings that are suitable for women.

Activity number and name: Activity 3.2.1 - Train women on organization/collective action and how to form and manage groups
Stakeholders or catalysts involved: FISH4ACP working with women groups and other VC stakeholders
Costs and investments: USD 20 000*
Type of investment: Training
Timing: May 2022 – February 2025
Description: Under this activity, women will be trained on the benefits of organization/collective action and how to form and manage groups. This activity would thus involve the identification of trainers, the design of training mechanism, the development of training materials, training delivery by trainers as well as support/technical assistance provided to the establishment and/or strengthening of women groups. The training will incorporate the recommendations from the gender study to be conducted under activity 3.1.1. Collaboration with partners (e.g. EMEDO) will be sought to avoid duplications and to create synergies. This activity will thus provide budget from FISH4ACP for relevant trainings, to be determined in more detail at the outset of the implementation phase of FISH4ACP.

Activity number and name: Activity 3.2.2 – Support linkages between local women groups and existing national and regional organizations/associations (e.g. TAWFA, AWFishNET)
Stakeholders or catalysts involved: FISH4ACP working with VC stakeholders
Costs and investments: USD 20 000*
Type of investment: Facilitation
Timing: May 2022 – February 2025
Description: This activity will allocate budget from FISH4ACP to provide facilitatory support to establish/strengthen the linkages between local women groups and national and regional organizations/associations (such as e.g. TAWFA, AWFish[74]), as a way to strengthen the stand of local women groups as well as to provide support to them more effectively and sustainably through national/regional networks. This activity will be implemented in collaboration with local partners who are active in working in women groups in fisheries, such as EMEDO.

Activity number and name: Activity 3.2.3 – Train women groups on women's rights, leadership, and communication
Stakeholders or catalysts involved: FISH4ACP working with women groups and other VC stakeholders
Costs and investments: USD 20 000*
Type of investment: Training
Timing: May 2022 – February 2025
Description: Under this activity, women groups formed and/or supported under activities 3.2.1 and 3.2.2 will be provided with training on women's rights, leadership, and communication skills. The goal is to enable women to be aware of their rights and to be empowered to defend their rights. The training will incorporate the recommendations from the gender study to be conducted under activity 3.1.1. FISH4ACP will provide budget for relevant trainings, but for sustainability purposes, the project will partner with local partners, rather than providing trainings directly.

Activity number and name: Activity 3.3.1 – Develop and disseminate communication products on gender equity and women's rights
Stakeholders or catalysts involved: VC Task Force, supported by FISH4ACP
Costs and investments: USD 10 000*
Type of investment: Facilitation
Timing: August 2022 – February 2025
Description: This activity would involve the development and dissemination of communication products on gender equity and women's rights in the fishing communities

[74] African Women Fish Processors and Traders Network – AWFishNET (https://awfishnet.org/) is a pan-African organization.

around the lake. The communication products will incorporate the recommendations from the gender study to be conducted under activity 3.1.1. FISH4ACP will provide budget for this activity, to be implemented in collaboration with the VC Task Force, women groups, local partners (e.g. media) and other VC stakeholders.

Activity number and name: Activity 3.3.2 – Conduct awareness raising/community events to advocate for gender equity and women's rights
Stakeholders or catalysts involved: VC Task Force, supported by FISH4ACP
Costs and investments: USD 10 000*
Type of investment: Facilitation
Timing: November 2022 – February 2025
Description: Under this activity, awareness raising/community events will be organized, utilizing the communication products to be developed under activity 3.3.1 and incorporating the recommendations from the gender study to be conducted under activity 3.1.1. FISH4ACP will provide budget for this activity, to be implemented in collaboration with the VC Task Force, women groups, local partners (e.g. media) and other VC stakeholders.

Activity number and name: Activity 4.1.1 - Conduct a pre-assessment study to design and prepare for the fish stock assessment
Stakeholders or catalysts involved: FISH4ACP working with LTA, governments of four countries bordering the lake, LATAFIMA and other donors
Costs and investments: USD 30 000*
Category of investment: Studies
Timing: April 2022 - October 2022
Description: A pre-assessment study on the feasibility for and design of the fish stock assessment will be conducted. The study will identify the scope of the assessment, the methodology employed, costs, potential partners involved, and will propose potential funding mechanism and a work plan with specific timing and roles. In terms of methodologies, more environmentally friendly technology options (for instance, those which do not generate additional CO2 emission due to relying on the use of vessels) will be explored and adopted as relevant and feasible. FISH4ACP will provide expert to conduct this assessment, in close consultation with the LTA, the governments of four countries bordering the lake, and other projects (e.g. LATAFIMA).

Activity number and name: Activity 4.1.2 - Engage partners and agree on a mechanism to collaborate on the funding and conduct of the fish stock assessment
Stakeholders or catalysts involved: LTA (lead), governments of four countries bordering the lake, with support from FISH4ACP, LATAFIMA
Costs and investments: USD 10 000*
Category of investment: Facilitation
Timing: October 2022 – April 2023
Description: Based on the pre-assessment study (activity 4.1.1), this activity would then involve identifying/selecting national partners, engaging with partners for the funding and implementation of the assessment, as well as and agreeing on the funding/implementing mechanism for involved partners to collaborate. The agreed funding mechanism will also provide details on how to fund the purchase/renting of the equipment required for the assessment as well as the management/maintenance of the equipment. The LTA, as an overarching management body of the whole lake, would take the lead in this stakeholder engagement process. FISH4ACP will provide experts to support, particularly in the development of mechanisms for collaboration (including, e.g. development of funding proposals) in close coordination with the LTA and LATAFIMA.

Activity number and name: Activity 4.1.3 – Purchase of equipment required for the conduct of the fish stock assessment
Stakeholders or catalysts involved: LTA, governments of four countries bordering the lake
Costs and investments: tbd (based on activity 4.1.1); but for the purpose of the investment table below (Table 35), is assumed to be USD 180 000
Category of investment: Equipment
Timing: May 2023 – November 2023
Description: Based on the pre-assessment study (activity 4.1.1) and the agreed mechanism for funding/implementation (activity 4.1.2), the equipment required for the conduct of the fish stock assessment will be purchased.

Activity number and name: Activity 4.1.4 – Train partner on assessment methods/SOPs
Stakeholders or catalysts involved: FISH4ACP, LTA and other donors (e.g. LATAFIMA)
Costs and investments: USD 20 000*
Category of investment: Training
Timing: November 2023 - December 2023
Description: This activity would involve training of national partners on fish stock assessment methodology and techniques. The goal is to provide training for partners in four countries around the lake, with close coordination with the LTA, especially in liaising with Burundi and Democratic Republic of the Congo which are not covered by FISH4ACP. This

activity will thus provide budget from FISH4ACP for relevant training, to be determined in more detail at the outset of the implementation phase of FISH4ACP.

Activity number and name: Activity 4.1.5 – Conduct lake-wide fish stock assessment and finalize assessment reports
Stakeholders or catalysts involved: LTA (lead), governments of four countries bordering the lake
Costs and investments: tbd (based on activity 4.1.1); but for the purpose of the investment table below (Table 35), is assumed to be USD 180 000 for the whole lake per assessment time
Category of investment: Studies/ Technical assistance
Timing: December 2023 – ongoing, assuming the stock assessment will be conducted for (at least) 2 times in the next 10 years
Description: Under this activity, the LTA will coordinate the implementation of the fish stock assessment and the development of the fish stock assessment reports, in collaboration with country governments. A pilot assessment will be carried out to pilot-test the methodologies and draw lessons for the conduct of a full-scale stock assessment. The assessment will need to be carried out regularly (ideally yearly), with a fish stock assessment report be prepared after each assessment.

Activity number and name: Activity 4.2.1 - Design the frame survey and form the survey team
Stakeholders or catalysts involved: LATAFIMA, in collaboration with LTA and governments of four countries bordering the lake
Costs and investments: n/a
Category of investment: Studies/ Technical assistance
Timing: December 2021 – January 2022
Description: The conduct of a frame survey is included under the scope of LATAFIMA project; and is planned to start in the dry season (July-August) in 2022. The design of frame survey is being developed (planned to be finished by the end of 2021), and the team (under LATAFIMA) is being formed.

Activity number and name: Activity 4.2.2 - Engage partners and agree on a mechanism to collaborate on the implementation of the frame survey
Stakeholders or catalysts involved: LTA (lead), LATAFIMA, governments of four countries bordering the lake
Costs and investments: n/a
Category of investment: Facilitation
Timing: February 2022 – April 2022
Description: Based on the design of the frame survey (activity 4.2.1), this activity would then involve engaging with partners for the implementation of the assessment, as well as agreeing on the implementation mechanisms for involved partners to collaborate. The LTA, as an overarching management body of the whole lake, would take the lead in this stakeholder engagement process.

Activity number and name: Activity 4.2.3 – Train partners on frame survey method
Stakeholders or catalysts involved: LATAFIMA
Costs and investments: USD 10 000
Category of investment: Training
Timing: May 2022 – July 2022
Description: Based on the design of the frame survey (activity 4.2.1), this activity would then involve training of national partners on frame survey methodology and techniques, to be provided by LATAFIMA.

Activity number and name: Activity 4.2.4 - Conduct frame survey and finalize frame survey report
Stakeholders or catalysts involved: LTA (lead), governments of four countries bordering the lake, LATAFIMA
Costs and investments: USD 220 000 for the whole lake per survey time
Category of investment: Studies/ Technical assistance
Timing: July 2022 – November 2022, then ongoing. Assuming the frame survey will be conducted for (at least) 2 times in the next 10 years, with the cost of the first time covered by LATAFIMA
Description: Under this activity, the LTA will coordinate the conduct of the frame survey and the development of the frame survey report, in collaboration with country governments and LATAFIMA. A pilot survey will be carried out to pilot-test the methodology and draw lessons for the conduct of a full-scale frame survey. The implementation of the frame survey in 2022 will be funded by LATAFIMA.

Activity number and name: Activity 4.3.1 - Design the catch assessment survey (CAS) and form the four national survey teams
Stakeholders or catalysts involved: LATAFIMA, in collaboration with LTA and governments of four countries bordering the lake
Costs and investments: USD 15 000
Category of investment: Studies/ Technical assistance
Timing: October 2022 – December 2022
Description: The design of CAS will build on existing systems and methods (e.g. eCAS in United Republic of Tanzania and Lake Victoria) and will provide details on the survey methodology, tools/equipment required (e.g. using electronic tools or not), costs, partners involved, and will propose a potential funding mechanism and a work plan with specific timing and roles. This design will also incorporate the findings of the frame survey. LATAFIMA will take the lead in developing this design, in collaboration with LTA and governments of four countries bordering the lake.

Activity number and name: Activity 4.3.2 - Engage partners and agree on a mechanism to collaborate on the funding and conduct of the CAS
Stakeholders or catalysts involved: LTA (lead), governments of four countries bordering the lake, with support from FISH4ACP and LATAFIMA
Costs and investments: USD 5 000*
Category of investment: Facilitation
Timing: December 2022 – January 2023
Description: Based on the design of the CAS (activity 4.3.1), this activity would then involve engaging with partners for the funding and implementation of the assessment, as well as agreeing on the funding/implementing mechanisms for involved partners to collaborate. The LTA, as an overarching management body of the whole lake, would take the lead in this stakeholder engagement process. FISH4ACP will provide experts to support the process, in collaboration with LATAFIMA.

Activity number and name: Activity 4.3.3 – Purchase of equipment required for the conduct of the CAS
Stakeholders or catalysts involved: LATAFIMA, LTA, governments of four countries bordering the lake
Costs and investments: tbd (based on activity 4.3.1); but for the purpose of the investment table below (Table 35), is assumed to be USD 40 000 for 4 countries
Category of investment: Equipment
Timing: February 2023 – June 2023
Description: Based on the design of the CAS (activity 4.3.1) and the agreed mechanism for funding/implementation (activity 4.3.2), the equipment required for the conduct of the CAS will be purchased.

Activity number and name: Activity 4.3.4 – Train partner on CAS method
Stakeholders or catalysts involved: FISH4ACP, LATAFIMA
Costs and investments: USD 15 000*
Category of investment: Training
Timing: June 2023 – July 2023
Description: Based on the design of the CAS (activity 4.3.1), this activity would then involve training of national partners on CAS methodology and techniques. The goal is to provide training for partners in four countries around the lake, with close coordination with the LTA, especially in liaising with Burundi and Democratic Republic of the Congo which are not covered by FISH4ACP. This activity will thus provide budget from FISH4ACP for relevant training, in collaboration with LATAFIMA, to be determined in more detail at the outset of the implementation phase of FISH4ACP.

Activity number and name: Activity 4.3.5 - Conduct CAS and finalize CAS reports
Stakeholders or catalysts involved: LTA (lead), governments of four countries bordering the lake, with support from LATAFIMA, FISH4ACP and other donors
Costs and investments: tbd (based on activity 4.3.1); but for the purpose of the investment table below (Table 35), is assumed to be USD 80 000 for the whole lake per survey time
Category of investment: Studies/ Technical assistance
Timing: August 2023, then ongoing. Assuming the CAS will be conducted for (at least) 5 times in the next 10 years
Description: Under this activity, the LTA will coordinate the conduct of CAS and the development of the CAS reports, in collaboration with country governments. A pilot assessment will be carried out to pilot-test the methodologies and draw lessons for the conduct of a full-scale stock assessment.

Activity number and name: Activity 4.4.1 – Review and update fisheries (national and regional) legislations
Stakeholders or catalysts involved: LTA and governments of four countries bordering the lake, supported by FISH4ACP and LATAFIMA
Costs and investments: USD 10 000*
Category of investment: Facilitation
Timing: January 2023 – ongoing
Description: Based on the findings and updated data from the fish stock assessment, frame survey and catch assessment survey, regional and national fisheries legislations will be reviewed to enhance the sustainable management of fisheries resources while also reducing the poverty of the riparian population. At the regional level, of particular relevance is the Framework Fisheries Management Plan (FFMP) and the regional charter. At the national level, fisheries policies and regulations will also be reviewed to be harmonized with regional frameworks. In United Republic of Tanzania, the review of fisheries legislation should focus on specific measures/provisions including, but are not limited to: (i) the legal size of fish that can be captured, (ii) mesh sizes and dimensions allowed for most gears, (iii) specifics of the hooks, for all gears, (iv) updated list of forbidden gears (e.g. monofilament or drift nets), (v) areas and seasons where/when fishing is banned, (vi) minimal or maximal distances from the shore where gears can be operated, (vii) nature and sentencing for fraudulent practices. FISH4ACP will provide budget to support and facilitate the revision and harmonization process as relevant.

Activity number and name: Activity 4.4.2 – Adopt reviewed fisheries legislations
Stakeholders or catalysts involved: LTA and governments of four countries bordering the lake
Costs and investments: n/a
Category of investment: Facilitation
Timing: n/a
Description: Under this activity, the revised fisheries legislations will be adopted by the LTA and the governments of four countries bordering the lake.
Activity number and name: Activity 4.5.1 – Facilitate the establishment of BMUs in important locations where BMUs are now lacking
Stakeholders or catalysts involved: VC Task Force, FISH4ACP, in collaboration with MLF, LGAs, TNC
Costs and investments: USD 15 000*
Category of investment: Facilitation
Timing: April 2022 – ongoing
Description: Under this activity, facilitatory support will be provided to the establishment of BMUs in important locations where BMUs are now lacking. The activity will build on the

findings/lessons learned from the execution of activities 1.4.1 – 1.4.3 and 1.5.1 – 1.5.2 about the upgrading at strategically located landing sites, as well as the findings from the gender study (activity 3.1.1) to support women's participation in and benefits from BMUs. FISH4ACP will provide funding to support the activity.

Activity number and name: Activity 4.5.2 – Purchase MCS equipment for BMUs
Stakeholders or catalysts involved: TNC, LATAFIMA, FISH4ACP
Costs and investments: USD 40 000*
Category of investment: Equipment
Timing: July 2022 – 2025
Description: This activity will involve the identification and purchase of necessary equipment (such as patrol boats, engines, life jackets, GPSs) for selected BMUs (or groups of BMUs) to conduct MCS and co-management activities. The identification of BMUs, the equipment to purchase, and the management/utilization of the purchased equipment will be decided in close consultation with the MLF, LGAs and fishing communities. Budget is available under existing projects to procure a number of patrol boats and equipment for BMUs in 2022 and within the next three years in Tanzanian part (TNC Tuungane) and in the whole lake (LATAFIMA). However, given the large scale of the lake and the widespread lack of MCS equipment for BMUs, additional support would still be needed. FISH4ACP would thus also provide budget to support the procurement of selected equipment, to be determined in more detail at the outset of the implementation phase of FISH4ACP.

Activity number and name: Activity 4.5.3 – Support BMUs' operational costs
Stakeholders or catalysts involved: TNC, FISH4ACP
Costs and investments: USD 30 000*
Category of investment: Equipment
Timing: July 2022 – 2025
Description: It is recognized that while there need to be financially viable mechanisms to fund BMUs' operations in the long run, it is still necessary to financially support BMUs in terms of their operational costs in the short run (next 5 years). To this end, FISH4ACP will provide budget to co-fund part of BMUs' operational costs (such as fuel). A mechanism will be designed to monitor BMUs' operational costs, based on which FISH4ACP support will be provided (for instance, using GPSs to keep track of the areas patrolled and estimate the amount of fuel that is needed).

Activity number and name: Activity 4.5.4 - Train local government officers on fisheries legislations, sensitization methods, MCS practices (who can then train BMUs)
Stakeholders or catalysts involved: MLF, TAFIRI, with support from FISH4ACP and other projects/donors (e.g. LATAFIMA, TNC)
Costs and investments: USD 15 000*
Category of investment: Training
Timing: July 2022 – February 2025
Description: Under this activity, local government officers will be provided trainings on fisheries legislations, sensitization methods, MCS practices, which they then can disseminate to local BMUs and VC actors. Building this local capacity is particularly important in locations where FISH4ACP and other projects/donors (e.g,. TNC) cannot reach out to BMUs and VC actors directly. Whenever possible, these trainings will be conducted together with the trainings of BMUs and MLF officers (under activities 4.5.5 and 4.5.9) to increase training efficiency. This activity will thus provide budget from FISH4ACP for relevant training, to be determined in more detail at the outset of the implementation phase of FISH4ACP.

Activity number and name: Activity 4.5.5 - Train BMUs on fisheries legislations, management skills, sensitization methods, MCS practices and use of MCS equipment
Stakeholders or catalysts involved: MLF, TAFIRI, with support from FISH4ACP and other projects/donors (e.g. LATAFIMA, TNC)
Costs and investments: USD 30 000*
Category of investment: Training
Timing: August 2022 – February 2025
Description: Under this activity, BMUs will be trained on fisheries legislations, MCS practices and the use of MCS equipment, as well as methods/skills in sensitizing and mobilizing fishers

and their communities to comply with the laws and adopt more sustainable practices. These trainings will be provided by existing extension/research institutions in United Republic of Tanzania, in collaboration with Fisheries Officers and local authorities. Potential ICT-based options for BMU operations will also be considered (for examples, using computers to record data instead of handwriting). Trainings will be accompanied with demonstration of good practices. The design of training will build on experiences in strengthening BMUs in other locations (e.g. Lake Victoria, Zanzibar). Whenever possible, these trainings will be conducted together with the trainings of local government and MLF officers (under activities 4.5.4 and 4.5.9) to increase training efficiency. This activity will provide budget from FISH4ACP for relevant training, to be determined in more detail at the outset of the implementation phase of FISH4ACP.

Activity number and name: Activity 4.5.6 - Develop viable funding mechanism(s) for BMU operations
Stakeholders or catalysts involved: FISH4ACP working with VC stakeholders
Costs and investments: USD 20 000*
Category of investment: Studies/ Technical assistance
Timing: June 2022 – December 2022
Description: Under this activity, a study on the potential funding mechanisms (or business models) for the BMUs will be conducted. The study will explore potential funding mechanisms (or business models), evaluate the financial viability of each model, and propose the most suitable option(s) as well as how to implement them (e.g. partners, roles, funding, timeline). Potential impacts of the model(s), such as gender impacts, will also be considered and measures to mitigate negative impacts will be identified. The conduct of the study will be done in close collaboration/consultation with the VC stakeholders and will build on experiences in strengthening BMUs in other locations (e.g. Lake Victoria, Zanzibar). Synergies with and lessons learned from other related activities (such as activity 1.1.3, 1.5.1, 1.5.2, 2.3.2) will be sought for in order to avoid duplications/mistakes.

Activity number and name: Activity 4.5.7 - Implement BMU funding mechanism(s) or business models
Stakeholders or catalysts involved: VC Task Force, FISH4ACP in collaboration with TNC
Costs and investments: USD 40 000*
Category of investment: Facilitation
Timing: January 2023 – ongoing
Description: This activity will be about the implementation of the funding mechanisms (or business models) designed under activity 4.5.5. A pilot of the mechanisms (models) will be carried out to demonstrate their commercial viability before being replicated and/or scaled up by FISH4ACP or other VC stakeholders. It is expected that with the increased uptake of

the BMU business models, the financial support for BMU's operational costs (activity 4.5.3) will be gradually decreased.

Activity number and name: Activity 4.5.8 – Support MLF offices/officers with equipment for surveillance
Stakeholders or catalysts involved: FISH4ACP, LATAFIMA
Costs and investments: USD 15 000*
Category of investment: Equipment
Timing: July 2022 – February 2025
Description: This activity will involve the identification and purchase of necessary surveillance equipment (such as binoculars, GPS, life rings, radio handsets, cameras, life jackets, rechargeable waterproof torches, raincoats, laptops/computers) for three Fisheries Resources Protection (FRP) stations/centers in three regions around the lake (Kigoma, Rukwa, Katavi). The identification of the equipment to purchase, and the management/utilization of the purchased equipment will be decided in close consultation with the MLF and Fisheries Resources Protection stations/centers. Budget is available under LATAFIMA project to procure a number of surveillance boats (e.g. small solar fiber boats, engines) and equipment (e.g. drones, safety equipment) for FRP stations, and therefore, the purchase of surveillance boats and engines will not be covered under FISH4ACP support.

Activity number and name: Activity 4.5.9 – Train MLF officers on MCS practices
Stakeholders or catalysts involved: FISH4ACP
Costs and investments: USD 16 000*
Category of investment: Training
Timing: July 2022 – February 2025
Description: Under this activity, the staff in FRP stations in three regions around the lake (Kigoma, Rukwa, Katavi) will be provided MCS trainings, which include but are not limited to safety at sea, sea operations, firefighting, first aid, personal survival techniques, small craft operations, and prosecution methodologies. It is expected that FISH4ACP will provide funding for the training of six FRP officers in six FRP stations along the lake. Whenever possible, these trainings will be conducted together with the trainings of BMUs and local government officers (under activities 4.5.4 and 4.5.5) to increase efficiency.

Activity number and name: Activity 4.6.1 - Develop and disseminate communication products on conservation and fisheries legislations
Stakeholders or catalysts involved: VC Task Force, FISH4ACP in collaboration with MLF, TNC, and LATAFIMA
Costs and investments: USD 10 000*
Category of investment: Facilitation
Timing: April 2022 – ongoing
Description: This activity would involve the development and dissemination of communication products on conservation and fisheries legislations. This activity will be supplementary to the trainings under the activities 4.5.4 and 4.5.5. FISH4ACP will provide budget for the activity, to be implemented in collaboration with the VC Task Force, MLF and other projects/donors (e.g. TNC, LATAFIMA).

Activity number and name: Activity 4.6.2 - Conduct awareness raising activities/events on conservation and fisheries legislations
Stakeholders or catalysts involved: LTA, MLF, LGAs, VC Task Force, supported by FISH4ACP and other projects/donors (e.g. TNC, LATAFIMA)
Costs and investments: USD 10 000*
Category of investment: Facilitation
Timing: June 2022 – ongoing
Description: Under this activity, awareness raising/community events will be organized, utilizing the communication products to be developed under activity 4.6.1. FISH4ACP will provide budget for this activity, to be implemented in collaboration with the VC Task Force, MLF, LGAs, and other projects/donors (e.g. TNC, LATAFIMA).

Drawing on the information provided above, the investment table below provides an overview of the investments needed to realize the vision and how these investments are expected to be financed. It should be noted that the level of investments identified in the tables below is indicative and will have to be confirmed by the various parties involved.

TABLE 35. VC UPGRADING INVESTMENT TABLE (USD)

In USD	Financing sources				Total
Type of investments	FISH4ACP	LATAFIMA	LTA/ Governments/ Donors	Private sector	**Totals by type of investments**
Equipment	405 000	95 000	197 400	2 240 000	2 937 400
Facilitation	282 000	75 000			357 000
Infrastructure			4 200 000		4 200 000
Studies / Technical assistance	315 000	235 000	988 000		1 538 000
Training	616 000	10 000	60 000		686 000
Totals by funding source	**1 618 000**	**415 000**	**5 445 400**	**2 240 000**	**9 718 400**

Note: Some investments dependent on further studies providing sufficient justification and more detailed costings.

The above costs are allocated between four outcomes of the upgrading strategy as follows:

- Outcome 1: USD 7 053 000, or 73% of total costs
- Outcome 2: USD 574 000, or 6% of total costs
- Outcome 3: USD 105 000, or 1% of total costs
- Outcome 4: USD 1 986 400, or 20% of total costs

To aid with implementation and planning, a provisional scheduling and drawn-down of FISH4ACP funds is provided in the table below (only for those activities to be funded by FISH4ACP) over the life of the project (2022 – 2025).

TABLE 36. PROPOSED PHASING OF FISH4ACP INVESTMENTS, 2022 – 2025 (USD)

	2022	2023	2024	2025	Amount
*1.1.1 Identify suppliers/fabricators of improved equipment/inputs with capacity and willingness to supply at the lake zone	5 000				5 000
*1.1.2. Identify processors, fishers and traders who want to adopt improved techniques to supply high-value markets	12 000				12 000
*1.1.3 Pilot/demonstrate improved drying/smoking and cold chain equipment/inputs with suppliers and processors	20 000				20 000
*1.2.1 With AFRACA and partner bank(s), develop financial products for VC operators	30 000				30 000
*1.2.2 Integrate financial products into the business model strategy in activity 2.2.2	3 000				3 000

*1.3.1. Identify Business Development Service (BDS) providers to provide training services on a commercial/quasi-commercial basis	30 000				30 000
*1.3.2. Develop training materials with/by input suppliers and/or BDS providers	60 000				60 000
*1.3.3 Integrate training services into the business model strategy in activity 2.2.2	3 000				3 000
*1.4.1 Carry out Scoping Study to identify strategic locations for landing sites and facilities/services required	30 000				30 000
*1.4.2 Prepare upgrading plan (for construction of facilities), and engage partners	30 000				30 000
1.4.3 Implement the upgrading plan		300 000			300 000
*1.5.1 Develop best management/operational model for landing site (e.g. direct management by LGA or PPP) and assess management/operational capacity gaps	30 000				30 000
*1.5.2 Prepare and deliver programme of capacity building support for landing site management/operations		60 000			60 000
*2.1.1 Carry out Scoping Study to identify target markets and buyers of high-quality processed fish on these markets	30 000				30 000
*2.2.1 Facilitate match-making forums between fishers/processors and buyers	35 000	35 000			70 000
*2.2.2 Facilitate development of business models between suppliers and buyers of fish and provide support required to establish business models e.g. contracting, planning, finance, skills training (linked to activities 1.1.4, 1.2.2 and 1.3.3)	70 000	70 000			140 000
*2.2.3 Facilitate provision of capacity building support required to grow business models	35 000	70 000	35 000		140 000
*2.3.1 Identify fishers, processors and retailers who want to form into groups or to improve their groups	12 000				12 000
*2.3.2 Facilitate the development of business models for the operation and management of organizations/groups of fishers, processors and retailers	30 000				30 000

*2.3.3 Facilitate provision of capacity building support required to form and manage operationalize the groups (linked to activities 1.1.4, 1.2.2 and 1.3.3)	35 000	70 000	35 000		140 000
*2.4.1 Identify members, prepare ToR and source operating costs					n/a
2.4.2 Quarterly meetings held to review the progress of implementing the upgrading strategy and discuss issues on Lake Tanganyika fisheries	4 000	4 000	4 000		12 000
*3.1.1. Complete a study on gender constraints to explore the root causes of the constraints and identify opportunities/solutions to address them	25 000				25 000
3.1.2. Implement recommendations from the gender study					n/a
*3.2.1. Train women on organization/collective action and how to form and manage groups	7 000	8 000	5 000		20 000
*3.2.2. Support linkages between local women groups and existing national and regional organizations/associations (e.g. TAWFA, AWFishNET)	7 000	8 000	5 000		20 000
*3.2.3. Train women groups on women's rights, leadership, and communication	7 000	8 000	5 000		20 000
*3.3.1. Develop and disseminate communication products on gender equity and women's rights	3 000	5 000	2 000		10 000
*3.3.2. Conduct awareness raising/community events to advocate for gender equity and women's rights	3 000	5 000	2 000		10 000
*4.1.1. Conduct a pre-assessment study to prepare for and design the fish stock assessment	30 000				30 000
*4.1.2. Engage partners and agree on a mechanism to collaborate on the funding and implementation of the fish stock assessment	5 000	5 000			10 000
*4.1.4. Train partners on stock assessment method/SOPs		20 000			20 000
*4.3.4. Train partners on CAS methods/SOPs		15 000			15 000
*4.4.1. Revise and update fisheries (national and regional) legislation		6 000	3 000	1 000	10 000

*4.5.1. Facilitate the establishment of BMUs in important locations where BMUs are now lacking	5 000	7 000	3 000		15 000
*4.5.2. Purchase MCS equipment for BMUs	14 000	20 000	6 000		40 000
*4.5.3. Support BMUs' operational costs	10 000	16 000	4 000		30 000
4.5.4. Train local government officers on fisheries legislation, sensitization methods, MCS practices (who can then train BMUs)	5 000	7 000	3 000		15 000
*4.5.5. Train BMUs on fisheries legislation, management skills, sensitization methods, MCS practices and use of MCS equipment	9 000	14 000	5 000	2 000	30 000
*4.5.6. Develop viable funding mechanism(s) or business models for BMU operations	20 000				20 000
*4.5.7. Implement BMU funding mechanism(s)		25 000	12 000	3 000	40 000
*4.5.8. Support MLF offices/officers with equipment for surveillance	4 000	7 000	4 000		15 000
*4.5.9. Train MLF officers on CS practices	2 000	7 000	7 000		16 000
*4.6.1. Develop and disseminate communication products on conservation and fisheries legislation	2 000	5 000	3 000		10 000
*4.6.2. Conduct awareness raising activities/events on conservation and fisheries legislation	2 000	5 000	2 000	1 000	10 000
Total	**662 000**	**802 000**	**146 000**	**8 000**	**1 618 000**

5.3 The FISH4ACP project design

For those activities detailed above which involve the FISH4ACP project, additional information is provided below (Table 37) on the non-financial resources required, the partners, and pre-conditions that will be required. Activity numbering uses the same numbering as in the overall upgrading strategy logframe (in section 5.1); but those activity numbers not involving the FISH4ACP project are excluded.

TABLE 37. FISH4ACP PROJECT ACTIVITIES PLAN

Outputs and Activities	Resource required (non-financial)	Potential partners	Pre-conditions
Output 1.2. Financial products developed for purchase of improved processing equipment/inputs			
Activity 1.2.1 With AFRACA and partner bank(s), develop financial products for VC operators	Banking/finance expert	AFRACA	Partner banks have drafted financial products with borrowing requirements appropriate for small-scale fishers and processors
Output 1.3 – Trainers of new technologies, standards and quality control for fishers, processors and traders identified and engaged in the VC			
Activity 1.3.2. Develop training materials with input suppliers and BDS providers	Training curricula developers	MLF, TAFIRI	Input suppliers and BDS providers identified
Output 1.4. Facilities in strategically located landing sites upgraded			
Activity 1.4.1 Carry out Scoping Study to identify strategic locations for landing sites and facilities/services required	Fish marketing expert	MLF, LGA, Regional Government	Government remains committed to upgrading 3 landing sites
Activity 1.4.2 Prepare upgrading plan (for construction of facilities), and engage partners	Fish landing site designer/engineer	MLF, LGA, Regional Government	Government remains committed to upgrading 3 landing sites
Output 1.5. Landing site management and service provision capacity strengthened			
Activity 1.5.1 Develop best management/operational model for	Institutional management	MLF, LGA, TAFIRI	Government amenable to adopting alternative management models, such as PPP

landing site (e.g. direct management by LGA or PPP) and assess management/operational capacity gaps	specialist (for fish landing sites)		
Activity 1.5.2 Prepare and deliver programme of capacity building support for landing site management/operations	Landing site management experts	MLF, TAFIRI	Landing site management team in place
Output 2.1. High-value target markets and suppliers identified			
Activity 2.1.1 Carry out Scoping Study to identify target markets and buyers of high-quality processed fish on these markets	Fish marketing expert		
Output 2.3. VC actor organisations established/strengthened			
Activity 2.3.2 Facilitate the development of business models for the operation and management of organizations/groups of fishers, processors and retailers	Fisher group/organization expert	MLF, TAFIRI	Organisations/groups are established
Output 3.1. Study on gender constraints and opportunities conducted and recommendations implemented			
Activity 3.1.1. Complete a study on gender constraints to explore the root causes of the constraints and identify opportunities/solutions to address them	Social/Gender expert	EMEDO, TAWFA, AWFishNET, TAFIRI	ToR for expert prepared and approved.
Activity 3.1.2. Implement recommendations from the gender study	Social/Gender expert	VC Task Force, VC stakeholders	Gender study is completed. VC stakeholders agree with and support the recommendations of the study.
Activity 3.2.1. Train women on organization/collective action and how to form and manage groups	Social/Gender expert	EMEDO, TAWFA,	Confirmed women's interest in forming into groups. Trainees identified and available for training, and their

		AWFishNET, TAFIRI	needs assessed. ToR for trainers prepared and approved.
Output 3.2. Women trained in leadership and organization			
Activity 3.2.2. Support linkages between local women groups and existing national and regional organizations/associations (e.g. TAWFA, AWFishNET)	Social/Gender expert, VC expert	EMEDO, TAWFA, AWFishNET, TAFIRI	Women groups identified and their needs assessed. ToR for experts prepared and approved.
Activity 3.2.3. Train women groups on women's rights, leadership, and communication	Social/Gender expert, VC expert	EMEDO, TAWFA, AWFishNET, TAFIRI	Women groups identified and their needs assessed. ToR for experts prepared and approved.
Output 3.3. Awareness raised on gender equity and women's rights			
Activity 3.3.1. Develop and disseminate communication products on gender equity and women's rights	Social/Gender expert, Communication expert	VC Task Force, EMEDO	A communication/dissemination strategy articulated. ToR for experts prepared and approved.
Activity 3.3.2. Conduct awareness raising/community events to advocate for gender equity and women's rights	Social/Gender expert, Communication expert	VC Task Force, EMEDO	A communication/dissemination strategy articulated. Communication products developed. ToR for experts prepared and approved.
Output 4.1. Lake-wide fish stock assessment conducted			
Activity 4.1.1. Conduct a pre-assessment study to prepare for and design the fish stock assessment	Fish stock assessment expert	LTA, LATAFIMA, country governments, TAFIRI	Confirmed interest in and need for the fish stock assessment by LTA and four country governments. ToR for experts prepared and approved.
Activity 4.1.2. Engage partners and agree on a mechanism to collaborate on the funding and implementation of the fish stock assessment	Finance and legal experts	LTA, LATAFIMA, country governments	LTA willing to coordinate the implementation of the fish stock assessment. Contributions committed by four country governments and/or donors.
Activity 4.1.4. Train partners on stock assessment method/SOPs	Fish stock assessment expert	LATAFIMA, country	Contributions committed by four country governments and/or donors. National partners identified and

		governments, TAFIRI	available for training. ToR for expert prepared and approved.
Output 4.3. Lake-wide catch assessment survey (CAS) conducted			
Activity 4.3.4. Train partners on CAS methods/SOPs	CAS expert, Fisheries expert	LTA, LATAFIMA, country governments, TAFIRI	Contributions committed by four country governments and/or donors. National partners identified and available for training. ToR for expert prepared and approved.
Output 4.4. Fisheries legislations revised based on updated data			
Activity 4.4.1. Revise and update fisheries (national and regional) legislation	Policy expert	LTA, LATAFIMA, country governments	Four country governments committed to implement the Framework Fisheries Management Plan (FFMP) and revise/harmonize their national legislations accordingly.
Output 4.5. MLF officers, local government officers, and BMUs capacity for co-management and MCS strengthened			
Activity 4.5.1. Facilitate the establishment of BMUs in important locations where BMUs are now lacking	BMU expert, Fisheries expert	TNC, TAFIRI, LGAs, MLF	Needs for BMUs for specific locations identified. ToR for expert prepared and approved.
Activity 4.5.2. Purchase MCS equipment for BMUs	MCS expert, Finance and legal expert	TNC, MLF, LGAs	Equipment needs for BMUs identified. Equipment procurement, operation and management mechanisms developed and approved.
Activity 4.5.3. Support BMUs' operational costs	MCS expert, Finance and legal expert	TNC, MLF, LGAs	Support needed for BMUs' operations identified. Procurement and monitoring mechanisms developed and approved.
Activity 4.5.4. Train local government officers on fisheries legislation, sensitization methods, MCS practices (who can then train BMUs)	MCS expert, Fisheries expert, Policy expert	LGAs, MLF, TAFIRI, TNC, LATAFIMA	Government officers and their training needs identified. ToR for expert prepared and approved.
Activity 4.5.5. Train BMUs on fisheries legislation, management skills, sensitization methods, MCS practices and use of MCS equipment	MCS expert, Fisheries expert, Policy expert	LGAs, MLF, TAFIRI, TNC, LATAFIMA	BMUs and their training needs identified. ToR for expert prepared and approved.
Activity 4.5.6. Develop viable funding mechanism(s) or business models for BMU operations	BMU expert, Business model	TNC, TAFIRI, LGAs, MLF	ToR for expert prepared and approved.

	expert, Finance and legal expert		
Activity 4.5.7. Implement BMU funding mechanism(s)	BMU expert, Business model expert, Finance and legal expert	TNC, TAFIRI, LGAs, MLF	Business models (funding mechanisms) for BMU identified/developed, and agreed by VC stakeholders. Contributions – cash and non-cash – committed by partners.
Activity 4.5.8. Support MLF offices/officers with equipment for surveillance	MCS expert, Fisheries expert, Finance and legal expert	LATAFIMA, MLF	Equipment needs for MLF offices identified. Equipment procurement, operation and management mechanisms developed and approved.
Activity 4.5.9. Train MLF officers on MCS practices	MCS expert, Fisheries expert, Policy expert	MLF	MLF officers and their training needs identified. ToR for expert prepared and approved.
Output 4.6. Awareness raised for fishers/ communities on laws and conservation			
Activity 4.6.1. Develop and disseminate communication products on conservation and fisheries legislation	Communication expert, Policy expert, Conservation expert	LGAs, MLF, TAFIRI, TNC, LATAFIMA	A communication/dissemination strategy articulated. ToR for experts prepared and approved.
Activity 4.6.2. Conduct awareness raising activities/events on conservation and fisheries legislation	Communication expert, Policy expert, Conservation expert	LGAs, MLF, TAFIRI, TNC, LATAFIMA	A communication/dissemination strategy articulated. Communication products developed. ToR for experts prepared and approved.

5.4 Risk analysis

The risk analysis (table below) reflects on the risks that can prevent the achievement of the envisioned impact and develops associated mitigation strategies affecting both the overall and project-specific action plans. The major risks include Government funding for upgrading the landing sites and VC actors' ability to adopt the improved technologies, for which mitigating options have been provided. Other major risks focus upon sustainable fisheries management such as BMU capacity, decline of fish

stocks and climate change. Whilst these risks are more difficult to mitigate, options have been provided to reduce the potential negative impact upon the project.

TABLE 38. RISKS ASSOCIATED WITH THE UPGRADING STRATEGY

Risk Name	Risk Nature	Risk Likelihood (1-5)	Risk Impact (1-5)	Overall risk level (1-25)	Mitigating Options
Upgrading of landing sites by MLF/LGA is delayed or cancelled	The upgrading strategy uses the landing sites as focal areas for interacting with VC actors, where access to improved services will be provided. Some of the landing sites are currently not in use due to flood damage and need to be relocated or renovated before they can resume operations	3	4	12	The machinery is containerized to allow transfer to better sited locations if required. Containerisation also allows transfer due to other risks such as flooding.
Banks do not provide loans or loans are not taken up by processors	The upgrading strategy is reliant on the adoption of improved processing equipment. Most of the processors are low income and may not be able to satisfy borrowing requirements	3	4	12	FISH4ACP seeks other funding models such as matching grants or subsidies with other donors
VC actors are not willing to invest in improved technologies	For artisanal processors in particular, processing is a part-time activity to earn supplemental household income. Therefore they could be reluctance to invest in upgrading the business	3	4	12	Commercially oriented VC actors are targeted
Road infrastructure is not improved sufficiently to ensure accessibility to/from landing	The road infrastructure around Lake Tanganyika region in United Republic of Tanzania, although improved in the last 5-10 years, is still poor. Government has plans to improve the roads, but these improvements may not be sufficient and/or fast enough to ensure reliable	2	4	8	FISH4ACP and VC-Task Force should work closely with government to facilitate timely infrastructural improvements.

sites and production areas	transport and accessibility, especially during rainy seasons.				
Power supply remains unstable	Power supply in the Lake Tanganyika region in United Republic of Tanzania, although improved than in the past, is still unstable. This may pose challenges to the adoption of cold chain and electric drying/smoking techniques.	2	4	8	Explore the feasibility of using energy from renewable sources, such as solar-powered driers and refrigerators. Explore options for better insulation materials/ techniques for cold chain.
Persistence of gender norms disadvantaging women	Improving deeply rooted social norms require strong support/ commitment from the community and VC stakeholders over a long period of time. Until the time this is achieved, women will still face gender-based challenges when participating in the VC.	3	3	9	The upgrading strategy includes various activities aimed at addressing gender constraints.
Technical and financial capacity of BMUs remains weak even after training/support	BMUs play a crucial role in the co-management system. In order for BMUs to function effectively they must have the financial resources, management skills, sound leadership and an able, committed membership. All these require a long time to build and strengthen, which may exceed the duration of the project.	3	4	12	The upgrading strategy includes various activities aimed at building capacity for the BMUs.
Lake-wide fish stock assessment is not funded	Underpinning sustainable fisheries management is reliable data on stock dynamics and biomass. Decision making for the management of the lake fishery as a whole will be impaired without such data.	4	2	8	The upgrading strategy includes activities related to engaging partners to obtain/secure funding for the fish stock assessment. Decision making proceeds taking the precautionary approach.
Decline of fish stock biomass	It takes time to see the impacts of improved management measures and fishing practices on fish stock biomass. In the meantime, fish stock biomass can	4	4	16	Implement the lake wide fisheries management plan as best as possible, combined with training, financial and livelihood supports

	decline due to weak management, persistent overexploitation, the impact of climate change and pollution. The value chain and its contribution to food security and livelihoods will be negatively affected by any stock decline.				for VC actors to comply with the regulations.
Climate change continues to impact negatively on fishing communities and VC activities	Increasingly changing and unpredictable weather patterns affect VC operations – from fishing to processing and retailing, making interventions equally unpredictable and uncertain.	4	4	16	See landing site development above. More effective climate change monitoring.
Poverty and lack of alternative means of livelihood force fishers to continue using illegal fishing practices	An important aspect of fisheries management is accommodating those who may have to leave the sector in certain times of the year or invest in appropriate practices due to implementation of management measures (e.g. closed fishing seasons, prohibition of illegal gears). In the absence of viable alternatives, VC actors will, out of necessity, continue to rely on the fisheries sector and using illegal practices for their livelihoods.	3	4	12	In collaboration with other partners (e.g. TNC, LATAFIMA, the Jane Goodall Institute, civil society, MLF), explore viable alternative livelihood options for VC actors, especially during closed fishing seasons.
Political influence on the implementation of specific management measures	Political pressure may pose challenges to the government's implementation of specific management measures (e.g. closed fishing seasons), especially given the riparian population's reliance on fisheries activities and the lack of alternative livelihoods (as discussed above).	3	4	12	See alternative livelihood support above.

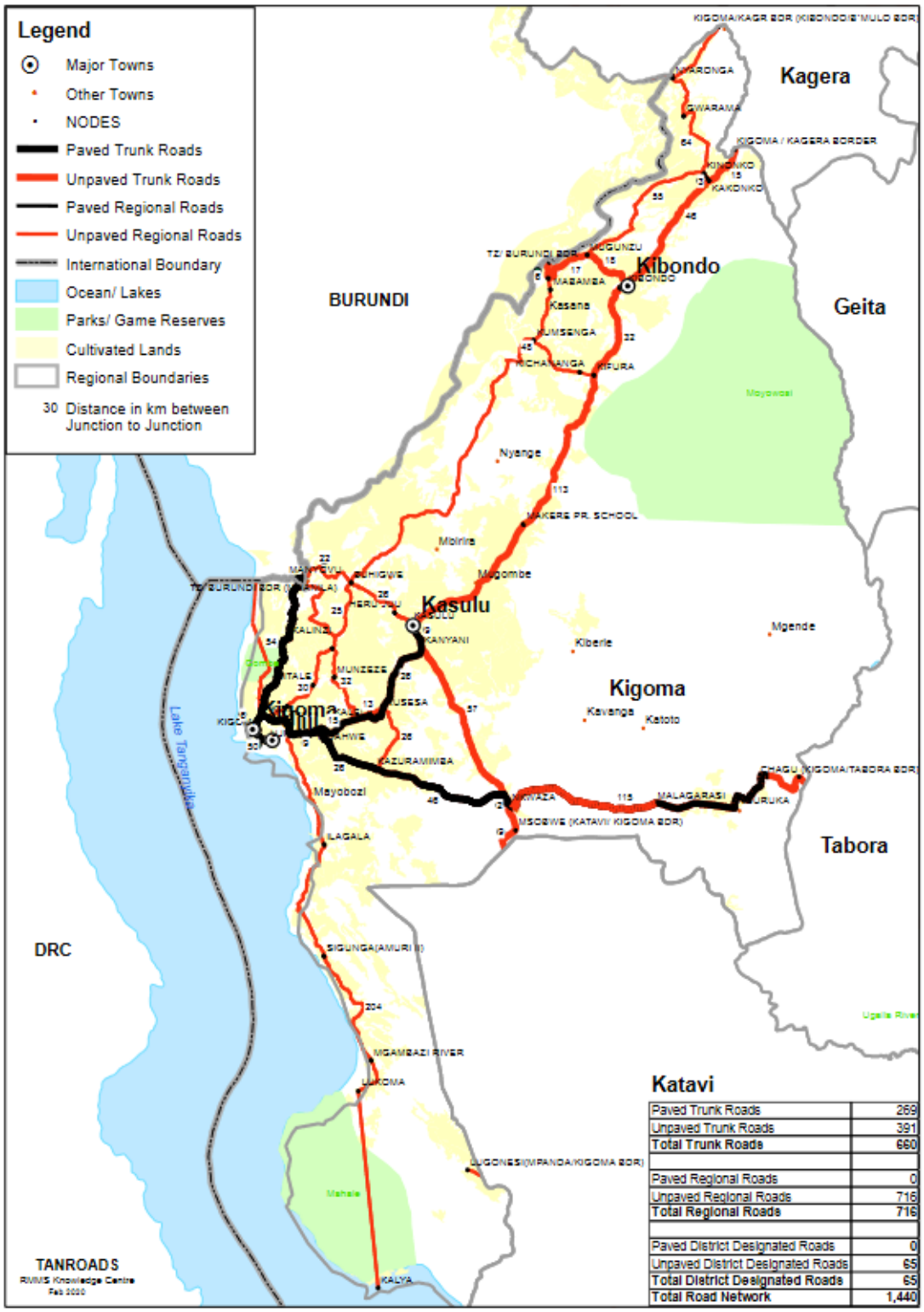
Note: Overall risk calculated by multiplying risk likelihood with risk impact.

Annex

Annex 1 – Secondary data collection

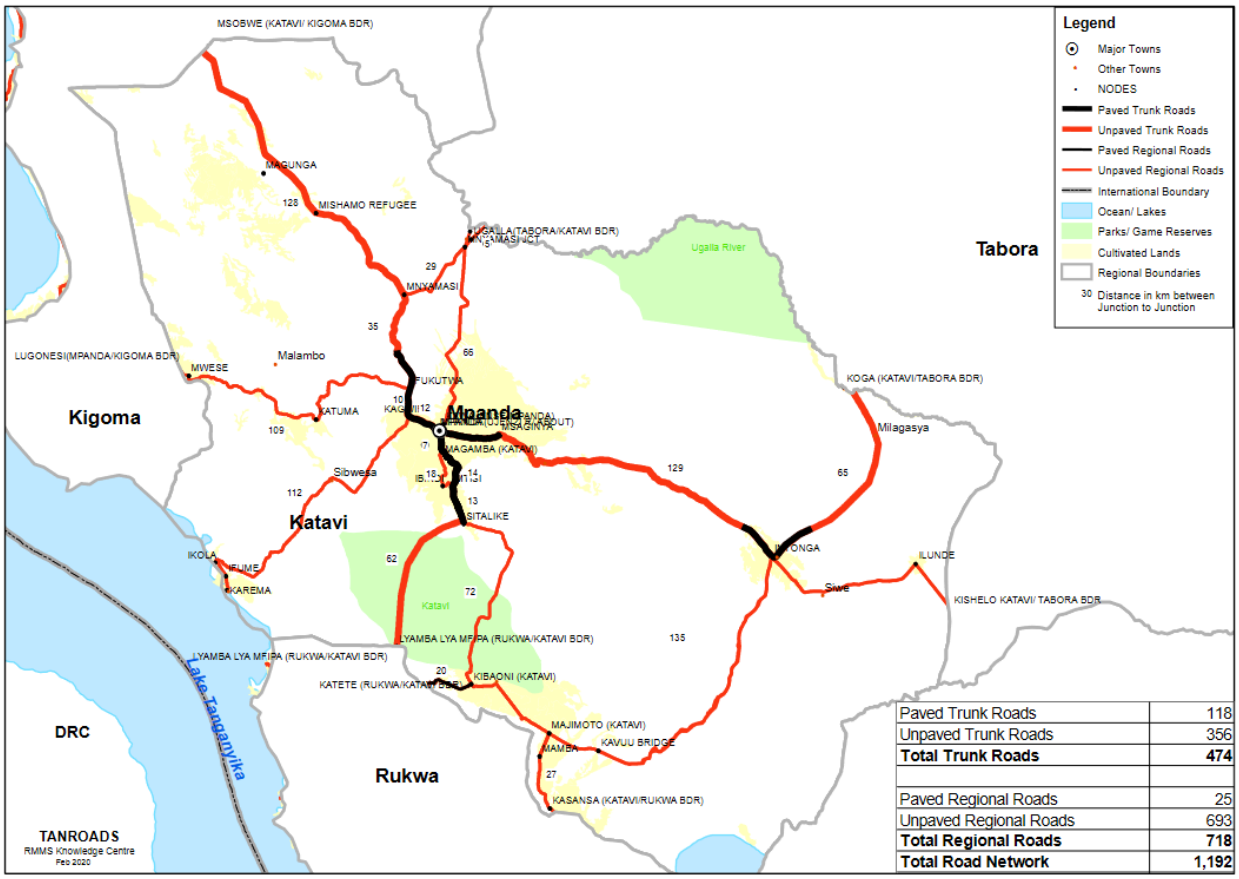
FIGURE 65. UNITED REPUBLIC OF TANZANIA MAP

FIGURE 66. KIGOMA REGION ROADS NETWORK



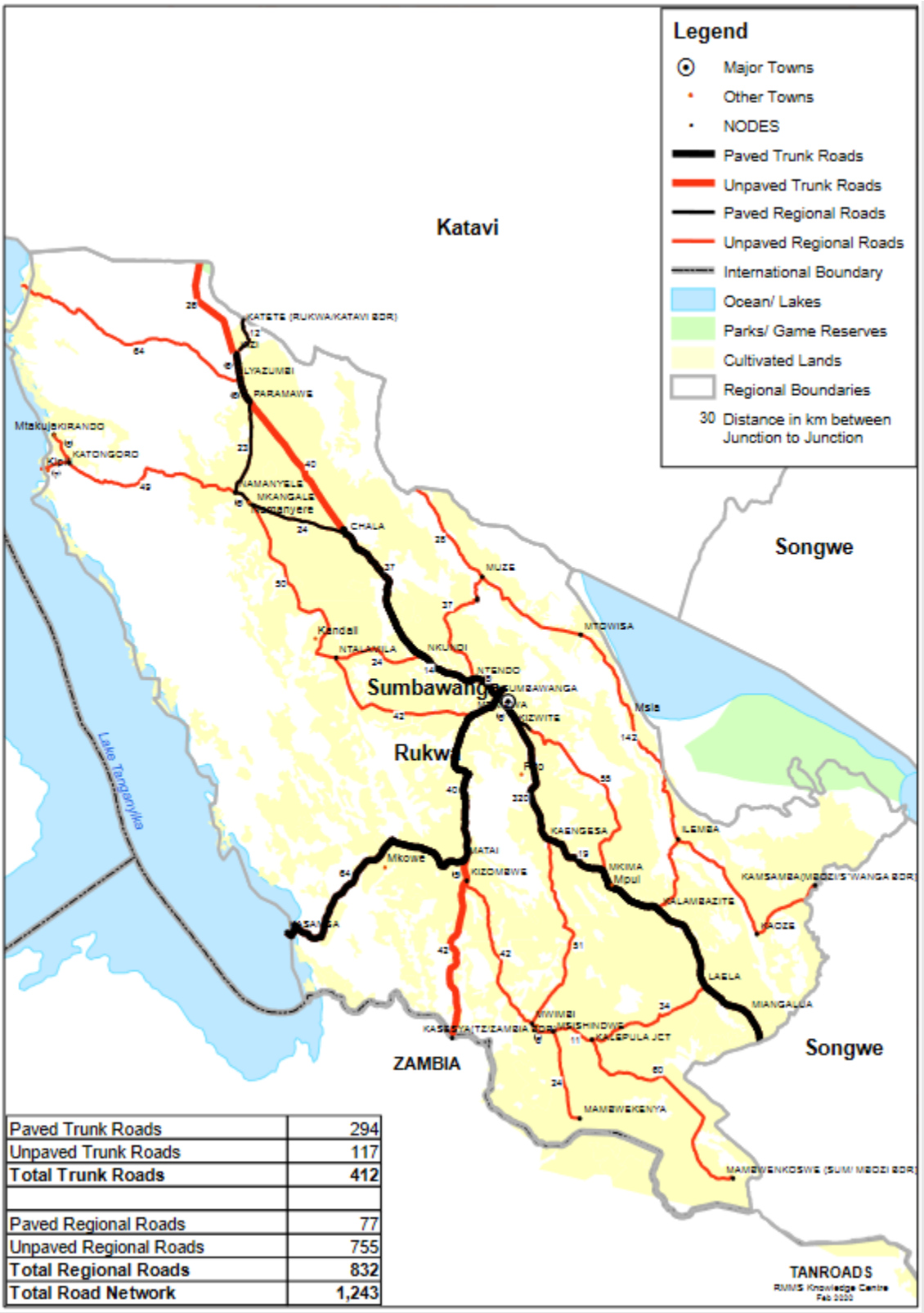
Source: https://www.tanroads.go.tz/road-networks/regional

FIGURE 67. KATAVI REGION ROADS NETWORK



Source: https://www.tanroads.go.tz/road-networks/regional

FIGURE 68. RUKWA REGION ROADS NETWORK



Paved Trunk Roads	294
Unpaved Trunk Roads	117
Total Trunk Roads	**412**
Paved Regional Roads	77
Unpaved Regional Roads	755
Total Regional Roads	**832**
Total Road Network	**1,243**

Source: https://www.tanroads.go.tz/road-networks/regional

FIGURE 69. UNITED REPUBLIC OF TANZANIA MAP, WITH NETWORKS OF ROADS, RAILWAYS AND AIRPORTS

Source: Map No. 3667 Rev. 6. January 2006. Department of peacekeeping operations. Cartographic section. (https://www.un.org/Depts/Cartographic/map/profile/tanzania.pdf).

2. The three fish species of focus in this value chain study:

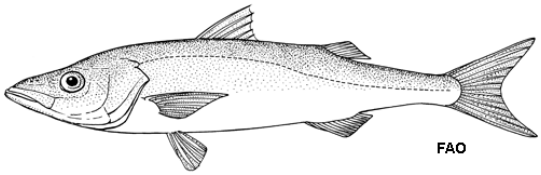
Stolothrissa tanganicae

English name: Lake Tanganyika sprat

Local names: dagaa (United Republic of Tanzania), Kapenta, Chilwe (Zambia), Ndagala (Burundi, Democratic Republic of the Congo, United Republic of Tanzania)

Source: https://www.fishbase.us/

Lates stappersii



English name: Sleek lates

Local names: Mvolo, Mikebuka, Nchebuka (United Republic of Tanzania), Nvolo (Zambia), Mukeke (Burundi), Mvolo, Mikeke (Democratic Republic of the Congo)

Source: https://www.fishbase.us/

Limnothrissa miodon

English name: Lake Tanganyika sardine

Local names: Lumbu, Dagaa (United Republic of Tanzania, Democratic Republic of the Congo), Kapenta (Zambia), Lumpu, Ndagala (Burundi)

Source: https://www.fishbase.us/ Picture by Mohamed, A.D.

Annex 2 – Primary data collection

TABLE 39. NUMBER OF RESPONDENTS INTERVIEWED DURING PRIMARY DATA COLLECTION PERIOD IN 2021

Survey/interview type	Number of respondents
Surveys	
Small-scale fishers	55
Small-scale processors	57
Workers	128
Consumers	122
Actor interviews	
Functional	30
Economic	33
Social	29
Environmental	39
Focus group discussions (FGDs)	
Small-scale fishers	3
Small-scale processors	2
Workers	3
Traders	2
Key informant interviews (KIIs)	
Commodity expert	3
Social and labour expert	1
Financial service providers	3
Input and service providers	3
BMU and Cooperative society	4
Ministry official	2
LTA	1
Market leader	2
Environmental experts	3

Annex 3 – Supporting information

TABLE 40. NATIONAL FISHERIES AND ENVIRONMENTAL POLICIES AND REGULATIONS REGULATING THE FISHERIES SECTOR IN LAKE TANGANYIKA

Policies/Regulations	Objectives	Content
Fisheries Act (2003)	To make provision for the sustainable development and conservation, regulation and control of fish and fish products.	Is the overarching framework regulating fisheries sector to promote the sector development
Fisheries Regulation (2009), amended in 2020	To provide for any other matters authorized to be prescribed under the Fishery Act 1995.	Contains more specific regulations than those in the Fisheries Act to control fishing, fish processing and trading activities
National Fisheries Policy (NFP) (2015)	To guide towards realization of the vision of the fisheries sector, which is to achieve sustainable fisheries that contribute to food security and nutrition, economic growth and improved wellbeing of fisheries stakeholders while conserving natural environment.	Sustainable management of fisheries resources; research and development; extension; fisheries infrastructure; utilization, processing and marketing of fish products; decent employment; youth involvement; finance; information services; input supply; regional and international cooperation; and cross-cutting issues including environment, gender equity, HIV/AIDS, public-private partnerships (PPP), and decentralization.
National Environmental Policy (1997)	To promote environmental sustainability, security and equitable use of resources.	The policy outlines six key environmental concerns, one of which directly relates to the deterioration of aquatic ecosystems.
Environmental Management Act (EMA) No.20 (2004)	To support pollution prevention and control, waste management, and compliance with/enforcement of laws.	The Act contains provisions for environmental management and planning and for doing environmental impact assessments.

National Water Policy (2002)	To address issues related to the management of water resources, water supply and sewerage.	The policy contains provisions related to accessibility of clean water and the management of aquatic systems.

Source: United Republic of Tanzania (2003, 2009, 2015), Breuil and Grima (2014), Interviews with experts and MLF officials in 2021, MLF (2021b).

TABLE 41. EXISTING REGULATIONS/MEASURES INFLUENCING FISHING ACTIVITIES ON LAKE TANGANYIKA IN UNITED REPUBLIC OF TANZANIA

Topic	Measures
Fishing areas	Fishing in breeding and nursery grounds and landing of fish in non-recognized sites and trading of fish in non-gazetted sites are illegal.
Immature fish species	Prohibition of fishing, possessing, processing, exporting, or trading the sprat and sardine whose total length is below 7cm and the perch whose length is below 26cm.
Fishing gears	• Prohibition of destructive fishing gears and methods such as beach seine nets and monofilament nets. • Prohibition of ring nets below 8mm mesh size and of gill nets (vertical integration) of more than 144 meshes and mesh size of less than 3 inches and more than 6 ply. • Prohibition of using ring nets unless operated in no less than 1000m range from the shoreline, island, or Peninsula, with light attraction during night time and using hooks with size above 9 for perch. • Prohibition of using ring nets and lift nets with mesh size of less than 8 mm for catching sprat and sardine.
Fishing methods	• Prohibition of using solar light bulbs in Lake Tanganyika with capacity of more than 10 watts. The total number of bulbs per boat should not exceed five for a single unit of fishing gear.
Fishing days/ periods	• No specific regulations on the number of days/fishing period in Lake Tanganyika.[75]

Source: Fisheries Act (2003). Fisheries Regulations (2009). Experts and MLF official interviews (2021).

TABLE 42. SOME LEGAL MEASURES REGARDING LAKE TANGANYIKA SPRAT, SARDINE AND PERCH IN DIFFERENT COUNTRIES

Burundi	RD Congo	United Republic of Tanzania	Zambia
Compulsory license	Administration and decentralized fisheries management	Compulsory license	Compulsory license

[75] Although there are no legal requirements in terms of fishing days or period, in practice, the type of fishing method determines the number of fishing days. For instance, those using gill nets, longline and handline can fish throughout the year, but for those using light-attraction fishing method such as lift net and ring net have limited number of fishing days depending on phases of the moon (usually, they fish between 14 days to 20 days per month when there is total darkness).

Minimum size of sardines 7 cm TL	services at the regional governor's level	Minimum size of sardines 8 cm TL	
Fishing prohibited during full moon period		Fishing prohibited during the full moon	
Minimum catch size of Lates: 26 cm TL		Minimum catch size of Lates: 26 cm TL	
Mesh size of nets: 4 to 5 inches (stretched mesh)		Net mesh size at least 3 inches (stretched)	Net mesh size at least 63 mm (stretched)
No monofilament FM		No monofilament FM	No monofilament FM
		Trawling prohibited	Driftnets prohibited
Beach seines prohibited			Beach seines prohibited
Fishing on spawning grounds is prohibited	Fishing on spawning grounds is prohibited	Fishing on spawning grounds is prohibited	Fishing on spawning grounds is prohibited

Source: Table 6 in LATAFIMA (2021).

TABLE 43. SOME ARTICLES IN THE REGIONAL CHARTER OF THE MEMBER STATES OF THE LAKE TANGANYIKA AUTHORITY PROVIDING FOR MEASURES FOR THE SUSTAINABLE MANAGEMENT OF FISHERIES IN LAKE TANGANYIKA AND ITS BASIN

Article	Content
Article 5	The minimum sizes required for catching the three main commercial fish species of Lake Tanganyika are as follows: *Lates stappersii:* 260 mm (10.2 inches) in total length *Limnothrissa miodon*: 110 mm (0.43 inches) in total length *Stolothrissa tanganicae*: 100 mm (0.39 inches) in total length The capture of fish smaller than the sizes indicated above is prohibited.
Article 6	Mesh sizes for fishing nets: Not less than 12 mm (0.47 inches) of stretched mesh (6 mm (0.24 inches) knot to knot) for any net, including the bunt, aimed at the capture of *Stolothrissa tanganicae* and *Limnothrissa miodon*. Not less than 63 mm (2.5 inches) stretched, so 31.5 mm (1.2 inches) knot-to-knot for capture of *Lates stappersii* by gillnets.
Article 7	Prohibition of the use of the following gears: driftnets of all kinds, monofilament nets of all kinds, beach seines of all kinds or any gear scraping the physical substrate at the bottom of the lake of in estuaries, any net lying flat on the bottom of the lake, any net or braided material of which the stretched mesh is less than 6 mm (0.24 inches), encircling gillnets.
Article 8	It is prohibited to fish with electric gear, explosives or any substance, natural or of chemical origin, liable to immobilize or kill fish.

Article 9	The maximum height for a gillnet is 2 m (2.2 yards) for nets used in coastal fishing and targeting coastal species. The maximum height for a gillnet is 4 m (4.4 yards) for nets aimed at capturing Centropomids.
Article 10	The maximum length of net for a gillnet crew is 1 000 m (1 093.6 yards), or 1 km (621.2 miles) (all the nets of one fishing unit).
Article 11	The length of a longline or hook line must not exceed 300 m (328.1 yards), with a maximum number of hooks set at 150 pieces. Fishing unit shall have three operational lines at the same time, each of which must meet the above criteria.
Article 12	The minimum size for any hook is 7 mm (0.28 inches) opening in the widest part of the hook handle, a size commonly known as "number 10"
Article 13	Breeding grounds are considered as protected aquatic areas, where fishing is prohibited.
Article 14	A biological rest period for the reconstitution of the fish stock will be observed each year by all riparian countries of Lake Tanganyika from 15th May to 15th August. In the first three years of the closed fishing season, the LTA member states should intensify data collection in fish stocks, biology and impacts on social economics of people so as to evaluate impacts of enforcing this charter.
Article 15	The minimum distance from the shore for the use of encircling or lifting nets using light and aimed at capturing offshore species (*Lates stappersii, Stolothrissa tanganicae, Limnothrissa miodon)* is set at 2 km (1.2 mile) in the waters of Lake Tanganyika. The minimum distance from the shore for the use of gillnets to capture Centropomids is set at 2 km (1.2 mile) in the waters of Lake Tanganyika.
Article 16	The proportion of fish smaller than the minimum sizes described in Article 5 must be less than 20 percent of the total catch in a fishing trip.

Source: Regional Charter 2021 for measures for the sustainable management of fisheries in Lake Tanganyika and its basin.

TABLE 44. NATIONAL ORGANIZATIONS AND ROLES

Organization	Role
Ministry of Livestock and Fisheries (MLF)	
Fisheries Development Division	Responsible for fishery management and administration, including: - Development and enforcement of fisheries policies, guidelines, standards, - Investment promotion in fisheries, - Fisheries resource development, - Fisheries quality assurance and control, and marketing, - Monitoring, Control and Surveillance (MCS), - Fisheries laboratory services - Liaise with regional and international organizations on fisheries issues
Fish Quality and Control Unit	Responsible for quality control of fish products
Fisheries Resources Protection Unit	Deals with monitoring, control, and surveillance of fishing activities

Fisheries and Aquaculture Research, Training and Extension services Division	Responsible for fisheries and aquaculture research, training, statistics and extension services, including: - Coordination of research, training, statistics and extension services activities, - Development and maintenance of research and statistical databases, - Development, delivery and dissemination of research, training, capacity building, extension packages and improved technologies
Ministry of Industry and Trade (MIT)	
Tanzania Bureau of Standards (TBS)	Responsible for the implementation of standards, quality control/assurance of commodities and metrology services, and the promotion of standardization in industry and commerce, including: - Development, framing, and modification of national standards, - Approval, registration, and control of the use of standards, - Assistance to industries in setting up and enforcing quality assurance and environmental management systems, - Monitoring standard compliance, - Educational work related to standardization and quality assurance
Business Registration and Licensing Agency (BRELA)	Responsible for business administration, company registration, trademark registration, and the issuance of industrial licenses.
Ministry of Health (MoH)	
Tanzania Medicines and Medical Devices Authority (TMDA)	Regulation and control of food quality and safety to protect and promote public health
Minister of State in the Vice President's Office for Union Affairs and Environment	
Environmental Division	Responsible for policy guidance for and coordination of environmental management and conservation of natural resources in United Republic of Tanzania.
Ministry of Regional Administration and Local Government (TAMISEMI)	
	Responsible for management of landing sites, in coordination with the District Executive Director (DED), who oversees development projects in the district. All fisheries officer in any given district are answerable to the DED.
Ministry of Foreign Affairs and East African Cooperation	
	Responsible for transboundary agreements related to fisheries sector or trade, e.g. management of Lake Tanganyika (LTA agreement), management of Lake Victoria and Nyasa, management of straddling species in Indian ocean.
Tanzania Shipping Agencies Cooperation (TASAC)	
	Responsible for boat safety training and inspection
Occupational Health and Safety Authority (OSHA)	
	Responsible for protecting workers from potential hazards at workplaces through conduct of inspections and OSH risk assessments, and provision of technical advice on OHS issues

Local Government Authorities (LAGs)	
	Major role in fisheries management and co-management at landing sites.

Source: MLF (2020a), TBS (2020), TFDA (2020), Minister of State in the Vice President's Office for Union Affairs and Environment (2020), OSHA's website: https://www.osha.go.tz/page/about-osha-more, Stakeholder consultations in 2021.

TABLE 45. LIST OF ASSOCIATIONS, COOPERATIVES, SACCOS AND OTHER GROUPS, AS OBSERVED DURING FIELD VISITS (2021)

Region	Group name (or type)	Membership
Kigoma		
Muyobozi	Muyobozi environmental association	Fishers
Muyobozi	Processor organization	Processor
Muyobozi	Union of fishers in Karago	Fishers, exporters
Muyobozi	Local self-help groups	Mixed
Kibirizi	Let's save each other	Wholesalers, retailers
Kibirizi	Hezagilwa group *("Hezagilwa" means "sacrifice")*	Wholesalers
Katonga	Juhudi group *("Juhudi" means "efforts")*	Wholesalers
Katonga	Entrepreneurs group of Katonga	Retailers
Katonga	Katonga Beach Fisheries Cooperative	Fishers, Processors
Lubengela	A local SACCO named "Upatu"	Mixed
Kigoma	Tanzania Women Fish workers Association (TAWFA)	Women processors and traders
Katavi		
Ikola	Union of fishers	Fishers
Ikola	Processor organization	Processor
Rukwa		
Stoo	Fisher Union of Tanzania	Fishers
Stoo, Sumbawanga	TARO SACCOS (Tanganyika & Rukwa Saccos)	Wholesalers, retailers, exporters
Kasanga	Fishers of Kasanga	Fishers
Sumbawanga	Union of fish traders	Wholesalers, retailers, exporters
Mbeya		
Kalungu	Kalungu Fisheries Committee ((kamati ya wavuvi kalungu))	Fishers
Matola village	Fish Traders in Mbeya	Retailers
Tunduma	Dagaa and perch seller union	Women retailers

Soweto market	A local SACCO named "Ushirika wa Wauza Samaki Soko la Soweto"	Retailers
Dar es Salaam		
Kariakoo	Union of dried dagaa and fish sellers (UWADASA - Umoja wa wauza dagaa na samaki wakavu)	Retailers
Kariakoo	Sardine and Fish Traders Cooperative Society (Umoja wa Wauza Dagaa na Samaki wakavu)	Retailers, wholesalers

Source: Pers. Comm. with VC actors, 2021.

Annex 4 – Assumptions overview

Number of boats (9,368 fishing units) is based on the Lake Tanganyika Regional Fisheries Frame Survey carried out in 2011, as no more recent data is available. Based upon anecdotal evidence the number of boats is likely to have increased in the intervening years.

Catch Per Unit Effort (CPUE) was then estimated based on data collected from the Small Fisher Survey as part of this study. For plank boats CPUE was 40kg and for small catamarans CPUE was 70kg. It was then assumed each boat went fishing 216 times a year.

The catch composition varies considerable between the north and south of the Lake, with the north catching more sprat/sardine and the south catching more perch. The total catch composition for the north and south of the Lake has been estimated based upon official MLF statistics of approximately 66 percent sprat/sardine and 33 percent perch.

The number of processors (5 564 processing business) is based on the Lake Tanganyika Regional Fisheries Frame Survey carried out in 2011, as no more recent data is available. The survey estimated the processing segment employed a total of 11 127 persons. Core actor economic interviews carried out as part of this study, estimated each processing business employed an average of 2 persons, including the owner.

The processor output is based upon an average (mean) of survey data collected from 58 small-scale processors as part of this study.

The number of retailers (2 693 retail business) is based on the Lake Tanganyika Regional Fisheries Frame Survey carried out in 2011, as no more recent data is available. The survey estimated the processing segment employed a total of 4 040 persons. Core actor economic interviews carried out as part of this study, estimated each retail business employed an average of 1.5 persons, including the owner.

The retailer output is based upon an average of data collected from core economic interviews as part of this study.

The percentage of fish 'home-consumed' or 'lost' is based upon the 'mode' of data collected from surveys and core actor economic interviews as part of this study.

Annex 5 – Detailed economic calculations

Table 46. Fisher operating account (baseline 2021)

		Base scenario (TZS)	USD
R	Total output value	20,626,000	8,910
	Fresh s/s	15,130,800	6,536
	Fresh Perch	4,191,200	1,810
	fresh s/s own	1,020,600	441
	fresh s/s lost	-	-
	fresh perch own	283,400	122
	fresh perch lost	-	-
I = Ic + Io	Intermediate Inputs	8,130,750	3,512
Ic	Inputs from inside the chain	-	-
Io	Inputs from outside the chain	8,130,750	3,512
	Fuel Fisher boat	4,244,267	1,833
	Charcoal for Fisher proces	480,000	207
	Poly sheet for fishers	169,000	73
	Sacks for fishers	180,750	78
	Firewood for fishers	40,000	17
	Sails for fishers	6,800	3
	Fishing line	2,000	1
	Food for boat crew	1,075,296	464
	Poles big for fishers	93,750	40
	Poles small for fishers	34,000	15
	sugar cane	16,000	7
	fish boat repair	326,250	141
	transport fishers	32,000	14
	boat engine repair	466,000	201
	solar lamp repair	26,000	11
	lamp battery recharge	420,000	181
	Fishing licence	134,667	58
	latra inspection	34,650	15
	processing licence fisher	7,260	3
	Market fee fisher	3,400	1
	Fishing licence 2	11,220	5
	Crew licence 1	37,400	16
	Crew licence 2	22,440	10
	Accomodation for boat crew	89,100	38
	lamp battery rent	178,500	77
VA = R - I	Gross value added	12,495,250	5,398
Fcc	Fixed capital consumption	2,030,976	877
	depriaciation fisher	2,030,976	877
NVA = VA -	Net value added	10,464,274	4,520
Oc	Other components	6,059,406	2,617
	labour family fisher	2,144,000	926
	labour hired fisher	3,915,406	1,691
P/L = NVA	Profits/Losses	4,404,868	1,903

TABLE 47. PROCESSOR OPERATING ACCOUNT (BASELINE 2021)

		Base scenario (TZS)	USD
R	Total output value	32,837,168	14,185
	Dried s/s sold process	25,985,600	11,225
	smoked perch process sold	5,896,000	2,547
	dry s/s processed own	779,568	337
	dry s/s processed lost	-	-
	smoke perch processed own	176,000	76
	smoked perch processed lost	-	-
I = Ic + Io	Intermediate Inputs	30,973,361	13,379
Ic	Inputs from inside the chain	28,502,000	12,312
	Fresh s/s	23,328,000	10,077
	Fresh Perch	5,174,000	2,235
Io	Inputs from outside the chain	2,471,361	1,068
	charcoal process	1,349,570	583
	poly sheets process	67,275	29
	smoking sticks process	800	0
	rope processor	1,800	1
	packaging processor	16,950	7
	trasport process	201,940	87
	storage process	10,000	4
	process licence processor	7,956	3
	council fee processor	305,037	132
	movement permit process	240,000	104
	trader id process	4,000	2
	drying rack rental process	222,500	96
	storage rental process	8,500	4
	depreciation processor	35,033	15
VA = R - I	Gross value added	1,863,807	805
Fcc	Fixed capital consumption	-	-
NVA = VA - F	Net value added	1,863,807	805
Oc	Other components	496,379	214
	labour family process	347,700	150
	labour hired process	122,012	53
	loan interest processor	26,667	12
P/L = NVA -	Profits/Losses	1,367,428	591

TABLE 48. WHOLESALER OPERATING ACCOUNT (BASELINE 2021)

		Base scenario (TZS)	USD
R	Total output value	319,014,196	137,803
	dried s/s wholesale sold	235,125,504	101,566
	fresh perch wholesale sold	1,250,000	540
	smoked perch whosale sold	63,635,000	27,488
	frozen perch wholesale sold	18,180,000	7,853
	dry s/s ws own	591,192	255
	dry s/s ws lost	-	-
	smoked perch ws own	50,000	22
	smoked perch ws lost	-	-
	fresh perch ws own	2,500	1
	fresh perch ws lost	-	-
	frozen perch ws own	180,000	78
	frozen perch ws lost	-	-
I = Ic + Io	Intermediate Inputs	258,374,742	111,609
Ic	Inputs from inside the chain	253,750,512	109,611
	Fresh Perch	7,007,000	3,027
	Dried s/s sold process	192,163,512	83,008
	smoked perch process sold	54,580,000	23,577
Io	Inputs from outside the chain	4,624,230	1,998
	ice wholesale	400,008	173
	firewood wholesale	168,000	73
	smoke stick wholesale	1,600	1
	fuel for transport wholesale	1,516,500	655
	diesel generator wholesale	368,000	159
	electricity wholesale	238,000	103
	water wholesale	11,880	5
	dishes wholesale	1,333	1
	iron sheet wholesale	667	0
	poly sheets ws	1	0
	package ws	66,000	29
	package ws 2	16,800	7
	rope ws	4,800	2
	trasnport ws 1	543,750	235
	trasnport ws 2	9,000	4
	trasnport ws 3	720,000	311
	mobile phone ws	15,000	6
	mechanic ws	8,500	4
	waste collect ws	10,098	4
	storage ws	20,000	9
	weight scales ws	12,000	5
	process license ws	3,667	2
	market fee ws	18,000	8
	trading licence ws	62,033	27
	council fee ws	110,000	48
	move permit ws	7,260	3
	trade id ws	3,333	1
	bus premises rent ws	258,000	111
	cold storage rent ws	30,000	13
VA = R - I	Gross value added	60,639,454	26,194
Fcc	Fixed capital consumption	1,797,597	776
	depriciation ws	1,797,597	776
NVA = VA -	Net value added	58,841,857	25,418
Oc	Other components	636,923	275
	labour family ws	323,310	140
	labour hired ws	176,946	76
	tax ws	136,667	59
P/L = NVA	Profits/Losses	58,204,934	25,143

TABLE 49. EXPORTER OPERATING ACCOUNT (BASELINE 2021)

		Base scenario (TZS)	USD
R	Total output value	622,779,625.0	269,019
	dried s/s export sold	496,520,955.0	214,480
	fresh perch export	12,542,000.0	5,418
	smoked perch export sold	105,932,500.0	45,759
	dry s/s export own	6,620,670.0	2,860
	dry s/s export lost	-	-
	smoke perch export own	1,057,500.0	457
	smoked perch export lost	-	-
	fresh perch export own	106,000.0	46
	fresh perch export lost	-	-
I = Ic + Io	Intermediate Inputs	593,866,331.0	256,530
Ic	Inputs from inside the chain	587,392,920.0	253,733
	Fresh Perch	4,232,800.0	1,828
	Dried s/s sold process	508,668,120.0	219,727
	smoked perch process sold	74,492,000.0	32,178
Io	Inputs from outside the chain	6,473,411.0	2,796
	firewood export	54,746.3	24
	package 1 export	317,312.0	137
	package 2 export	22,252.5	10
	ropes export	190,642.5	82
	food export	18,000.0	8
	box export	1,275.0	1
	dish export	5,010.0	2
	besini export	5,000.0	2
	poly sheet export	46,800.0	20
	transport 1 ex	1,526,584.5	659
	transport 2 ex	210,384.0	91
	processor service ex	1,870,838.0	808
	processor service 2 ex	60,000.0	26
	storage ex	83,999.3	36
	porter ex	7,650.0	3
	counci fee ex	419,000.0	181
	immigration fee ex	37,500.0	16
	process licence ex	1,833.5	1
	royalty ex	1,535,833.5	663
	trade licence ex	15,000.0	6
	storage rental ex	33,750.0	15
	weight scale rental ex	10,000.0	4
VA = R - I	Gross value added	28,913,294.0	12,490
Fcc	Fixed capital consumption	69,028.0	30
	depriciation ex	69,028.0	30
NVA = VA -	Net value added	28,844,266.0	12,460
Oc	Other components	537,674.5	232
	labour ex hired	281,008.0	121
	loan interest ex	6,666.5	3
	tax ex	250,000.0	108
P/L = NVA	Profits/Losses	28,306,591.5	12,227

TABLE 50. RETAILER OPERATING ACCOUNT (BASELINE 2021)

		Base scenario (TZS)	USD
R	Total output value	50,694,860	21,898
	frozen perch retail sell	6,502,860	2,809
	smoked perch retail sell	9,704,000	4,192
	fresh perch retail sell	1,980,000	855
	dried s/s retail sell	27,336,000	11,808
	dry s/s retail own	600,000	259
	dry s/s retail lost	-	-
	smoke perch ret own	104,000	45
	smoke perch ret lost	-	-
	fresh perch ret own	28,000	12
	fresh perch ret lost	-	-
	frozen perch ret own	60,000	26
	frozen perch ret lost	-	-
	fresh s/s retail sell	4,380,000	1,892
I = Ic + Io	Intermediate Inputs	39,961,403	17,262
Ic	Inputs from inside the chain	39,297,268	16,975
	Fresh s/s	2,956,500	1,277
	Fresh Perch	1,705,600	737
	dried s/s wholesale sold	25,590,168	11,054
	fresh perch wholesale sol	135,000	58
	smoked perch whosale sc	6,930,000	2,994
	frozen perch wholesale s	1,980,000	855
Io	Inputs from outside the chai	664,135	287
	water retail	5,473	2
	electricity retail	20,549	9
	cooking oil ret	3,290	1
	charcoal ret	27,000	12
	travel ret	37,062	16
	packaging ret	10,321	4
	dish ret	600	0
	basket big ret	800	0
	basket small ret	600	0
	raised rack ret	2,000	1
	sacks ret	80	0
	sadoline ret	500	0
	transport service ret	287,040	124
	process service ret	14,400	6
	security service ret	360	0
	market fee ret	20,000	9
	trade licence ret	7,420	3
	council fee ret	32,740	14
	royalty ret	10,000	4
	business rental ret	160,200	69
	smoke kiln rental ret	22,500	10
	freezer rental ret	1,200	1
VA = R - I	Gross value added	10,733,457	4,636
Fcc	Fixed capital consumption	63,328	27
	depriciation ret	63,328	27
NVA = VA -	Net value added	10,670,129	4,609
Oc	Other components	769,518	332
	labour family ret	614,742	266
	labour hired ret	83,376	36
	loan interest ret	5,400	2
	tax retailer	66,000	29
P/L = NVA	Profits/Losses	9,900,611	4,277

TABLE 51. SUMMARY VALUE CHAIN OPERATING ACCOUNT (BASELINE 2021)

		Base scenario (TZS)	USD
R	Total output value	296,283,166,582	127,984,089
I = Ic + Io	Intermediate Inputs	95,401,148,390	41,209,999
Ic	Inputs from inside the chain	-	-
Io	Inputs from outside the chain	95,401,148,390	41,209,999
VA = R - I	Gross value added	200,882,018,192	86,774,090
Fcc	Fixed capital consumption	20,081,116,272	8,674,348
NVA = VA - F	Net value added	180,800,901,920	78,099,742
Oc	Other components	62,978,912,595	27,204,714
P/L = NVA -	Profits/Losses	117,821,989,325	50,895,028

TABLE 52. VC PRODUCTS CAPTURED/PROCURED, SOLD, USED FOR HOME-CONSUMPTION, OR LOST ALONG THE VC (IN KG)

VC actors	Produced or procured	Sales	Home-consumption	Loss
Artisanal Fishers	92 930 560	82 700 704	5 583 328	4 646 528
Artisanal Processors	70 217 680	65 015 340	1 947 400	3 254 940
Wholesalers	43 252 000	40 718 700	92 840	2 440 460
Exporters	24 357 796	23 443 178	265 736	648 882
Retailers	51 083 780	46 409 500	624 180	4 050 100
Total loss				15 040 910
Share of loss in fresh equivalent weight in whole VC				**16%**

Note: All the quantities are in fresh equivalent weight.

TABLE 53. VC PRODUCTS CAPTURED/PROCURED, SOLD, USED FOR HOME-CONSUMPTION, OR LOST ALONG THE VC (IN %)

VC actors	Sales	Home-consumption	Loss
Artisanal Fishers	89%	**6%**	**5%**
Artisanal Processors	93%	**3%**	**5%**
Wholesalers	94%	**0.2%**	**6%**
Exporters	96%	**1%**	**3%**
Retailers	91%	**1%**	**8%**

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This report presents the results of the value chain analysis of the Lake Tanganyika sprat, sardine and perch value chain in The United Republic of Tanzania conducted from 2021-2022 by the value chain development programme FISH4ACP. This report contains a functional analysis of the value chain, assesses its sustainability and resilience, develops an upgrading strategy and an implementation plan to which FISH4ACP will contribute.

FISH4ACP is an initiative of the Organisation of African, Caribbean and Pacific States (OACPS) aimed at making fisheries and aquaculture value chains in twelve OACPS member countries more sustainable. It contributes to food and nutrition security, economic prosperity and job creation by ensuring the economic, social and environmental sustainability of fisheries and aquaculture in Africa, the Caribbean and the Pacific.

FISH4ACP is implemented by FAO with funding from the European Union (EU) and the German Federal Ministry for Economic Cooperation and Development (BMZ).

This document was produced with the financial assistance of the European Union (EU) and the German Federal Ministry for Economic Cooperation and Development (BMZ). The views expressed herein can in no way be taken to reflect the official opinion of the EU, the Organisation of African, Caribbean and Pacific States and BMZ.

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