

**CDT Gap Analysis Report for Kilwa Octopus Fishery**  
**for**  
**Application of the Comprehensive Traceability Principles &**  
**Pathway in the Octopus Fishery**  
**Kilwa District, Tanzania**



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## Disclaimer

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This report herein referred to as the ‘gap analysis’ report was prepared to support the design of the strategy toward development of octopus traceability program at Kilwa district in Tanzania. The report is therefore a property of the SALT/Fishwise and USAID as among the output deliverables in the octopus traceability sub-agreement AID-OAA-A-17-00020. The report is based on literature, review of previous reports, and field consultations at Kilwa district. The report is only meant to support the design of the octopus traceability project at Kilwa district, and authors declare that the report has not been peer reviewed. Information disclosed in this report can be used for the intended purpose of designing a strategy for the implementation of the octopus traceability project at Kilwa district in Tanzania. It has not meant to accuse or reveal necessary information leading to any legal actions. The ideas and opinions expressed in this report are those of authors and may not necessarily reflect those of the partners (SALT/Fishwise, and or USAID) or consulting institutions. The correctness and conclusions presented in this report are bound based on the time of field consultations, review of previous reports and drafting of the report. Although authors and their associated affiliation worked hard to get this work together, it cannot guarantee the full correctness or accuracy of the information included in this report.

**Cover Photo:** A photo of stakeholder’s engagement during CDT analysis at Somanga, Kilwa District.

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## **Abbreviations and Acronyms**

BMU	Beach Management Unit
CBD	Convention on Biological Diversity
CCC	Collaboration Coordinating Committee
CFMA	Collaboration Fisheries Management Areas
CDT	Catch Documentation and Traceability
CMS	Conservation of Migratory Species of Wild Animals
CPUE	Catch Per unit Effort
DO	Dissolved oxygen
eCAS	Electronic Catch Assessment Survey
eCDT	Electronic Catch Documentation and Traceability
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FGD	Focal Group Discussion
FIS	Fisheries Information System
FO	Fisheries Officer
ICT	Information and Communications Technology.
IUU	Illegal Unregulated and Unreported
MCS	Monitoring Control and Surveillance
MLF	Ministry of Livestock and Fisheries
MPAs	Marine Protected Areas
NE	North East
NGO	Non-governmental Organization
PPPs	Public-Private Partnerships
SALT	Seafood Alliance for Legality and Traceability
SE	South East
SSF	Small Scale Fisheries
TAFIRI	Tanzania Fisheries and Research Institute
TZS	Tanzanian Shillings
USA	United State of America
USAID	United State Agency for International Development
WCS	World Conservation Society
WWF	World Wide Fund for Nature

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## Executive Summary

FishWise through USAID has engaged Aqua-Farms Organization (AFO) to conduct the Seafood Alliance for Legality and Traceability (SALT) application of the electronic Catch Documentation and Traceability (eCDT) Principles & Pathways in the octopus fishery of Kilwa District, in Tanzania. Applications of the eCDT Principles & Pathway are intended to improve biodiversity conservation, fisheries management, and increase transparency in seafood supply chains. The project has two main objectives: i) To provide comprehensive seafood traceability technical assistance and management of the program activities outlined in the scope of work; and ii) Support communications and outreach for comprehensive seafood traceability program activities.

This report covers the background research and catch documentation and traceability (CDT) gap analysis undertaken to identify gaps for the future implementation of eCDT technologies in the Kilwa District octopus fishery. The CDT Gap analysis was conducted in combination with an extensive literature review, field observations, and surveys in Kilwa District to identify gaps and opportunities for the uptake of eCDT. The assessment identified social and economic drivers for the CDT, the supply chain, eCDT technology, and data needs and requirements to apply the comprehensive traceability principles. Furthermore, the analysis assessed the structure and management of the Kilwa octopus fisheries sector including relevant national and international instruments, private sector engagement in CDT, and lastly challenges and opportunities, regarding implementation of eCDT.

A majority of the catch documentation is manual and paper based, although there are a number of digital initiatives in place, such as the use of electronic Catch Assessment Survey (eCAS) technology that digitizes elements of catch documentation in Tanzania. The existing technology collects data for the Fisheries Framework Survey, every two years, which includes gender, number of boats/fishing vessels, fishers, gears and submit to MLF for national fisheries statistics. Moreover, the technology was initiated purposely for catch assessment surveys which collect data after every 10 days randomly about catch, location, type of gears, time, fishers, and boat or vessels, etc. Also, the scientific data-morphometric measurements (length, weight, water quality i.e temperature, DO, salinity etc) were collected for research purposes and recommendation measures. The data collected is largely managed under eCAS databases housed by MLF and TAFIRI, with a room for further consolidation and integration. Among the main challenges of eCDT is the adoption of the technologies and the direct socioeconomic benefits for the coastal communities.

Finally, the assessment presents possible pathways for technology implementation, as well as its partners, towards setting up a comprehensive eCDT. Based on the assessment there is a need for a centralized system for data collection by engaging all key stakeholders in Kilwa octopus fishery in the eCDT program, and a need for more enumerators and capacity building to be engaged to expand the areas of data collection in the supply chain. Moreover, there is a need to take into account the existing legal framework and procedures of



Tanzanian government and stakeholders to approve and adopt the eCDT program, this report recommends a breakthrough of plans step by step to achieve immediate, mid and long term goals.

# 1. Introduction

## 1.1 Purpose and objectives

The purpose of this project is to support the application of the comprehensive traceability principles and pathway in the octopus fishery in Kilwa District, Tanzania for improved biodiversity conservation and fisheries management in Tanzania, increased participation, society benefits and increased transparency in seafood supply chains.

The project has two main objectives:

- i. Provide comprehensive seafood traceability technical assistance and management of the program activities outlined in the scope of work, and
- ii. Support communications and outreach for comprehensive seafood traceability program activities.

## 1.2 Kilwa District and octopus fishery

Kilwa District is a small lagoon island located in the southern coast of Tanzania at latitude 8° 58 South, 39° 30 East. The weather and climate are both influenced by the two alternating monsoon winds, the northeast (NE) and southeast (SE) monsoons. The SE monsoon season occurs between May and September and is characterized by southeast winds of relatively high speeds (Semba et al., 2019) while the NE monsoon occurs from November to March and is dominated by winds of relatively low magnitude blowing northeast. While SE monsoon affects the southern part, the NE monsoon season mostly affects the northern side of Kilwa and influences the fishery.

The inhabitants of coastal areas of Kilwa District depend on fishing as the main economic activity (Mbije, 2013), which is conducted throughout the year. According to the Marine Fishery Frame Survey report of 2018, Kilwa District has the highest number of fishers (7,818) accounting for 14.8% of the population, compared to all other districts along the entire Tanzania coast (1,424 kilometers long), while about 4,438 people depend on fisheries related activities to support their livelihood (URT, 2018).

Kilwa District is endowed with valuable marine resources which include a variety of fish (350 species) and Cephalopods (URT, 2017), with the highest number of landing sites of about 32 of all landing sites in Lindi region (URT, 2018). Octopus is among the most important fisheries and makes an immense contribution in livelihoods, employment and economic development among local coastal communities in Tanzania including Kilwa District (Rocliffe and Harris, 2016). Octopus are targeted for both local consumption in the domestic market and the export market, especially in the European market (Mgawe and Mhongola, 2020; Rocliffe and Harris, 2016). It is estimated that over 7,000 people are directly or indirectly employed along the octopus value chains (Mgawe and Mhongola, 2020). Interestingly, the Kilwa District fishery is notable for involving a large number of women accounting for 30% of octopus fishers in Tanzania (Mgawe and Mhongola, 2020).

The fishery is exclusively artisanal using simple gears such as a spear for harvesting while most women walk around during the low tides to collect octopus. Fishing activities/collection are conducted in coral reefs (local fishers call miamba) and particularly during the low tides and by men diving in deep water. There are three important commercial species of octopus which are mainly caught namely; *Octopus vulgaris*, *Octopus macropus* and *Octopus cyanea*, with the *Octopus cyanea* accounts for the majority (over 90%) of the catch (Mgawe and Mhongola, 2020; Guard and Mgaya, 2002; Rocliffe and Harris, 2016). Songosongo island contributes a large volume of octopus catches compared to other landing sites in Kilwa. In 2020, the octopus production at Kilwa District was recorded to be 61.34 metric tonnes (URT, 2020). Most of the Kilwa octopus catch is sold to large traders and companies mainly in Dar es Salaam for export. The Octopus fishery value chain in Kilwa consists of different stakeholders including gear vendors, fishers, local processors, agents, tax collectors, industries processors and exporters, NGOs (supporting advocacy, awareness, management and capacity building training), government (local and central), universities and research institutes.

### **1.3 Electronic Catch Documentation Systems and Fundamental Principles and Status**

ECDT refers to the practice of collection, sharing and tracking verifiable information through all stages of harvesting, processing and transportation of seafood products using digital means (SALT, 2021). It enables a faster transfer, use and cross-check products information throughout the supply chains. When data is recorded from the harvest ground to the point the product is dispatched, it increases accountability and transparency, identifies risk sources, simplifies reporting and ensures legal compliance in each link of the supply chain. According to SALT 2021, an eCDT system is perceived to be comprehensive if it addresses and achieves verifiable ecological, social, and economic data. The integration of such aspects can provide important information to support decisions for sustainable management of the fisheries resources, legal and equitable human wellbeing conditions for seafood workers, as well as identify and prevent illegal, unreported, and unregulated (IUU) fishing practices and mislabeled products from entering domestic and international markets (SALT, 2021).

[SALT](#) in collaboration with the seafood traceability community established six comprehensive principles for implementing eCDT in the seafood industry's traceability programs. “The Principles are high-level and flexible so that technological solutions and implementation strategies can vary to reach a country’s goals. The Principles are not presented in any priority order, nor are they intended to be sequential” (SALT, 2021).

The Principles are:

- i. **Maximize Ecological, Social, and Economic Benefits:** This principle aims to develop an eCDT program that enhances management of the fisheries (ecological), protection of human rights and labor in seafood supply chains (social), and compliance to meet market requirements for the seafood products (economic).

- ii. **Use Data to Inform Decision-Making:** Ensure that accurate and verifiable information is available to the appropriate people for decision making while designing, implementing, and improving the eCDT program
- iii. **Create a Program that is Electronic, Interoperable, and Data Secure:** Determine the best eCDT technologies that meet data collection, analysis, and security requirements. Set priorities for seamless data exchange with existing traceability systems while keeping costs to a minimum.
- iv. **Be Inclusive and Collaborative with Stakeholders:** Ensure collaboration with the key stakeholders and beneficiaries as well as advocates of both groups in the design and implementation of the eCDT system.
- v. **Build a Lasting and Scalable Program:** Plan for upscale and sustainability of the eCDT system both financially and politically.
- vi. **Address Data and Verification Needs Across Fisheries and Supply Chains:** Establish and implement an eCDT system that has unique data and verification at point across the supply chain as well as ensuring privacy and data access protocols that protect worker rights.

## 1.4 Terms of Reference

Conducting a CDT gap analysis of the Kilwa District octopus fishery to identify gaps for the future implementation of eCDT. The analysis will identify socioeconomic drivers for eCDT technology, assess the value chain, eCDT needs, data needs and requirements to execute the technology. Unique to the CDT Gap Analysis process is a Structure Conduct Performance Assessment and Value Chain Analysis for fisheries or seafood commodities. Using the data from this research, the final output of the CDT Gap Analysis includes an evaluation of a fisheries' situation and CDT status, map(s) of relevant supply chain(s), and identified CDT gaps, issues, barriers, and opportunities. Depending on what analysis has already been conducted, this is meant to identify essential points for consideration during the codesign event.

### Key Outputs

- i. Desktop review to identify gaps.
- ii. Presentation of key gaps, issues, and barriers for SALT and stakeholders to inform the co-design event and eCDT strategy development.

## 1.5 Methodology

- i. **Desktop review** It relied on prior knowledge from CDT publications of Vietnam, Malaysia and ASEAN countries since they are advanced on eCDT. Reports, grey literature and peer reviewed publications were reviewed to understand on the status and the gaps for the future implementation of eCDT

ii. **In house brainstorming** an inhouse brainstorming meeting with stakeholders from Academic institutions, Research Institutions, NGO's, and Kilwa community assisted to generate baseline information for CDT gap

iii. **Field observation, focus group discussions, individual and key informant interviews**

The gap assessment questions were prepared by adopting and modifying the recommendations and standard for eCDT gap analysis (Figure 1) that are fully transparent, sustainable and comply with national and international market requirements developed by USAID Oceans, the system has proven to work as outlined from USAID Oceans Fisheries Catch Documentation and Traceability in Southeast Asia from A Conceptual Overview (CDT 101). Our questionnaire targeted different stakeholders across the value chain namely; fishers, captains, agents, traders, industry, Beach Management Units (BMU) and Fishery Officers, government institutions, and NGOs.

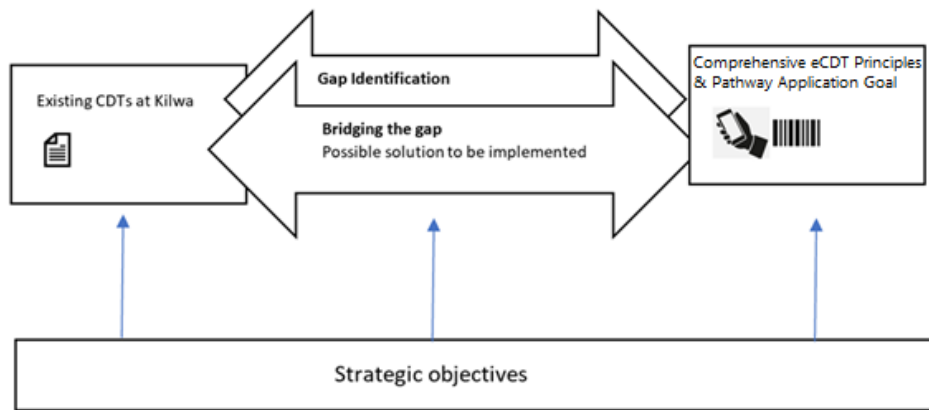


Figure 1: Gap analysis framework (Adopted from USAID Ocean CDT 101)

iv. **Structure Conduct Performance and an in depth analysis**

The octopus fishery market was studied, and discussions were held amongst different actors to understand the nature of the octopus market, its behavior and how it affects the market performance. Supplement information was gathered from textbooks, past projects and journals. Although the judgment on the market structure was vague, it was based on the information obtained from the questionnaire responses from different actors (Figure 2). In our analysis we observed;

- a. **Structure of the market:** Organizational features of Kilwa District octopus market and the evaluation was based on the equipment costs, its ownership, numbers of sellers, barriers to entry (capital barrier, policy barrier, licensing) and competition level, as advised from Wolday 1994. Demography strata in terms of age and gender, experience in trading and education level was also collected. Through probing during the interview the level of trading for middlemen were recorded as whether primary

(source of octopus came from fisher directly) or secondary (octopus sourcing from middlemen).

- b. **Conduct:** We studied market behavior and strategies used by the actors in pricing, buying and selling as well as the power in determining octopus prices. We recorded the choice of octopus grading at the market place and the grading system.
- c. **Market Performance:** The profitability of the octopus fishery and how efficient in terms of production. Interview focus on variable costs like fuel, gears, food, transport and porter costs. Fixed costs like equipment repairs and license renewal.



Figure 2: Structure conduct performance

## 1.6 Limitations

Information and data collected in this assessment exclusively focused on CDT matters of the octopus fishery in Kilwa District. The report does not cover other fisheries in the district as well as the gap in other parts of the country. This was to maintain the focus on laying down the foundational road map for eCDT to be established with accuracy.

## 1.7 Organization of the Report

The report is designed with four parts namely,

- i. **Baseline information of the CDT Gap Analysis in Kilwa:** The background on the Kilwa octopus fishery and the methodology and limitations of the gap analysis.
- ii. **Overview of the CDT in Kilwa:** This explains the current CDT in Kilwa octopus fisheries, the value chain, socioeconomic drivers, the current eCDT and private sector engagement in CDT.
- iii. **Key Findings:** This section discusses significant eCDT gaps, challenges and opportunities.
- iv. **Recommendations:** A roadmap towards abridging the eCDT gap.

## 2. The Current CDT in Kilwa District Octopus Fisheries

### 2.1 Octopus value chain in Kilwa District

Kilwa octopus fishery is exclusively a Small Scale Fishery (SSF), characterized by labor intensive work with multiple actors in the supply chain (Figure 3). The octopus supply chain consists of activities that can be categorized as fishing, landing, storage, processing, transportation, marketing and consumption. At each stage, there are associated inputs, actors, pathway options and/or strands that the activities accomplish. The flow of octopus from fishers to the end markets is summarized in Figure 4.

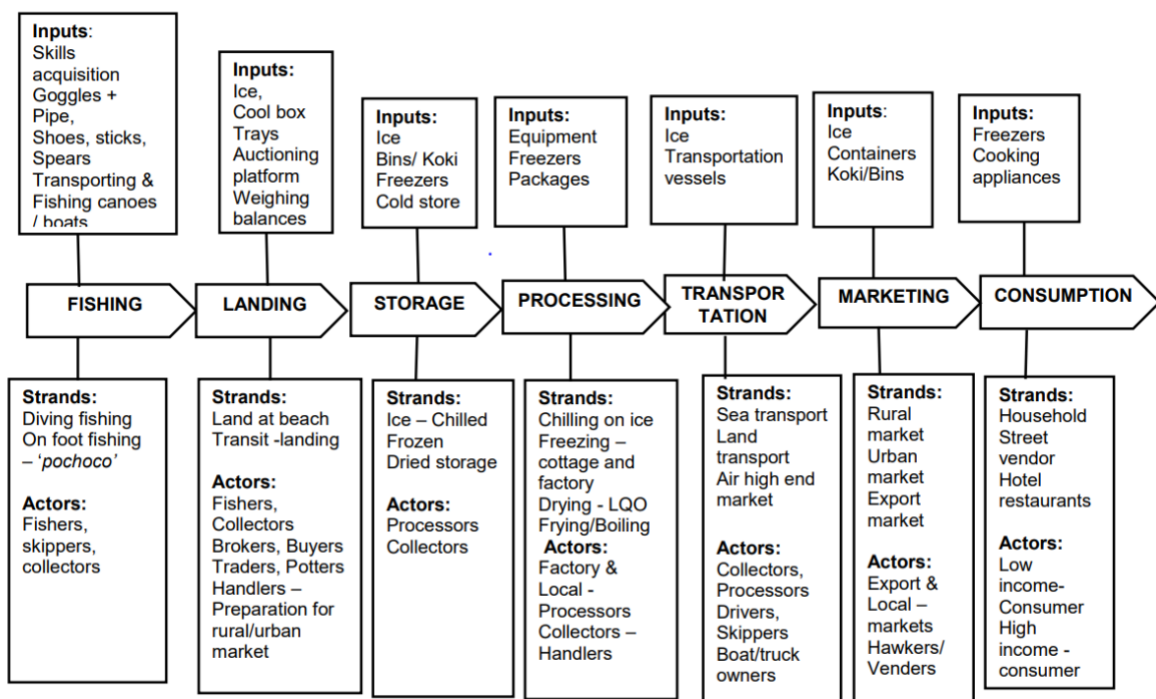


Figure 3: Flow of activities in the octopus supply chain, with inputs, actors involved and pathway options for the activities (Adapted from Mgawe, 2020).

Octopus are caught by mainly three types of fishing methods; the first group are called 'foot fishing' or *pochoco* in Swahili composed of mainly women and children who walk along the exposed reef at low spring tide collecting octopus mainly using iron rods. The second group consists of the divers (men) who use mainly much longer iron rods to catch the highly demanded large sized octopus, and snorkels. The third method is much under trial by the Tanzania Fisheries Research Institute (TAFIRI) in cooperation with the private company (Tanpesca), and involves experimenting with the use of pots in catching octopus. The method has been regarded as sustainable and healthier as opposed to the use of iron rods that attract rusts. The pot fishing method however, did not provide promising results and the first trial conducted did not catch any octopus (Bigeyo Pers Communication). The captains of the fishing vessels or 'nahodha' in Swahili are the ones who are responsible to take fishers to the reefs where they can catch octopus. The decision of which reef they will

fish is announced by the captain when boarding, and the captain chooses the reef on a rotational basis based on catching experience and where they think fishers could get (more) octopuses. Upon docking, a vessel could have only women fishers or divers or a mixture. While women and children normally fish octopus by walking along the exposed reefs, divers (men) fish for octopus underwater mainly using snorkeling. The fishing activity in most reefs is under the influence of the tide, such that the fishing vessels went fishing during ebb tide, and fishing activity stops before water level is high. This is important for women fishers and children who have less swimming capacity. The captains (nahodha in Swahili) and his assistant also conduct fishing activities. The captains normally give fishers a sign to stop fishing and wait for all fishers to board. It is important to note that all fishers remember and return onshore normally with the same vessel they used in a particular day. The points of weighing the octopus catch vary with locations and depend on agreement between the captains and the boat owner (normally the sole buyer). The existing model in most fishing villages is that the fishers have to sell the octopus catch to the owner of the vessel, sometimes through the boat captains. While at Songosongo and Kilwa Kivinje normally the captains weigh the catch for every fisherman and pay the fishers off-shore, at Somanga the weighing takes place on shore at the landing site. During the weighing process, when offshore the boat captain writes (sometimes assisted by fishers) on a paper the name of the fisher and the total catch caught by each fisher. When conducted onshore, the vessel owner (and the buyer of the catch) appoints a person (sometimes from among fishers or a beach person) to assist in weighing the catch normally using a small digital balance). The vessel owner or agent (collectors) appointed by the owner (or sometimes the boat captain) then pay the fishers when weighing onshore, or the captain pay the fishers offshore before the start of the return journey. Each fisher onboard are required to pay 500 TZS per kilogram of the fished octopus as a transport fee. Hence to compensate for the transporting fee, the fishers sell octopus at 3500 TZS per kilogram, instead of 4000 TZS octopus selling price at the landing site.



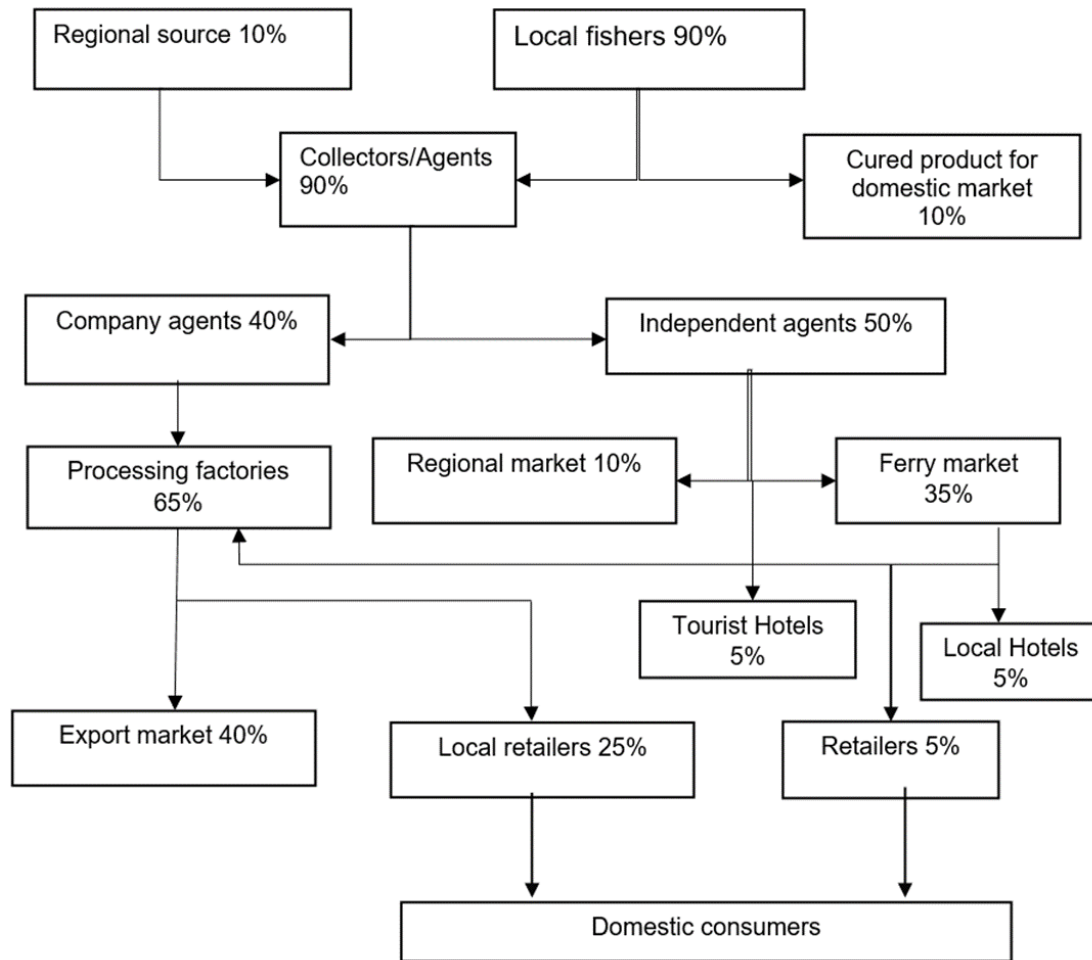


Figure 4: Flow of activities in the octopus supply chain, with inputs, actors involved and pathway options for the activities (Adapted from Mgawe, 2020). The percentages indicate the approximated proportion of octopus moved from one actor to another.

The collectors or agents who are normally the owners of the vessels then store the total catch after weighing in ice within a cool box or large buckets at the landing site. When it comes to tax collection for the fished octopus there are two kinds of arrangements. The catch that is transported outside the site, the collector or agent needs to pay a tax on site through an authorized officer. The situation is different when an agent takes the catch to the exporting processing company branches, which the tax is normally collected at the branch by the officers. Upon weighing and paying the tax, a permit to transport octopus is then offered by the responsible officer in cooperation with the fishery officer office. For the catch from islands like in Songosongo, it has to undergo the port custom clearance before octopus get exported elsewhere. There are two types of collectors (agents), the first group are the ones who do the work for the exporting company branches, and a second group are free to choose the markets either the exporting companies (Tanpesca) or target the Ferry market in Dar es Salaam. When the catch from Kilwa targets the Ferry market at Dar es Salaam, a catch is either distributed to the retailers who process and sell value added octopus to the local consumers, sometimes fresh sold to the hotels or even exported reach regional and international markets (independent collectors/agents, Bahari foods or

Tanpesca again). For the purpose of exporting to reach regional and international markets, a fishing license, an exporting license and permit is offered by the Ministry of Fishery. It should be noted that the collectors at Kilwa send the octopus catch to Dar es Salaam to get at least double the income relative to the buying price from the landing site (TZS 4,000). One further reason is that the octopus buying price at the Tanpesca branch in Kilwa fluctuates based on the available stock at the plant, and supply of octopus from fishing activities vary according to seasons. The highest catch was highly reported during the southeast (SE) monsoon (June - September) especially in September, after successful spawning and recruitment from May and August (Guard and Mgaya, 2003; Silas, 2020; Mtonga et al. 2022).

Cold chain and handling of octopus are the areas that need more improvement for the success of the traceability program. The freshness of octopus depends on the storage temperature and time. The typical octopus fishing at Kilwa District octopus are normally kept in ice at the landing site, almost approximately four hours after fishing the first octopus on the reef. Considering the typical tropical climate with high temperature (28 - 30°C), the catch is vulnerable to storage. Upon reaching the landing site, a government official (tax collector) needs to be there in time to oversee the weighing of the catch with collectors/agents before being mixed with ice. Delay of this process further leads to more quality degradation of the fresh octopus. Recently lack of enough facilities and fast coordination to enable effective cold chain management caused a loss of over 15 tons of octopus during the octopus fishery opening after months of closure at Songosongo. At the processing branch (Tanpesca) they are able to identify the deteriorated octopus by sensing the smell and looking at the color of the octopus.

Processing and storage of octopus is conducted to target both local and international markets. The three main methods used include i) freezing (at factory and cottage level), ii) chilling, and iii) curing (tenderization, boiling, frying and sun drying). Freezing at the factory is mainly conducted to maintain the good quality octopus and meet the needs for the international markets (mainly in Europe and Asia). The independent individual traders are also involved in internal long distance, regional and international markets using the corresponding domestic freezing facilities herein referred to as cottage freezing. Chilling is also commonly used for temporary storage to enable octopus reach mainly the intended in-country destinations. The process relies on the ice (plants) established at the landing sites, such as the ice plant at Songosongo established by WWF. The process involves storage of octopus in a vessel with an ice which tends to melt along the way. From the landing site, chilling is applied to enable octopus transport to reach the processing plants (like Tanpesca), Dar es Salaam Ferry fish market, hotels, office factory main headquarters (in Dar es Salaam) or neighboring external markets Mozambique and Kenya). Curing (sun drying and frying) is conducted to target mainly the local consumers. The process involves a series of steps not limited to gutting to remove viscera, tenderization by beating the catch using a woody thick stick, washing, boiling for a few minutes, sometimes sold as soup and meat, or further fried (in fat) and cut into pieces and retailed as snacks. Sun drying is among the processing methods that has been practiced for a long time. The mainly sun-dried

octopus products originate from the deteriorated octopus catch (in terms of quality) or undersized (below the recommended 500 g octopus size limit; (Table 1). Although sun drying provides a reliable and cost-effective way of preserving octopus for long term and transportation, the method has high negative consequences in reducing the price of octopus, and the quality demanded by the markets in Europe and the far east. The price of 5 kg of fresh octopus for instance can be around TZS 20,000 (US\$8.6), while the same amount of sun-dried octopus can be sold at a maximum of TZS 7,000 or US\$3 (Mgawe, 2020). Sun drying of octopus at Kilwa prevailed mostly during the opening of the octopus fishery closure, when the cold chain management system was overwhelmed by unexpectedly high catch.

## 2.2 Social and economic drivers for eCDT

Octopus remained among important fisheries in Tanzania as a source of the country's income and livelihood. The stock assessment reports for the Tanzanian octopuses are limited, either very old or covered up to three sites out of hundreds (Silas, 2022). According to Comtrade, between 2008 – 2012 Tanzania generated around US\$ 6.8 million by exporting approximately 1,500 tons of octopus to various countries in the world. Recently (2016 – 2018) the fishery doubled the export to reach over 3,400 tons, with an estimated value of about 7.7 million US\$ (Mtonga et al. 2022). In the same years, the main buyers of octopus were Europe (mostly Portugal, Italy, France, Israel, Netherlands, Mauritius and Spain) and China.

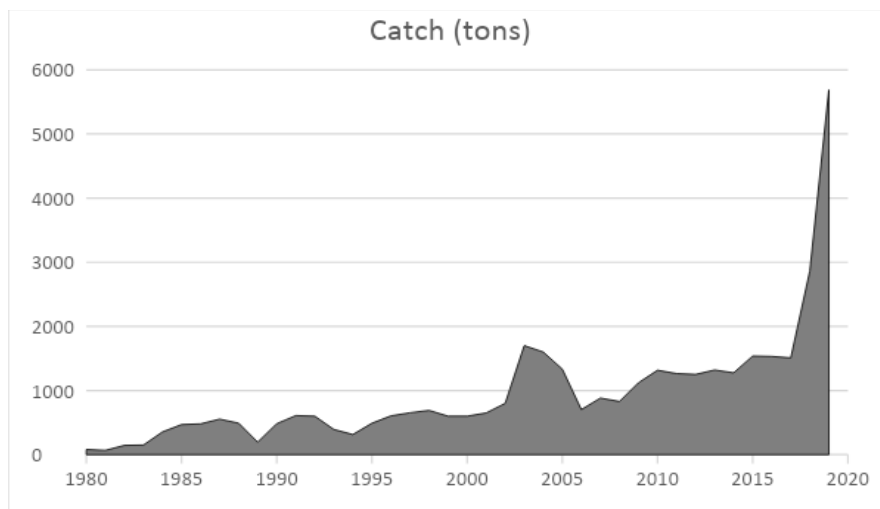


Figure 5: Graph showing the octopus fishery production from 1980 to 2018. (Modified from Mtonga et al. 2022).

FAO statistics indicate a recent increase in exploitation of Tanzanian octopuses, from around 480 tons (in 1990), the catch then stayed below 2,000 tons until 2018, and more than doubled to a new highest record of 5,700 tons in the year 2019 (Figure 5). The increased catch of octopus was due to the increasing number of octopus fishers, mainly because of population growth.

A rapid increase in exploitation of Tanzanian octopus over the years threatened the sustainability of the fishery. Almost twenty years ago, small sized octopuses were reported in Tanga and Mtwara (Guard and Mgaya, 2002), and recently at Jibondo Mafia (Silas, 2022). These and other reports indicated a need for further action toward continuous (and real-time) data collection or monitoring of the sites, and robust analysis (reporting) to support management in making timely decisions. The process that will contribute to biodiversity conservation and sustainable utilization of fisheries resources to support livelihood.

At Kilwa District in total there are over 30 octopus fishing grounds producing over 500 tons of octopus annually. The government enforces regulations through BMUs like size limit (500g for octopus), but reports show that the octopus below 500g are still harvested illegally to feed the local markets, but not further exported to the external market because of the strict restrictions by the exporting companies. One reason for the undersized octopus is that fishers have reportedly not been able to preselect the octopus size before fishing. And that they use iron rods which remain unsustainable for human health. Furthermore, some of the mostly remote sites like at Songosongo they do implement a periodic octopus fishing closure. The closure facilitated an increased octopus catch, but there are still challenges regarding benefit sharing among genders, and such that male continue to poach for octopus illegally and seem to dive at the nearby reefs.

The Government of Tanzania presented a need for a traceability project and recommended a first pilot for the octopus fishery. The eCDT program is expected to increase awareness, close the inequality gap, reduce IUU fishing, conserve biodiversity and enhance transparency among actors to share important events along the chain to facilitate the traceability of octopus products from the fishers to the final consumers (national, regional and international). Furthermore, the eCDT program may help to unlock international markets such as the United States, where consumers demand an effective traceability and information about what they eat.

### **2.3 Current state of the eCDT Program at Kilwa District, Tanzania**

At Kilwa District, the overall catch is documented using a combination of both papers and electronic systems. The co-management units called ‘Beach Management Units’ (BMUs) were given mandate by the Fisheries Act No 22 of 2003 to assist in overall management of fisheries resources, one of their roles was to assist in data collection. In some fishing villages like Somanga in Kilwa, the BMU has a specific section with individuals trained in data collection. The government through the Ministry of Fisheries and Fisheries officers provided the BMU data section at Somanga Kilwa with the smart phones containing an application known as eCAS. The application is used by the BMU to feed the data they collect following their calendar (ten days in every month). However, the data collection exercise is not strictly to octopus, and the BMUs in the Kilwa District were given responsibilities to capture different species. Upon feeding the data in the eCAS, the data are shared directly to the Tanzanian Ministry of Fishery. Data that are collected with the eCAS include common name (selection tool), length, weight, sex and fishing ground where

a species was caught. Furthermore, the NGO Wildlife Conservation Society (WCS) also provided the BMU data collection section at Kilwa Somanga with smart phones through shark and rays project to assist in data collection (Figure 6). The smart phones contain a freely available application called 'KoBoCollect', the application collects information on the weight, size, sex and fishing grounds where the shark and rays were fished. This also involves sharing of the collected information instantly. Tax collectors on the other hand use an electronic system to input the name of the fish, the amount of fish catch (octopus), and later the system calculates the tax (around 5% per each kilogram) that a fish collector (a boat owner) needs to pay. The system was put in place by the Kilwa District council, to ensure the collected tax is fed into the government system directly. In this case a tax is charged through the collectors (agents) immediately after weighing before ice is introduced, and not with fishermen.

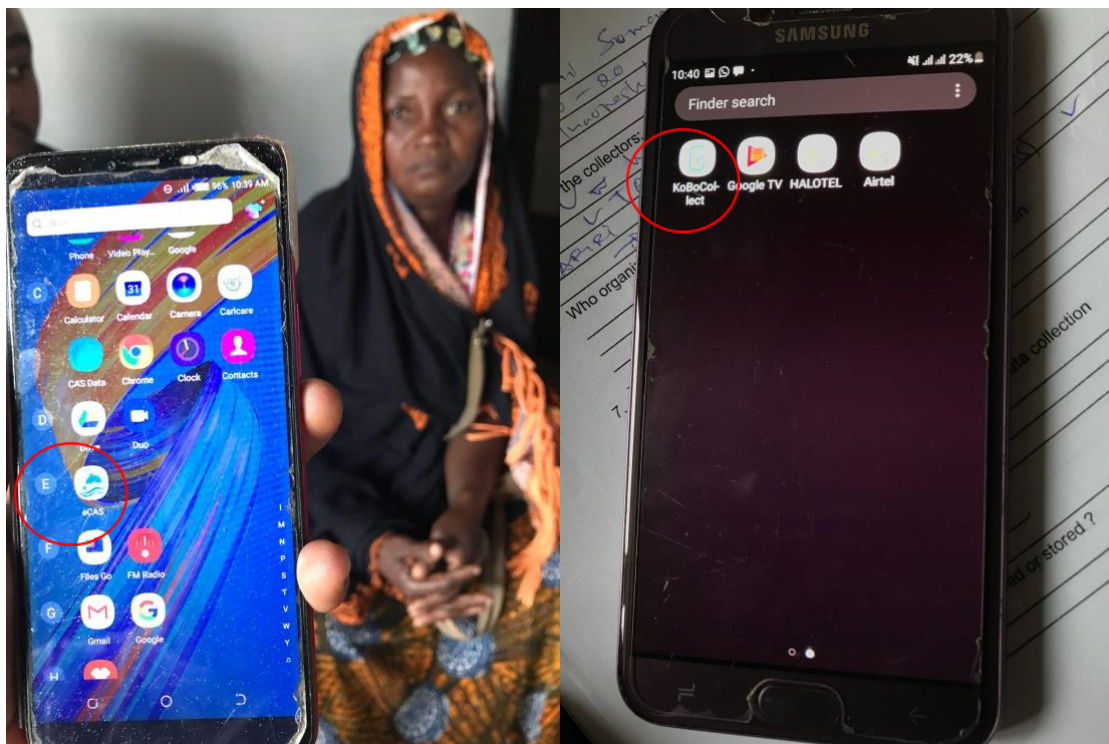


Figure 6: Showing the two data recording and sharing tools currently being used at Kilwa.

The two photos were taken at Kilwa Somanga (during the focus group discussion) where the two programs (eCAS and KoBoCollect) are applied by the trained women BMU data collection section of the village. The smart phones were provided by the government (for the eCAS system) and the WCS (for the KoBoCollect program). Note that the BMU first inputs the data in the paper collection sheet before input the data in the respective application, and when they have internet.

Looking at the supply chain of octopus we can see that data collection is limited up to common names of the fish (sometimes consisting of multiple species), weight, sometimes length and the fishing ground where the catch originates. At the point of fishing the data

collection practices vary with the sites, but they all record the name of the fisher and the total weight that each fisher caught only for payment purposes. While at Kilwa Songosongo and Kivinje the octopus data pertaining the total catch for each fisher (with name) are recorded in supervision of the captain (*nahodha*) at the fishing site before getting back onshore, the weighing of the octopus catches for each fisher at Somanga normally take place onshore upon landing. All these data are later shared by the octopus collector (boat owner) at the landing site. When recording of the weight of the catch take place onshore, then a fish collector (or a boat owner) usually appoints a person onshore to assist with weighing a total octopus catch for each fisher on board. Thus, the fishers then are paid the total payment after deducting the transport cost. At this stage (fishing and landing), the data recording process takes place using papers for the purpose of paying the individual fishermen, and that the paper gets discarded and not paid attention further after all payments have been made.

The second point where the octopus catch gets collected are at the branches of the industries responsible for processing and exporting (Tanpesca at Kilwa District). At this point the collectors who decide to take octopus catch to the industry branch, upon arriving the catch is normally offloaded with its ice, checked for some quality aspects and then reweighted for payment purpose. According to the Tanpesca branch manager at Kilwa Kivinje, the freshness or quality aspects checked are those used to quickly spot any spoilage such as smell, and colour (normally white colour indicates freshness, but not always the case) (Figure 7). The data recording again here is first a paper based, and information collected are the names of the collectors and the total amount of the catch (in kilogram). Secondly, the manager at the branch put all this information in excel and later shared these with the headquarters. As described in the value chain, the collectors do not always send the octopus catch to the processing industry branch and when the buying price at the industry is low the collectors ship the catch to Dar es Salaam. The price fluctuates at the industry branch depending on octopus availability (function of season) and available stock. At Dar es Salaam the catch is normally sold at the Ferry fish market to either the small retailers, hotels or even fed back to the processing industries (Bahari foods, Tanpesca). Data collection at these points are not anymore very easy to track because Ferry fish market receive surplus catch from almost all fishing zones in Tanzania.



Figure 7: Octopus catch offloaded by the collector at the TANPESA branch of Kilwa, ready for reweighing and storage.

## **2.4 Management, structure and Institutional arrangement of Tanzanian Fisheries sector**

### **i. Organisation structure of Tanzanian fishery sector**

Tanzania's octopus fishery sector is guided by the Fisheries Act No 22 of 2003 and the fisheries regulations of 2009. These tools provide arrangements and structure that aim to safeguard fishery resources in the country, including the octopuses. The management interventions outlined the law and regulation including and not limited to the size limit, closed seasons, management zones, access to fishing, compliance & law enforcement, co-management and Marine Protected areas.

Fishery sector in Tanzania falls under the ministry of fishery, responsible for overseeing fishery and aquaculture in the country. The head of the sector is therefore a minister appointed by the President, and is responsible to oversee the activities in the sector. The ministry performs its duties through a Permanent Secretary, the office that interlink with the Fisheries Development division and amongst the four other divisions (1. Admin and human resource Management 2. Policy and Planning 3. Fisheries aquaculture research training and extension services, and 5. Aquaculture) (Figure 8).

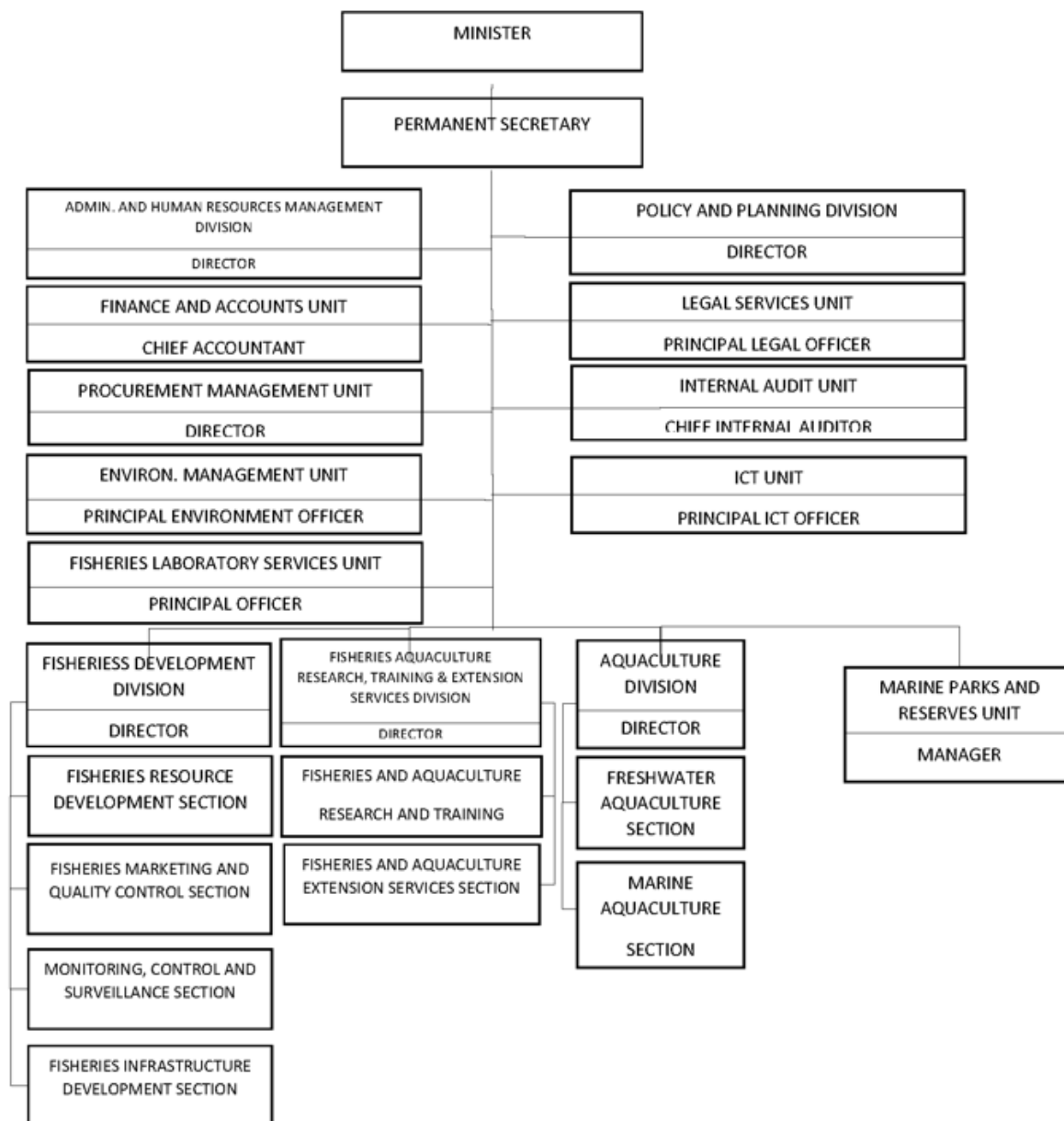


Figure 8: Structure of Tanzanian fishery management (source: MLF 2022)

The Fisheries division is responsible for activities pertaining development of fishery resources, fisheries marketing, quality control, monitoring control and surveillance, and fisheries infrastructure development. The section has fishery officers at all levels from regional, district, ward and village categories. This organization provides a streamline of information and exchange to facilitate sustainable fishery management and development. At the village level, the fishery management activities are assisted by the co-management structure called Beach Management Units (BMUs). BMUs were formulated by the Fisheries Act No 22 of 2003 constituting among important fishery actors in the village, and are responsible for supporting enforcement of the regulations, data collection, ensuring compliance to sustainability and overall fishery development.



## ii. Fishery regulations relevant to octopus fishery and traceability

The Fisheries Act No 22 of 2003 and the Fisheries Regulations of 2009 provide measures and guidelines for managing octopus fishery in Tanzania. Guide to management of Tanzanian octopuses is provided mainly by the PART III regarding Development of the Fishing Industry and PART V that focus on the Management and Control of the Fishing Industry, all in the Fisheries Act No 22 of 2003. The Fisheries Act No 22 of 2003 including the Fisheries Regulations of 2009 provided strategies to manage fishery resources such as size limit, closed seasons, management zones, access to fishing (licensing), compliance & law enforcement, co-management (BMU) and Marine Protected areas. Different compartments of management are summarized in the Table 1 below.

Table 1: Showing some of the management interventions stipulated in the Fisheries Act No 22 of 2003 and/or Fishery Regulations of 2009 for management of fishery resources in Tanzania.

Intervention	Fisheries Act No 22 of 2003 and/or Fishery Regulations of 2009
Size limit	The Fisheries Regulation 59 (1) and its amendments of 2020 provide that no person shall fish, cause to fish, possess, collect, land and process octopus below the size limit of 500 g. Furthermore, the regulation 59 (3) stipulates that no person shall trade or export processed octopus below the limit of four hundred and forty grams.
Closed Season	The Fisheries Act No 22 of 2003 Section 17 (g) gave mandate to the minister of fishery to initiate closed season, ban certain fishing methods and species of fishing. The minister also has a mandate to determine the periods of closure according to the regulation. In some communities, the closure however can be initiated voluntarily by the respective village upon agreement among themselves.
Management Zones	The Fisheries Regulation of 2009 in the Section 17 gave a mandate to the minister to initiate measures to ensure sustainable management of the fishery such as prohibition of fishing in certain areas. Additionally, the regulation guides the minister to establish the controlled areas like the critical and potential breeding areas.
Access to Fishing (licensing)	The Fisheries Act No 22 of 2003 in the Section 22 provides a requirement for the license for anyone before undertaking fishery activities not limited to fishing, processing and or manufacturing fish and fishery related products, selling and marketing fishery related products, import or export fish or fishery related products. The license is provided by the Director or authorized officer. Requirements of license extend to the fishing vessels and traders.

Compliance and law enforcement:	Fisheries Act No 22 of 2003 in the Section 17 gives mandate to the minister to take necessary measures to ensure sustainability of the fishery resources, the interventions related to enforcement, monitoring, surveillance (Section 32 (1) guide establishment of the surveillance unit) and control. The mechanism gives room for collaboration with communities and parties through agreements in regional and international space.
Co-management arrangements (the Beach Management Units or BMUs)	Fisheries Regulations, 2009 (13) provides establishment of the co-management structure from within the members of the fishing community (ies) constituting actors in the fishery (fishers, agents, traders etc). The Fisheries Act No 22 of 2003 in the Section 18 of the law gives mandate to the Director of fishery division to work with the Beach Management Units in matters relating to fishery.
Marine Protected Areas	Marine Parks and Reserves Act No. 29 of 1994 (Section 8(2) and Section 10 in particular) provides a guide to establish the Marine Protected Areas (MPAs) for conserving biodiversity or at the areas displaying features of significance such as historical, scientific or critical habitat values.

### iii. Relevant international instruments

Tanzania is a signatory to a number of international agreements relating to protection and sustainable management of marine biodiversity resources. Some of these are provided in the Table 2 below.

Table 2: Showing international agreements on protection and sustainable management of marine biodiversity in Tanzania

Agreement	Date or year of entry
Convention on Biological Diversity (CBD)	The convention was signed on the 12th June 1992 and ratified it on 8 March, 1996
Convention on International Trade in Endangered - CITES.	The convention was ratified on 29th November 1979 and became effective on 27 February 1980
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	The convention became effective on the 1st July 1999
The Memorandum of Understanding on the Conservation and Management of Dugongs and their Habitats Throughout their range	The MOU was signed on the 31 October 2007

International Whaling Commission (IWC)	Tanzania's date of receipt of notification of adherence was June 23, 2008, and date of entry into force was also June 23, 2008;
Indian Ocean and South East Asian Memorandum of Understanding on the Management and Conservation of Marine Turtles	The MoU was signed on the 23rd June 2001 and entered into force on 1 September 2001

iv. **Provisions relating to traceability, data collection and sharing**

The fisheries data collection system in Tanzania has been computerized since 1989 and started with the Tanzanian Fisheries Information System (TANFIS), which was later replaced by Catch Assessment System (CAS), now eCAS. The current eCAS is a mobile and web-based application developed and pioneered by TAFIRI five years ago, to collect fisheries data for marine fisheries along the coastal waters of Tanzania. Through the eCAS system, data on specific fisheries are collected, and the input data include the catch and effort data, species composition, biometric and morphometric information of the species. The system can produce reports with details on the catch rate by craft type, summary of total catches in metric tons and value in Tanzanian Shillings. Nevertheless, there are some challenges also associated with the use of the eCAS. These include the network problems for remote areas, power supply for charging mobile phones and the motivation by the data collectors to use the system. Therefore, as a way forward to include the traceability and sharing, several recommendations have been offered to improve the system and its usage. These include i) providing more mobile phones and power backups to data collectors, ii) improve social inclusion by also involving women in the data collection, iii) create a system that can be used offline and updated once connectivity is restored, iv) allow data collection and sharing to key stakeholders to allow traceability along the the supply chain. The current system is under the mandate of the Ministry of Fisheries, though the ministry involves other several players including the national fisheries research institute (TAFIRI), as well as national and international NGOs. In regards to data sharing, the ministry consolidates the data into databases to facilitate data sharing and support the member countries to address the burden of collecting, collating and sharing data which is meant to support the harmonization/ sharing of fishery statistics, research purposes and other multiple reporting.

### **3. Private Sector Engagement in CDT**

#### **3.1 Private sector in octopus fishery**

The octopus fishery is driven by both increasing local consumption and export market, as it is driven with both individuals or sole proprietors, it is dependent on the seven (6) seafood processing plants, namely Bahari foods, Alpha Krust (Tanpesca), Instadar, Abajuko Enterprises Ltd, Kawthari Sea Foods, and Seafood that export to Europe and Asia.

Among the clearly identified benefits to private sector in Kilwa are:-

- i. Improved understanding of the risks and potential opportunities related to the octopus fishery, sustainability, environment, climate and improved biodiversity;
- ii. Increase quality.
- iii. Improve product recalls.
- iv. Improve inventory tracking.
- v. Improve food safety.
- vi. Improve customer service.
- vii. Respond to the growing consumer demand.
- viii. Verify harvest date, location and freshness of the products
- ix. Improved understanding of biodiversity changes, consumer changes impacts and how to decrease risks and secure more robust supply chains;
- x. Assistance in meeting statutory requirements as well as export market standards for both EU and USA
- xi. Cost-savings through more efficient resource use and improved sustainability;
- xii. Access to stakeholders and technical assistance;
- xiii. Insight into current and future policy environment;
- xiv. Improved publicity, enhancing their profile with stakeholders and consumers.

### **3.2 Information and communication technology providers**

In Kilwa, there are both private communication platforms as well as those accessible to the public, however the present methods are limited to places and places. Mainly in Kilwa the most reliable company is Airtel and has ability to offer up to 3G only in some places and Edge network in remote places, while network providers such as Tigo, Halotel, and Vodacom are limited to townships only. Despite the fact that the fishery of Kilwa is of great importance to the economy of Kilwa but it is not the driver of these networks to be present in the area but rather the natural gas extraction industries in the place, but the gas explorers in place have their private communications channels that are not accessible to others.

### **3.3 Associations, organizations, and research institutes**

There are international NGOs such as WWF and Blue Ventures who are particularly interested and supporting the closures and co-management of the octopus fishery in Kilwa, as well as offering funds to support the supply strengthening the supply chain, MCS as well as implementation of the SSF guidelines. Furthermore, these organizations and local NGOs such as Sea Sense and Aqua-Farms Organization are working with BMU and local groups to enhance their organization capacity through leadership training. The BMU are part and parcel of the community but created by the guidance of the fisheries act of 2003. For every landing site there is a BMU and they have strong departments of MCS and data collection, which are used by the TAFIRI to collect various information and project data through e-CAS, on average in every community there are up to 5 BMU members who are beach

recorders. These are potential entry points for eCDT but also could be used as a trainer to spread the knowledge on data collection from fishers, captains and agents.

As Kilwa area has a great interaction between fishing grounds of different villages, through the support of WWF and Blue Ventures, the communities have formulated the Collaborative Fisheries Management Areas (CFMA'S) where they are guided by the Collaboration Coordinating Committee (CCC) that are represented by 5 BMU members from each landing site and they represent the BMU chairperson, Secretary, data recorder, MCS member and a village chairperson (Figure 9). Across all the 8 places in Kilwa there are a total of 18 BMU's that formulated 3 CCC namely, Team force, Somaki and Nyamanji Sopoja that stands for the CFMA

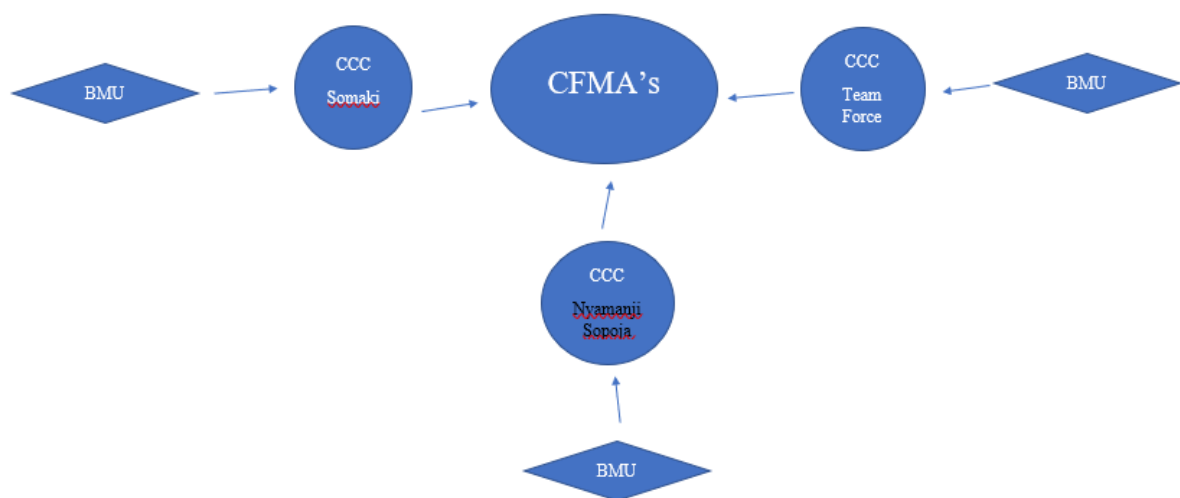


Figure 9: A diagram showing the management of the Collaborative Fisheries Management Areas (CFMA's)

Furthermore, Kilwa has 5 associations of fisher, namely *Chama cha Wavuvi wa Kilwa Kivinje* (CHAWAKKI), *Umoja wa wavuvi wa pweza Somanga* and *Umoja wa wavuvi Kivinje*. These associations are at the early stages of development within 1-3 years and are still mobilizing themselves to show the fisheries more reasons of why to join the association so as together they can seek for their potential rights, have access to finance and other support.

### 3.4 Community, Labor and Welfare

As the assessment focused on CDT, it also highlights the labor and welfare of workers in the octopus fishery value chain, however the information gathered does not capture a robust information on the human welfare conditions of the Kilwa octopus fisheries workers. As it is a small-scale fishery encompassed by many individual fishers and considered as informal workers there are various issues that are not in place to support a great human welfare in the fishery. All fishers in Kilwa are registered through the fisheries officer as per the fisheries act of 2003 and for the Songosongo Island they even have identity cards that give them access to the closed reef. As most of the reefs are not at a walking distance many

fishers go onboard into a fishing board and fish out to the sea through freediving, while women walk across the shore to collect octopus, however there is minimal safety measures in place such as having and using life jackets during cruise, as well as the methods used in freediving are not taken into account to precautionary measures to avoid drowning of the fishers. Furthermore, as outlined in the communication part connectivity at sea is limited despite fisheries carrying their mobile phone the vessels have no any communication outlets at the sea that can communicate with land.

Most of the fishers are doing the job as independent fishers and they board into the boats as paying passengers by paying a ferry fare of 500 TZS per kilo of catch octopus, this makes them independent and with no contracts with either vessel's owners. However, most of the vessel's owners are the traders waiting at the landing site and they influence the fishers to strictly sell the octopus to them and them only creating a lack of negotiation power of the fisher as well as freedom to sell to other traders.

As with regards to access to credits, finance and insurance, as small-scale fishers, who work mostly independently it is not easy to access credit, however with the growing associations it might be a good approach to access finance in the near future. as per the National fisheries policy of 2015, among the actions listed was to sensitize financial institutions to offer credits to fisher folks, furthermore, as the safety at sea is of huge concern, there is one insurance in place that was launched in December 2021, giving room for small scale fishers and their vessels to be insured in case of accident. However, the spread of awareness on how this is important and acceptability is still very minimal country wise as well as for Kilwa octopus fishery. As most of the fishers are independently fishing and they contribute to the fair of the taxi boat by 500 per kg harvested on board and these funds are cut off directly from the buyer from there price per kilo obtained.

#### **4. Key Findings : eCDT Gap, Challenges and Opportunities**

The Ministry of Livestock and Fisheries (MLF) is at the final stage of approving the Tanzania Fisheries Master Plan aims at making a comprehensive review with a view to coming up with a new plan which will replace the current one which was drafted in 2002 (Said by Hon. Masimba Ndaki, Minister of the sector when presenting the ministry budget in Tanzania parliament in May 2021) and the Octopus fishery management plan. Among the key priority areas that the ministry plans to implement are intensifying security and inclusive monitoring as well as sustainable use of fisheries resources in the country. Other priorities include strengthening revenue collection on fisheries products of which octopus' fishery is counted among the most promising areas. Moreover, the MLF underpinned the need for the information about seafood exported as key for the revenue generation and building trust of Tanzania seafood products to ensure and strengthen market competition in the global market; and applying new technologies to monitor and manage fisheries resources (MLF, 2016). Octopus fisheries are an important resource for Tanzanian coastal communities (Rocliffe and Harris, 2016; Mtonga et al. 2022). In many coastal zones with coral reefs including Kilwa District, octopus fishing is dominated by small-scale and is a

particularly important economic activity for both women as well as men (Silas et al. 2022). In recognition of the importance of octopus fishery to the coastal communities, its contribution to the national economy and there is a need to ensure its sustainable use.

Kilwa district Octopus fishers, agents and processing industries target both local and international markets (WWF, 2020; FAO, 2020). The eCDT technology will help to improve conservation by making data available for fishery monitoring that will be used by the fisheries sector, satisfy consumers both within and outside the country, and also enhance sustainability towards certification and stewardship. The eCDT will also foster the compliance which is periodically audited by the European Commission on hygiene matters. The effort to establish a baseline for a Kilwa Octopus fishery CDT to cutter the government and global standard needs, it requires a clear understanding of the overarching socioeconomic factors, policy context and the available technologies for the implementation of eCDT in the selected area. As such, this section breaks down the current scenery enabling catch documentation, gaps, data and technology needed to execute the system in the Kilwa fishery, from socio-economic drivers, policy and technological perspectives.

#### **4.1 eCDT gap and technology needs**

Kilwa district comprises three major octopus landings namely; Songosongo, Kivinje and Somanga. These areas are recognized as amongst the productive sites for octopus' fisheries along the Tanzanian coastline. Fishers sell their catch to agents and some are employed by boat owners to catch for them and further sell to the processing plant, Tanpesca, in Mafia and Kilwa Kivinje and moreover, transport to Dar es Salaam Ferry fish market. For large and medium traders, they process octopus and export to the international markets in Europe and Asia after verification from the MLF quality control and assurance section (Zhao, 2018). Some of the catch is supplied to the tourist hotels within Kilwa districts and large in Mtwara and Dar es salaam region. But also, in the local market throughout the country. Generally, the nature of the Kilwa octopus' fishery like many other small-scale fisheries, comprises many fishers, and diverse patterns of interacting actors in the supply chain includes; buyers, inspectors (government authorities i.e resources managers and tax collectors), middlemen, processors, and community members.

The following are the gaps:

**There are several ongoing activities and initiatives that can be the backbone for an established eCDT:** As the system of octopus closure is practiced, during the opening day attracts many stakeholders including ministry, academia, NGOs and researchers who come to collect data for research and monitoring purposes. Most of the catch documentation practiced in the landing sites is paper based and very limited, especially by tax collectors that are done electronically to issue the receipt to transport the products to other areas. Furthermore, the actors mainly BMU, beach recorders and traders (agent) have developed their own ways of recording the data. Some use phone notebooks, special forms with

formats supplied by the ministry, notebook, and normal messages to send information to buyers or any person along the chain to assist selling or buying products on the amount of the catch, size, and price of the octopus's product. From the field observation it has been noted that, most fishers don't record the catch in neither paper work nor electronically, normally sell catch to agents or boat owners and earn their cash. It might be due to low education and awareness specifically on the use of technology for data recording and storage. The observation is not unique but Tanzania in general the paper-based catch documentation is used in most of the fishing landing sites.

**There are Various technologies in place and Key Data Elements being collected that can be organized for a comprehensive eCDT:** There is a related catch information documentation using mobile phone with Fisheries Information System (FIS), KoboCollect, FishMob, ARTFISH, FIRCIS and electronic Catch Assessment System (eCAS) (Annex 3) specifically for Tuna fishery and which is governed and implemented by the Deep Sea Fishing Authority. eCAS also is used by TAFIRI to record catch data from other fishes for fisheries statistics. Furthermore, there is a piloting study conducted in Songosongo that records the octopus catch from pots to see efficiently of the technology in catching octopus though it doesn't bother with the catch outside the pots (personal communication by Bigeyo Kuboja). The CDT system exists to collect, share and analyze very little information relating to weight of octopus catch, size, where or location, gear used, name of fisher, and price. There are a lot of loopholes in regards to ecological, economic, and social data related to octopus' products as they move along the supply chain, such that they are traceable from point-of-harvest to seafood retailers or consumers.

**The current data collection approach is so segmented and the clarity on data sharing and protocol needs to be centralized:** The data collected are utilized by the government agencies such as academia and researchers, private fishing companies ie Tanspeca, BMU, fishing associations and, and NGOs such as WWF, AFO and Blue Ventures for imposing management and conservation measures and business strategy. So, developing a good strategy for application of the traceability principles and pathways in Kilwa district requires addition of electronic devices i.e. smartphones or any digital machines to incorporate key data elements to comply with the requirement of traceability principles and pathways. Moreover, the technology that can be easily adopted by actors along the supply chain such as the use of smartphones.

**There is a huge gap of awareness on the role of eCDT to improve biodiversity conservation and fisheries management but a demand and local acceptance among fishers, traders, BMU, private companies and MLF itself for data documentation is very high:** Education and building capacity among actors is needed to implement the eCDT system in the area. Most of the information provided here are from field observation, personal communications and limited published and unpublished literature survey in relation to CDT. The information is also inherently limited during stakeholders mapping workshops and field observations. Generally, in the current CDT Catch is either brought onshore by a fishing vessel or transshipping vessels and is unloaded, sorted, weighed and



transported directly to fish markets, seafood processing plants, or stored at the landing sites. Fish buyers/agents, seafood processors, and middlemen are responsible for providing information to the local BMU, fisheries officer and tax collector to get a catch statement for the octopus catch then the information is submitted to the MLF for fisheries statistics documentation.

## **4.2. Data Needs and Requirements to Execute the Technology**

In the past few years, the eCDT has been developed to improve fisheries monitoring for many species, this includes using devices like mobile phones or tablets for data collection to replace the paper-based system (Mbunda and Kapinga, 2020). An insight from the field by Salma (a beach recorder at Kilwa) explained that the paper-based octopus fisheries data collection is simple but takes longer time for data entry in the field and into the online database/excel, and forms are lost. Also, it's very difficult for the community to visualize and interpret the status of the catch in general. The data needs and requirements to execute the eCDT should be catered to selected actors along the supply chain. Also, the data and technology must be robust and accessible to all stakeholders from the government agencies such as academia and researchers, private fishing companies (i.e., Tanpesca), BMU, fishing associations and NGOs such as WWF to consumers for management purposes and traceability. Most of the data needed but not limited by mentioned actors are fisher's name, fishing location and time, gears, the total of octopus caught, and details (biology) on the octopus like mantle length, sex, weight, price (economic). To accomplish this, there is a need to train community-based partner organizations such as BMU, fishers' associations, agents/traders on how to transform paper-based data collection systems into eCDT such as mobile systems. Before the implementation of the eCDT, there is a need to simulate tools/devices to give a full understanding of the process before actually deploying the system in the selected octopus landing site. Then after thorough assessment the system will be ready to be implemented by the selected communities preferable BMUs, Beach recorders, Fisheries officers, traders or agents based on field observation. From the field assessment it has been observed that the community data collectors are enthusiastic to shift from paper based to digital.

Moreover, there is a need to have eCDT technology that is easy to use and fast in recording data and If possible, showing real-time data that can be analyzed and give day to day feed back to the communities as continue to contribute to traceability and pathway principles, so that they can make fisheries management decisions participatory and in a timely manner as in line with the National Five-Year Development Plan 2021/22-2025/26 that focus on modalities for promotion of participation of the Private Sector and Non-State Actors in economic development. As highlighted, what is needed first to execute the technology, community data collectors must be trained and assisted on a daily basis until they are familiar with the new system. Moreover, from the existing eCAS system , it would be easy to navigate and adopt the technology because they already have experience with such tools.

### 4.3 Challenges and Opportunities

The main challenges eCDT is relating with adoption of the technology, and socioeconomic benefits and most of them still prevail; Among others highlighted key issues are; with new eCDT technology it will require registration to operate from ministry since it could need more information and might take longer to be implemented due to bureaucracy. Alternative eCAS can be modified and introduce another module for traceability and will not require new registration again by e-government. Since eCAS collects several pieces of information, there is an ongoing task of changing the name to Fisheries Information Platform to accommodate all fisheries data. Data enumerators need incentives to collect the fisheries data, they need motives to operate in the landing sites.

Challenges include;

**Data hiding and falsification:** Octopus catch data are provided by either fisher, fishing vessel owners, skippers, middlemen, and agent/buyers through a paper-based system or orally to be recorded by data collectors. It might happen that some actors give wrong information to data collectors because if not properly verified. Here there is a need for a clear strategic plan for data documentation, awareness to participate in the exercises and whenever possible law enforcement includes fines for any falsification of data.

**Lack of centralized database:** The lack of a national fisheries database on catch makes it difficult to cross-check and verify information received from the community data collectors. There is a need to have a centralized database system that will receive all information along the supply chain.

**Lack of support from fishers and harsh environment:** The inadequate law enforcement effort on data documentation may open a room for fishers to not participate effectively in providing information exercises to data collectors. Awareness raising to participate will be the key solution to cut this challenge. Also, using mobile phone technologies by fisher's it could cause challenges due to their working environment is of great risks.

**Poor and insufficient networks and cellular tower:** The eCDT system requires the network to enable sharing of information along the supply chain. Some places like Songosongo have unstable networks and don't have towers to supply the network. Poor handling of the technology along the seafood supply chain might hinder the sustainability of the system. The eCDT system that will record the save the information and share the information in the unstable networks is preferable.

**Lack of incentives to data collectors:** A lack of motivation and support to data collectors might influence the system implementation. Such incentives required are daily transport costs to visit various landing sites and back home.

**Weak cooperation between stakeholders and actors:** Any weak cooperation between such as the Ministries and actors along the supply chain may interfere with the data collection process.

In Tanzania, eCDT along the coast of Tanzania is not much practiced and not yet officially streamlined under policy and regulations, most of the challenges can be overcome and setting strategies to conquer. Despite the challenges in moving toward the eCDT, there are also various opportunities that can be integrated see section 5

Some opportunities includes;

- i. Incorporation of octopus eCTD in the eCAS system that will require little modification to be used along the chain as well as the reconfiguration of the Fisheries Information System (FIS) as an MLF database for fisheries statistics.
- ii. Pilot of eCDT at Songosongo and parallel site of Somanga/Songamnara

## **5. Recommendations**

The USAID through SALT FishWise and the government of Tanzania has interests to initiate an eCDT system for the octopus fishery at Kilwa district in Tanzania. After implementation, a system will improve the transparency in the fishery, assist decision making, widen the external markets and promote biodiversity conservation.

This part presents the recommendations for the successful eCDT system from the main findings, including also the possible strategies for eCDT development, implementation, and form of the public-private partnerships. The part was supplemented by further materials cited which can be accessed in the Annex.

- i. Utilize the existence of the electronic Catch Assessment Survey (eCAS) to include the necessary missing data elements and enable public-private partnerships to make the eCDT for the octopus fishery, with the potential to establish a pilot site**

The eCAS system currently used by the BMUs in Tanzania to collect the country's fishery statistics needed by the ministry can be improved to include the data elements that are necessary to have a functional eCDT. The system record catch statistics with common names of species (octopus as Pweza in Swahili), it also provides an opportunity to record the basic catch information like length, weight and sex. Development of eCAS was an important government investment step toward electronic catch documentation (and traceability), therefore this can be a good opportunity to further concentrate resources, reduce development costs and enhance improvement. The eCAS system is currently being used by the trained BMUs at different landing sites at Kilwa can be modified to collect information about the social welfare, quality standards, and capture key events in the octopus supply chain (Figure 10). A system can be modified to enable data sharing across actors for transparency and validation. After modifications a system can, be made available to other important actors in the chain (from fishers to final users), through capacity and an

active octopus eCDT implementation plan. A policy, enabling environment or willingness of the government to accept such improvement needs to be conducted, in addition to the comparative related costs for improvement or making of the new eCDT system for the octopus fishery need to be assessed further.

Songosongo can be a very good spot for conducting a pilot of the octopus traceability program, first it is among the highest supplier of octopus in Tanzania, the population is less enabling in remote areas enabling full control and enforcement of the eCDT, and the level of public participation, fishers can be easily monitored, community-local leaders cooperation and awareness in conservation matters is high considering the currently successfully octopus fishing closure programs. In addition, Songosongo is an island, therefore the catch can be easily controlled and traced with port in and out schemes toward the mainland industrial side, preventing any potential leakage in the highly populated mainland areas.

**Point of Critical Tracking events in Kilwa Octopus Fisheries**

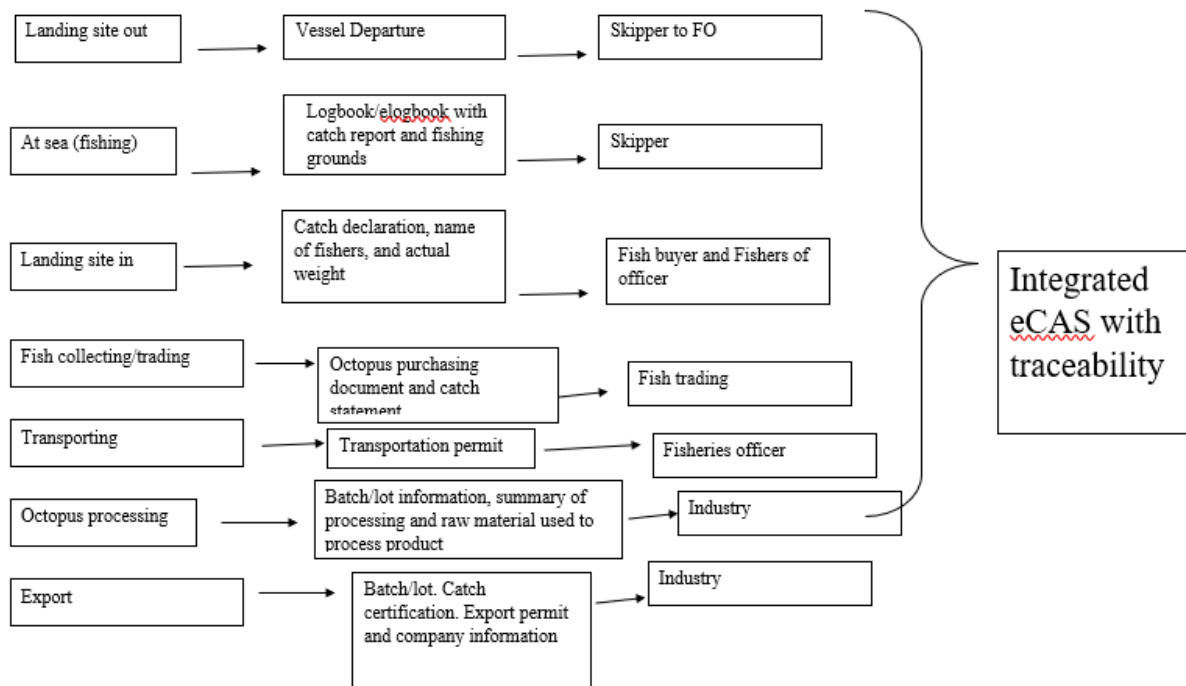


Figure 10: Points of critical tracking events in Kilwa Octopus Fisheries

**ii. Strengthening technical capacity and infrastructure across actors in the octopus supply chain to support eCDT**

Data entry to record critical events at different points for traceability consist of a mixture of paper based and some forms of electronic. Still there is a need to build capacity of actors at different stages of data entry to ensure they understand traceability and provide full participation following the to-be-designed octopus eCDT implementation plan. Additionally, the infrastructure needs to be improved for easily supporting the eCDT see current and proposed structure of the supply chain (Figure 12).



















Kilwa octopus supply chain¶							
	Landing site out	At sea (Fishing)	Landing site in	Fish collecting/trading	Transporting	Processing	Export
<b>Current¶</b>	Non	Non	 Non, or paper	 Non, or paper	 paper	 Paper and electronic	 Paper and electronic
Data capture method (Not integrated across supply chain)¶							
Actors¶	Skipper to Fisheries officer	Skipper	Fish buyers, middlemen, agents and fisher of officer	Fish trading	Fisheries Officer	Industry	Industry
Document type¶	Vessel departure	Logbook/eLogbook with catch report and fishing grounds	Catch declaration, name of fishers, and actual weight	Octopus purchasing, document and catch statement	Transportation permit	Batch/lot information, summary of processing and raw materials used to process product	Batch/lot, catch certification, export permit and company information
<b>Future¶</b>	 Data collection device	 Data collection device	 Data collection device	 Data submission to central Government	 Data submission to central Government	 Data submission to central Government	 Data submission to central Government
Electronic data capture method, to be integrated in entire value chain¶							

Figure 11: A graphical representation of current versus future data capture across Kilwa District octopus fishery supply chain

**iii. Considering human welfare and gender equity as additional component during implementing of the eCDT**

The promising advantages of the eCDT is it captures data regarding age, gender, working capacity or skills of actors in the supply chain. Such data will help to monitor the welfare and gender issues like benefit distribution in the chain, shares between fishers, boat owners and boat assistants, payments or benefits of laborers/workers in the workplaces (including within the trading and processing companies). These are the information that are currently not monitored with the existing basic data input systems. Thus, essential standard Key Data Elements need to be established to ensure human welfare and gender issues are considered, and made compulsory through relevant legal frameworks.

**iv. Develop and promote an alternative fishing gear to substitute the currently used Iron rods**

At present, fishers at the Kilwa octopus fishery still use the iron rods that are not sustainable and non-healthier. The government of Tanzania recommended use of the rods made from woods but fishers found them non-durable. To ensure fishers comply with the transparency and principles of the traceability such as avoiding falsification when providing the data on the gear used, an immediate action is needed using innovation and technology to come up with the octopus fishing gear that are sustainable and preserve consumer’s health. The Tanzania Fisheries Research Institute (TAFIRI) research team is currently experimenting the use of the pots in fishing octopuses, but recently the trials were non-successful because no octopus were caught. A first step toward launching of the effective eCDT system, would require an immediate response to recommend a gear that is more sustainable.

**v. Utilize the Public-Private Partnerships (PPPs) in eCDTS design and implementation. PPPs are vital in concentrating resources like technology, infrastructure, knowledge and human resource) for successful development of the effective eCDTS**

Successful PPPs are vital to bring together actors across the octopus supply chain and related activities (fishers, collectors/agents, vessel owners, processing companies, buyers, exporters) with interests to support implementation of the eCDT to widen markets (US and other EU markets). Partnerships can enable utilization of the available spaces, possible modification of the eCAS technology to meet eCDT needs, use available infrastructure to support the eCDT, enabling industry commitments, provision of incentives and support to the data collectors, integrating licensing, approval, certificates and permits from other databases into a one shared platform. Partnerships can also facilitate engagement of the communication and technology companies (smart device suppliers, mobile telecommunication services, to enhance data acquisition, validation and analysis). Involvement of the financial and insurance companies for instance may provide incentive support during piloting and full-scale implementation. The government can for instance assist with the available employees on ground to have additional roles in the octopus eCDT implementation, training (Tanzania Fisheries Research Institute), the same case for the companies. Technology providers can provide maintenance and additional support like training and overall operation of the eCDT system. A system of dependence and risks based on the interests of the private and public sectors to gain mutual economic, ecological and social benefits resulting from a widened market opportunity as after successful implementation of the eCDT.

**vi. Developing an implementation strategy for short (6 months), mid (two years), and long (4 years) implementation of a pilot eCDTs, outlining public and private sector roles and responsibilities**

Taking into account the existing legal basis and procedures of Tanzanian government and stakeholders to approve and adopt the eCDT, this report recommends a breakthrough of plans step by step to achieve immediate, mid and long-term goals. The first six months can be used to comprehensively evaluate the existing databases on fishery (licensing, certificates etc), national legal framework on fishery data, technology adoption and approval. The mid-term phase would be used to formulate the national action plan for implementation of the eCDT with clear roles and responsibilities of stakeholders. The same phase in the final year can be utilized to integrate the current national fishery databases (licenses, certificates etc), build capacity of key entry points and conduct a pilot at Kilwa octopus fishery. The third long term phase can be used for reviewing to improve the data collection e-logbooks and e-forms (catch declaration), further capacity building the actors in the octopus supply chain on eCDT system, upscaling the eCDT initiative to reach the whole Kilwa district and national wise. The same phase will be used for monitoring, evaluation, inspections and provide room for adjustment needed for improving the eCDT countrywide (Figure 12).

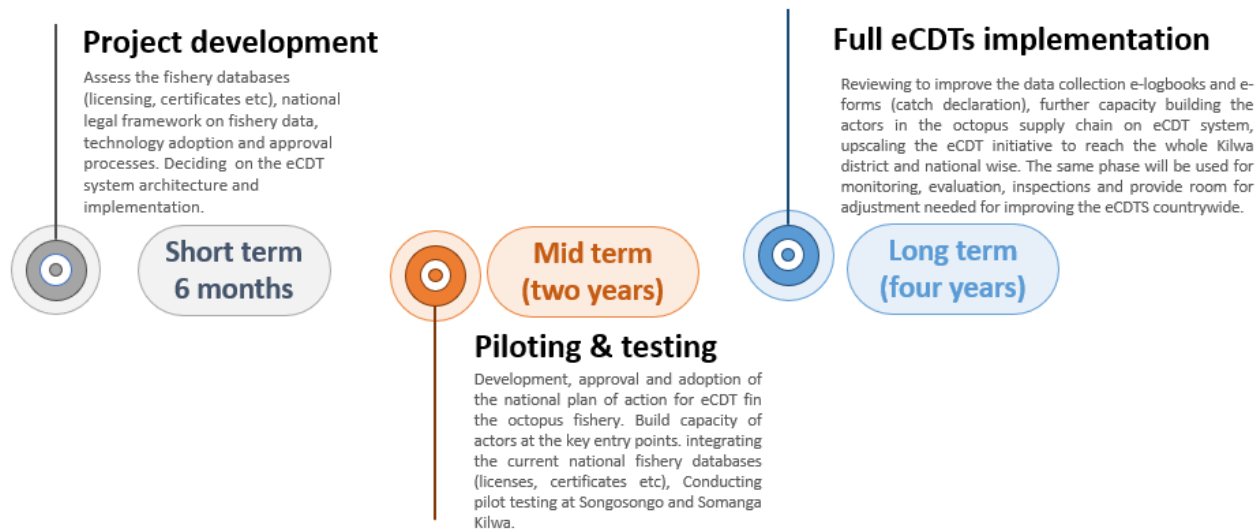


Figure 12: Showing the recommended pathway toward full implementation of the eCDT system at Kilwa district and Tanzania.

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## 7.0 Annex

### ANNEX1: FISHING DEMOGRAPHICS OF KILWA

<b>SITE</b>	<b>No. of fishing Vessels</b>	<b>No of Fishers</b>	<b>Number of BMU</b>	<b>Registered BMU</b>	<b>BMU with Offices</b>	<b>Number of landing sites</b>
Kilwa District	1584	7818	18	5	4	32
	<b>Fish processors</b>	<b>Fish traders</b>	<b>Boat builders</b>	<b>Transports</b>		
	1069	2666	70	423		

Source: summarized from the Marine fisheries framework survey 2018 by MLF



b. Fishing data collection form

FOMU YA TAKWIMU ZA UVUNAJI WA SAMAKI

BMU YA.....

WILAYA YA.....

BANDARI YA.....

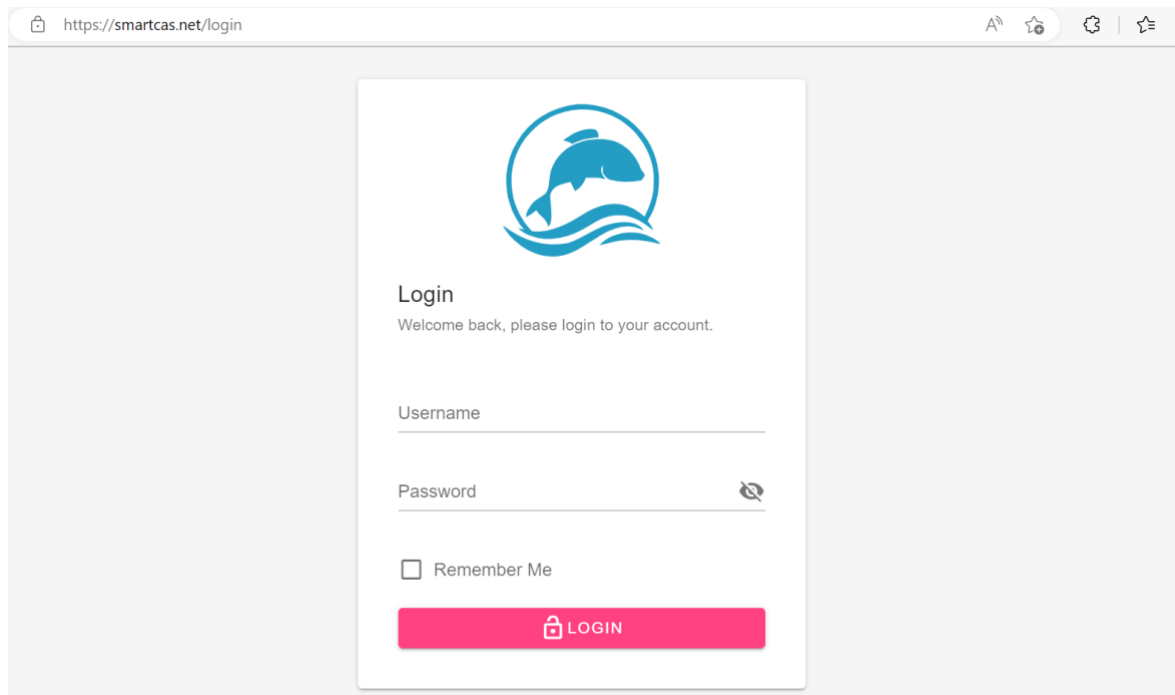
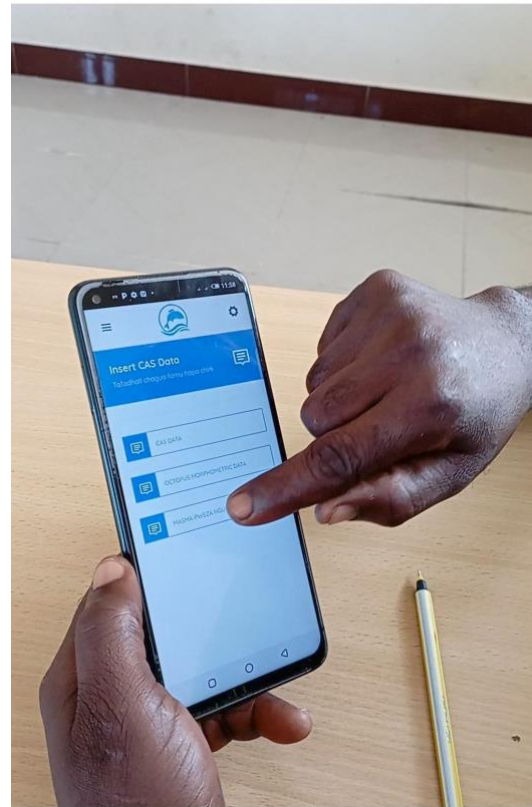
Tarehe	Jina la chomba	Aina ya Chomba	Uendeshaji (Mashine/Tanga)	Idadi ya Wavuvi	Aina ya Samaki	Uzito(kg)	Idadi	Bei	Thamani	Sehemu aliyovulia	Muda wa uvuvi		Aina ya Mtego
											Kuandaka	Kurudi	

JINA LA MTAKWIMU..... SIMU NAMBA..... SAINI.....

### ANNEX 3: Current Technologies

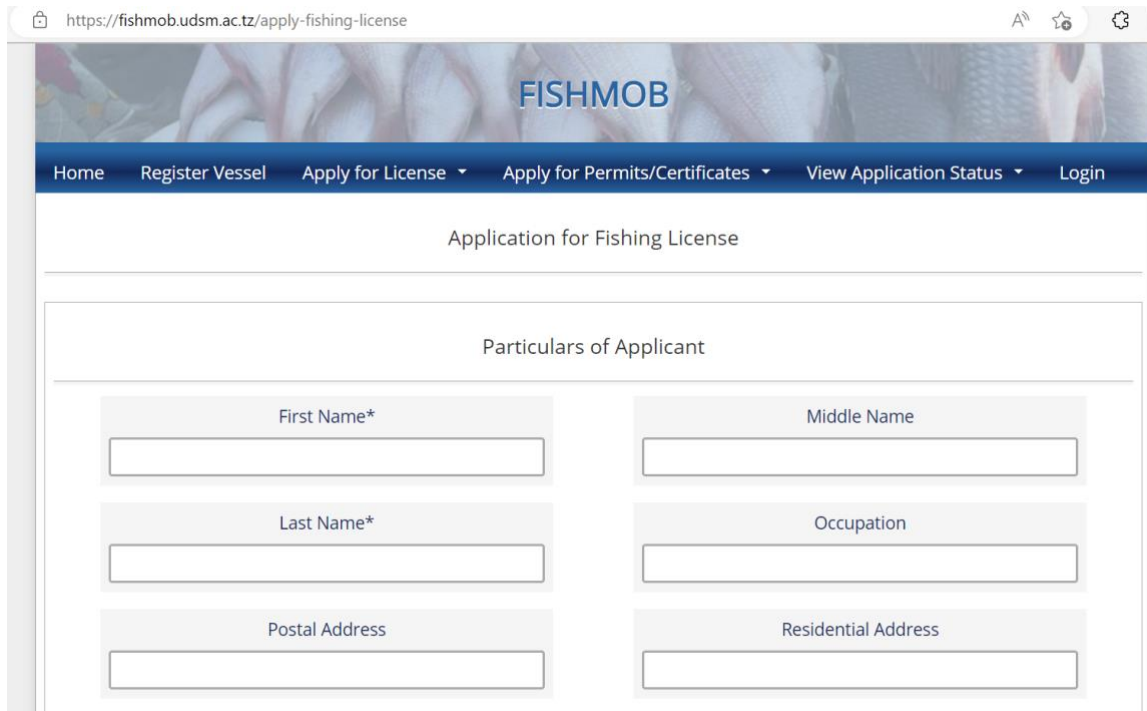
- a. eCAS app and web service for inputting the Catch Assessment data

<https://smarcas.net/login> (Accessed 06th February 2023)



## b. FiSHMOB

For application of fishing licences - <https://fishmob.udsm.ac.tz/apply-fishing-license>, below are information recorded.



The screenshot shows the FiSHMOB website interface for applying for a fishing license. The browser address bar displays <https://fishmob.udsm.ac.tz/apply-fishing-license>. The website header includes the FiSHMOB logo and a navigation menu with the following items: Home, Register Vessel, Apply for License, Apply for Permits/Certificates, View Application Status, and Login. The main content area is titled 'Application for Fishing License' and contains a section for 'Particulars of Applicant'. This section includes six input fields arranged in two columns: First Name\* (with an asterisk), Middle Name, Last Name\* (with an asterisk), Occupation, Postal Address, and Residential Address.

## PROPOSED REPORTS

- General Fisheries Statistics
  - Total Number of Registered Fishermen
  - Total Number of Registered Vessels
  - Total Number of Licenses (Active / Expired) - Fisherman and Vessels
  - Total Number of Registered BMU
  - Total Number of Landing Sites
- Registered Fishermen - Waterbodies - Given Time Period
- Registered Vessels - Waterbodies - Given Time Period
- Registered Licenses - Waterbodies - Given Time Period
- Number of Gear / Tools in use - Waterbodies - Given Time Period
- Fish Species - Waterbodies

c. FIRCIS

Online export permit system administered by the Ministry of Livestock and Fisheries for importing and exporting of fish and fishery products.

<http://196.192.79.199:8080/registration>

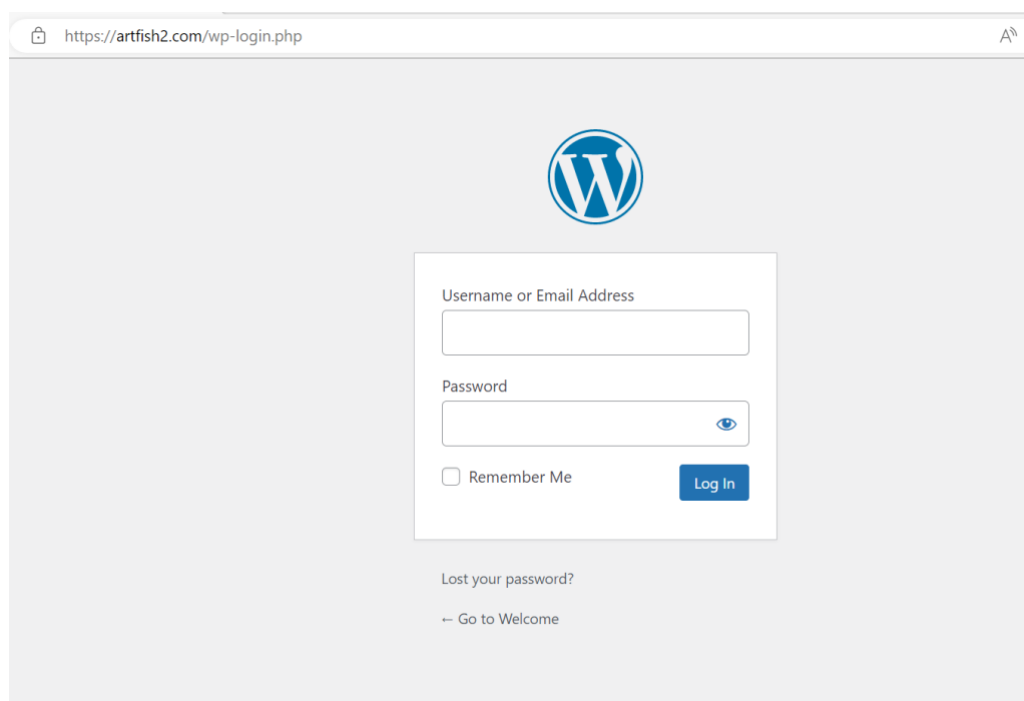
The screenshot shows the FIRCIS registration page. At the top left is the FIRCIS logo and name. At the top right are links for 'Register' and 'Login'. The main content area is titled 'Register Here' and contains a registration form with the following fields: 'First Name \*', 'Last Name \*', 'Postal Address \*', 'Residential Address \*', 'Business Location' (a dropdown menu), 'Email \*', 'Phone \* eg 07171121314', 'Nationality' (a dropdown menu), 'Gender' (radio buttons for 'Male' and 'Female', with 'Male' selected), 'Password \*', and 'Confirm Password \*'. A blue 'Register' button is located at the bottom right of the form. Below the form, there is a small text '108108 Article Tax.pdf' and a 'Show' button.

The screenshot shows the FIRCIS login page. At the top left is the FIRCIS logo and name. At the top right are links for 'Register' and 'Login'. The main content area is titled 'Login Here' and contains a login form with the following fields: 'Your Email \*' and 'Password'. A blue 'Login' button is located below the password field. Below the button is a blue link for 'Forgot Password?'. The browser's address bar shows 'Not secure | 196.192.79.199:8080'.

#### d. ARTFISH2

ARTFISH stands for Approaches, Rules and Techniques for Fisheries statistical monitoring. Designed by FAO, the program provides users with robust, user-friendly and error-free approaches with computer software, to achieve the implementation of cost-effective fishery statistical collection with minimal external assistance. The purpose was to organize the system standards and classifications as well as primary sample data into standardized database structures and produce estimates of total effort, catch and values.

<https://artfish2.com/wp-login.php>, <https://www.artfish2.com/zanzibar/samakis.php>



The screenshot shows the WordPress login interface. At the top, the URL is <https://artfish2.com/wp-login.php>. The page features the WordPress logo and a login form with the following elements:

- Username or Email Address input field
- Password input field with a visibility toggle (eye icon)
- Remember Me checkbox
- Log In button
- Lost your password? link
- ← Go to Welcome link



The screenshot shows the Samakis login page. The URL is <https://www.artfish2.com/zanzibar/samakis.php>. The page header includes the title "Samakis - A Fisheries Information System for Zanzibar" and logos for the Southwest Indian Ocean Fisheries Governance and Shared Growth Program (SWIOFish), the World Bank, and the Government of Zanzibar.

The page is in English, with options for العربية and Swahili. It features a login form with the following elements:

- Public access (no login required) checkbox
- User id. input field
- Password input field
- With tutorial radio button (selected)
- Without tutorial radio button
- Login button

A central image shows a traditional wooden fishing boat on the water. To the right, there is a welcome message and contact information:

Welcome to Samakis, a web-supported system for the statistical monitoring of fisheries in Zanzibar. Please first select the language desired using the three underlined options.

You may then gain restricted access to the public services which involve data summaries and general information on the system methodology and its operations.

Functions for privileged access will need a valid user id and a password.

For further information and queries please contact:

Zanzibar  
sdsep@mpeche.gov.tz

The footer of the page reads "Samakis - A Fisheries Information System for Zanzibar".