ASSESSING TANZANIA AQUACULTURE FOR ECONOMIC DEVELOPMENT

Final Report

Prepared for: ACQUACULTURE ASSOCIATION OF TANZANIA (AAT)

Submitted by: DAIMA ASSOCIATES LIMITED

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15 March, 2019
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ACRONYMS

DSFA  Deep Sea Fishing Authority
FETA  Fisheries Education and Training Agency (FETA)
LGA   Local Government Authority
MDAs  Ministries, Department and Agencies (MDAs)
MoLF  Ministry of Livestock and Fisheries (MoLF)
MNALF Ministry of Natural Resources, Agriculture Livestock and Fisheries (Zanzibar)
NADS  National Aquaculture Development Strategy
NEMC  National Environment Management Council
NFSDP National Fisheries Sector Policy Development
NSGRP National Strategy for Growth and Reduction of Poverty
SUA   Sokoine University of Agriculture
TAFIRI Tanzania Fisheries Research Institute
PO-RALG President’s Office-Regional Administration and Local Government
TDV-2025 Tanzania Development Vision 2025
UDSM  University of Dar es Salaam
EXECUTIVE SUMMARY

0.1 Project Summary

The main objective of this study undertake the situational analysis of the aquaculture industry current environment and regulatory framework, challenges and changes over time that could be a basis for review of existing policy and institutional support to drive the rational development of the sector. The study sets out to identify opportunities and constraints of development of Tanzania aquaculture industry and to determine the need for policy and institutional support to drive the rational development of an environmentally responsible aquaculture sector. The study sets out to illustrate the adequate and efficient institutional support for the development of sector and explore ways to influence the Government to improve the national aquaculture policy and its implementation strategies and to establish a consultative platform that will give new impetus to aquaculture development and pro-active and transparent dialogue at all levels.

0.2 Background

The motivation of this study arises from the realization that aquaculture is a fast-growing food production sector in the world’s fish supply and Tanzania has great a potentials for aquaculture growth that has yet to be fully harnessed. Tanzania is endowed with conducive climatic diversity, natural features and other resources that favour the culture of a wide variety of aquaculture species but only a small portion of these resources are currently being utilized. It has therefore been deemed imperative to assess the current situation of Tanzania aquaculture industry, its state of development, opportunities and challenges of realizing a more developed and environmentally responsible aquaculture sector. The role of this undertaking is to assess the Tanzania aquaculture industry in economic development and illustrate the adequate and efficient institutional support for the development of an environmentally responsible aquaculture sector. In this context, the study has engaged the stakeholders on issues and experiences in relation to current and future aquaculture industry in Tanzania with a view to identifying challenges, opportunities and suggestions of where improvements could be made. The motivation is twofold: first is to influence the government to begin the process of developing a national aquaculture policy and its implementation strategies; and second, is to establish a consultative platform that could give a new impetus to aquaculture development and pro-active and transparent dialogue at all levels. The findings and recommendations arising from the study are on interest to stakeholders of the sector, notably, government and the private sector.

The process of undertaking this study involved desk review and field interviews. An in-depth desk review of the state of the aquaculture industry and its regulatory framework was undertaken. The study primarily involved undertaking guided interviews, meetings and focus group discussions with key stakeholders on business operations, industry challenges in regard of the regulatory framework, and opportunities for growth and innovations and solutions. Interviews were conducted with key aquaculture stakeholders in the private sector ((fish farmers
in pond and cage farming business) covering the whole value chain, research and training institutions and the public implementers (central, regional and local government authorities). The study comprised of 32 respondents who consisted of eight public implementers, 22 private implementers and two research institutions. The geographical coverage of this study consisted of the coastal zone (Mlandizi and Bagamoyo), Southern highlands (Mbeya) and the Lake Zone (Bukoba, Mwanza, Bunda and Musoma).

0.3 Main Findings

(i) **Status of aquaculture industry:** Aquaculture is practiced by both farmer groups and private individuals engaged in ponds farming and cage farming. In recent years, fish farmers have been shifting from ponds to cage farming where they have also been adopting improved and new technology. Species are mainly tilapia, catfish and seaweed. In the recent past concerns have been raised about dwindling fish resources attributed to many factors including climate change (leading to drying up of rivers which used to be important habitats for fish); pollution of water bodies, and unsustainable fishing practices. This is an opportunity for the development of the aquaculture industry. The Fisheries Sector Development Programme has the overall goal of developing a sustainable, competitive and more efficient fisheries and aquaculture industry that contributes to the improvement of the livelihoods of stakeholders and the national economy while preserving the environment.

(ii) **Policy and regulation reforms** are implemented but are not known to the aquaculture stakeholders. Aquaculture policy implementation strategies has not provided adequate space for the private sector in that it is not supported with adequate incentive of entry. Venturing in aquaculture takes a long process and with costly procedures. The stakeholder from the private sector expressed concern over the lack of coherent policy and regulatory framework for guiding investments and conservation in aquaculture activities. The activities are coordinated by a multiplicity of regulations and institutions and thus make compliance very costly and difficult.

(iii) **Cage Zoning and Conservation:** Many areas have not undergone mapping and preserving caging and sailors are not restricted in distorting and tempering with cages. In the absence of mapped caging areas some private businesses expressed concern over the delay they experience in obtaining operating licences or even permission from village governments to enable the private businesses start operating.

(iv) **Coordination challenge:** There is weakness on strategic coordination among government agency and institution. Inadequate Coordination is apparent on strategic coordination among government agency and institution exhibiting weak linkages among key government policy institutions such as between National Environmental Management Council and LGAs, especially the Environmental
Management Department or between Fisheries department in Region Commissioner and Fisheries unit at LGAs. There are many cases of overlapping in the mandate such as the agency and department regulating the industry seems to have an overlap in the regulation and implementation of aquaculture aligned rules and regulation, this is complicated by inadequate information sharing.

(v) **The institutional mechanism for public-private policy dialogue** on aquaculture industry development matters was found to be functioning in a rather ad hoc manner. Public-private sector policy dialogue deserves greater support to make sure it is institutionalized and is functioning regularly.

(vi) **Market for fish**: The farmers sell their fish to local market and people around the farm. Aquaculture products have a growing domestic and regional market. Aquaculture accounts for no more than 8% of the EAC regional consumption. It is important to take an initiative to develop the sector to meet the growing demand for fish considering other factors i.e. population growth, increased income and urbanization. This is an opportunity to be tapped. Marketing and Advertising of Fish Produce: Produce are sold locally however, there is an opportunity of unlocking borders by selling it to the EAC regional market to countries like Rwanda and Burundi who don't have Tilapia. In addition, improvement of regional infrastructure i.e. through the standard railway gauge trade will be smooth. In Tanzania, there are regions with no Tilapia (Manyara, Singida and Mbeya) which can be good geographical segment. International markets such as DRC, Rwanda and Burundi are huge opportunities which has not yet tapped. Reaching these markets will promote productive and hence develop the aquaculture industry at large.

(vii) **Access to fingerling and hatchery seeds is a challenge**: Brood stock source is from both the wild and from breeding stations out of the country. The wild parents are obtained from Lake Victoria for Tilapia and rivers for catfish. Supply of fingerlings is associated with low quality and unreliability of supply. The prices of fingerlings differ where it is more expensive in private hatcheries and the lower cost fingerlings from public institutions are in short supply. The hatcheries are characterized by low level of investment and limited power supply making them to produce under their capacity thus the total number of fingerlings produced is less than the demand.

(viii) **Fish Farming Equipment**: Most of the farming equipment are imported at high cost. Local industries have an opportunity of producing variety of equipment that the industry needs. Costs of imported equipment is rated high. The locally available nets are purchased from Arusha (Gill Net) but others are imported.

(ix) **Access to feeds** faces the challenges of shortage, quality and high cost. Currently, there are no big feed production factories in the country and small feed producers do not offer quality feed. Farmers opt to import feeds. Domestic production has been reported to be discouraged by high tax barrier that raise the cost of
production. Feeds for Aqua farming is an opportunity for engaging in import substitution since producing local quality feeds at lower prices, taking advantage of abundance of a wide variety of foodstuffs in the country.

(x) **Access to financial services** in the aquaculture industry is a drawback to the industry. Feed for fish is a high cost for business operation in fish farming. Capital and access to finance poses a challenge to aqua farmers as the business itself has a lot of requirements and most farmers don’t have enough capital to meet them. There is the challenge of meeting collateral requirements, affording the high interest rates, lack of investment finance and absence of grace period to allow for production to take place. Arrangements have not been to facilitate farmers to access credit to meet working capital and investment finance requirements.

(xi) **Knowledge and technology**: though there is an increasing number of people employed in aquaculture sector, most local farmers employed have little knowledge of best aqua-farming practices. The academic and research institutions that deal with fisheries research and training consist of Sokoine University of Agriculture (SUA), University of Dar es Salaam (UDSM), Tanzania Fisheries Research Institute (TAFIRI) and COSTECH. However, most of the fish farmers access technical advisory services from public Aquaculture extension Officers with 60% of the farmers getting skills from government institutions and 40% of farmers these technical advisory services from private certified farmers and aquaculture experts. Despite having academic research institutions skills are not fully utilized as training received is not practised as intended. For example, some fish farmers have received training in feed production but the knowledge is not utilized as there is a skills gap in fingerlings production. Consequently, high quality feed inputs are produced by foreigners. There is a need for training and sensitization on safety and security.

0.4 **Recommendations**

1 **Policy and regulation reforms** need to be made practiced with greater transparency so they are better known to the aquaculture stakeholders. Aquaculture policy implementation strategies should provide adequate space for the private sector consistent with concerns that have been raised in the Blueprint.

2 **Cage Zoning and Conservation**: Priority should be accorded to mapping and preserving caging so as to ensure sustainability and easy access to the cage zones. Mapped caging areas will facilitate private businesses to start their operations in timely manner and in sustainable ways.

3 **Coordination needs to be more strategic and rationalized**: Strategic coordination among government agency and institution is needed to more effectively coordinate the development of the aquaculture industry in the country. Rationalization of mandates should aim to reduce overlapping in the mandate
among public institutions and in the regulation and implementation of aquaculture aligned rules and regulation facilitated by improved information sharing among all stakeholders in this industry.

4 The institutional mechanism for public-private policy dialogue on aquaculture industry development matters deserves support to make sure that it is functioning regularly and efficiently as an institutionalized platform. There is a strong case for ensuring that public-private sector policy dialogue institutional mechanism is institutionalized and made to function regularly.

5 Create linkage between stake holders and government institutions through institutionalized policy dialogue. Building Partnerships is important in increasing the likelihood of success with smallholder aquaculture enterprises. Meaningful policy dialogue should be accompanied by enhanced voice of stakeholders including the small businesses in the industry through a strengthened association.

6 Market for fish is growing and needs to be tapped. Aquaculture products have a growing domestic and regional market. Aquaculture accounts for no more than 8% of the EAC regional consumption, a factor that presents an opportunity for taking the initiatives to develop the sector to meet the growing demand for fish considering other factors i.e. population growth, increased income and urbanization are favouring increasing demand. Reaching the growing national and regional markets presents an opportunity for developing the aquaculture industry in the country. There is need to develop a well-organized market system for insurance of market and good prices. This could also require developing of regular extension network by involving all services providers to reach more farmers. Promote market access improvements particularly combined with organizational improvements that can generate further value for farm products and develop new markets.

7 Access to fingerling and hatchery seeds should be supported.: Brood stock source from the wild should be progressively replaced by the development of breeding stations in the country. Investment in domestic production of quality fingerlings and hatchery seeds needs to be provided with institutional and policy support. It is recommended that the establishment of breeding program for assurance of affordable brood stock and eliminating dependency of brood stock from the wild.

8 Fish Farming Equipment: Most of the farming equipment are imported at high cost. Local industries have an opportunity of producing variety of equipment that the industry needs. The development of local manufacture of fishing equipment should be provided with policy and institutional support.
9 **Access to feeds and fingerlings should be enhanced.** Local feed production should be supported produce quality feed at competitive prices taking advantage of the opportunity for engaging in import substitution taking advantage of abundance of a wide variety of foodstuffs in the country. Improvement of the business environment should be realized by building the capacity to produce fingerlings and feeds locally while in the interim facilitating managed importation to facilitate growth of the aquaculture industry.

10 **Access to financial services should be facilitated in the aquaculture industry**
Options such as product insurance, options of forms of collateral that are within reach of farmers, open windows for investment finance to fund medium-to-long term investments in aquaculture. Arrangements should be made to facilitate farmers to access credit to meet working capital and investment finance requirements.

11 **The practice of reallocating the fund for extension and other support services is the district fishing charges to other uses should be discouraged.** In fact, these funds obtained from fishing licenses, permits, penalties and tax whereby 15% of total revenue obtained from fishing activities remains in the district for supporting fishing activities should be ringfenced to make sure the funds is used for the purpose for which it was established.

12 **Knowledge and technology:** though there is an increasing number of people employed in aquaculture sector, most local farmers employed have little knowledge of best aqua-farming practices. The academic and research institutions that deal with fisheries research and training should step up fish farmers access to technical advisory services from public Aquaculture extension Officers. Since LGAs which were staffed with aquaculture officer did well in providing ext5ensi6n services, it is proposed that staffing of LGAs should include such officers in all LGAs where aquaculture is being practices. The advisory technical services should target communities, fish farmers, fishing companies and associated organizations.
1.0 BACKGROUND AND CONTEXT

Aquaculture is a fast-growing food production sector, now supplying approximately half of the world’s fish supply. Over 80% of the world’s aquaculture occurs in developing countries; as a result, aquaculture is a promising tool to reduce poverty and achieve greater social equality as well as to drive economic growth. By providing a low-cost, high-protein source of nutrition to food-insecure populations at a low environmental impact, aquaculture can not only combat poverty and unemployment but also reduce food scarcity and malnutrition. Tanzania has great potentials for aquaculture growth because it is endowed with climatic diversity, natural features and other resources that favour the culture of a wide variety of aquaculture species. However, though not yet quantified, only a small portion of these resources are utilized.

The emerging challenge for the aquaculture industry is finding a way to balance the drive for economic growth with fulfilling the promise of aquaculture as a tool for social empowerment. It is against this background that Aquaculture Association of Tanzania has commissioned this study for comprehensive scoping study to “assess Tanzania Aquaculture for Economic Development”. Aquaculture in Tanzania is an emerging industry that is currently dominated by nile tilapia (Oreochromis niloticus), rainbow trout (Oncorhynchus mykiss), African catfish (Clariasgariepinus), seaweed (Eucheuma cottonii, E. spinosum) and milkfish (Chanoschanos) production. The countrywide distribution of fishponds is determined by several factors such as availability of water, suitable land for fish farming, awareness and motivation within the community on the economic potential in fish farming.

The industry is dominated by small scale farmers producing fish for household consumption and for the domestic market. As a result, the contribution of aquaculture sector to national food security and economic development is still insignificant. The annual farmed fish production is extrapolated at 1 522.80 tonnes which is about 0.435 percent of the average annual fish landings which is around 350,000 tonnes. The impact on poverty reduction is therefore also insignificant (FAO,2019). However, there are potentials for increased fish production through aquaculture which adds to the declining catch from the capture fisheries.

1.1 Aquaculture Regulatory and Institutional Framework

Tanzania Aquaculture sector development governed under the Fisheries Act of 2003 with a sole purpose of ensuring environmental protection and protection to producers, and other resource users in order to ensure provision of safe aquaculture products. PART 4 (Aquaculture development) of the Fisheries Act, 2003 stipulates and elaborates 15 sections of aquaculture development to be legally binding. These include;

1. Restriction on import and export of fish and introduction of new species,
2. Director to collaborate with ministries
3. Large scale aqua farmer to seek guidance and permission
4. Director to advise aqua farmers
5. Aqua farmer to consult authorized officer
6. Control of aquaculture practices
7. Aquaculture not to disrupt environment
8. Aquaculture not to affect other human activities
9. Cage culture to be permitted by Director
10. Register of aqua farmers
11. Large scale aqua farmer to submit report
12. Local authority may intervene
13. Aqua farmer not to pollute
14. Conditions for hygiene in large scale aqua farm
15. Conditions for Seaweed farming

The Fisheries Act 2003 led to the formulation of the National Fisheries and Aquaculture policy of 2015 and Fisheries and Aquaculture Regulations of 2009. Also, the aquaculture sector is interlinked with other sectors where other sector Acts also affects the sector i.e. the Environmental Management Act 2004 and Water Resource Management Act 2009. The objectives of the National Fisheries Policy are set to be realized through active contribution of various stakeholders including Central Government, Local Government Authorities (LGAs), local communities, private sector, academic and research institutions. Their roles include formulation and implementation of policies and regulations, provision of extension, information, research and training services, protection of the environment and investments.
2.0 OBJECTIVES OF THE STUDY

2.1 The Main Objectives

The main objective of this assignment was to assess the Tanzania aquaculture for economic development. The study was to illustrate the adequate and efficient institutional support for the development of an environmentally responsible aquaculture sector. It assessed the opportunities and constraints to developing aquaculture industry and to determine the need for a policy to drive the rational development of the sector. The findings from this assignment will be used to influence the Government in two aspects: to begin the process of developing a national aquaculture policy and its implementation strategies and to establish a consultative platform that will give new impetus to aquaculture development and pro-active and transparent dialogue at all levels.

2.2 Specific Objectives

More specifically this assignment has addressed the following objectives;

a) Conduct an in-depth situational analysis of the aquaculture industry current regulatory framework, challenges and changes over time and current environment that could be a basis for review of existing policy;

b) To assess the aquaculture industry current regulatory framework, including identifying policy (and or practical issues) from the perspective of the relevant Ministries, Department and Agencies (MDAs);

c) To make review of the practical limitation around recommended courses of action geared towards providing advice and guidance to the government (decision makers) on good practice for dialogue and review process, specifically in relation to:
   i) Issues with the current regulatory framework;
   ii) Policy and/or practical issues from the perspective of the relevant MDAs.
3.0 APPROACHES AND METHODOLOGY

This study has adopted a multi-dimension methodology to conduct this assignment, the method was chosen because of it is flexibility of facilitating an indebt context analysis of the main issues under the assessment. The study focused on assessing Tanzania aquaculture industry for economic development. In conducting field work, the study selected potential aquaculture areas, basing zones, thus coastal zones, Southern highlands, Lake Zones, and other areas.

3.1 Literature Review

This assignment has used both official and scholarly documents on areas of aquaculture development in Tanzania, information regarding regulatory framework, policy guidelines, and strategies governing the aquaculture industry in Tanzania. Relevant documents (both regional and global) on aquaculture value chain were reviewed for comparatives assessment and benchmark relative to realities on the ground.

3.2 Sampling Procedures

The study comprised of 32 respondents who consisted of public implementers, private implementers and research institutions. Interviews conducted were in Mbeya, Bukoba, Bunda, Mwanza, Kibaha and Bagamoyo. The sample framework was constructed to give a reflection of aquaculture industry in Tanzania, taking views from those regions with huge potential of aquaculture performance. Below is an illustration of stakeholders interviewed by region/district

<table>
<thead>
<tr>
<th>Name of Organization</th>
<th>No.</th>
<th>Organization</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td><strong>Public Implementers</strong>&lt;br&gt;(Government /Local Government Authorities)**</td>
<td>1.</td>
<td>National Environmental Management Council (Mbeya office)</td>
<td>Mbeya</td>
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<td></td>
<td>2.</td>
<td>Bukoba District Council</td>
<td>Bukoba</td>
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<td></td>
<td>3.</td>
<td>Bunda District Council</td>
<td>Bunda</td>
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<td></td>
<td>4.</td>
<td>Kagera Regional Office, Aquaculture Development Division</td>
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<td></td>
<td>5.</td>
<td>Regional Office, Economic and Productive Department (Fisheries)</td>
<td>Mbeya</td>
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<tr>
<td></td>
<td>6.</td>
<td>Mwanza Regional office, Aquaculture Development Division</td>
<td>Mwanza</td>
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<td></td>
<td>7.</td>
<td>Mbeya Fisheries and Livestock Department</td>
<td>Mbeya</td>
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<td></td>
<td>8.</td>
<td>JWTZ Makoko Musoma</td>
<td>Musoma</td>
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<tr>
<td><strong>Private Implementers</strong></td>
<td>9.</td>
<td>Aqua Soul Fish Farm</td>
<td>Bunda</td>
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<td>10.</td>
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<td>Abeyunge Fish Farm</td>
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<td>Mama Mwakilima Fish Farm</td>
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<td>Adam Mwandambo Fish Farm</td>
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<td>Farajani Bonifasi Fish Farm</td>
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### 3.3 Information from Key Stakeholders

In illustrating the adequate and efficient institutional support for the development of an environmentally responsible aquaculture sector, this study assessed the entire value chain governing aquaculture industry in Tanzania, for adequate analysis the study findings. Information from key stakeholders was gathered through interviews and focus group discussions, and sharing documentary findings from secondary sources.
4.0 MAIN FINDINGS OF THE STUDY

The study has revealed main findings in the areas of status of the aquaculture industry in the country, examined the policy and regulatory frameworks, research and training, examined potentials for growth of the sector and addressed challenges facing the development of the sector.

4.1 Status of Aquaculture Industry

Aquaculture is practiced by both farmer groups and private individuals. Aquaculture species commonly used in Mwanza, Bunda and Kagera is the Nile Tilapia. Aqua farmers owner’s entry into the industry is due to the influence made by aquaculture experts, private certified farmers (through field visits to aqua farmers sites), government and EAC regional influence (Uganda, Kenya). Farmers have linkages with local and international aqua companies from East Africa, Egypt, Thailand, China and Norway. These linkages facilitate access to inputs, technical assistance and consultation services. However, these linkages are rather sporadic and ad hoc. Since the institutionalized arrangement to developing such linkages is still weak it does not yet guarantee sustainability. Fish farming businesses in Mwanza are still new most of them began from 1 to no more than 5 years ago except for Mpanju fish who began its operations in 2012. Fish produce harvested for sale is at 300-400grams with an estimated price per unit at Tshs.1500-Tshs.3,000 and per Kg at Tshs.5,000 -Tshs.6,000. Lake Zone investment opportunities in aquaculture consist of; Installation of fish cages in suitable sites along Lake Victoria; Development of fish ponds; Hatcheries for the production of fingerlings to farmers using fish cages and fish ponds; and manufacturing of fish feeds and supply to fish farmers. However, the scale of investments in fish ponds in Bunda ranges from one pond to seven ponds. On the other hand, Cage fish farming is relatively new in some parts of the lake zone.

For the past 3 years fish farmers have rapidly shifted from ponds to cage farming reaping up to 3 tonnes of fish produce from cages as a result of adoption of improved or new technology

In the Coastal Zone, fingerling production and management is done by government and private sector. The hatcheries are categorized into indoor and outdoor. The indoor hatcheries (most privately owned) have simple technology of tanks, glass jars, and pipe for hatching, most of the hatchery has got no technological equipment like incubatory. Tilapia and brood stocks are cultured in pond and eggs are collected and taken into the hatchery for hatching, then returned to another pond where they are feed with feeds mixed with sex hormone to produce monosex fingerling. The outdoors hatching contains ponds where brood stock are cultured and reproduce and collection of fingerling the stocks density of the parents’ fish differs from one another ranging between 4m$^3$ for Tilapia to 7m$^2$ for catfish. The Indoor hatcheries are characterized by low level of investment and limited power supply this makes them to produce under their capacity thus the total number of fingerlings produced is less than the demand.

**Source of water** is rivers, Steams, Wetlands, and few use water from wells. Some hart experienced the shortage of water during dry season. The knowledge of pond construction is present and most of the ponds are well constructed with required depth of 1.5m, outlet and average size of 200m2. Harvesting is done by total harvesting or partial where nets are typical
gears used storage facility like cold rooms and ice bars, due to power problems the latter is mostly used. Post-harvest loss is prone to farmers as the result of poor storage facilities, forcing farmers to sell their produce at a very low cost to avoid huge loss. In the coastal zone, fish produce harvested for sale is at Tshs.5,000 per Kg for Nile Tilapia while Catfish is sold at Tshs.3,500. Fingerlings on the other hand cost from Tshs.200 to Tshs.300. Source of supplementary feed are sourced locally and from Zambia.

**Brood stock source:** is from both the wild and from breeding stations in Uganda and Thailand for catfish and Tilapia respectively. This increases the expenses for the summers to import the fish parents from outside the country. The wild parents are obtained from Lake Victoria for Tilapia and rivers for catfish in assize of 200-250g and 1000g respectively the detailed information of the five in interviewed is shown below.

**Supply of Fingerlings:** The prices of fingerlings differ where it is more expensive in private hatcheries. Tilapia fingerlings are sold for Tshs.50 in government hatcheries and Tshs.200-300 in private and Catfish for Tshs.200 in Government and Tshs.400-500 in private. Most farms especially in Mbeya region use “Tribulus terrestris extract”. This is a local technology used to retrieve female fingerling from male. Nevertheless, most of the farms use local means of harvesting such as the commonly used was Beach Seine and blast harvesting gear.

**Market:** The farmers interviewed sell their fish to local market and people around the farm, and those whom produce fingerlings are selling fingerlings to neighbor hatchery and small-scale fish farmers. Some of the farmers use weight measures to measure the size of their fish while others still use buckets as a measure.

4.2 **Policy and Regulations for Aquaculture**

The Aquaculture Industry in Tanzania is implemented under the Fisheries Act of 2003 that led to the formulation of National Fisheries and Aquaculture policy of 2015 and Fisheries and Aquaculture Regulations of 2009. Other intersectoral Acts includes Environmental Management Act 2004 and Water Resource Management Act 2009. The governance of Aquaculture industry in Tanzania is provided by Director of Aquaculture Development Division that is under the Ministry of Livestock and Fisheries. Together with the Minister and Permanent Secretary, they play a significant role in the implementation of aquaculture activities in Tanzania.

4.2.1 **Government Department and Institutional Mandates**

The Ministry of Livestock and Fisheries (MoLF) is responsible for the preparation, implementation, monitoring and reviewing of fisheries policies and regulatory frameworks in Tanzania. In addition, the President’s Office-Regional Administration and Local Government (PO-RALG) participates in the implementation of the policies through LGAs. In then LGAs which are staffed with aquaculture officer it was found that the main activities are conducted by extension services and mainly targeted within communities, fish farmers, fishing companies and associated organizations.
Fisheries management is a shared responsibility for both Tanzania mainland and Zanzibar. The MoLF is responsible for the management of inland fisheries and for marine fisheries within the territorial waters of the mainland coastline, and Ministry of Natural Resources, Agriculture Livestock and Fisheries (MNALF) in Zanzibar is responsible for management of territorial waters of Zanzibar and Pemba islands.

The Goal of the Department of Fisheries Development is “to ensure that fisheries resources are developed, managed, conserved and utilized sustainably for economic growth and improved human livelihood.” In addition to the MoLF, there are several institutions that work in the fisheries sector. They work in research, training and development of the fisheries sector. Some of these are; Deep Sea Fishing Authority (DSFA) established by the MALF and MNALF, has overall responsibility for fisheries resource management, including access by foreign vessels.

4.2.2 Underlying Policy and Strategy

Tanzania Development Vision-2025 (URT 1999)4 and the National Strategy for Growth and Reduction of Poverty (NSGRP/MKUKUTA; URT 2005b and 2010)5 articulate the country’s aspiration of reducing poverty. The Tanzania Long Term Perspective Plan in particular the First Five Year Development Plan (2010/11-2015/16) and the Second Five Year Development Plan (2016/17-2020/21) have articulated the growth path towards achieving the TDV 2025 goals (URT 2011). Fisheries development has been pointed out in these frameworks as a source of both income and nutrition.

The National Fisheries Sector Policy Development and Strategy Policy 1997 (URT 1997b ) and the Fisheries Regulations, 2009 (URT 2009a) have been guiding development in this sub sector. The Fisheries Sector Development Programme has the overall goal of developing a sustainable, competitive and more efficient fisheries and aquaculture industry that contributes to the improvement of the livelihoods of stakeholders and the national economy while preserving the environment (URT 2009b).

The Fisheries Policy Statement and Vision is that “By 2025 to have a progressive fisheries sector contributing significantly to socio-economic development through sustainable utilization of fisheries resources while conserving the environment.” The overall objective of the National Fisheries Policy is to develop a robust, competitive and efficient fisheries sector that contributes to food security and nutrition, growth of the national economy and improvement of the wellbeing of fisheries stakeholders while conserving the environment. The National Fisheries Sector Policy and Strategy has been published and accommodates, among others, strategies on the development and promotion of aquaculture sub-sector.

Recognizing the potential contribution of aquaculture towards achieving these goals the government through the Ministry of Agriculture, Livestock and Fisheries has established a Directorate of Aquaculture Division to support the development of this sector. The directorate has already put in place a National Aquaculture Development Strategy (NADS). It is also strengthening the existing freshwater hatchery centres particularly those, which produce Nile tilapia and catfish fingerlings in Morogoro Region.
The National Fisheries Policy is influenced by various other national policy documents listed below, which are; National Research Agenda 2014-2019; National research and Development Policy 2010; The National Integrated Coastal Management Strategy 2003; National Environment Policy; National Water Policy 2002; and National Biotechnology Policy 2010. There are also a number of regional and international conventions including treaty that guide and influence fisheries policies. The conventions include; UNCLOS, RAMSAR, UN MDGs, SADC Fisheries Protocol, CBD, CCRF, CITES, UNCCC, FAO VGSSF among others.

4.2.3 The Current Legal and Regulatory Framework

The Fisheries Act, 2003 is the main legal text for the governance of fisheries in Tanzania. The Fisheries Act is presently under revision to better reflect international best practices in fisheries governance and management. The Act covers the Administration of the Fisheries, Development of the Fisheries and Aquaculture, Fisheries Management and Control, Fish Quality Management and Standards, Financial Provisions, Enforcement and Sanctions and other general provisions related to Environmental Impact Assessments, Research, Exceptions, etc.

The laws are implemented through the Fisheries Regulation 2009, which govern licensing, permits and technical requirements. In particular, the rules related to trade, hygiene and HACCP are well developed to meet the export standard requirements of the EU. Other legislation, which affects the fisheries sector, includes: Tanzania Fisheries Research Institute Act 1980; Deep Sea Fishing Authority Act 2007; Territorial Sea and EEZ Act 1989; Marine Parks and Reserves Act 1994; The National Environment Management Act.

In the recent past concerns have been raised about dwindling fish resources attributed to many factors including climate change (leading to drying up of rivers which used to be important habitats for fish); pollution of water bodies, and unsustainable fishing practices (Juhudi Development, 2012; URT 2013). Overfishing to meet increased demand by fish processing plants as well as continued distress and degradation of spawning sites/areas has contributed to deteriorating yields. As a result, the MALF have published the National Fisheries Policy 2015.

Procedures for Setting Aquaculture Farm: The table below has established the procedures for starting small and larger aquaculture farm in Tanzania. Although these procedures seem to be simple, in practice these procedures for setting aquaculture farm are not well known among the users in the private sector.

**Procedure for Setting Small Aquaculture Farm**

<table>
<thead>
<tr>
<th><strong>Farm Size</strong></th>
<th><strong>Small Fish Scale Fish Farming (&lt; 1Ha)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Authority/Agency</td>
<td>Consultation with Local &amp; District Government Authority</td>
</tr>
<tr>
<td>Person Responsible</td>
<td>District Fisheries Officer</td>
</tr>
<tr>
<td>Information Required</td>
<td>Guidance in regard to their land use plan, water use permit &amp; associated by-laws</td>
</tr>
<tr>
<td>Certification</td>
<td>Permit for Small Scale Aquaculture Farming (QAAPP/14)</td>
</tr>
<tr>
<td></td>
<td>Permit for Aquaculture Farming</td>
</tr>
</tbody>
</table>
### Procedure for Setting Larger/Commercial Aquaculture Farm

<table>
<thead>
<tr>
<th>Farm Size</th>
<th>Larger/ Commercial Fish Farming 5Ha &amp; Above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authority/ Agency</td>
<td>Applying for a permit from Director of Aquaculture as described in QA/APP/14 set out in the fifth schedule of Fisheries regulation 2009Consultation to local &amp; District Government Authority</td>
</tr>
<tr>
<td>Guidance</td>
<td>Land Ownership/Title Deed, Environmental Assessment (PEA) under National Environmental Management Council (NEMC)</td>
</tr>
<tr>
<td>Documents Required</td>
<td>Land Ownership/Title Deed, Environmental Impact Assessment, Layout plan of the Farm, Water Use Rights Permit</td>
</tr>
<tr>
<td>Type of Permit</td>
<td>Permit for Larger Scale Aquaculture Farming (QA/APP/14)</td>
</tr>
<tr>
<td>Approval &amp; Certification</td>
<td>Certificate of Approval for fish or Aquaculture Establishment (QA/APP/14)</td>
</tr>
</tbody>
</table>

#### 4.2.4 Public-Private Dialogue

The institutional mechanism for public-private policy dialogue on aquaculture industry development matters was found to be functioning in a rather ad hoc manner. There is a strong case for ensuring that public-private sector policy dialogue institutional mechanism is institutionalized and made to function regularly. Public-private sector policy dialogue deserves greater support through creating and conducting sufficient and efficient public private dialogue platforms as well as conducting community capacity building exchange support.

#### 4.3 Research and Training

The academic and research institutions that deal with fisheries research and training consist of Sokoine University of Agriculture (SUA), University of Dar es Salaam (UDSM), Tanzania Fisheries Research Institute (TAFIRI) and COSTECH. Their roles include:
- Provision of scientific information;
- Conduct joint research with international fisheries academic and research institutions;
- Accumulate research findings and ensure their dissemination to stakeholders; and
- Advice on utilization, management and conservation of fisheries resources.

The Tanzania Fisheries Research Institute (TAFIRI) carries out research in Fisheries and has its Head-Office in Dar es Salaam. TAFIRI has offices in Mwanza, Kigoma and Kyela. The institute has a number of researchers in the fresh water and marine capture fisheries, aquaculture and mariculture, fish processing and quality as well as social studies in fishing communities. TAFIRI work in collaboration with international organizations such as FAO (has project like SMARTFISH and SWIOFP). In coastal zone, the Fisheries Education and Training Agency (FETA) work with Stakeholders like Ruvu fish farm. FETA also works with Hills Mapinga, Sea weed farmer (Mkulima wa Mwani Usichoke), technical experts and community representatives, through using their site as training place, field extension, buying and selling fish feed, selling of fingerlings and seminars.

The Faculty of Aquatic Sciences and Technology (FAST) at the University of Dar es Salaam, Sokoine University of Agriculture (department of Aquaculture), the Fisheries Education Training Agency (FETA) under the National Council for Technical Education offers courses in Fisheries
and Aquaculture, FETA has centres in Mbegani, Mwanza, Kigoma and Mtwara. Most of the fish farmers reported that they acquired skills from Aquaculture extension Officers, from fishers Agency and other government colleges and university. However, some farmers expressed concern that visits by extension officers were not frequent enough (e.g. one farmer reported that he had not been visited by the extension officer for the last 6 months). Some of them got skills from friends and neighbours fish farmers.

**Knowledge and Skills:** Most of the fish farmers got skills from Aquaculture extension Officers from fishers Agency and other government colleges and university. Some of them got skills from friends and neighbouring fish farmers. The farmers were influenced by various government institution and aquaculture experts to raise the specie. The data obtained from the research indicates that 60% of the farmers access technical advisory services from public institutions and 40% of farmers access these services through private certified farmers and aquaculture experts. Aqua farmers in the coastal zone have experience from a range of one year to 29 years. Farm management and production by fish farmers use pond technology (earthen or concrete) for fish grow out culture.

Main source of fund for extension and other support services is the district fishing charges on licenses, permits, penalties and tax whereby 15% of total revenue obtained from fishing activities remains in the district for supporting fishing activities. These sources of funds do not fully meet requirements of aquaculture development. The shortfall arises from the practice of diverting this source of government budget to finance other activities.

In the Lake zone, Training and skills are acquired from Institutions like TAFIRI and FETA which are effective as the skills have enabled businesses to improve with promising results. Skills development is also acquired from regional training institutions. The number of experts in the aquaculture field is increasing, raising employment in the lake zone as more entrants are investing in aquaculture. However, for the case of Tanzania there is skills gap in feed production.

**Seaweed Farming** in Bagamoyo (Mlingotini); The idea of farming seaweeds in Bagamoyo was developed by Lenadi in 1995, Lenard was extension officer from FETA Mbegani campus. Seaweed is formed by stretching 4m nylon ropes between two pegs the lines are placed 30-45cm apart. A farming group as ‘Mkulima wa Mwani Usichoke’ with 30 members formed following several challenges faced the farmers in the early 2000s. They currently cultivate cottonee seaweed and spino seaweed, Seaweed farmers use seaweed plant to produce different product like Soup, jelly and human traditional medication and others which help to gain income.

### 4.4 Opportunities for Growth

#### 4.4.1 Feed Production

Feed Production: Feeds for Aqua farming is an opportunity whereas currently most of the farmers import feed from other countries. Producing local quality feeds with lower prices will reduce farmers transactional cost hence promote efficiency production.
Due to poor fish feed there is an opportunity of quality feed production. Currently, there are no big feed production factories in the country and small feed producers do not offer quality feed. Farmers opt to import feeds from Egypt, Mauritius, Netherland, Zambia, Kenya etc. However, due to high tax barrier, farmers suffer high cost of production.

4.4.2 Production of Equipment

Fish Farming Equipment: Most of the farming equipment are imported at high cost. Local industries have an opportunity of producing these equipment that the industry needs. Costs of imported equipment is rated high. The locally available nets are purchased from Arusha (Gill Net) but others are imported. Materials are too expensive (TZS 5 Million at the initial stage).

4.4.3 Financial Development

There is an opportunity for financial services in the aquaculture industry. Access to finance is a drawback to the industry. Feed for fish is a high cost for business operation in fish farming. Other set-up costs i.e. fish nets are also very costly. Special arrangement can be made to facilitate farmers where banks can offer farmers credit to enable them meet working capital and investment finance requirements. Working capital requirements include the purchase of items such as feed purchase, nets and investment financing includes such items as building advanced technological hatcheries, improved infrastructure (use of plastic cages instead of steel cages) etc.

4.4.4 Cage Zoning and Conservation

Cage Zoning and Conservation: There is a need for mapping and preserving caging areas. In the Lake Zone caging areas are not mapped and sailors are not restricted in distorting and tempering with cages. Mapping of caging areas and restricting sailors in distorting / tempering with the cages. In the absence of mapped caging areas some private businesses expressed concern over the delay they experience in obtaining operating licences or even permission from village governments to enable the private businesses start operating. Furthermore, the Government can also support in investment in fibre to create safety environment for fishermen as well as reduce taxes to create incentive for investors. Moreover, research and training institutions require strengthening. Simultaneously, the government should work towards increasing the number of training institutions in the zones.

4.4.5 Growing Market

Aquaculture accounts for no more than 8% of the EAC regional consumption. It is important to take an initiative to develop the sector to meet the growing demand for fish considering other factors i.e. population growth, increased income and urbanization. In fostering aquaculture at the regional level, a fish farming project (true-fish) 2019-2024 will be executed in areas covering the Lake Victoria basin; Kenya, Tanzania and Uganda. The aim of the EU-EAC TRUE-FISH programme is to resolve some of the key challenges as well as sustainability risks for the development of market-led, competitive and sustainable commercial aquaculture in the Lake Victoria basin (EAC, N.D). Other objectives include improving access to commercial networks
for aquaculture related businesses and increasing availability and quality of local skilled workers (Ngowi, 2019).

Marketing and Advertising of Fish Produce: Produce are sold locally however, there is an opportunity of unlocking borders by selling it to the EAC regional market to countries like Rwanda and Burundi who don't have Tilapia. In addition, improvement of regional infrastructure i.e. through the standard railway gauge trade will be smooth. In Tanzania, there are regions with no Tilapia (Manyara, Singida and Mbeya) which can be good geographical segment.

International markets such as DRC, Rwanda and Burundi are huge opportunities which has not yet tapped. Reaching these markets will promote productive and hence develop the aquaculture industry at large.

4.5 Challenges Hindering Aquaculture Industry

Farmers are facing many challenges in moving forward aquaculture industry both technical and non-technical challenges.

4.5.1 Policy and Regulations

Policy and regulation reforms are implemented but are not known to the aquaculture stakeholders.

Aquaculture policy implementation strategies need to be improved as the role of the private sector is not supported with adequate incentive of entry. Venturing in aquaculture takes a long process and with costly procedures. Registering procedure requires going through NEMC, TAFIRI and other 3 bodies. Charges are quite expensive. For example, a local aqua-farmer investor can pay Tshs. 15 million with no promise/guarantee whether you will get other approvals meaning it's a blind-gambling investment.

Inadequate Coordination: There is weakness on strategic coordination among government agency and institution. For example, there was less linkage between National Environmental Management Council and LGAs, especially the Environmental Management Department. This is accompanied by lack of strategic collaboration between Fisheries department in Region Commissioner and Fisheries unit at LGAs. The LGAs and TAFIRI were reported to have weak interaction in supporting the aquaculture development in Tanzania. Generally, there is seemingly less horizontal and vertical coordination among key stakeholders in the aquaculture value chain i.e. Hatcher layout, construction of fish pond, fingerling production, market & marketing system and transportation. Inadequate coordination is manifested in the overlapping of the mandate: The agency and department regulating the industry seems to have an overlap in the regulation and implementation of aquaculture aligned rules and regulation, this is complicated by inadequate information sharing. For establishment of larger or commercial aquaculture, someone is required to search for permits from NEMC (EIA report), Land permit from LGAs, Water Basin Authority, EWURA, and TFDA. Overlapping in the mandate is exhibited between agencies and departments responsible for regulating the industry. This challenge is complicated by further by inadequate information sharing. For establishment of larger or commercial aquaculture, someone
is required to search for permits from NEMC (EIA report), Land permit from LGAs, Water Basin Authority, EWURA, and TFDA.

The stakeholder from the private sector expressed concern over the lack of coherent policy and regulatory framework for aquaculture activities. Coordination of aquaculture activities in Tanzania is not accompanied by definite legal framework to guide investment and conservation issues. The activities are coordinated by a multiplicity of regulations and institutions and thus make compliance very costly and difficult.

Inadequate Budget from LGAs; There is inadequate Budget set by LGAs for the development of aquaculture industry in Tanzania. In most cases larger part of the budget in MoLF tend to be directed to Livestock development, this give difficulties for aquaculture staffs making a field visit to Aquaculture sites (they tend to offer visit by using their own saving, and may be twice per annum). In the LGAs, more funds is also allocated to Natural resources managements, because it’s a unit that give most LGAs with direct revenue, no efforts or budget is allocate for establishment of hatchery. It was reported that, staffs in the Aquaculture unit do normally submit the budget for the construction and rehabilitation of hatchery, fish ponds, but eventually there is no disbursement of funds from the LGAs.

Registration, Farmers face challenges in starting this business as it requires numerous permits and procedures, approximately 15 permits and to process all permits may take up to 3 years with the cost of acquiring these permits being substantially high for instance it Ruvu farm had to spend about Tshs. 20 million to have a NEMC permit Limited access of floating seeds. To possess chemicals (potassium permanganate) for treating fungus requires approval from the government's chief chemist. The process is time consuming causing delay in operations.

Aquaculture and fisheries are treated as a single entity but in reality, the two have very different requirements. The needs for fisheries are quite different in comparison to aquaculture. The government has to implement the policies, laws as two separate entities. In transportation, there are issues of double charges in different stops. Some charges change without giving sufficient notification.

### 4.5.2 Access to Inputs

**Access to supply of fingerlings:** there is a problem in the access of fingerling, establishment of hatchery seeds. There are three problems that were mentioned by the farms. First, the quality of fingerlings is low making it take too long for the fish to grow to commercially viable size. The locally managed hatchery that sell fingerling to small farmers do not produce fingerling that are raised basing on standards required. There is no institution that offers quality fingerlings. The available fingerlings that are offered are mixed sex while fish farmers require mono sex. Most of these fingerlings raised tend to have stunted growth a situation which makes it difficult for farmers to farmers to make profits. Second, the option of importing fingerlings is hindered by the import taxes. Third, centres producing fingerlings are located in distant places. Fingerlings need to be transported in a proper transportation condition to avoid draining out that leads to loss from high mortality rate.
**Access to Aquaculture Inputs supply**: there is a problem in the access of fingerling, establishment of hatchery seeds. The Hatchery farm seem to be located distances in Mbeya and Iringa for example are required to look for fingerling from RUIRA (Government hatchery) in Songea (Government), Rungwe (private firm), some are in Tukuyu, Morogoro, Mwanza. Nevertheless, there are locally managed hatchery that sell fingerling to small farmers but this fingerling are not raised basing on standards required, most of these fingerling raised tend to have stunted growth until maturity 3-4 fish can make-up 1kg instead of 1 fish per kg. This does not give a motivation on return invested to small farmer’s standards.

**Shortage, quality and cost of feeds** in Tanzania whereas many feeds produced locally are of lower quality, costly and inadequate supply. In most cases they have less that adequate protein content and the content is often not displayed on the labels on the packages. This leads to low quality fish produced and they take long time to be harvested hence high production costs. It was reported that feeds from Zambia are of better quality than fees from Tanzania. For instance, farmers using feeds from Zambia reported that it takes 5 months for the fish to growth to 300 grams which feeding fingerlings with feed made in Tanzania takes 10 months for the fish to reach 300 grams.

Some farmers produce feeds for their own use using locally available machines to produce both powdery and un-floating pellets. They obtain raw materials from the local market such as cassava flour, rice bran, maize bran and cotton seed cakes. The cost of production is still rated high (at around Tshs.3,000 Tshs./kg) for the formulated feed from the producers. This is still too costly for small farms to be profitable.

The chain of production from storage of raw materials to the drying of processed pellets makes the feed exposed to contamination and loss of nutrients. The raw materials and feeds are stored in polythene bags and sometimes kept direct to the floor where the moisture can cause moulds due to high temperature.

Some farmers seek to pursue the option of feed imports but this option is rendered less attractive because of high import taxes. Feed is imported from Uganda and Zambia but it is costly. Nevertheless, if feed were to be imported directly or produced in-country it would reduce production cost.

### 4.5.3 Investment and Finance

**Capital and access to finance** poses a challenge to aqua farmers as the business itself has a lot of requirements and most farmers don’t have enough capital to meet them. There is the challenge of meeting collateral requirements, affording the high interest rates, lack of investment finance and absence of grace period to allow for production to take place.
4.5.4 Research and Training

In this study findings have revealed, despite having academic research institutions skills are not fully utilized as training received is not practised as intended. For example, some fish farmers have received training in feed production but the knowledge is not utilized since there is skills gap in fingerlings production. Consequently, high quality feed inputs are produced by foreigners.

Though there is an increasing number of people employed in aquaculture sector, most local farmers employed have no knowledge of best aqua-farming practices. Even skilled fisheries graduates have no information of cage farming, they are only exposed ponds. There is a need for training and sensitization on safety and security. Working conditions of fish farmers could be improved by improved transportation, modern life jackets, shelter at the farm and reasonable pay.
5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Aquaculture is a fast-growing food production sector and demand for its products is rising fast. Tanzania has great potentials for aquaculture growth because of its conducive natural conditions. The emerging challenge for the aquaculture industry is finding a way to balance the drive for economic growth with fulfilling the promise of aquaculture as a tool for social and economic empowerment. This study has shown that the Tanzania aquaculture industry can contribute much more to economic development provided institutional support for the development of an environmentally responsible aquaculture sector is available. The study has revealed main findings in the areas of status of the aquaculture industry in the country, examined the policy and regulatory frameworks, research and training, examined potentials for growth of the sector and addressed challenges facing the development of the sector. There is an opportunity for developing this industry if appropriate action is taken. Appropriate actions are presented in the form of recommendations.

5.2 Recommendations

5.2.1 Improving Business Enabling Environment

- The government should empower research and training institutions to do better research in quality fingerlings. On the other hand, as a short-term emergent strategy, the government should consider possibility of importing quality fingerlings provided that it is the same species as locally farmed/available species. Conversely, training provided by training institutions should be upgraded to meet new technological advancement to improve locally capacity and practical use of knowledge attained. The Government should facilitate research institutions like TAFIRI to conduct a feasibility study and mapping of areas to conduct aqua-farming so as to not leave the burden to farmers.

- Improvement of the business environment by ensuring importation of quality fingerlings; tax exemption in cage nets and fish feed; and subsidy on fingerling to boost the industry. Moreover, improved working conditions of fish farmers could be improved by improved transportation, modern life jackets, shelter at the farm and reasonable pay. Chemicals for treating infections like fungus should be available on time.

- The Government could also invite feed investors in the country to support the industry. This will also allow controlling/ have an eye on safety production process unlike when feed is done oversees. They should also sensitize plastic industry to support and promote cage farmers by producing quality plastic cages that can withstand climate change (heavy waves) as well as other environmental treats like sea otter and water hyacinth.
• Aquaculture and fisheries should be regulated, monitored and supported according to its difference in nature to reap the option benefit from the two complementary sectors. Charges should be clear and transparent and reasonable and elimination of non-tariff barriers that lead to double charges.

5.2.2 Policies and Regulations

• Develop data system for easy access of information and data for planning and decisions making.

• Create linkage between stake holders and government institutions government research, university, NGOs, farmers for easy dissemination of information and knowledge sharing.

• Regular review and harmonization of policies, regulations legislation to meet the current needs. The policy provided should be implemented as intended to help farmers to reach their goals and this should be insisted by the Government.

• Policy and regulation reforms are implemented but are not known to the aquaculture stakeholders. Thus, working on public and private Aquaculture dialogue platform is highly recommended.

• Promote the establishment of fish farmers associations, so that it can be easy for the farmers to access loans to reached in other services, this also can-do business among the selves and it can help control of seeds and feed prices since the farmers will have one say through their association.

5.2.3 Markets and Inputs

• Market is still a problem whereas huge markets such as Congo and Uganda are still untapped. There is a need to establish a strong connection between the governments in these countries so as to link farmers and business people in both sides to enhance a flow of aqua produce between these markets.

• International market linkages for farmers where fish farmers can have assured market locally and internationally. This could include, promotion of local and foreign investors to invest in feeds production industries by subsiding the industries to ensure they meet international quality standards and produce at lower cost.

• Develop well organized market system for insurance of market and good prices. This could also require developing of regular extension network by involving all services providers to reach more farmers.
- Market access improvements particularly combined with organizational improvements - can generate further value for farm products. Such improvements may also open opportunities for cooperation with larger customers and new markets and may create incentives for better management, through, for instance, meeting certification standards.

### 5.2.4 Research and Skill Development

- Establishment of breeding program for assurance of affordable brood stock and eliminating dependency of brood stock from the wild. Promote affordable technology e.g. simple indoor hatcheries chaps flushing eggs from the female and take them into incubatory and promote the use of solar power to overcome electricity problem. Ova prim hormone, Androgen hormone should to be sold in our country which will help in quality seed production. Farmer should be allowed to produce these hormones locally under a controlled system.

- Increase accessibility to quality fingerlings by establishing of hatcheries that will be distributed all around the country this decrease stressful and expensive transport of life fish. Develop regular extension network by involving all services providers to reach more farmers.

- Increase knowledge in farm management skills water quality, feed and feeding, factory affecting growth. Increase accessibility of quality and affordable seeds and feed by establishing more hatcheries and feed producers across the country.

### 5.2.5 Building Partnerships

- Building Partnerships: Partnerships are important in increasing the likelihood of success with smallholder aquaculture enterprises. Public agencies, private investors and smallholders and their organizations bring different skills and resources and these complementary partnerships can reduce risk and increase the overall chances of success. Coalition building and creating partnerships for investment in smallholder aquaculture and ensuring such coalitions have access to the resources and skills they need to cover all categories of investment and manage risk more effectively.

- Investments in “organizational glue” by improving horizontal linkages so that smallholders can form farmers groups. And promote establishment of vertical arrangements with buyers and suppliers, are often necessary. Collectively, farmers can create economies of scale for access to goods and services and improve bargaining power, improve management systems, build social capital and create more equitable relations with input and output markets.
5.2.6 Delivering Professional Services

- Investment in intermediary organizations to deliver professional services to smallholders and enable strength security and bargaining power through cooperation. There are opportunities for emerging ideas of social enterprise to be applied to the business of smallholder oriented organisations. Networking arrangements can produce greater economies of scale and the sharing of experiences across wider networks can be used to advocate for greater awareness of investment and change in smallholder aquaculture.

5.2.7 Investment and Financing

- Investments in production facilities (e.g. ponds, cages), infrastructure, input supplies (e.g. hatcheries) and post-harvest facilities may be necessary to improve farm performance and add value to products and the small holder business. Such improvements will often require access to loans with longer pay back periods. The right combination of these types of investment and a viable business should be at the core of financing schemes for small holder aquaculture.

- Developing investment funds and financing mechanisms for smallholder aquaculture enterprises. There are a number of investment funds from government and philanthropic sources. Their impact can be increased through partnerships and packaging of the investments in ways that cover the spectrum of needs across the “improvement pathway”.