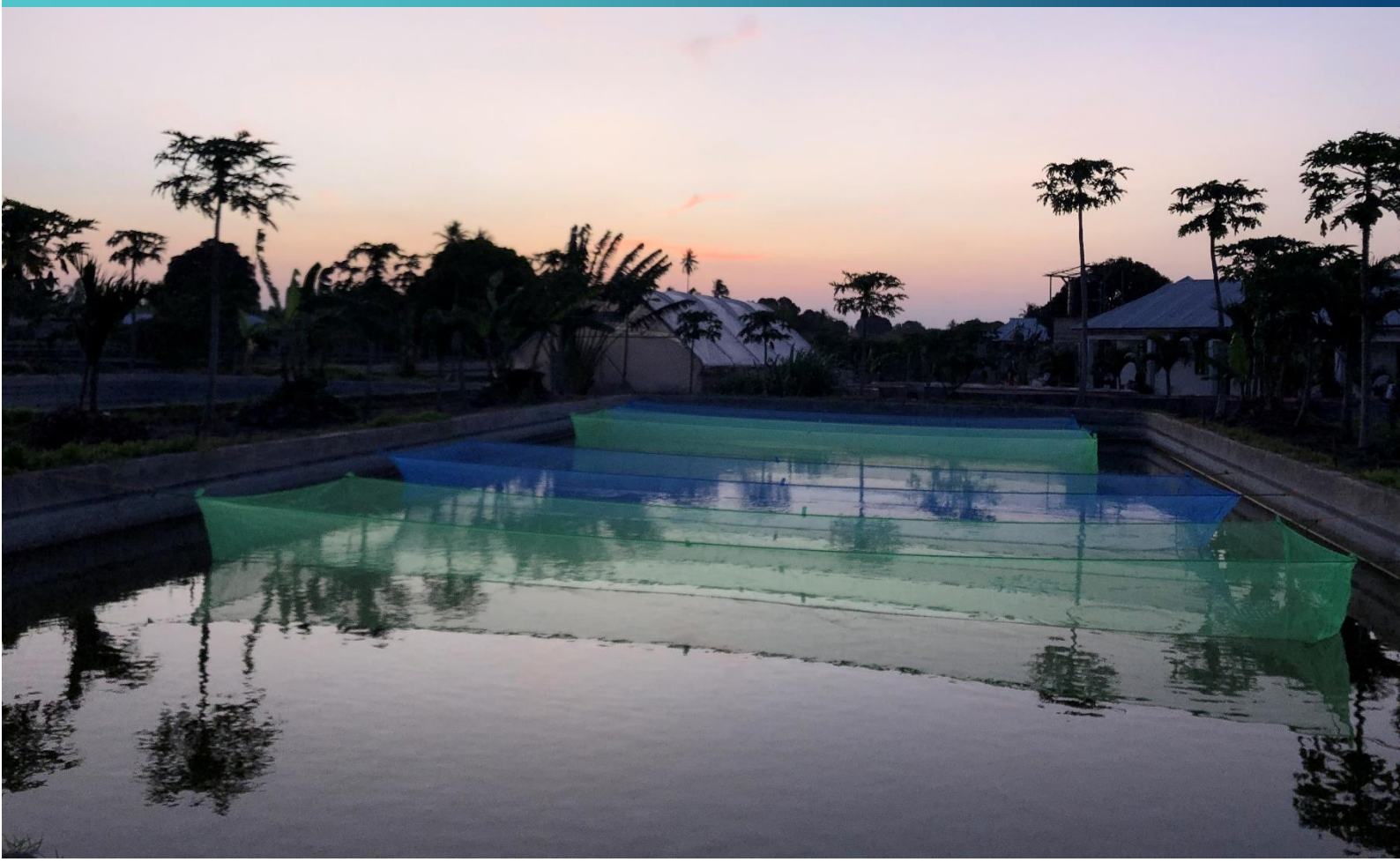

Inception Study Aquaculture Sector Tanzania

Identifying opportunities for Dutch - Tanzanian public and private sector cooperation

Date : May 2019
Version : Final Report

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About this report

This report contains the results of the Inception Study which was conducted in Tanzania in 2019 by Larive International and Lattice Aqua. The report presents the findings of both a desk study and a comprehensive set of field interviews which were conducted with aquaculture industry experts, farmers, public and private stakeholders in Tanzania and interviews with Dutch aquaculture experts. The study was commissioned by the Embassy of the Kingdom of the Netherlands in Tanzania.

Key words: aquaculture; fish farming; aquaculture value chain; sector development; Tanzania; East Africa; cage farming; RAS farming; pond farming.

Picture cover: Big Fish pond farm in Kigamboni, Tanzania (picture by Wouter van Vliet, Inception Study team member).

Foreword

Aquaculture has the potential to become a key driver for a food secure nation and can assure general economic development. Tanzania is blessed with the natural conditions and entrepreneurs which can build the sector into one of the cornerstones of Tanzania's agriculture sector. Today, an estimated 20,000 people find employment and livelihoods in the freshwater aquaculture sector.

Increasingly, Tanzanian and international stakeholders recognize this potential, triggering investments along the entire value chain. Also, the Netherlands government is proud to contribute to its development by supporting the development of a demonstration fish farm, showcasing Dutch innovative aquaculture technology and transferring practical skills and knowledge.

The sector should have the ambition to continue and increase its current growth. This will require continued attention to several areas along the value chain and the enabling environment. Tanzanian stakeholders established an aquaculture working group in 2018 which pointed out specific priority areas which include training, farmer inputs and policy development. This study builds on these priority areas and help to inform sector stakeholders not only on the status of the aquaculture sector but also formulates specific recommendations.

Furthermore, this study can hopefully encourage future Dutch-Tanzanian cooperation in the aquaculture sector. Concretely, it may serve as input for a Memorandum of Understanding on aquaculture cooperation between Tanzanian and the Netherlands. The report therefore has a special focus on areas where Dutch-Tanzanian stakeholders can cooperate and together build a bright future for Tanzania's aquaculture sector.

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Contents

Abbreviations

AAT	Aquaculture Association of Tanzania
ACBF	African Capacity Building Foundation
ANEA	Aquaculture Network of East Africa
AWG	Aquaculture working group
BMP	Best Management Practices
COSTECH	Tanzanian Commission of Science and Technology
DAARS	Department of Animal, Aquaculture and Range Science (Sokoine)
DANIDA	Danish International Development Agency
EAC	East African Community
EIA	Environmental Impact Assessment
ESRF	Economic and Social Research Foundation
FCR	Feed Conversion Rate
FETA	Fisheries Education Training Agency
FTA	FoodTechAfrica
LVFO	Lake Victoria Fisheries Organisation
LTA	Lake Tanganyika Authority
IDRC	International Development Research Centre
IOA	Indian Ocean Aquaculture
MALF	Ministry of Agriculture Livestock and Fisheries
MLF	Ministry of Livestock and Fisheries
NADS	National Aquaculture Development Strategy
NORAD	Norwegian Agency for Development Cooperation
UDOM	University of Dodoma
UDSM	University of Dar es Salaam
RAS	Recirculation aquaculture Systems
RVA	Rift Valley Aquaculture Ltd.
SUA	Sokoine University of Agriculture
TAFIRI	Tanzania Fisheries Research Institute
TBS	Tanzania Bureau of Standards
UNDP	United Nations Development Programme

Management Summary

Tanzania's aquaculture sector offers vast potential for growth. Its climate is ideal for fish farming and the demand for fish is rapidly rising due to population growth and rising incomes. Wild catch is decreasingly unable to meet the rising demand as natural water bodies are overfished. These combined factors have been driving up fish prices, making fish less affordable for the lower- and middle-income segments of the population. These combined forces result in an estimated fish demand deficit of 480,000 tons per annum representing both a food security issue but at the same time an economic opportunity for locally farmed fish. Despite its potential and widely recognized importance, this study identified several areas which require improvement for the sector to unlock its full potential.

Today, aquaculture in Tanzania is mostly a small-scale activity and usually not practiced as a stand-alone economic activity, but rather as subsistence farming integrated with other agricultural activities. Together, farmers produced around 3,240 tons of fish in 2014, growing from 1,522 tons in 2007, representing a small but growing sector. Women make up the majority of businesses and jobs in the value chain as they work on fish farms but also dominate the fish processing and fish trade in Tanzania.

The Tanzanian government actively supports sector growth by developing a dedicated aquaculture development policy. A dedicated law to support the sector and an aquaculture working group testify of the government's strong ambition and commitment to the sector. The government's main goal is to support commercial fish farms that will produce quality fish products in large quantities for both export and the domestic market. This study identified several concrete regulatory improvements with regards to import regulation, licensing and permits, zoning of cage farm activity and VAT regimes for feeds. Involving sector stakeholders into policy development can be facilitated through the Aquaculture Association of Tanzania and a permanent Aquaculture Working Group.

This study identified a need to develop practical and market-oriented capacity among universities, training institutes and private sector staff. This situation can be improved by integrating a "learning-by-doing" approach in the educational sector. Also talented university graduates should be stimulated to take on operational jobs in the private sector.

The sector does not yet offer the required economies of scale to warrant the investment in a large-scale feed factory. Therefore, a conducive import and tax regime with regards to feed imports is required. National demand for seeds is estimated at 30 million fingerlings, whereas current production stands at a mere 5 million fingerlings. Besides increased volumes there is a need for genetic improvement programs and optimization of hatchery management practices.

The extensive nature of pond farms is reflected in some studies estimating the production per hectare as low as 1.8 kg/ha.[1] Given Tanzania's fish demand gap (480,000 tons), this means that a staggering 90 to 266 million hectares of land will be needed to close the gap, even without considering future

[1] Shoko, A. P. A., Matola, H. D. Mzighani, S. & Mahika, G. C. (2011a) Fishpond Performance of Nile Tilapia Oreochromis niloticus (Linnaeus, 1758) in the Lake Victoria Basin, Tanzania. Journal of Aquaculture in the Tropics: 26 (1-2).

demand growth. It needs no argumentation that small-scale extensive pond farming with current technologies and practices provides no answer to Tanzania's food security challenges. Fish marketing is mostly a small scale and local activity with 91 percent of farmers selling their harvest within their own locality. The most optimal product-market combination for pond farmers seems small sized (<500 grams) tilapia which as they are efficient to produce and find a ready market among mid-income and lower income consumers. Access to finance is not challenged by the absence of financing institutions or financial products but mainly by the lack of bankable business cases, offering a low risk profile.

Several promising private sector initiatives have been identified which function as "light house" projects and serve as successful examples for the wider sector. These private sector initiatives play an important role with regards to production of inputs (fingerlings), distribution of quality feeds and are a training and employment base for aquaculture graduates. Several effective donor-driven initiatives were identified, focussing mostly on research, knowledge and skill transfer, input improvement and introduction of best practices.

The study analyzed which development opportunities can be addressed by joint Dutch – Tanzanian public and private stakeholder intervention:

1. Vocational knowledge and skills improvement program fish farming
2. Tilapia and catfish genetics improvement program
3. Hatchery management training program
4. Hatchery Mwanza region feasibility study
5. Feed management training program
6. Fish branding and marketing strategy and training
7. Cold store pilot
8. Fish meal processing feasibility study
9. Aquaculture Hub development
10. Improvement of regulatory framework
11. Dedicated aquaculture policy
12. Improvement of sector organisation and coordination of the sector

1. Introduction

1.1. Background to the study

Tanzania's aquaculture sector offers vast potential for growth. However, despite the clear opportunity for local fish production, the sector has not yet unlocked its full potential. Tanzania's government institutions have made significant efforts to build the aquaculture sector. Specific policy targets are outlined in the government's economic development agenda which include a range of government interventions under different initiatives, such as the start of a degree program in aquaculture; establishment of rules and regulations to guide and protect the sector as well as to promote various initiatives in aquaculture. Despite positive early outcomes, including raising the production level of fish in freshwaters ponds, Tanzania will need to make additional progress to meet its targets in the economic development agenda.

Dutch-Tanzanian collaboration

The Ministry of Livestock and Fisheries of Tanzania ("the Ministry") has joined hands with the Embassy of the Kingdom of the Netherlands in Tanzania ("the Embassy") and explore opportunities for collaboration on aquaculture development. To this end, a mission was organised in August 2018 by the Embassy and the Ministry to Kenya. The mission's delegation comprised of key public and private sector stakeholders (list in Annex 3), together making up a representative aquaculture working group. The objective of the mission was to exchange ideas on sector development and share lessons learned with Kenyan and Dutch stakeholders. The mission visited innovative fish farms and a fish feed factory and inspired the participants to bring about more synergy between the two countries and accelerate the development of the sector by building on transferable best practices. The mission was followed-up by an Aquaculture working group workshop (25-28 September 2018) in Morogoro, Tanzania to discuss a road map for the aquaculture sector in Tanzania towards 2023.

The key issues singled out in the Aquaculture working group workshop are:

1. The existing knowledge gap within the sector and lack of practical skills
2. Poor access to affordable quality fish feed and seed
3. Inadequate sector coordination and market linkages
4. The challenging business environment due to imported fish, tax regimes and high cost of inputs

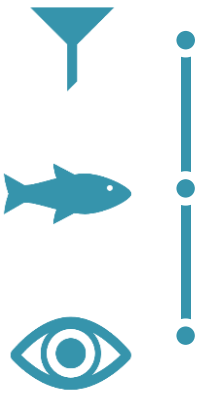
The delegation expressed the need to study the opportunities for further development of the sector in more detail. Specifically, the identification of opportunities which are currently insufficiently met by existing public and private sector initiatives is needed. The ambition of such study is to pinpoint specific opportunities which can be addressed by joint Tanzanian – Dutch cooperation. Hence, the study has formulated recommendations, linking to specific capabilities of Dutch – Tanzanian stakeholders.

1.2. Objectives of the Inception Study

The overall objective of the study is to identify commercial freshwater aquaculture development targets of the Tanzanian government which are not or insufficiently met by existing development initiatives and programs. Subsequently, opportunities for Dutch public and private stakeholders to play a role in the development of the sector are identified and formulated.

1.3. Structure of the report

The inception study first identifies the main development opportunities in reaching the targets outlined in the economic development agenda of the Tanzanian government regarding the growth of the aquaculture sector. Secondly, ongoing and planned development initiatives have been identified. The analysis then identified which development opportunities are covered by existing and planned initiatives and which opportunities are not covered. Finally, capabilities of Dutch private and public sector stakeholders to act on those development opportunities are translated into concrete follow-up recommendations.



Phase 1: Identification of development opportunities

Phase 2: Review of current and planned development initiatives

Phase 3: Analysis of remaining challenges

1.4. Approach and research methodology

Phase 1: Identification of development opportunities
A value chain approach is adopted, ranging from inputs, production, processing, market linkages and the enabling environment. Focal areas have been distilled and analysed in terms of importance to the development of local farmer input and fish production for the local market. The emphasis has been on fish species which offer high returns with regards to animal protein production. Mariculture and wildcatch (fisheries) are excluded from the scope of this study.

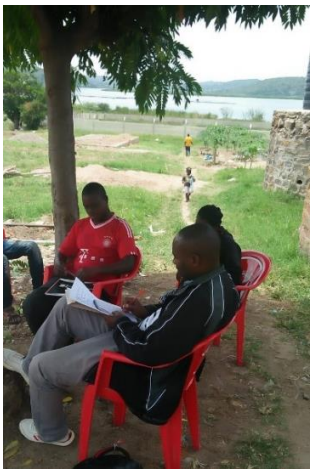
Methodology. The high-level identification of development opportunities is based on desk research of recent reports and policy documents produced by governments, educational institutes, international (development) organisations, private sector and others. The findings from the desk research have been followed up by 38 interviews with independent industry experts, farmers and development agencies.

Phase 2: Review of development initiatives
Alignment between stakeholders in the sector is a crucial starting point for effective development. Several aquaculture development efforts are underway or being developed for Tanzania. Also, private sector initiatives have been included in the analysis. The inception study has reviewed these initiatives and determine how they contribute to the development of the aquaculture sector. Interventions by the development initiatives are related to the development opportunities identified by this study where possible.

Methodology. The review of country-wide development initiatives is primarily executed through interviews with key representatives and were guided by a pre-developed questionnaire (see Annex 1.).

Phase 3: Analysis of remaining development opportunities
New areas of intervention as well as collaboration with existing initiatives will be included into the analysis. This part of the study has been summarized into a comprehensible matrix. The analysis of development opportunities has resulted in the identification of ten concrete interventions.





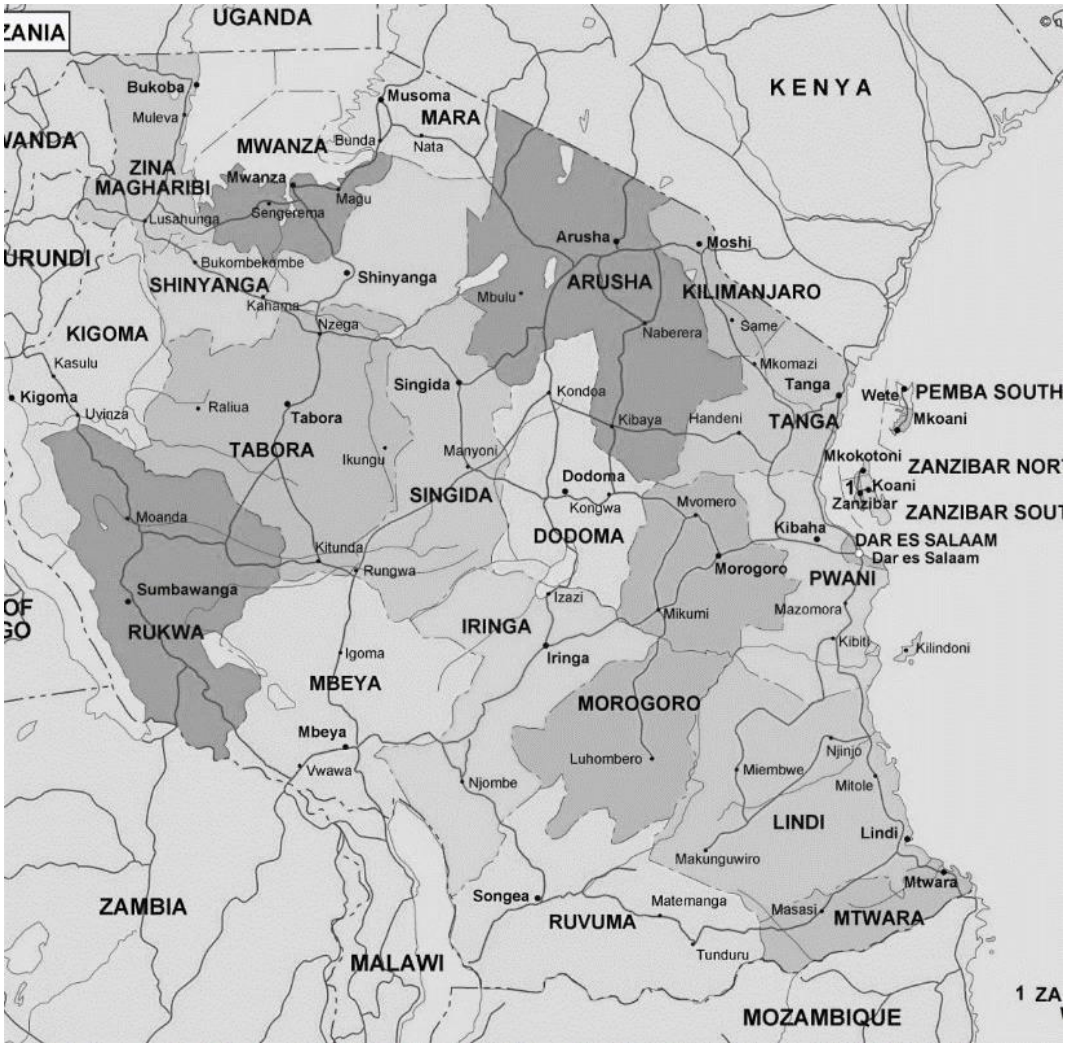
Picture: Inception Study team members conducting expert interviews with cage farmers in Mwanza Region.

2. Findings

2.1. Context analysis

Introduction to the market

Tanzania has great potential for aquaculture production. Its climate is ideal for farming indigenous fish species including tilapia and African catfish, being the favoured species for Tanzania's lower- and middle-income classes. Market demand for fish is growing rapidly due to population growth and rising incomes. However, supply from wild catch is dwindling as natural water bodies are overfished and enforcement of regulations on fishing is limited at best. This situation results in an estimated fish demand deficit of 480,000 tons per annum.[2] These combined factors have been driving up fish prices, making fish less affordable for the lower- and middle-income segments of the population. This development presents both a food security issue but at the same time an economic opportunity to supply the market with locally produced fish.



[2] Ministry of Livestock and Fisheries

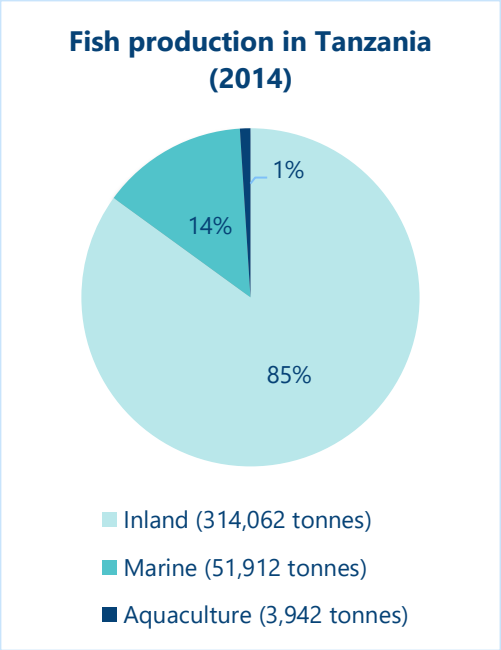
Map: Tanzania's regions. Cage farming is mostly done in Mwanza and Mara regions. Most commercial pond farming in Eastern Tanzania.

The population in Tanzania is growing and developing economically driving the increasing demand for sustainable animal protein. The annual fish consumption in Tanzanian is estimated at 7-8 kg per capita, being much lower than the global average consumption of 20 kg but close to average African per capita consumption of 8 kg per year, indicating the large market potential.

Export of tilapia from Tanzania is banned. Import of fish has been allowed on the basis that it contributes to food security as fish contributes up to 30 percent of animal protein intake of the population.

Production

Tanzania is currently mainly relying on inland fisheries from Lake Victoria (85 percent) and marine fisheries (14 percent) for its fish consumption. Only around 1 percent, or 3,942 tonnes is produced by aquaculture.[3] It should be noted that these are general official estimates. However, the actual production volumes may differ.



Source: Fisheries Statistics 2014 and Department of Fisheries Development, MALF

It is expected that wild catch volumes from Lake Victoria will drop significantly in the coming years, as is the case in Kenya, Rwanda and Uganda. Official FAO statistics for example show a 7 percent decline in neighbouring Uganda, although unofficial figures range between 10 percent and 30 percent of output decline for Tilapia. Reasons include overfishing, increasing pollution around urban areas, lack of fishing regulations (both on national and regional level) and lack of enforcement. Therefore, the growing demand gap will have to be filled by (a) imports (b) local production in Tanzania or (c) substitutes of other protein sources (i.e. poultry). The demand deficit will also drive up fish market prices and make fish farming a more lucrative business.

Today, aquaculture in Tanzania is mostly a small-scale activity and usually not practiced as a stand-alone economic activity, but rather as subsistence farming integrated with agricultural activities such as horticulture and rearing of livestock. For the farmers that have taken up aquaculture, Nile Tilapia (Oreochromis niloticus) is the main freshwater fish produced. Up until 2014 it accounted for ~80 percent) of fish production from aquaculture. The number of farmers involved in tilapia production is 17,725, operating 20,235 of ponds, indicating the small average number of ponds per farmer.[3] Together the farmers produced around 3,942 tons in 2014, growing from 1,522 tons in 2007, showing a small but growing sector.

[3] Fisheries Statistics 2014 and Department of Fisheries Development, MALF

Fish farming is generally not viewed as an economically viable venture with a majority of producers using family labour to carry out farming activities. As a result, little time, labour and money are invested into the sector. Women make up the majority of businesses and jobs in the value chain as they work on fish farms but also dominate the fish processing and fish trade in Tanzania.

Although freshwater fish farming is mostly a smallholder and subsistence activity, there are some notable exceptions of larger commercial farms who operate between five and forty ponds. Several areas have been designated by the Tanzanian government as aquaculture development areas, including the strip of land along the Ruvu river, about 80 km north of Dar es Salaam. Being close to a source of fingerlings and/or fish feed clearly stimulates the development of such farms. For example, around Ruvu Fish Farm, several smaller pond farm have sprung up, sourcing both feed and fingerlings from Ruvu, as well as basic knowledge on pond construction and farming practices.

Some cage farms are operational or being established on Lake Victoria in Mwanza, Bukoba and Bunda districts. Cage farming requires relatively low investment capital. However, it comes with a number of environmental and logistical challenges, including the degradation of the local ecosystems and the large distance from Lake Victoria to the main urban centres in Eastern Tanzania where the most lucrative fish markets are. Furthermore, cage farming requires considerable working capital as cages are relatively large and a lot of feed is needed to grow fish until harvest size. The logistical costs associated with transport from the lake area to the market are significant and generally traders take the fish across Tanzania, with little or no cooling as flaked ice at point of harvest is generally not available.

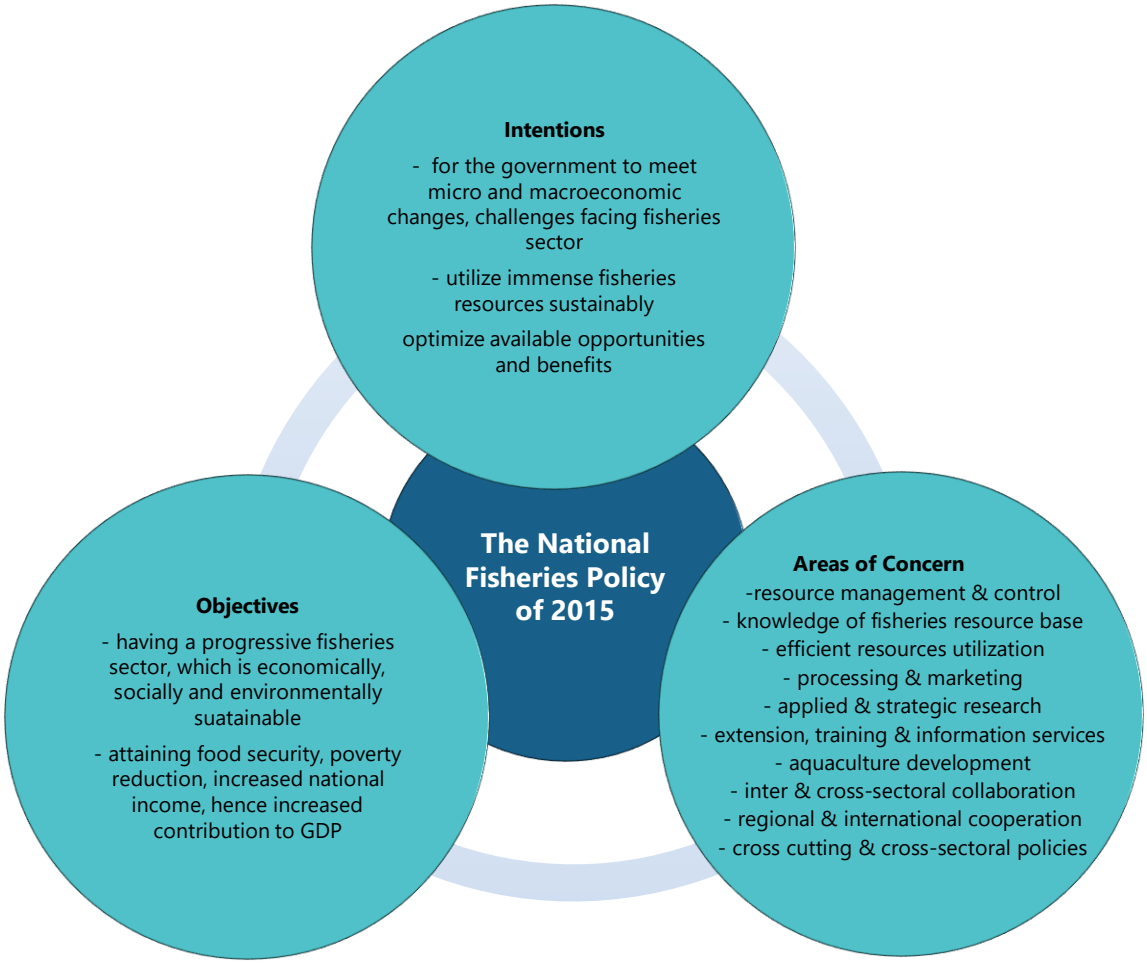
Government policy

The Tanzanian government prioritizes the development of the agricultural and fisheries sectors. Within the Tanzanian government, The Ministry of Livestock and Fisheries is responsible for the development of the aquaculture sector. Within the Ministry, there is the Department of Fisheries Development which has a dedicated Aquaculture Department (or Directorate of Aquaculture) who operates fifteen Aquaculture Centres throughout the country.

In October 2015, the Ministry published the National Fisheries Policy, again with a clear focus on the development of the national aquaculture sector.

The overall vision of the Ministry is to develop an aquaculture sector that is commercially run, vibrant, diversified and sustainable using highly productive resources to ensure food security and nutrition, employment and improved income for the households and nation at large while conserving the environment. Tanzania's goal is to have private sector commercial fish farms that will produce quality fish products in large quantity for both export and the domestic market.[4]

[4] Ministry of Livestock and Fisheries. Catfish guidelines



Furthermore, a National Aquaculture Development Strategy (NADS) has been developed by the government. The strategy covers a period of fifteen years (2008/9-2022/23) and has the purpose to increase the levels of production and benefits from the aquaculture industry. The vision of NADS is to: Establish vibrant diversified sustainable aquaculture businesses which will last for 15 years, starting from 2008/09 to 2022/2023. The mission of NADS is to:

- Promote private - public - government partnership which will expand aquaculture sub-sector hence creation of employment.
- Develop sustainable aquaculture business which will contribute to social-economic welfare of national and coastal communities.

In January 2019, the Ministry started the preparation of a concept note on the "development of sustainable aquaculture value chain in Tanzania". The overall objective is to increase quantity, quality and commercially oriented production of aquaculture products, while conserving the environment, to satisfy domestic and external market demands, raise income of farmers and the nation. Four goals are specifically addressed:

1. Strengthen the delivery of aquaculture extension services.
2. Increase the capacity of producing aquaculture seeds.
3. Enhance aquaculture feed production.
4. Promote and enhance commercial aquaculture production.

The aquaculture sector is relatively new to Tanzania which is reflected in its current regulatory framework. However, the government has recognizes the potential of aquaculture and the need for a dedicated aquaculture law and regulatory framework. Hence, a new aquaculture law is being developed which caters to the specific needs of the sector. Furthermore, the government has formed a aquaculture working group which testifies their ambition and commitment to the sector.

On the ground, the Ministry has worked on improvement of the enabling environment for aquaculture businesses. The Ministry is strengthening the existing freshwater hatchery centres, which are currently seven, especially those that produce tilapia and catfish fingerlings.[5] In addition, the Ministry has established three aquaculture centres in Tabora, Lindi and Tanga to serve their respective zones.

Education

The Sokoine University (SUA) and Dar es Salaam University (UDSM) and the School of Biological Sciences in the College of Natural and Mathematical Sciences of the University of Dodoma (UDOM) offer programs on Aquatic Sciences and Aquaculture. Vocational training is primarily provided by the Fisheries Education Training Agency (FETA), offering courses in fishing technology, aquaculture, fish processing, quality control and coastal resource management. Please find a more detailed analysis of the education sector in chapter 2.2.1.

[5] Shoko A.P. et al, The status and Development of Aquaculture in Tanzania, East Africa, 2011

2.2. Identification of development opportunities

Several aquaculture development opportunities are identified through interviews with key stakeholders from public institutions, universities, NGO's and private sector players (interviewee list in Annex 2). The selection of development opportunities is based on the focal points as identified by the Aquaculture working group (AWG).[6]

2.2.1. Knowledge and skills (education, training and research)

Education and training

Proper knowledge and (practical) skills is probably the most essential building block for a thriving Tanzanian aquaculture sector. Given that the private sector is the main driver for sector growth, it is important that the aquaculture sector can attract well-trained staff. This study found that well-trained staff is hard to find. Although two universities offer aquaculture educational programs, they deliver a limited number of students to the sector. Furthermore, graduates lack practical skills and oftentimes need months of intensive practical training before they their skills match the industry requirements. This is partially caused by the lack of facilities where the student can acquire vocational skills (for example, a functional hatchery for training purposes). Furthermore, it was found that many university students do not have the ambition to work in a fish farm, hatchery or feed mill but prefer employment with government institutions or international NGO's.

Respondents mentioned several knowledge and skill gaps which virtually covers the entire value chain. Gaps included practical capacity on cage farming, feed production and management, hatchery management, basic farm management, water quality management and (semi-)intensive farming technologies. Need for cage farming skills was pointed out by several respondents as this is where most of the current sector growth is taking place whereas education and training institutes remain primarily focussed on pond culture. Given that Tanzania is a large country, it was found that knowledge on best practises (through extension services) do not reach the farmers countrywide.

Sokoine University (SUA), Dar es Salaam University (UDSM) and the School of Biological Sciences in the College of Natural and Mathematical Sciences of the University of Dodoma (UDOM) offer aquaculture programs. SUA has the Department of Animal, Aquaculture and Range Sciences, UDSM has the department of Aquatic Sciences and Fisheries responsible for aquaculture-related courses. ODUM has a program on Aquaculture and Aquatic Sciences.

Practical or vocational training in fisheries (including aquaculture) is provided by the Fisheries Education Training Agency (FETA), offering trainees courses in fishing technology, aquaculture, fish processing, quality control and coastal resource management. FETA has four centres in Mwanza, Gabimori, Kigoma and Bagamoyo. Although the national government prioritizes vocational aquaculture training, this is not sufficiently translated into the development of basic practical skills required by the aquaculture sector. This is partially caused by a lack of exposure of the FETA staff to global best practises, hence leading to shortcomings in the vocational training programs. FETA is

[6] National Aquaculture Technical Committee (NATC). Draft version "Aquaculture Sector in Tanzania: A Road Map to 2023". October 2018.

originally focussed on education and training in fisheries and only recently has expanded its scope to include aquaculture. To develop capacity, FETA staff is among others deployed at commercial farms, including Ruvu Fish farm. Furthermore, FETA has no practical training facilities such as laboratories for testing water quality, the preparation of quality fish feeds and basic aquatic animal health diagnostics, proximate analysis for feeds, fish cages, feed production equipment or recirculating aquaculture systems. Whilst interviewing at the FETA location in Bagamoyo, we learned that further investment on site was blocked due to the facilities being located at a site being considered as a possible greenfield location for the future sea harbour (currently located in Dar es Salaam).

Research
The government has mandated the Tanzania Fisheries Research Institute (TAFIRI) with research programs on fisheries and aquaculture. Its research topics include stock assessment and fisheries statistics, fish biology, hydrobiology and water pollution, gear technology, aquatic ecosystems and biodiversity, climate change and environment, capture fisheries, aquaculture, socio economics and marketing. Four research centres in Dar es Salaam, Mwanza, Kigoma and Kyela, and one substation are set up throughout the country. Furthermore, TAFIRI provides training programs to the sector.

During interviews with stakeholders, the main challenge highlighted for good-quality aquaculture research is the lack of sufficient and consistent state funding. This necessitates researches to rely on research projects financed by international donor organisations. Although the donor-issued projects are much welcomed, they prevent researchers to develop a long-term strategy and build a permanent organisation. Furthermore, donor-driven research is oftentimes not focussed at the needs of the commercial aquaculture sector but rather on subsistence farming.

Various research needs were mentioned by interviewees and include cage farm development, intensive farming techniques, feed formulation, biodiversity and environmental impact of aquaculture. In Tanzania, aquaculture research proposals have to compete with proposals from other agriculture-related topics for state funding, making the change of success low.

Summarizing, the following development opportunities are identified with regards to knowledge and skills:

1. Improvement of practical skills and commercial approach among aquaculture university graduates.
2. Improvement of practically skilled operators in cage farming, feed management, hatchery management, basic farm management, water quality management and intensive technologies.
3. Promotion of interest by graduates in operational private sector jobs on farms, hatcheries and feed mills.
4. Improvement of exposure of university and FETA teachers and trainers to commercial aquaculture.
5. Improvement of practical training facilities at universities and FETA.
6. Facilitation of state funding for commercial aquaculture research.

2.2.2. Input accessibility and affordability

Access to affordable and quality inputs (primarily feeds and seeds) are key to a thriving aquaculture sector. Professional quality feeds are by far the main cost driver for farmers as it makes up 60-75

percent of production costs and is vital to healthy fish growth. Professionally manufactured feeds are an important component of modern commercial aquaculture, providing the balanced nutrition needed by farmed fish. The feeds, in the form of granules or pellets, provide the nutrition in a stable and concentrated form, enabling the fish to feed efficiently and grow to their full potential. Fish seeds hold the genetic material which determines to a large part the growth speed and health of fish. For both feed and seeds the main issues identified concern the access to them and awareness among farmers on best practices.

Feed availability and management

Access to affordable and quality feed is a challenge to Tanzanian fish farmers. About 76 percent of small-scale farmers generally produce their own fish feeds at their farms.[7] Most, if not all, of these home-made feeds are of low quality as farmers lack the knowledge, ingredients, recipes and equipment needed to produce feed of a high and consistent quality. Commercial and larger farmers require better quality feed and obtain their feed from local small- and medium sized feed manufacturers in Tanzania or the region. These suppliers are either professional feed manufacturers (e.g. UgaChick in Uganda, Unga in Kenya, Skretting & Aller Aqua in Zambia) or large horizontally integrated fish farmers who produce home-mixed feeds (e.g. Eden farm in Tanzania). Tanzania currently has no dedicated fish feed producer, although Hill Feeds indicated their interest during the trade mission to Kenya and a Tanzanian fish farm has expressed their interest in procuring a low-cost feed mill from China, to produce feed (largely for their own fish production). Governments in the region also supply feeds, however of low quality and high costs, rendering them unsuitable for commercial fish farming as well as distorting the market and discouraging commercial investments. The largest and most professional farms use a mix of locally produced feed and high quality but costly imported feeds.

Research by WorldFish in Kenya highlighted that investment in high quality feeds by commercial farmers is reasonable: productivity is significantly higher while 'costs per kg of fish produced' are lower; one can shorten the production cycles by more than half, compared to homemade feeds (mash). Comparative testing over 271 days yielded clear results, indicating that professionally produced fish feeds where more expensive to procure, but have a significantly lower feed conversion rate (FCR). This means that more of the applied feed is directly translated into the body mass of the fish. Hence, using quality fish feeds has significant impacts on productivity and profitability at farm level.

Transplanting these findings to Tanzania lead to the recommendation that in the early stages of development, it makes sense to import high-quality fish feeds. Once the domestic aquaculture market is big enough to sustain one or more professional feeds mills, such investments can be made by commercial companies, reducing the need for imported fish feed from neighbouring countries.

Making high-quality feeds available and affordable for Tanzanian fish farmers is probably the fastest way to strengthen local commercial fish production. High quality feeds can only be produced in high volumes (5,000 tonnes/year and more) as it requires considerable investments in a professional feed

[7] Mwaijande, F. and P. Lugendo (2015) Fish farming value chain analysis: policy implications for transformations and robust growth in Tanzania. Journal of Rural and Community Development, Vol. 10 (2), p. 47-62.

mill and purchasing power when sourcing key ingredients including fishmeal, soy and maize. Professional fish feed mills have been established in recent years in East Africa, in all neighbouring countries to Tanzania (Unga and Sigma Feeds in Kenya, Skretting and Aller Aqua in Zambia, Ugachick in Uganda), jointly having an estimated capacity of 45,000 tons of feed annually. These mills are able to supply the Tanzania market with quality fish feeds from this capacity. Other feed currently being imported through distributors include Koudijs (Netherlands), Maran (Saudi), Raanan (Israel) and Novatek (Zambia).

For farmers, it is thus important that importing feeds into Tanzania is not obstructed by (informal) taxes and duties. For today's production volumes, additional fish feed production capacity in Tanzania is not yet required in terms of volumes. As the market grows, local companies can review the business model of fish feed production in Tanzania, both for own production and for other farmers. Small scale feed production lacks the required critical mass to produce quality feeds, which is derived from having the right mix of ingredients, caloric value, feed additives and extrusion equipment.

Tanzania could become an important supplier of fish meal to fish feed producers. Fish meal is an essential ingredient which provides the protein content of quality feeds. Fish feed producers in the region are eager to source fish meal locally if the quality and price are right. Lake Victoria sardine (Dagaa) is potentially an excellent source of fish meal but currently no quality Dagaa-to-meal processing is in place in Tanzania. Currently, Dagaa is left to dry on beach fronts where it can easily spoil, especially during rainy seasons. Furthermore, high concentrations of sand and other particles are often found in Dagaa and fish meal which renders it unsuitable for professional fish feed production.

On farm level, proper feed management is essential for the sector to become more competitive. In general, Tanzanian farmers struggle to be profitable as they spend too much resources on farming inputs, primarily fish feeds. Farmers generally lack awareness of the importance of quality fish feeds and efficient feeding strategies. Also, the ability to verify the quality of the various feeds on the market is an issue as there is a lack of testing laboratories and a reliable certification system. The Tanzania Bureau of Standards (TBS) can play an important role in developing and implementing such certification system.

Seeds

Seed is the second most important input for fish farmers as it highly determines growth rates of fish. There are nine hatcheries operational in Tanzania, of which three are government owned and the others are private companies producing mostly tilapia (70 percent) and catfish (30 percent).[8] Respondents indicated that no operational hatcheries are currently located in Western Tanzania, however. This necessitates the transports of fingerlings over large distances. For example, it was mentioned by a respondent of 60,000 fingerlings being transported over 1,400 kilometres, from Dar to the Mwanza region. Aquasol, a company in the Bunda region, lost 34 percent of their fingerlings during transportation from Uganda.

[8] Shoko, A.P. & Komugisha, B. R. (2018) Assessment of the conditions for genetic improvement in East Africa: Genetic performance, organizational capacity and policy: Tanzania: A consultant report submitted to Worldfish-Msingi.

With regards to government broodstock development, it was found that government-owned hatcheries have taken their broodstock from the wild and improved them over time. Private sector hatcheries are either specialised hatcheries or large farms who sell their excess production to smaller farmers in their area. Some larger commercial hatcheries import live fingerlings from hatcheries in the region and even from the Netherlands. Interviewees also provided examples of fingerlings being brought across the border in Isibania, along the shores of Lake Victoria. Kenyan hatcheries around Kisumu were indicated as the supplier, for lack of local alternatives in the greater Mwanza area.

Quality fingerlings are hard to come by. According to Ministry estimates, the total fingerling production is 5 million fingerlings per year with a demand of 30 million per year, indicating a large demand gap in terms of quantity. Although no reliable research exists on this topic, many respondents reported fingerlings with low growth rates, caused by poor genetic material. Poor performance of fingerlings is caused by hatcheries using genetic strains which are not controlled. Also, around 40 percent of farmers source their tilapia fingerlings from the wild and 30 percent sources them from other farmers or own production.[9]

Picture: private sector hatchery Indian Ocean Aquaculture Ltd (picture by Bart Malaba, Inception Study team member)

Tanzanian government institutions such as TAFIRI, could be more involved and control the quality of the gene pool as there is a clear need for high quality and reliable broodstock which can be used to

[9] Shoko, A.P. & Komugisha, B. R. (2018) Assessment of the conditions for genetic improvement in EastAfrica: Genetic performance, organizational capacity and policy: Tanzania: A consultant report submitted to Worldfish-Msingi.

supply the hatcheries in the country. Indonesia and Egypt, both having successful tilapia industries, have set up large scale government run hatchery programs to control the gene pool and may provide a good benchmark. Since the import of live broodstock and fingerlings may be risky with regards to biosecurity (e.g. the on-going tilapia Lake virus outbreak) it is advisable to hold and improve a quality gene pool in Tanzania and reduce dependence on imports.

As farmers are not able to verify the quality of the fingerlings they purchase, they can be buying low quality input leading to a disappointing harvest. Quality of fingerlings is also negatively affected by poor harvest and transport practices at most hatcheries, leading to low survival rates during the grow-out phase.

Summarizing, the following development opportunities with regards to input accessibility and affordability are identified:

- Improved availability of affordable and high-quality fish feeds.
- Improvement of practical knowledge and skills with regards to feed management by farmers.
- Development of fish meal processing capacity to be used as fish feeds ingredient.
- Need for improved availability of quality tilapia and catfish gene pool (broodstock).
- Development of tilapia hatchery in Mwanza Region.
- Need for testing facilities and certification systems for fish feeds.
- Need for increased knowledge and skills on good hatchery practices.
- Improvement of standardization and certification of feeds and other inputs by TBS.

2.2.3. Farming technology

Farming is mostly done in ponds and cages. The vast majority of farms have a limited number (1 – 3) of ponds, use extensive farming methods and low-quality inputs. Much of this small-scale pond production is destined for home consumption or local sales (e.g. neighbours). There are some larger commercial pond farmers in Bagamoyo, Kisarawe, Kibaha, Mkuranga and Kagera who in some case have vertically integrated, by setting up their own hatchery and home-made feed production. Cage farming in Lake Victoria has been growing over the past years but is still lagging behind other countries boardering the lake such as Kenya and Uganda. This is partially explained by entrepreneurs facing difficulties with obtaining permits to set up cage farms in the lake. There are currently two large commercial cage farms in Lake Victoria. From interviews, it was gathered that the process of obtaining the necessary permits to start cage farming in the lake took over 36 months. Part of the reasons for the long duration was (interdepartmental) unclarity about the requirements for the applicant.

The dominance of small-scale fish farming is reflected in national production volumes. This study estimated production by small-scale pond farmers to be 80-90 percent of the nation's total with large scale pond farms and cage farms each making up around 5-10 percent of total production. Developments in Zambia, Uganda and Kenya have shown that cage farming can develop rapidly, once a conducive legal environment with regards to licensing and permits is established and critical inputs are available in volume and at reasonable costs. Notable examples of large-scale farms include Yalelo in Zambia and Source of the Nile in Uganda, each producing ~ 5,000 tons annually per location.

Small-scale pond farms

Small-scale farmers struggle to achieve high productivity and to produce consistently in terms of product quality (larger sizes) and year-round supply. Productivity is estimated around 5.3 kg/ha which is very low compared to benchmark production markets in for example South East Asia and Egypt.[10] Other studies even estimate the production per hectare as low as 1.8 kg/ha.[11] Given Tanzania's fish demand gap of 480,000 tons of fish per annum, this means that a staggering 90 to 266 million hectares of land will be needed to close the current gap, even without considering future demand growth. It needs no argumentation that small-scale extensive pond farming under current conditions provides no answer to Tanzania's food security challenges.

Extensive small-scale pond farming systems are dependent of the natural productivity and the physical conditions of the water with very little or no input and a low management level. Oftentimes fish farming is regarded as a part-time activity and done next to other cash generating businesses and farm activities. Given the lack of record keeping and the fact that they earn money with their other businesses, farmers are oftentimes unaware that their fish farm is actually not a profitable business.

Commercial pond farming is only feasible above a minimum required economy of scale (>10 semi-intensive ponds) as professional fish farming is a capital-intensive business. Investments in pond construction, training of staff and inputs require considerable investment and working capital. Especially working capital for good quality feeds throughout the grow-out period of 6 to 7 months is oftentimes lacking. Furthermore, respondents indicated that especially small-scale farmers lack the buying power to purchase inputs at bulk discounts.

Picture: cage farm in Mwanza Region (picture by Stephano Karoza, Inception Study team member)

[10] Chenyambuga, S.W., Mwandya A., Lamtane H. A. and Madalla N. A., 2014: Productivity and marketing of Nile tilapia (Oreochromis niloticus) cultured in ponds of small-scale farmers in Mvomero and Mbarali districts, Tanzania. Livestock Research for Rural Development. Volume 26, Article #43.

[11] Shoko, A. P. A., Matola, H. D. Mzighani, S. & Mahika, G. C. (2011a) Fishpond Performance of Nile Tilapia Oreochromis niloticus (Linnaeus, 1758) in the Lake Victoria Basin, Tanzania. Journal of Aquaculture in the Tropics: 26 (1-2).

Semi-intensive pond systems, mostly producing tilapia, have been the major contributor to aquaculture production. Ponds are fertilized using both chemical and organic fertilizers, supplemental feeding is based on cereal bran and other locally available feeds. Intensive production of tilapia and catfish using exogenous feeding has just started by a few operators. Pond farming is mostly practised without low control of the culture environment, water quality and biosecurity.

Cage Farming

From an economic point of view, cage farming is an attractive farming technology as it requires relatively low investment. Therefore, the cage farming sector is likely to grow. Currently, several investment plans by international commercial-scale companies exist. However, it should be noted that, contrary to common belief, this study found that in some locations the number of cage farmers was in fact decreasing as some struggled to run a profitable business. The high costs for feed and need for sufficient working capital is one of the major issues for cage farmers.

Major challenges with regards to cage farming are the environmental concerns and disease risks. Cage farms rely on natural water current for supply of oxygen and removal of waste (fish faeces and feeds). Therefore, it is important to not surpass the carrying capacity of natural water bodies and control the growth of cage farms as to not overcrowd certain (shallow) parts of the lake. Water pollution by cage farms can be limited when farmers apply the right feeding strategies by preventing over-feeding and the use of low-quality feeds. Finally, there is a risk that a high density of cage farms increases the risk of the spread of diseases (e.g. Tilapia Lake Virus). Pollution and disease risks are best countered by controlled allocation of cage farm zones by Tanzanian authorities, taking into account the environmental carrying capacity of Lake Victoria. So far, the expansion of cage farming has been limited by the Ministry of Environment and the Ministry of Livestock and Fisheries over worries about water pollution, use of antibiotics and the threat of contaminating the local species by escaped fish.

RAS

Recirculation Aquaculture Systems (RAS) only exists on a pilot scale in Tanzania. Some farms in Dar es Salaam have experimented with RAS set-ups, however with limited success. A notable initiative is the FoodTechAfrica consortium, constructing a RAS demonstration pilot in Dar es Salaam together with Big Fish farm. RAS farming is an intensive technology which recirculates water through the fish culture environment and adds oxygen. RAS is a high-output, compact and water and input-efficient technology and particularly suitable for areas where land is expensive and water is scarce. Given that the farming system is fully controlled and closed it is also widely used in hatchery systems where biosecurity and full control over the culture environment is paramount.

The main challenges related to RAS technology are the need for consistent electricity supply, skilled operational staff and required investment capital. RAS technology is efficient and has a greater output of fish yet is more complex than pond and cage farming and will therefore need well-trained staff.

Picture: experimental RAS farm in Dar es Salaam (picture by Bart Malaba, Inception Study team member)

Summarizing, the following development opportunities with regards to farming technology were identified:

- Extensive management level and regarding fish farming as a side-business.
- Improved control of the culture environment (and water quality) in ponds.
- Improvement of farm record-keeping which also makes farmers aware of business case of their farm.
- Need for well-trained staff to operate Recirculating Aquaculture Systems (RAS).
- Risks for natural water body pollution and spread of diseases by uncontrolled growth of cage farms.

2.2.4 Market access

Small farmers, operating 1-3 ponds, harvest once or twice per year which makes supplying year-round to their market infeasible, forcing them to sell on ad-hoc basis to fish traders who offer low prices.

Fish marketing in Tanzania is mostly a small-scale activity with a locally organised value chain. 91 percent of small scale fish famers sell their fish within their own locality with the remainder being sold on nearby markets.[12] The sales weight of tilapia is mostly below 500 grams of which most (93 percent)

[12] Van der Heijden, P.G.M., Shoko, A.P. (2018) Review and analysis of small-scale aquaculture production in East Africa. pp 30.

is sold fresh.[13] Fresh fish is preferred by consumers of all income categories and consumers are prepared to pay a premium of TSh 1,000 to 1,500 per kg (USD 0.43 – 0.65) for fresh fish.[14] Prices vary from USD 1.34 at farm gate to USD 2.23 per kg in retail markets. Prices in Dar es Salaam are considerably higher, ranging from USD/kg 3.13 at farm gate to USD/kg 4.47 at retail markets.[15]

Lower-income segments, being the largest market in Tanzania, generally prefer the smaller-sized tilapia and are prepared to pay a premium of up to TSh 3,000 (USD 1.3) per kg for small sized fish.[16] This means that when measured per kg, small-sized fish is actually cheaper than larger sized (>500 grams) fish. However, the smaller sized tilapia is limited available on the market, presenting an obstacle to further expansion of the market. Lack of availability of smaller sized fish is partially explained by the law which prohibits the sales of tilapia under 25 cm. Small, or undersized fish are prohibited to catch in the wild in order to protect wild stocks. However, this law does not differentiate between wild catch and farmed tilapia. Larger sized tilapia is generally bought by high-income groups.

Wild caught tilapia is generally preferred over farmed tilapia by Tanzanian consumers, especially among high-income groups. Farmed tilapia does not have a good reputation because of a (perceived) muddy taste of farmed fish and consumers perceiving wild catch tilapia to be tastier and healthier. High-income consumers prefer wild catch as it is larger in size (500 grams – 1 kg) than farmed tilapia. Furthermore, it was found that farmed tilapia experiences price pressured from imported small-sized and very cheap imported tilapia which is oftentimes defrosted and (dishonestly) sold as local fish.[17] It seems therefore, that consumers need to be sensitized on the fact that farmed tilapia can be as tasty and healthy as wild catch. Clear marketing and differentiation of farmed tilapia versus wild catch and imports would help farmers fetch a better price for their locally farmed fish.

Picture: road-side sales of smoked catfish in Rufiji Region (Wouter van Vliet, Inception Study team)

Catfish is a popular fish species in Tanzania, especially among lower-income groups. The market price for fresh catfish is around TSh 5,000 and 6,000 (USD 2.1 – 2.5 per kg) in Dar es Salaam markets. Most catfish is sold in smoked form as to extend its shelf live. Smoked catfish market

[13] Van der Heijden, P.G.M., Shoko, A.P. (2018) Review and analysis of small-scale aquaculture production in East Africa. pp 30.
[14] Preliminary conclusions of on-going FTA study in Tanzania with regards to consumer preferences in Dar es Salaam.
[15] Van der Heijden, P.G.M., Shoko, A.P. (2018) Review and analysis of small-scale aquaculture production in East Africa. pp 30.
[16] Preliminary conclusions of on-going FTA study in Tanzania with regards to consumer preferences in Dar es Salaam.
[17] Msingi. East Africa Tilapia market: Size, Sustainability and Opportunities for growth in Aquaculture in Uganda, Tanzania, Rwanda and Kenya. 2017

prices vary considerably and are based on market location and size of the fish. Catfish is caught in the wild as well as farmed. In the dry season (June/July – November) catfish is only supplied by farmers.

Catfish production has great potential as farming is relatively easy compared to tilapia. Catfish is a robust species which can breathe above water, requires relatively low management and grows on cheaper feeds. Catfish can also be kept in much higher densities (up to three times) compared to tilapia. The downside is that catfish is regarded as a low-end fish by consumers and fetches a much lower price per kg than tilapia. Since changing the overall consumer perception of catfish requires a lot of time and effort, it should be explored how catfish can be processed into more appealing fish products. Some successful processing examples exist in the East African region, for example processing catfish into "fish" sausages and "fish" samosas.

Despite the opportunities for product differentiation, it should be concluded that tilapia and catfish are primary products that are commoditized. It is generally difficult for commoditized products to succeed on margin. A thin-margin, high volume market requires a focus on cost-optimization and efficiency. The emphasis has to be on volume. Unfortunately, it seems that local fish farmers currently have little interest in targeting their product to retail markets where they could sell sufficiently large volumes. This is partially explained by the absence of good infrastructure and cold chain facilities. In fact, it is arguable that it is local farmed fish, rather than wild catch, that is threatened by imported fish. It turns out that smaller sized imported fish is equally targeting the same buyers that farmed fish targets. Street-side retailers prefer imported fish because, among other reasons, it comes in a broader range of sizes and particularly offers sizes as small as 100 grams which then allows it to be sold at price points that are affordable to a wider group of consumers.

Summarizing, the following development opportunities with regards to market access were identified:

- Large demand and good prices for small sized fish among low-income consumers. However, law prohibits the sales of tilapia under 25 cm.
- Reputation and (perceived) "muddy" taste and healthiness of farmed fish among consumers. Consumers generally prefer wild catch fish.
- Need for good marketing and differentiation of farmed tilapia versus wild catch and imports.
- Improvement of catfish market positioning and processing as it is regarded as a low-end species and receives a lower market price.
- Need to increase production volumes by farmers as they generally produce a commodity product (tilapia or catfish) for low margins.

2.2.5. Financial access

There is a clear need for the aquaculture sector to access external financing. Many pond and cage farmers expressed the ambition to expand but lack investment capital. Financing investments through fish sales revenues is oftentimes not enough to finance upscaling. Aquaculture farms are both in need of investment capital as well as working capital, the latter being sometimes half of the total required capital but often overlooked by farmers.

There are several financial institutions with a focus on to the agricultural sector in Tanzania. For example, the Tanzania Agricultural Development Bank Limited. Although no specific aquaculture financial products or services exists, the general agricultural finance instruments are also available to

the aquaculture sector. However, financial institutions have not yet provided much capital to the aquaculture sector. The main reason is the lack of established and profitable fish farmers in the country. Since banks are generally risks aversive, they will only provide loans and credit after one or more farms have proven to be profitable on a commercial scale. Adding to this challenge is a low-level of farm administration and bookkeeping among fish farmers which further increases risks for banks.

The lack of collateral for small scale farmers is also an issue. Grouping of small businesses into larger associations may solve this issue as they can then start a loan and savings group. Also, groups of farmers can take on loans and credits and bring in collective guarantees and collateral.

Summarizing, the following development opportunities with regards to access to finance were identified:

- Development of proven aquaculture business which provide a low-risk profile for investors.
- Opportunity for improvement of bookkeeping and business planning skills among farmers.
- Limited collateral among small-holder farmers.

2.2.6. Sector organisation

Solid private sector associations are important and can potentially provide many benefits to its members. Associations may provide capacity building, collective buying of inputs, networking and advocacy. Various entrepreneurs reported that procedures have still not been streamlined and are sometimes unclear, which means they experience a lot of bureaucracy. The fact that the government is dedicated to develop this sector, gives sector associations a perfect window to address inefficiencies and work together to improve the business climate for aquaculture entrepreneurs.

Although other East African countries such as Kenya and Uganda have well-established private sector associations, Tanzania has only recently (2016) established the Aquaculture Association of Tanzania (AAT). AAT represents the interest of various stakeholders across the aquaculture value chain. These include fish farmers at all levels, feed and seed producers, processors, marketers, service providers, research and training institutions, local and international partners and government agencies. AAT has sixty registered members and another three hundred members on a waiting list. However, this could not be independently verified.

Besides formal associations, there are various informal social media platforms playing an increasingly important role in sector organization. Examples include Facebook pages (e.g. Sarnissa[18]) and various aquaculture WhatsApp groups (e.g. Fish farming oriented) with a large following among young aquaculture entrepreneurs. These platforms are an effective tool for sharing information and networking.

On a regional level, there are various initiatives which aim to organize the sector and share information. On a government level, the main initiatives are coordinated by the Lake Victoria Fisheries Organization (LVFO) who, amongst other things, has developed the Cage Culture Guidelines for Lake Victoria in order to harmonize cage farming. Another notable initiative is Msingi, a British-funded NGO

[18] https://www.facebook.com/sarnissaafrica/

with a regional focus. Msingi has organised a region-wide informal aquaculture round table which brings together commercial aquaculture business.

Summarizing, the following development opportunities with regards to sector organisation were identified:

- Need for development of strong aquaculture private sector representation.
- Opportunity to develop a regional body for private sector driven representation.

2.2.7. Aquaculture regulation

The general regulatory framework for aquaculture entrepreneurs in Tanzania offers room for improvement. The main issues concern unfavorable import regimes, complicated environmental regulations and government market intervention.

A main threat to the development of the Tanzanian aquaculture sector is the import of cheap frozen Asian fish. Although volumes are still limited, they are growing rapidly and already put downward price pressure on the Tanzanian fish market. Since a large part of the imported tilapia is of small size, they are directly competing with fish farmers who mostly produce small-sized tilapia rather than wild catch fisheries who catch larger sized fish. Given the nascent character of the Tanzanian sector, it is questionable if it can withstand competition from efficient Asian producers. Protecting local production from these imports seems therefore necessary until Tanzanian companies have improved their businesses and produce for competitive market prices. The current import duty on fish and fish products is helpful but needs better enforcement. Other tariff and non-tariff barriers to frozen fish imports can be considered.

Aquaculture companies require various inputs and equipment which are unnecessarily complicated and costly to import. There are challenges to be overcome with regards to importing of genetic material. Strict laws apply in Tanzania to safeguard indigenous species. In order to import live genetic material, a permit needs to be obtained from the Ministry in Dodoma. Acquiring the necessary permits for genetic imports can be a tedious and time-consuming task, as one will have to deal with bureaucracy. There is a lack of clear policy on how and what is required, to grant permits. Genetic material is considered as agricultural inputs and should be exempt from import taxes. However, in practice taxes and release charges are still levied and importers have no other choice as to comply with these illegal practices as their live fish (brood stock) need quick clearance and transport to the fish farm. The recent outbreak of the Tilapia Lake Virus in Asia has further complicated importing live genetics and led to a (temporary) ban importation of live tilapia fish.

Picture: bag of imported extruded floating fish feed (picture by Wouter van Vliet, Inception Study team member

Importing aquaculture farm equipment, such as tanks and water treatment systems, should be exempt from import duties and attract VAT only. In practice however, these components may still attract unpredictable and "informal" taxes. These import costs are hard to predict and therefore complicate business planning.

VAT on imported fish feeds are a major cost component for aquaculture farmers. Given that feed makes up around 70percent of production costs and fish sales are VAT exempt, farmers cannot recover the VAT on feeds through their fish sales.

Aquaculture investments are complicated by lengthy and costly application procedures for environmental impact assessments and other permits and licenses. For large scale aquaculture businesses, the related costs are a minimum of TSh 10 million (USD 4,320). Adding to this are several other permits and licenses required to start operations. One farm reported a total of 17 permits and licenses are required before operations can start. Although good environmental policies are important, especially in the case of cage farms, these procedures are an obstacle to investments. Eventually, all these costs will translate into higher production costs and fish sales prices for consumers.

Summarizing, the following development opportunities with regards to aquaculture regulation are identified:

- Improved enforcement of import duty on imported fish and fish products.
- De-complexing of procedures to obtain import licenses for genetic material.
- De-complexing of customs clearing and releasing procedure for the import of live fish.
- Facilitation to reclaim VAT on imported fish feeds for fish farmers.
- De-complexing of process to obtain permits and licenses for fish farms establishment.

2.3. Review of current and planned development initiatives

Alignment between stakeholders in the sector is a crucial starting point for effective development. Several aquaculture developments by private sector, public sector and international donors have been identified by this study. This study has reviewed these initiatives and identified their relevant interventions. For each initiative a profile has been created which includes objectives, interventions, partners and budgets where possible. Interventions by the development initiatives are related to the development opportunities as identified by this study.

A stakeholder map has been developed to visualize the various initiatives and their relationship vis-à-vis commercial farmers.

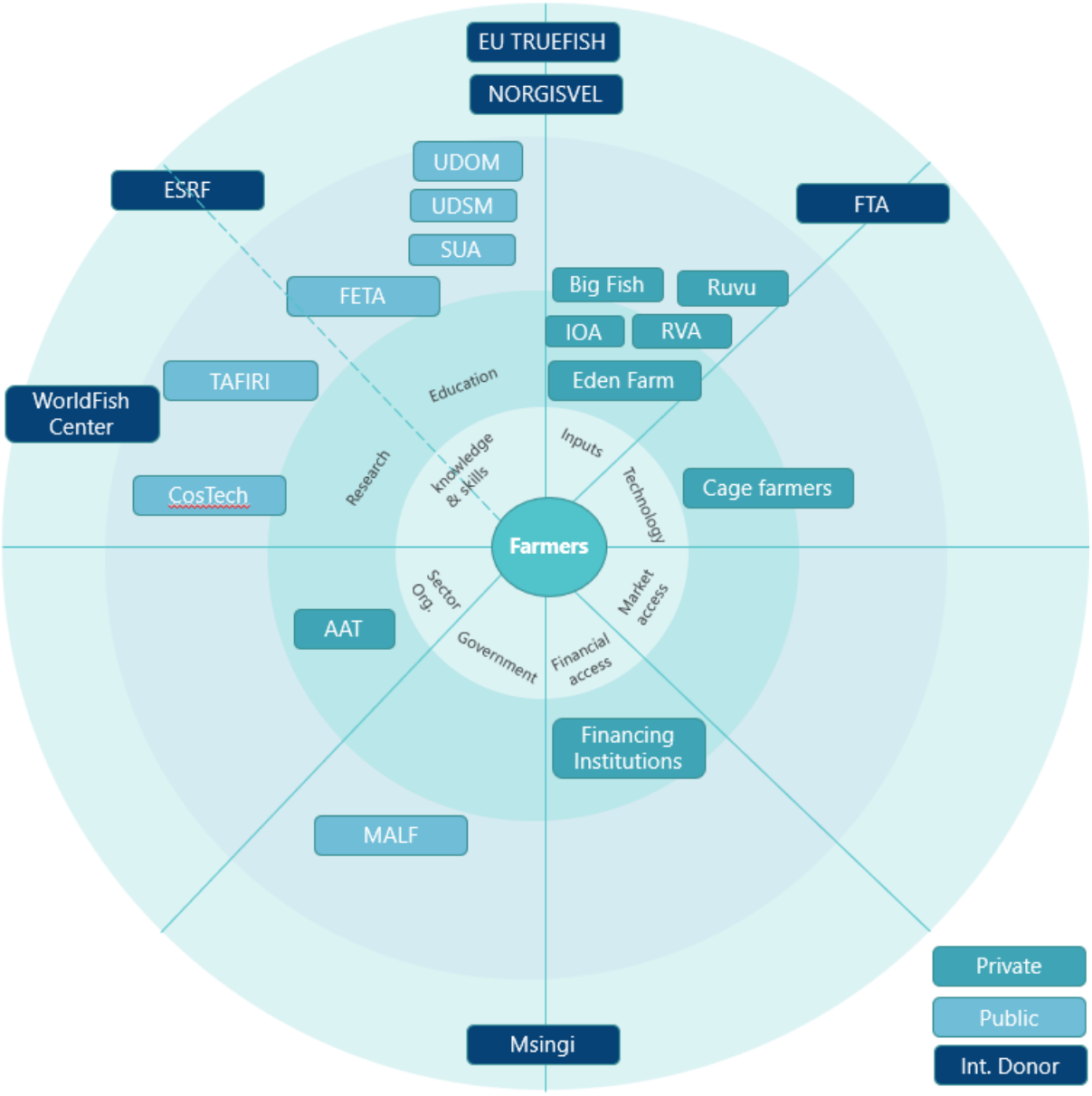


Figure: stakeholder map, presenting private and public sector initiatives and international donors with an impact on aquaculture farm development.

2.3.1. Private sector initiatives

Several private sector initiatives with a positive impact on sector development have been identified in Tanzania. These initiatives are first of all commercial businesses, but at the same time function as "light house" projects which serve as successful examples to the wider sector. The reviewed private sector initiatives play an important role with regards to production of inputs (fingerlings), distribution of quality feeds and provide a training and employment base for aquaculture graduates.

Name:	*Ruvu Fish Farm*
Type of organisation:	Fish farm and hatchery
Description/objective:	Ruvu Fish Farm aims to accelerate the development of the aquaculture sector in Tanzania and provides quality fish meat, fingerlings, fish feed and technical knowhow. Ruvu's mission is to keep working with key participants in the aquaculture sector, small-scale fish farmers, Ministry of Livestock and Fisheries Development, educational institutes and the private sector in building a sustainable and commercially viable aquaculture sector. The farm is funded by the Danish International Development Agency (DANIDA) and soon to become a privately-owned company.
Type of intervention:	Production of quality tilapia fingerlings and distribution of imported feed.
Interventions:	Hatchery producing quality tilapia fingerlings (100,000 – 150,000 per month) for other farmers. Furthermore, serving as a "light house" large commercial farm to inspire other farmers to copy its best practices.
Partners:	DANIDA

Name:	*Riga's Safina's Big Fish company Ltd. (Big Fish)*
Type of organisation:	Fish farm and hatchery
Description:	Big Fish is a tilapia pond farm and hatchery in Dar es Salaam.
Type of intervention:	Production of fingerlings (input); Training
Interventions:	The company is investing in a professional hatchery and quality broodstock which will enable the distribution of quality genetics to the wider sector. The company is the key local partner of the FTA Impact Cluster Program for which it will demonstrate international RAS and hatchery best practices and offer a training program.
Partners:	FTA Impact Cluster Tanzania

Name:	*Rift Valley Aquaculture Ltd. (RVA)*
Type of organisation:	tilapia hatchery

Description:	Rift Valley Aquaculture Ltd. is a family-run business producing fingerlings using YY technology (hormone-free production).
Type of intervention:	Production of quality tilapia fingerlings
Interventions:	YY technology fingerling production and distribution.
Partners:	Til-Aqua BV

Name:	*Indian Ocean Aquaculture (IOA)*
Type of organisation:	Fish farm, hatchery and feed mill
Description & objective:	IOA produces tilapia along the Rufiji river. The company aims to deliver on the goal of providing the freshest, high quality fish for the Tanzanian market.
Type of intervention:	Production of fingerlings and feed
Interventions:	The company uses quality YY fingerling brood stock imported from the Netherlands, using part of production in its own grow-out farm and selling the remainder to local farmers.

Name:	*Eden Farm*
Type of organisation:	Hatchery and fish farm
Description & objective:	Eden Farm is a hatchery producing fingerlings in Dar es Salaam and produces tilapia.
Type of intervention:	Input production (fingerlings and feed); training.
Interventions:	Eden farm is a main supplier of fingerlings and worked with government programs on genetic distribution in the past. Aquaculture students from Sokoine University, both former and current, receive training on hatchery management, feed production and grow-out production, albeit on a limited knowledge level.

Name:	*Cage farmers Lake Victoria*
Type of organisation:	Cage farmers
Description & objective:	This study has identified several commercial cage farmers in Sengerema and Ukerewe districts, both in Mwanza Region. Most prominent in terms of production capacity are the following: 1. Meck Fish farm (38 cages, Kamanga beach, Sengerema) 2. Jackson fish farm (12 cages, Kirumo Beach, Sengerema) 3. Yanga Makaka fish farm (8 cages, Chamabanda beach, Sengerema) 4. Niko fish farm (6 cages, Kabusuli beach, Sengerema) 5. Lake side fish farm (5 cages, Kabusuli beach, Sengerema) 6. OHK AQA Farm (4 cages, Mlango Mmoja beach, Ukerewe) 7. Kasegenya fisheries company (3 cages, Nalubale beach, Ukerewe)

	These farmers mostly work with home-made cage farms, imported feed and source fingerlings from Uganda, TAFIRI or Ruvu Fish Farm. About half of them indicate that they lack qualified cage farm staff.
Type of intervention:	The interviewed cage farmers do not purposely intervene in the sector from a development perspective but are important as they provide a critical mass for the aquaculture industry (e.g. market for inputs) to develop. They can also provide a base for aquaculture students to find employment and gain practical skills and knowledge.

Name:	*Aquaculture Association Tanzania (AAT)*
Type of organisation:	Private sector association
Description/objective:	AAT represents the interest of various stakeholders across the aquaculture value chain. These include fish farmers at all levels, feed and seed producers, processors, marketers, service providers, research and training institutions, local and international partners and government agencies. AAT has sixty registered members and another three hundred members on a waiting list.
Type of intervention:	Sector organisation
Interventions:	AAT is in its start-up phase and no clear interventions have been identified. The association has received funding from NORGIVSEL to implement a capacity building program for its members. Other planned activities are the organisation of stakeholder meetings. The association has plans to become a fresh produce (fish) holding company, deal with feed issues and coordinate the value chain.
Budget:	NORGISVEL funding for three years is secured for a capacity building program.

2.3.2. Public sector initiatives

The Tanzanian public sector plays a key role in the development of the aquaculture sector. A few takeaways from the public sector are that the public sector is lacking the funding to enact major positive changes in the sector.

Name:	*Ministry of Livestock and Fisheries*
Type of organisation:	Tanzanian Ministry
Description & objective:	The ministry of Livestock and Fisheries is responsible within the Tanzanian's government for the development of the aquaculture sector.
Type of intervention:	Creating enabling environment for aquaculture value chain
Interventions:	Development of coherent aquaculture development policy and supporting regulatory framework. Coordinate the work of other relevant institutions such as TAFIRI and FETA. Reduction of import duties on agricultural equipment. Distribution of floating fish feeds to farmers.

Name:	*Fisheries Education Training Agency (FETA)*
Type of organisation:	Training institute
Description & objective:	FETA's mission is "to provide quality fisheries and aquaculture education and training, conduct applied research and disseminate appropriate technologies to stakeholders through improved service delivery".
Type of intervention:	Knowledge and skills (training)
Interventions:	FETA offers courses in fishing technology, aquaculture, fish processing, quality control and coastal resource management. Although the national government strongly supports vocational aquaculture training, this is not sufficiently executed in terms of development of basic practical skills required by the aquaculture sector. Furthermore, FETA has no practical training facilities.

Name:	*Tanzania Fisheries Research Institute (TAFIRI)*
Type of organisation:	Fisheries Research Institute
Description & objective:	Coordinate fisheries research in Tanzania with a focus on aquaculture
Type of intervention:	Research on genetic issues; Approval of genetic import; EIA's
Interventions:	Study on tilapia genetics. Genetic improvement program. Indicates the need for import of live fish. Issuing of strategic Environmental Impact Assessments.

Name:	*Tanzanian Commission of Science and Technology (COSTECH)*
Type of organisation:	Research and technology development
Description & objective:	Parastatal organization with the responsibility of coordinating and promoting research and technology development activities in Tanzania.
Type of intervention:	Knowledge development
Interventions:	Project: "Integrating Agriculture and Aquaculture for Increased Farm Productivity project in Tarime district, Mara region."

Name:	*Sokoine University (SUA)*
Type of organisation:	University
Description & objective:	SUA is based in Morogoro and has Department of Animal, Aquaculture and Range Sciences offering aquaculture programs.
Type of intervention:	Knowledge and skills (education)
Interventions:	Sokoine University and Dar es Salaam University offer programs on Aquatic Sciences and Aquaculture.

Name:	*Dar es Salaam University (UDSM)*
Type of organisation:	University
Description & objective:	UDMS has the department of Aquatic Sciences and Fisheries responsible for aquaculture-related courses.
Type of intervention:	Knowledge and skills (education)
Interventions:	University of Dar es Salaam offers both undergraduate and post graduate courses in Aquatic sciences, Fisheries and Aquaculture. The university also offers a two year fisheries diploma program. University of Dar es Salaam have partnered with WorldFish.

Name:	*University of Dodoma (UDOM)*
Type of organisation:	University
Description & objective:	ODUM is based in Dodoma and has a program on Aquaculture and Aquatic Sciences.
Type of intervention:	Knowledge and skills (education)
Interventions:	The University of Dodoma recognizes the lack of trained experts in the field of aquaculture and aquatic sciences. To breach this gap in knowledge the university designed an aquaculture and aquatic sciences program.

2.3.3. International donor initiatives

Several donor-driven initiatives are active in the development of the aquaculture sector, each in various stages of implementation. The initiatives are mostly focus on research, knowledge and skill transfer, input improvement and introduction of best practices.

Name:	*EU-TRUEFISH*
Type of organisation:	Donor funded development program
Description & objective:	Aims to contribute in developing competitive, gender equitable and sustainable commercial aquaculture in the Lake Victoria basin.
Type of intervention:	Value Chain Development
Interventions:	The project covers the following components 1. Business (access to commercial networks): - Strengthened commercial networks for competitive aquaculture-related businesses. 2. Skills (availability and quality of local skilled workers in aquaculture-related businesses): - Upgraded practical training delivery by formal training institutions - Strengthened linkages between training institutions, and with aquaculture business operators. 3. Sustainability (sustainable and bio-secure regional aquaculture production systems): - Strengthened aquatic animal health conditions - Lake Victoria zoning: support an orderly and sustainable cage culture development

	- Improved protection of biodiversity Given that the program is still under development, it is unclear which specific interventions (e.g. training topics) will be provided.
Budget:	EUR 10.15 million over five years (2019-2024)
Partners:	European Development Fund, European Commission Delegation to the East African Community. Implementing partners in Tanzania: FAO, TAFIRI.

Name:	*FoodTechAfrica (FTA) Impact Cluster Tanzania*
Type of organisation:	Public-Private Partnership
Description:	FTA is a consortium of Dutch aquaculture companies, university and government who invest in the Tanzanian aquaculture sector by setting up a demonstration fish farm and training program.
Type of intervention:	Training; Demonstration of farming technology; Fingerling production
Interventions:	Demonstration and training program on hatchery best practices, hormone-free YY fingerlings and RAS and aerated pond farming. Research: tilapia and catfish consumer preferences and genetics in Tanzania.
Budget:	EUR 900,000
Partners:	Netherlands Ministry of Foreign Affairs, Viqon BV, Holland Aqua BV, Fishion BV, Til Aqua BV, Larive International BV, Genap BV and Riga's Safina's Big Fish company Ltd.

Name:	*Msingi East Africa Limited*
Type of organisation:	International NGO
Description & objective:	Msingi's aquaculture industry program aims to facilitate and accelerate the growth of a competitive aquaculture industry in the region.
Type of intervention:	Value chain development
Interventions:	- Improving access to high quality, competitively priced aquaculture inputs including feed, fingerlings and equipment. - Enhancing the technical and management capabilities of fish producers to increase their profitability. - Addressing key inefficiencies in fish marketing - Building long-term buy-in and securing support for industry growth and transformation within the private sector and regional Governments. - Supporting the introduction of innovative solutions to East Africa from other more advanced aquaculture industries.
Budget:	GBP 30 million initial budget
Partners:	Gatsby Africa, DFID

Name:	*NORGISVEL*
Type of organisation:	Aquaculture development program

Description & objective:	Focus on capacity building, tilapia production, education and business development in Tanzania. Vocational and practical training of young entrepreneurs. The program aims to create fulltime jobs for 120 individuals with a focus on ensuring gender balance. Beyond the training component the project will establish a commercial fish farm, producing fish for the market and fingerlings for fish farmers.
Type of intervention:	Knowledge and skills; inputs (genetics); farming technology and methods.
Interventions:	Construct a hatchery and grow-out farm as well as the Aquaculture Incubation Center at Ruvu river for training. FETA and AAT to deliver capacity building. Investment and developments targeting improved feed and seed production. Investment in the cold chain: purchase of ice significantly cuts down the profit margins.
Budget:	EUR 3.8 million, program is just starting up
Partners:	Funded by NORAD. Other partners are FETA and AAT

Name:	*Economic and Social Research Foundation (ESRF)*
Type of organisation:	Non-profit research institution
Description & objective:	The ESRF is a institution for research and policy analysis. The overall objective of ESRF is to conduct research in economic and social policy areas and development management and use its research outcomes to facilitate the country's capacity for economic development and social advancement.
Type of intervention:	Knowledge and research
Interventions:	ESRF previously conducted an analysis of the Fisheries Sub-Sector Value Chain. ESRF also funded the Sumaponics RAS demo in Dar es Salaam and with support from the UNDP. ESRF organized a recirculation aquaculture training workshop in 2017.
Partners:	Government of the Republic of Tanzania, UNDP, African Capacity Building Foundation (ACBF), International Development Research Centre (IDRC).

Name:	*World Fish*
Type of organisation:	International NGO
Description & objective:	Wold Fish's objective in Tanzania is to increase aquaculture production, reduce post-harvest fish losses, enhance the role of fish in nutrition provision, boost fish consumption by women and children, and encourage better management of small-scale coastal and inland fisheries.
Type of intervention:	Research and increase awareness of nutritional value of fish
Interventions:	- Enhance the role of fish in national food and nutrition security agenda. - Enhancing governance of coastal and inland small-scale fisheries. - Post-harvest management in fish value chains from Lake Victoria. - Increasing the consumption of capture fish by pregnant and lactating women, and by infants.

	- Enhancing governance of coastal small-scale fisheries. - Investment and policy research to increase women and youth participation and benefits derived from aquaculture and aquaculture-related activities. - Increasing farmed fish production (tilapia).
Partners:	Government of the Republic of Tanzania, TAFIRI, University of Dar es Salaam, Lake Tanganyika Authority (LTA), Lake Victoria Fisheries Organization (LVFO).

2.4. Analysis of development opportunities and conclusions

This chapter presents the development opportunities in the sector which are currently not met by development initiatives, necessary interventions, relevant Dutch capabilities and recommended follow-up. The conclusions are summarized into a separate matrix per development opportunity theme.

2.4.1. Knowledge and skills

Development opportunity	Relevant initiatives	Necessary intervention	Dutch capabilities	Recommended follow-up
Improvement of practical training facilities at universities and FETA.	SUA, UDSM, UDOM	Exposing staff and students to real-life farming & practical training facilities at universities	Yes, commercial demonstration and training farm in Dar es Salaam (Big Fish)	Expand commercial demonstration and training facilities in capacity and geographically
Promotion of interest by graduates in private sector jobs	SUA, UDSM, UDOM	Promote operational jobs in universities	Limited impact through training program	None
Improvement of practical skills of farm staff and management (incl. feed management)	FETA, FTA, SUA, UDSM, UDOM, Ruvu	Strengthen capacity FETA and practical/commercial training facilities	Yes, use Practical training center at Big Fish and Ruvu	Vocational training program: basic and advanced fish farming
Improvement of practical skills of hatchery staff and management	FETA, FTA, SUA, UDSM, UDOM, Ruvu	Strengthen capacity FETA and practical/commercial training facilities	Yes, tilapia genetics expert company	Vocational training program in TZ and NL. Expansion commercial hatchery training centers in TZ
Lack practically skilled cage farm staff and management	FETA, FTA, SUA, UDSM, UDOM	Practical training program for FETA and cage farm management	Yes, Dutch training capacity	Training program sustainable cage farming
Facilitation of state funding for commercial aquaculture research.	TAFIRI, MLF	TZ government provides funding for national research	Yes, Dutch training capacity	None, research should be initiated and executed by TZ institutions

2.4.2. Input accessibility and affordability

Development opportunity	Relevant initiatives	Necessary intervention	Dutch capabilities	Recommended follow-up
Improved availability of affordable and high-quality fish feeds.	Professional feed mills in Kenya and Zambia	Reduce tariff and non-tariff import barriers on feeds. Put in place incentives for (international) feed companies to invest in Tanzania	Yes, several Dutch feed companies	Promote with TZ Gov. reduction of import barriers. Incentives for establishment of international feed manufacturers in TZ.
Limitation of subsidized distribution of low quality feeds and other inputs	MLF	Sensitizing of counterproductive effect of subsidized feeds and other inputs	Yes	Promote market dynamics for feed and other inputs
Need for testing facilities and certification systems for fish feeds	None	Testing facilities and certification program by independent institution (e.g. TAFIRI) and labelling	Limited	Improvement of standardization and certification of feeds and other inputs by TBS
Development of fish meal processing capacity to be used as fish feeds ingredient	None	Improvement of quality of fish meal production	Yes	Exploration of technical and commercial feasibility of fish meal production
Availability and control of quality tilapia and catfish gene pool	TAFIRI, FTA, Ruvu, RVA, Big Fish	Import of quality fingerlings, development of gene bank, genetics improvement program, training to TAFIRI and commercial hatcheries staff	Yes, tilapia and catfish genetics experts	Promote enabling of import of live fish. Train TAFIRI and commercial hatchery staff in gene pool management and improvement
Supply of quality fingerlings to farmers	Ruvu, TAFIRI, Big Fish, RVA	Train hatchery management	Yes, tilapia and catfish genetics experts	Training program on hatchery management and distribution
Fingerling production in Mwanza region	None	Development of tilapia hatchery in Mwanza region	Yes, tilapia and catfish genetics experts	Explore technical and commercial feasibility of hatchery in Mwanza region

2.4.3. Farming technology

Development opportunity	Relevant initiatives	Necessary intervention	Dutch capabilities	Recommended follow-up
Extensive management level and regarding fish farming as a side-business	FTA, Ruvu	Promote aquaculture as commercial and professional business	Yes, demonstration and training capabilities	Aquaculture academy where stakeholders experience 24/7 farm management
Improvement of farm record-keeping	None	Training of farmers in business administration and planning	Yes, business skills training capabilities	Develop and implement aquaculture business management training
Improved control of the culture environment (and water quality) in ponds	FTA, Ruvu	Training of farm management and staff on controlled farming practices	Yes	Training program controlled farming
Risks for natural water body pollution and spread of diseases by uncontrolled growth of cage farms	None	Training on feed management to cage farmers	Yes	Training program on feed management cage farmers
Need for well-trained staff to operate RAS	FTA	Increased awareness of RAS advantages	Yes	Demonstration and workshops in RAS advantages. Development training program

2.4.4 Market Access

Development opportunity	Relevant initiatives	Necessary intervention	Dutch capabilities	Recommended follow-up
Ban on small sized (<25 cm) tilapia	None	Law can differentiate between farmed and wild caught tilapia	Advocacy on favourable aquaculture business climate	None
Poor reputation of farmed fish among consumers	FTA market study	Development of marketing strategy and promotion campaign farmed fish	Yes, fish marketing experts	Blind testing panel. Fish branding marketing strategy and promotion campaign farmed fish

Catfish processing offers new market opportunities	None	Experimenting with catfish processing and market test	Yes, catfish marketing experts	Develop catfish processing pilot and market test
Increase production volumes farmers	None	Aggregate production capacity by grouping of farmers and collective sales and improve production efficiencies	Yes, introduction of (semi-) intensive farming technologies	None
Transport and cold chain infrastructure	NORGIVSEL	Set up cold chain pilot	Yes, cooling and distribution expertise	Develop cold chain pilot and awareness program

2.4.4. Financial access

Development opportunity	Relevant initiatives	Necessary intervention	Dutch capabilities	Recommended follow-up
Develop proven aquaculture business cases for investors (good return and low-risk for investment)	FTA, Ruvu and some private sector	Promote successful companies and make their business case visible	Yes, business planning skills	Select successful businesses and develop business case to be used for promotion
Opportunity for improvement of bookkeeping and business planning skills among farmers	None	Business acumen training geared towards fund raising by farmers	Yes, business acumen training	Develop and implement business acumen training and assist fund raising
Limited collateral among small-holder farmers	None	Grouping of farmers who provide collective guarantees to financiers	Yes, business acumen training	Training program to assist fund raising for groups of farmers

2.4.5. Sector organisation

Development opportunity	Relevant initiatives	Necessary intervention	Dutch capabilities	Recommended follow-up
Need for development of strong aquaculture private sector representation	AAT	Strengthening of commercial aquaculture organisation	Limited	None
Development of regional body for	Msingi	Strengthening of regional commercial aquaculture	Limited	None

private sector driven representation		organisation through financing		

2.4.6. Aquaculture regulations

Development opportunity	Relevant initiatives	Necessary intervention	Dutch capabilities	Recommended follow-up
Improved enforcement of import duty on imported fish and fish products	Ministry of Trade and MLF to coordinate	Enforcement of duties on import of frozen fish	Yes, government to government	Promote enforcement with TZ Gov.
Risks for pollution and spread of diseases by uncontrolled growth of cage farms	MLF, TAFIRI	Enforcement of Lake Victoria zoning	Limited	None
De-complexing of procedures to obtain import licenses for live genetic material	Ministry of Trade, MLF, TAFIRI	De-complexing of application procedure	Yes, government to government advocacy	Promote de-complexing of import with TZ gov.
Facilitation to reclaim VAT on imported fish feeds for fish farmers	Ministry of Trade, MLF	VAT cannot be reclaimed by fish farmers, hence VAT waiver	Yes, government to government advocacy	Promote VAT waiver on feeds with TZ gov.
De-complexing of process to obtain permits and licenses for fish farms establishment	Ministry of Trade, MLF, TAFIRI	De-complexing of application procedures	Yes, government to advocacy	Promote VAT waiver on feeds with TZ gov.

Recommendations

Based on the findings of this study, it is our recommendation to combine Tanzanian and Dutch public and private efforts in order to offer an integrated approach towards the Tanzanian aquaculture sector, based upon the needs of local stakeholders and commercial opportunities identified within the sector. During this study it has become clear that both countries share a common ambition to invest and build a thriving sector which is beneficial to all value chain actors.

Improving Tanzania's aquaculture sector requires a wholistic approach, focused on increased domestic productivity in an environmentally and socially responsible way. This can be realized via the introduction of more knowledge and capital-intensive production systems adapted towards local circumstances, in direct combination with selective (vocational) training and technical advice. The enabling environment can be upgraded by providing a conducive regulatory framework, market oriented educational institutes and an established private sector organization. Positive initiatives such as the development of a dedicated aquaculture law and investments in education and research were observed and provide confidence in a continued commitment by Tanzanian public stakeholders.

Several specific interventions are recommended to address the most pressing development opportunities which were identified by this study. Practically all value chain actors can play an important role in realising these recommendations and hence become drivers for growth and positive change. Given that this study focusses on involvement of Dutch aquaculture stakeholders, only interventions are recommended which can be implemented with direct or indirect Dutch involvement.

1. Vocational knowledge and skills improvement program fish farming

Private sector fish farmers lack well well-trained operational staff for primary fish production. Skilled operators are needed to operate both pond, cage and RAS fish farms. Given the expected growth of cage farming, there is for example a pressing need for practically skilled staff able to understand all the intricacies of such an operation in local reality. Such skilled staff are now 'procured' from neighbouring countries, with examples of farm staff being attracted from Zambia, Malawi, Kenya and Ghana highlighted by interviewees. Practical training facilities that provide a real-world experience for trainees are lacking.

Suggested activities:

- Organise workshop to identify training needs among public and private stakeholders in (a) pond farming, (b) RAS farming and (c) cage farming.
- Develop curriculum and implement an encompasses training program on 'stacked' expertise levels, with topics including upgraded ponds, RAS and cage farming, control of biomass, feeding strategies, hygiene & fish-health, farm equipment, farm impact on environment, water quality stocking density, farming techniques and sales and marketing.
- Training facilities should be established in close cooperation with FETA and commercial fish farmers, to assure maximum uptake among the stakeholders.
- Permanent embedding of the knowledge and skills can be achieved by establishing a permanent vocational training centre ("Aquaculture Academy"). Securing long-term involvement of international expert companies will support its sustainability.

- Beneficiaries of the program: selected trainees from FETA (training of trainers) and commercial farmers.

2. Tilapia and catfish genetics improvement program

Tanzanian hatcheries have insufficient access to quality tilapia and catfish broodstock, and a lack of expertise to develop own broodstock improvement programs. Solving this issue requires a long-term improvement program of the tilapia and catfish gene pools in Tanzania in which the quality is controlled. The required expertise is available in the Netherlands.

Suggested activities:

- Develop a tilapia and catfish genetics improvement program together with public and private sector beneficiaries.
- Develop permanent breeding centre for safeguarding quality gene pool to supply hatcheries throughout the country.
- Train the staff of the breeding centre in genetic improvement best practices.
- Promote the use of YY tilapia genetics as this enables hormone-free hatchery practices.
- Utilize the training program and additional demonstration workshops to showcase the advantages of quality broodstock to Tanzanian hatcheries.
- Beneficiaries: FETA, TAFIRI and private sector hatcheries.

3. Hatchery management training program

Public and private hatcheries play a key role in the sector by producing and distributing quality fingerlings for the farmers. Theoretical and practical training of operational staff and management is required to optimize production of mono-sex tilapia and catfish seeds. Secondly, there is a need for post-harvest handling and transportation of fingerlings which can substantially increase fingerling quality and survival rates.

Suggested activities:

- Train public and private hatcheries with regards to hatchery management and distribution.
- Utilize the training program and additional demonstration workshops to showcase the advantages of quality broodstock to Tanzanian hatcheries.
- Embedding knowledge and skills through refresher courses in a permanent Aquaculture Academy.
- Beneficiaries: operational staff and management of public and private hatcheries.

4. Hatchery Mwanza region feasibility study

Cage farms in the Mwanza region are the fastest growing component in the Tanzanian aquaculture sector. However, no commercial hatcheries exist in the region which forces farmers to source fingerlings from hatcheries in Uganda and Eastern Tanzania. Long and complicated transport routes lead to low survival rates and high costs for the farmers. Therefore, it is recommended to support the development of a Mwanza-based commercial hatchery.

Suggested activities:

- Conduct a study on the technical and commercial feasibility of investing in a commercial hatchery in Mwanza Region.

- Develop a bankable business plan and present to potential investors and partners.
- Support the implementation of the development of the hatchery through technical assistance.
- Train future hatchery staff.
- Beneficiaries: commercial hatchery operator and cage farmers in Mwanza region.

5. Feed management training program

The lack of practical knowledge and skills with regards to proper feed management is a critical hindrance for sector development. Feed is the single most important cost driver for fish farmers and has a large impact on farmers' profitability. Therefore, a training program on efficient feed management to fish farmers and trainers ("train the trainers") is recommended.

Suggested activities:

- Develop curriculum and implement training program on feed management best practices.
- Training subjects to include feed handling and storage, biomass and feeding, feeding line adjustment, daily feed management, feed load and system interaction, growth and biomass calculation, technical results and profitability
- Beneficiaries: FETA and private sector fish farms.

6. Fish branding and marketing strategy and training

Access to markets and fetching the right price for their fish is essential for a thriving aquaculture sector. Several market-related challenges exist. Positioning of farmed fish in the market and differentiation from imports and wild catch remains an issue as wild catch is preferred and imports are inexpensive. Accessing the right market is a second issue given that most small-scale farmers sell only nearby markets and do not align their production planning with market demand. Furthermore, farmers lack the possibility to store their fish and control the timing of sales. All in all, there is much room for improvement of marketing and supply chain management. Support should be based on the premise that locally produced fish for the local market, should be recognizable to the consumer as such. Hence, a branding strategy providing differentiation between local production vs import will have to be devised and implemented.

Suggested activities:

- Organise stakeholder workshop to devise strategy for fish branding and marketing. Workshop includes presentation of recent fish consumer preference study in Tanzanian by FTA.
- Review best practices of fish marketing and branding in Zambia, Ghana and Egypt.
- Develop curriculum and training program on fish marketing and sales best practices for small and medium sized fish farmers.
- Beneficiaries: small and medium sized fish farmers in Mwanza and Coast regions.

7. Cold store pilot

Access to markets by fish farmers is limited by the absence of cold store infrastructure, forcing farmers to sell their harvest quickly to local markets for sub-optimal prices. Cold storage enables farmers to prolong the shelf life of their harvest, sell to more distant and lucrative markets and control the timing of their sales. It is therefore recommended to set up a (solar powered) cold storage pilot in an area with a high concentration of fish farms (e.g. Ruvu river area).

Suggested activities:

- Start with a study on the technical and commercial feasibility, location and identify (local) partners. Seek cooperation with NORGISVEL cold chain initiative.
- Develop business case for cold storage facility.
- Provide training program for cold storage operational staff.
- Awareness campaign on benefits of facility to fish farmers.
- Beneficiaries: group of (small scale) fish farmers, cold storage operator.

8. Fish meal processing feasibility study

Tanzania could become an important supplier of fish meal to fish feed producers. Fish meal is an important ingredient which provides the protein content of quality feeds. Fish feed producers in the region are eager to source fish meal locally if the quality and price are right. Lake Victoria sardine (Dagaa aka Omena) is potentially an excellent source of fish meal for feed production but currently no quality processing is in place in Tanzania. Currently, Dagaa is left to dry on beach front where it can easily spoil, especially during rainy seasons. Furthermore, high concentrations of sand and other particles are often found in Dagaa and fish meal supplies which renders it unsuitable for fish feed production. Processing of Dagaa fits well within the Tanzanian agricultural industrialisation policy. Furthermore, it will enable fish feed producers to source locally and drive down market prices for quality feeds.

Suggested actions:

- Conduct a study towards the technical and economic feasibility of processing wild caught Dagaa into fish meal for high quality fish feed production.
- The study should consider the impact of using Dagaa for fish feed production on availability of Dagaa for human consumption.
- Direct beneficiaries: fishermen and traders of Dagaa in Lake Victoria (mainly Mwanza) Region; processing company; regional fish feed manufacturers.

9. Aquaculture Hub development

The Tanzanian aquaculture sector needs across the board improvement, necessitating an integrated value chain approach to sector development. The development of an "Aquaculture Hub" can be a cornerstone in this process. An Aquaculture Hub is a centrally located, strong aquaculture farm which provides inputs, training and market access to smaller farmers in the region. In most successful East African aquaculture markets, it has been a key player, of several key players together, which has created the critical mass needed for infrastructure development. The envisioned Aquaculture Hub contains a hatchery, feed distribution, training and technical support center and supports an outgrower scheme. The training and support center should be developed into a permanent Aquaculture Academy for commercial aquaculture training to public and private stakeholders.

Suggested actions:

- Conduct feasibility study and develop business plan for Aquaculture Hub.
- Identify Tanzanian aquaculture entrepreneur who have the ability to become the central farm in the Aquaculture Hub model.
- Develop hatchery, grow-out farm, training and support center and feed distribution capacity.
- Develop and implement integrated training program on hatchery management, grow-out, processing, fish sales and marketing and business acumen.

- Beneficiaries: central farm; small-scale farmers in region.

10. Development of regulatory framework

The Tanzanian sector needs a conducive regulatory framework to continue its sustainable development. Several specific regulatory development opportunities have been identified by this study with regards to import duties and licenses, informal taxes, VAT regimes on feeds and obtaining licenses to start farming operations. Advocacy with Tanzanian regulatory bodies on behalf of the aquaculture sector is therefore highly recommended.

Suggested actions:

- Improved enforcement of import duty of 25 percent on imported frozen fish and fish products;
- De-complex application procedures for genetic material import licenses;
- Improvement of the import procedures of live fish;
- Removal of tariff and non-tariff import barriers for fish feeds (same as poultry sector);
- De-complexing application procedures for licenses for aquaculture production facilities.

11. Dedicated aquaculture policy

The aquaculture sector is relatively new to Tanzania which is reflected in its regulatory framework. Policy, regulations and institutions are still mostly focused on fisheries with aquaculture recently added to the spectrum. There is a clear need for a dedicated and integrated approach to aquaculture which reflects the specific needs and dynamics of the farming sector which is very different from the fisheries sector in many respects.

Suggested actions:

- Development of dedicated aquaculture law reflecting the different market dynamics of aquaculture compared to the fisheries sector.

12. Improvement of sector organisation and coordination

This study found a clear need for improved sector organisation and coordination. The recently established Aquaculture Association of Tanzania should play a pivotal role in organising the private sector. Furthermore, it was found that stakeholders from public sector, private sector and international and local donors/NGO's are not well-aligned in terms of aquaculture development initiatives.

Suggested actions:

- Strengthen the Aquaculture Association of Tanzania by increasing its added value for its members. Key role for AAT should be to liaise with the Government on issues affecting the industry. Furthermore, AAT can provide concrete services to its members such acquisition of funding for training program and research & education programs which will benefit the private sector.
- The Tanzanian Horticulture Association (TAHA) and the Kenyan Aquaculture Association (AAK) are in close proximity and in a great position to offer the AAT their key lessons learned. Given that the AAT is a newly formed association, much can be learned from existing bodies in the vicinity, such as TAHA and the AAK. Particularly on sector and stakeholder coordination.
- Facilitation of bulk purchase and distribution of inputs or storage of produce may also be considered as this delivers short term and tangible benefits to members. However, this is only feasible if AAT can maintain an independent position vis-à-vis input producers.

- AAT should equally represent all types and sizes of aquaculture business. Especially the tendency to focus on small-holder farming should be avoided as this may make the association less attractive for larger key players in the sector.
- A permanent aquaculture working group by the Ministry should play an important role in aligning stakeholders and aquaculture development initiatives. Government, education & research and private sector interest should be equally represented in the working group.
- The permanent aquaculture working group should organise round table meetings during which Tanzanian and international stakeholders are invited to present their work in the sector.

Annexes

Annex 1: Questionnaires used during expert interviews

Questions for key informants (government, researchers, large farmers, input producers)

Note: please select only questions which are relevant for the interviewee

1. What are the key trends in aquaculture sector?
2. What are the critical success factors on national level?
3. What are the main policies/strategy documents?
4. What are the main government aquaculture development programs (current and past 5 years)?
5. What are key problems facing fish farmers in each aquaculture segment (ponds, cages)?
6. What are the key barriers to entry for new fish farmers?
7. Which farming technologies are currently successful, and why?
8. What are challenges regarding farming technology and methods? Please specify:

8.1 cage farming (e.g. diseases, theft, zoning, feeding, pollution)

8.2 pond farming (e.g. growth cycle, water quality)

8.3 RAS farming

9. What are challenges regarding inputs? Please specify:

9.1 feed (e.g. price ingredients, market demand and price, availability, quality, labelling, regulations, permits, taxes)

9.2 fingerlings (e.g. genetic pool, permits, market demand and prices)

10. What are challenges regarding market access for farmers (e.g. prices, transport)?
11. What are challenges regarding access to finance for farmers (e.g. interest rates, weak business case)?
12. What are challenges regarding organisation of the sector (e.g. no associations, no leadership, costs)?
13. What are challenges regarding role of government? please specify:

13.1 investment guidelines

13.2 cage farm guidelines survey, zoning, mapping & gazetting cage sites

13.3 import regulation (e.g. feed, farm equipment, genetics)

13.4 no clear laws/regulations

13.5 no government assistance (e.g. extension services)

14. Which type of knowledge and skills are lacking? Please specify per topic:

14.1 pond, cage and RAS farming

14.2 feed and fingerling production

14.3 business management (e.g. book keeping)

14.4 fish marketing (e.g. price levels, product-market combination)

14.5 fish cooling, logistics and supply chain management

14.6 animal health

15. What type of concrete development/investments are highly needed?

Questionnaire for development initiative/international funders/NGO

Note: key informant interview questions can also added to this question list

1. Is your program involved in aquaculture development programs?
2. If so, what is the background of your program?
3. What is the overall objective of your program?
4. What are the specific type of interventions of your program?
5. Does your program involve: A) Capacity building B) inputs C) farming technology and methods D) Market Access E) Access to finance F) organisation of the sector G) policy H) research I) Financial
6. Who is the target group of your program?
7. Where are activities located?
8. What metrics do you aim to achieve? (e.g. no. of farmers trained, tons of fish produced)
9. What has been the impact so far of each intervention?
10. What are the lessons learned per each intervention?
11. What is the budget (quantify) of your program?
12. How is your budget divided over the various interventions (quantify)?
13. What is the timeline of your program?
14. What is the stage of implementation of your program?
15. Who finances your program?
16. Which partners are involved in your program and what are their roles?

Wv & BM: explain FTA strengths: RAS, feed, fingerlings, training, cold chain

17. Do you see opportunities for collaboration between your program and NL/FTA stakeholders?
18. Are you aware of any other aquaculture development programs in TZ?
19. What type of concrete development/investments are highly needed?

Annex 2: List of interviewed persons or organisations

Name:	Organisation:
Mr. H. Vishani	Rift Valley Aquaculture
Mr. G. Rucho	Aquaculture Association Tanzania
Mr. S. Karoza	Aquaculture Specialist & Researcher at SUA
Dr. Simtoe	FETA, Director of Training
Mr. Mahega,	Aquasol Cage Farming
Mr Musyangi	Aquasol Cage Farming
Mr. E. Zabron	Aquasol Cage Farming
Dr. A. Shoko	TAFIRI
Mr. Ambwene	GreenFishInvest
Mr. D. Boselie	Gatsby Africa
Mr. J. Arul	Indian Ocean Aquaculture
Mr. Kumbo	Ruvu Fish Farm
Lt. Joseph Lyakurwa	SumaPonic
Dr. Mzighani	TAFIRI, Acting Director
Dr. Kangwe	TAFIRI, Director of Resource Centre
Ms. Siwema Luvanga	TAFIRI
Professor Bwathondi	UOD, Dept of Aquatic Sciences and Fisheries Technology
Mr. A. Mndeme	CEO Riga's Safina's Big Fish Farm
Dr Yahya Mgawe	CEO FETA
Mr. M. Nzingula	Fisheries Officer
Mr. J. Kinyage	Sokoine University & CEO of AQUACOM

Mr. W. Bwemelo	Eden Fish farm
Dr. Sloans K. Chimatiro	WorldFish, Country Director
Mr. I. Goulding	MegaPesca
Mr. F. Perini	European Commission Delegation
Ms. S. Ngamau	Creadev
Mr. S. Ahmed	NMB bank Tanzania
Mr. I.J. Masus	NMB Bank Tanzania
Mr. R. Magoma	NMB Bank Tanzania
Multiple interviewees	Meck Fish farm
Multiple interviewees	Jackson fish farm
Multiple interviewees	Lake side fish farm
Multiple interviewees	OHK AQA Farm
Multiple interviewees	Kasegenya fisheries company
Multiple interviewees	Niko fish farm
Multiple interviewees	Yanga Makaka fish farm

Note: email addresses and telephone numbers are not included in this report due to privacy regulations but are available upon request.

Annex 3: Stakeholders taking part in mission to Kenya

Name	Organization
Dr. Charles Mahika	Director of Aquaculture / Head of delegation Ministry of Livestock and Fisheries
Dr. Hamisi L. Nikuli	Head of Aquatic Animal Health and Coordinator of Aquaculture. Ministry of Livestock and Fisheries
Mr. Geofrey Ladis Rucho	Aquaculture Association of Tanzania
Mrs. Maria Tumwesigye Ijumba	Head of Cluster and Partnership Development. SAGCOT Centre Limited
Dr. Emmanuel Andrew Sweke	Head of Research Department, Kigoma Centre. Tanzania fisheries research institute (TAFIRI)
Mr.Christopher Israel	Vet and Technical Advisor. Hill Company (animal feed manufacturer)
Dr. Simtoe Ambakisye Polland	Director of Training and Research. Fisheries Education and Training Agency (FETA)
Mr. Abraham Mndeme	President - Riga's Safina's Big Fish Ltd.
Mrs. Theonestina Mutabingwa	Agriculture Policy Officer. Embassy of the Kingdom of the Netherlands Tanzania