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Challenges and Emerging Opportunities associated with Aquaculture development in Zambia

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Abstract

The Aquaculture subsector in Zambia produces about 10, 000 tonnes per year of fish and of this, 75 percent comes from small-scale aquaculture, while commercial fish farmers produce the other 25 percent. Aquaculture is expanding in all ten provinces of the country, and as a result, Zambia is now one of the largest aquaculture producers in sub-Saharan Africa. This trend presents enormous investment opportunities in the sector with the government creating an enabling environment. A paradigm shift from mere management of a collapsing capture fishery to the promotion of aquaculture would reduce fishing pressure on capture fisheries and provide opportunities for improved nutrition and increased incomes for the rural poor. However full potential in aquaculture has not been fully seized owing to a spiral of bottlenecks associated with the subsector. In this article an attempt has been made to outline chronologically aquaculture projects that have been implemented in the past and also highlight on the challenges and emerging opportunities associated with aquaculture development in the country. Suggestions have been made on priority areas requiring attention in order to accelerate sector development.

Keywords: Challenges, Opportunities, Aquaculture development, Paradigm shift.

1. Introduction

Zambia is a country richly endowed with natural resources best suited to aquaculture production. Fifteen (15 million) hectares of water in the country is in the form of rivers, lakes and swamps, which provide the basis for aquaculture development^[1]. Aquaculture promotion in Zambia has a long history, dating back to the 1950s when the first attempts were made by the Joint Fisheries Research Organization (JFRO) to raise indigenous species of the Cichlidae family, mainly tilapias, in dams and earthen fish ponds. The sector has remained at relatively low levels with most past interventions by way of programs and projects in the agriculture sector tending to focus on crops at the expense of fisheries. Aquaculture farming systems in Zambia include cages, ponds, circulation tanks, and dams and account for an estimated 13% of total fish production^[2].

The contribution of fish to Gross Domestic Product (GDP) in 2013 was estimated to be 1.4% percent^[3]. This estimate is based largely on the contribution from capture fisheries, because production from fish culture is still limited and not regularly reported.

Fish production is important to the national economy in Zambia and contributes significantly to employment, income and food production. It is estimated that up to 55 percent of the national average protein intake is from fish. The importance of fish in Zambian household food expenditure increases in proportion with increasing levels of poverty. Aquaculture among the small-scale farmers is predominantly carried out in areas with less livestock (goats) and in protein deficient areas where it contributes significantly to food security among the farmers and provides income. These farmers are able to exchange or barter fish for other farm crops. The impact can be measured in terms of general family welfare and the ability to pay school fees in most households^[4]. Aquaculture development has been facilitated by the Government programs through the Department of Fisheries and Donor funded project with a main objective of improving nutrition and food security for the poor. The paper attempts to identify the bottlenecks and opportunities associated with aquaculture development in Zambia in order to make recommendations for relevant remedial measures and interventions that will accelerate development of the sector. A recap on aquaculture projects provides an understanding on various interventions that the government through bilateral cooperation has implemented all

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aimed at developing the sector;

2. Aquaculture Developments

2.1 Review of aquaculture projects

In 1972, integrated fish farming methods were introduced using fertilizer, manure and maize bran as supplementary feed. During the same period there was an inflow of refugees from warring neighboring countries and this resulted in increased demand for source of cheap protein. This saw the influx of major foreign technical assistance programmes in various parts of the country. A number of donors have subsequently taken an active part in assisting the government to encourage farmers to adopt aquaculture. This has been done by introducing pond culture in rural areas as a way of improving nutrition. The government has provided extension services which have made a marked improvement to fish culture activities^[5]. The country has had a series of aquaculture projects including;

FAO/UNDP (1980-1989).

Projects produced technical and extension manuals from the results of on-station technology trials. The integrated approach packages included the use of external inputs such as pigs and Peking ducks which were adopted by medium and large scale commercial farmers. However the adoption of the same by small-scale farmers was low due to demand for external inputs such as feed for these animals. The main facet of the project was to promote integration of animal and crop husbandry in aquaculture practices.

ICARA I and ICARA II (1982-1988).

These projects supported the construction of more than 1 000 fish ponds at Maheba refugee camp in Solwezi and Mwinilunga Districts in Northwestern Province. They also introduced a community based extension approach where extension agents were living among the refugee communities. The projects intended to provide both employment and food security to the refugees and villagers within project catchment areas.

FAO/ALCOM (1987-1999).

The program aimed at improving the extension methods in Eastern and Luapula Provinces. The program advocated the use of the participatory approach in preference to a top-down approach. The fish farmers were engaged in articulating their aspirations and needs and therefore the projects were more farmer directed.

NORAD (1987-1998).

The projects opened up satellite stations using Misamfu fish farm at Kasama in Northern Province as the referral center to provide extension and fingerlings to rural farmers. This approach improved extension services to the extent that the number of farmers increased to 1 200 farmers in 1993 from the 700 farmers in 1988. This approach however, could not be sustained as it was not only a top-down approach but was also costly, in addition to inadequate technical manuals produced as from 1994.

AFRICARE (1992-1995).

Project was a follow-up to ICARA Projects I and II. The project was based in the Northwestern province of Zambia, it was a community based program with extension approach where extension agents implemented fish farming practices among the refugee and outlying communities.

FAO/ALCOM (1995-2000).

The project focused on community-based management of small water bodies in Southern Province. One of the objectives was to introduce a participatory system for better utilization of the limited water resources. Through this project, aquaculture was introduced and promoted to produce fish as an alternative source of animal protein.

ASIP I (1995-2000).

The Agriculture Sector Investment Plan was initiated in 1996 under the auspices of the Ministry of Agriculture, Food and Fisheries (MAFF). Major changes that affected aquaculture extension included re-organization and restructuring leading to integration of agriculture

and aquaculture extension services under the Department of Field Services reducing aquaculture to a very small sub-component. Aquaculture planning was decentralized at the district level together with other sub-program.

RAP (1996-present).

The Rural Aquaculture Program, started in 1996 It provides American Peace corps volunteers at local community level as aquaculture extension agents in Northern, Muchinga, Northwestern, Copper belt, Luapula, Eastern and Central Provinces. RAP promotes management techniques that rely on locally available resources among farmers thus minimizing the need for external inputs. The technical standards and the extension approaches strictly follow set standards targeting capacity building and fish production among rural small holders.

SHAP (1998-2001).

Smallholder Aquaculture Program worked in collaboration with RAP in Northern, Northwestern, Luapula, Copper belt and Central Provinces. The project aimed at increasing fish farm production using on farm resources.

Integrated Aquaculture Irrigation (2001-2003).

The project targeted the small-scale farmers with traditional irrigation systems. The main objective was to optimally utilize water resources for increased fish and crop production per unit area. It promoted use of farmer friendly technologies through the farmer field schools approach. This project was implemented in Mkushi and Serenje Districts of Central Province.

The In-Country Aquaculture Training (2002 – 2004)

The In-Country Aquaculture Training (ICAT) project was operational from 2002 to 2004 and was organized at the National Aquaculture Research and Development Centre (NARDC) with support from Japanese International Cooperation Agency (JICA). The objective of the project was to strengthen the aquaculture research extension through improvement of knowledge and skills among extension agents so that they were able to advise farmers in ways of improving productivity.

The Farmer Based Aquaculture Training (FAT) 2006 – 2008

The project was a Training Technical Cooperation between the Governments of Japan (through the Japan International Cooperation Agency (JICA) and the Government of the Republic of Zambia (GRZ). The Project was implemented by the Department of Fisheries (DOF) in the Ministry of Agriculture and Cooperatives (MACO). The program which was operational between August 2006 to 31st March 2008 aimed at training and equipping both extension agents and fish farmers with latest fish farming technology. Lead farmers were identified and trained^[6].

UNDP/GEF Lake Tanganyika Integrated Management Project-Zambian Component (2008-2013)

The Lake Tanganyika Integrated Management Project (LTIMP) was part of a regional program of four riparian states namely the Republic of Tanzania, the democratic Republic of Congo, the Republic of Burundi and the Republic of Zambia. The aim of the program was to set up an effective system for managing the biodiversity of Lake Tanganyika and its basin of which Zambia is part. The Zambian component, which started in 2008 and was scheduled to run for six years till August 2014. The Zambia component focused on sedimentation control (in Mpulungu and Kaputa Districts with a total budget of US\$2.84 million. The enterprises development component promoted aquaculture especially in Mpulungu, in areas in upper parts of the district, within 15 to 40 Kilometers distance from the Lake Tanganyika.

2.2 Production Systems

The most common type of aquaculture in Zambia is fish farming based mostly on species from the Cichlid family namely, *Oreochromis* and *ersonii* (64%), *Tilapia rendalli* (20%), *Oreochromis niloticus* (5.2 %), *Oreochromis macrochir* (5%), and to a lesser extent, but in order of significance Carp, crayfish (red claw, maron and

yabbies), and catfish <1%). After several years of adaptive research, fish farming in Zambia has attained a high level of diversity ranging from extensive to intensive practices; and from multi-species to mono species culture [7]. Currently fish farming systems practiced in Zambia include: extensive and non-commercial fish farming; semi-intensive; and intensive aquaculture practices.

The non-commercial fish farming systems are the most prevalent forms of aquaculture and have been encouraged by the Government for the purposes of strengthening food security and nutrition in areas with communal water bodies and characterized by protein food deficiency due to lack of livestock rearing practices. The stocking of fish in existing impoundments, mainly community small water conservation dams have had some community participation. Levels of management are generally low. In general, there is usually no regular feeding or fertilization as this system relies on natural reservoir fish food production.

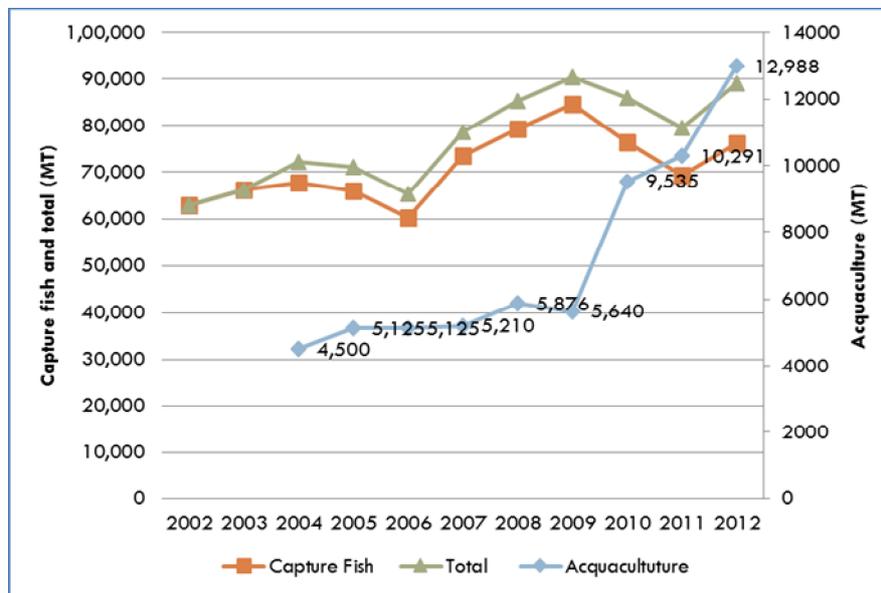
For this type of aquaculture there is very little control and regulation of environmental conditions compared to other types of aquaculture. Extensive fish culture is being carried out in private and communal areas particularly in drier parts such as Southern and Eastern provinces where many reservoirs are constructed to mitigate drought. A number of smallholder farmers practice mixed species culture using indigenous tilapia. The aquaculture industry is now more diversified than it was 50 years back. In addition to stocking fish in conservation reservoirs and ponds, fish culture employs earthen ponds, tanks and cages. Average pond size per farmer among small scale farmers has remarkably reduced from 400 m² in the eighties to 246 m² today. This is partially because of emphasis on rural aquaculture through household subsistence ponds rarely exceeding 100 m² each. A few commercial entrepreneurs have also attempted to set up recirculation systems with limited success [8].

2.3 Aquaculture production

By 1966, there were 1,321 ponds recorded in Zambia with a total area of 100 hectares producing approximately 88 metric tonnes (MT) in 1967 and by 1985 pond production had increased to 750 MT. Of this 86 MT (11.5%) were produced by small-scale rural fish farmers, 94

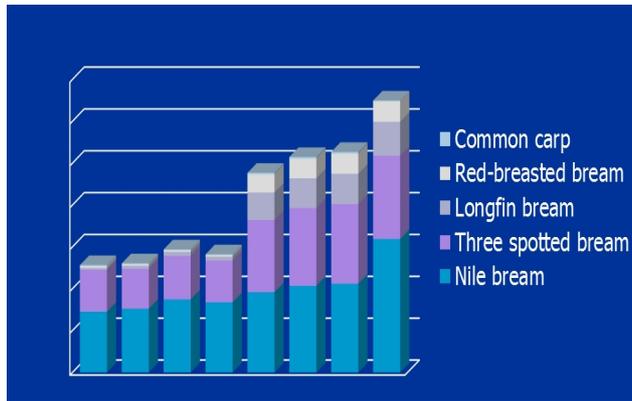
MT (12.5%) by Government fish culture stations and 570 MT (76.0%) by commercial farmers. After this initial development, there was a rapid decline probably due to decreased extension services and partly because of reduced commercial incentives to increase production due to the system of price controls introduced by government on food items in the post 1968 economic reforms. In addition, aquaculture development programs were mainly targeting small-scale farmers, a trend that has continued to the present [9]. Currently there are more than 6,460 small-scale farmers with 13,900 fish ponds covering 342 hectares of water producing about 1.2 and 1.6 MT per ha per year [8]. These farmers are predominantly in the eastern, north western, northern and Luapula provinces. There are also 15 active large commercial fish farms spread along the railway line in Copper belt, Lusaka and Southern provinces where ideal business conditions exist. Joint extension efforts by the private sector and the government have seen aquaculture expand in all nine provinces of the country, putting Zambia among the largest aquaculture producers in Sub-Saharan Africa with an estimated production in 2000 exceeding 8 500 tonnes at a value of US\$ 19 million. Total average production of the main species farmed fluctuates between 8 000 and 10 000 tonnes/year of which 75 percent is estimated to be from small scale producers. Fluctuations in production can be attributed to the small-scale producers who abandon production and who produce seasonally. In 2000 the total value of aquaculture production was estimated to be US\$ 19 million. According to FAO figures for 2003, the quantity of production was 4 501 tonnes and the value of production US\$ 5 669. Depending on availability, finfish fetches on average US\$ 2 per kg. Crustaceans fetch a higher price at US\$ 11 per kg. There are 2 commercial enterprises practicing cage culture on Lake Kariba; Yalelo Limited and Lake Harvest both using 20 to 25m diameter cages. Both enterprises grow *Oreochromis niloticus* in floating cages and use extruded feed with anticipated production in excess of 80 tonnes per cage [10].

The graphs below show fish production statistics in Zambia;



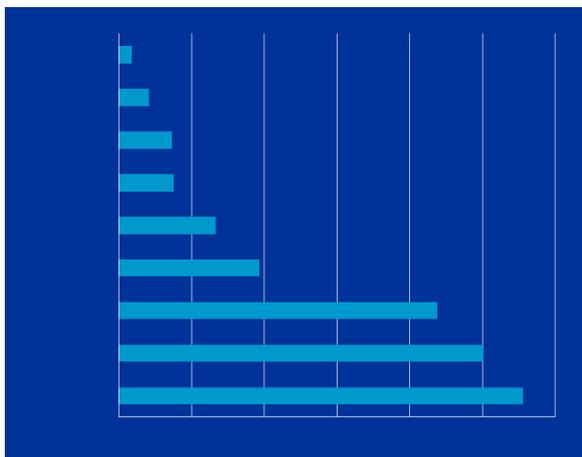
Source: MAL, Department of Fisheries.

Fig 1: Reported Fish production in Zambia (from 2002 to 2012)



Source: Department of Fisheries Annual Report 2012

Fig 2: Aquaculture production by species between 2005 and 2012 in Zambia



Source: Department of Fisheries Annual Report 2012

Fig 3: Aquaculture production by province in Zambia in 2010

3. Aquaculture Development Constraints

Despite the remarkable development in the aquaculture sector in Zambia making it one of the leading countries in fish farming in Southern Africa and in the SADC region in particular, the development does not commensurate with the potential of the sector. Several factors appear to impede aquaculture development and the authors identified the following constraints:

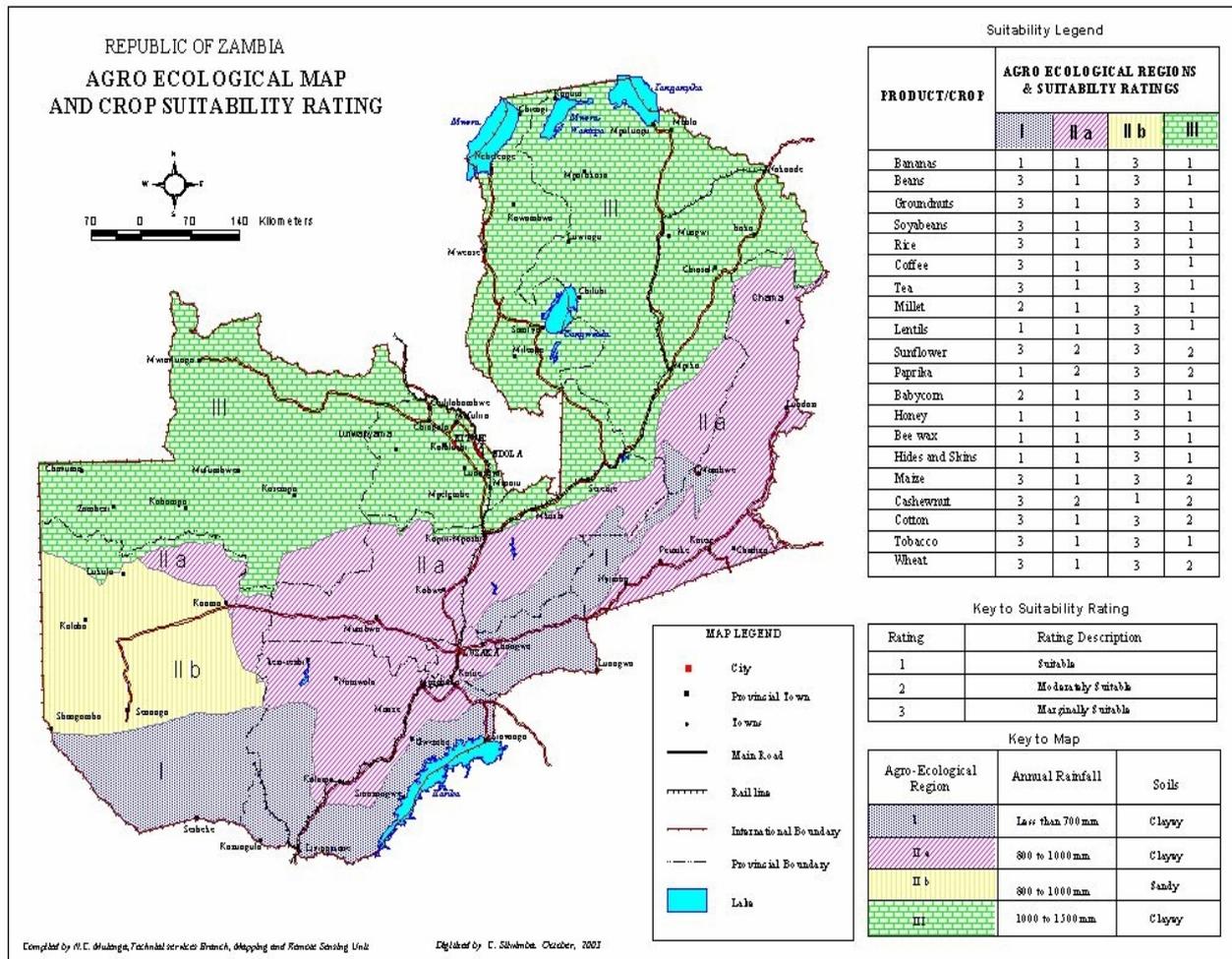
- (i) Uncoordinated promotion of aquaculture by various institutions, which include Government, research institutions, Non-governmental organizations, and Universities, among others. The variation in the approaches to aquaculture promotion compromises on the quality of information that eventually rolls out to the target beneficiaries who are the farmers.
- (ii) Shortage of experts in major aquaculture faculties to design aquaculture development programs and oversees their implementation. Critical shortage of experts in areas of production system, fish genetics, fish diseases and Fish nutrition leads to the low esteem of the sector and subsequently being graded inferior to Agriculture and therefore accorded little attention.
- (iii) Ineffective extension services (inadequate capacity, shortage of staff, training packages and materials) depriving fish farmers of the much needed technical services;
- (iv) Insufficient financial resources by Government to implement even the most basic research and development programs.
- (v) Insufficient knowledge in aquaculture sector leading to inappropriate design of aquaculture research and development projects
- (vi) Non availability of concrete policy guidelines for the development of the fisheries sector;
- (vii) Weak research programs which are not farmer demand- driven

- (viii) Lack of certified quality fish seeds and commercially produced feed and if available are expensive to afford by the smallholder farmers;
- (ix) Low investments by the private sector.
- (x) Inadequate entrepreneurship skills by farmers and lack of credit;
- (xi) Poor record keeping by the farmers and inaccurate data collection procedures lead to distorted information being disseminated and therefore aquaculture perceived as non-viable farming practice.
- (xii) The small size and geographical dispersion of production units tend to raise the unit costs of access to services and markets. For instance, it complicates the delivery of inputs (seed and feed) and extension services;
- (xiii) Limited access to finance by farmers and traders in the aquaculture value chain, which, is partly due to financial institutions limited awareness on potential and viability of aquaculture;
- (xiv) Local fish species have been marginalized thereby farmers resort to imported brood-stock which is prone to disease;
- (xv) Inadequate producer organization: cooperatives/farmers groups; out grower schemes and therefore lead to weak advocacy by producer associations;
- (xvi) Fish losses due to human theft, otters and prey birds are a major bottleneck in some communities, while commercial entrepreneurs experience post-harvest losses mainly due to inadequate transportation, storage and processing facilities;
- (xvii) Low priority accorded to fisheries and aquaculture development programs in national development programs;
- (xviii) Too much emphasis accorded to maize farming at the expense of aquaculture, livestock and other farming systems in development programs.

4. Opportunities for Aquaculture Development in Zambia

The aquaculture sector is a potential contributor to the economic development of Zambia and is presented with several opportunities such as;

- (i) The local communities having accepted that aquaculture is a food production system and that it has potential of offsetting the fish deficit created as a result of the dwindling catches from capture fisheries;
- (ii) An appropriately trained workforce is essential to aquaculture development. In this regard the government of the republic of Zambia has put in place various levels of training for staff that include offering of up to first degree aquaculture program at the Copper belt University. Fish farmers alike are exposed to specialized hands on trainings.
- (iii) Zambia being endowed with abundant water particularly in high rainfall areas (Agro Ecological Zone III) that can be reclaimed for aquaculture purposes;
- (iv) Livestock husbandry practices particularly in Eastern and Southern Provinces make integrated fish farming easy and profitable;
- (v) Good soils and climatic conditions suitable for fish farming in most parts of the country;
- (vi) A farming community keen to take up and integrate aquaculture in their food production processes;
- (vii) Availability of an aquaculture extension service throughout the country monitored by the Department of Fisheries.
- (viii) Availability of an Aquaculture Research division in the Department of Fisheries coupled with appropriate state of art infrastructure such as National Aquaculture Research and Development Centre;
- (ix) Availability of provisions in the Fisheries Amendment Act of 2007 and the Environmental Protection and the Pollution control Act of 1990 for the management of Aquaculture;
- (xiv) Availability of proven methods that can be adopted for engaging in economically viable aquaculture;
- (xv) The interest shown by cooperating partners to support aquaculture development in the country;
- (xvi) Aquaculture development is implemented in a manner consistent with the National Development plan.
- (xvii) Aquaculture can easily be integrated into conventional farming including small scale crop and animal production in the rural areas of the country. See crop suitability rating in figure 4 below according to different agro ecological zones in the country.



Source: ZDA, Agriculture sector profile, 2011

Fig 4: Agro ecological Map and Crop suitability rating

5. Priority Areas to Accelerate Aquaculture Development In Zambia

Significant progress has been made to address the mainstreaming areas of aquaculture in order to meet the developmental challenges associated with nutrition and food security for the people. However a deliberate paradigm shift would be required to change both research and extension approach to aquaculture for meaningful development to be actualized.

The following areas would be critical to appropriate interventions that will subsequently revitalize and promote aquaculture development in Zambia;

(i) Aquaculture productivity

It is currently estimated that there is a short fall of about 40,000 metric tonnes of fish to meet the national demand, there is a bottomless market demand for fish in Zambia. Most of the fish is imported from China, Namibia, Zimbabwe and South Africa. Some of the fish is imported in to the country, repackaged and exported to neighboring countries. The supply vacuum creates a favorable window of opportunity to articulate appropriate aquaculture technology which will enhance production and productivity, particularly for the smallholder farmers who contribute 75% to aquaculture fish production. Cage aquaculture for both commercial and out-grower schemes must be promoted sustainably.

(ii) Weak institutional capacity

Although appropriate aquaculture institutions may exist in Zambia, their coordination is fragmented and therefore compromises their ability to implement aquaculture policies cohesively. Under the liberalized market economy, government as a public institution will need to support and collaborate with the private sector in order to ensure service delivery to critical mass is comprehensive.

(iii) Weak Monitoring and Evaluation framework

The Ministry of livestock and fisheries will need to generate a functional monitoring and evaluation domain. There would be need to develop a comprehensive information gathering tool which will generate and archive baseline data on aquaculture. Statistical figures presented in most reports are often contradictory and lack validation. Monitoring and evaluation protocol must be developed ultimately together with stake holders and mainstreamed within the sector.

(iv) Weak Policy and legal framework in aquaculture sector

Good and sound aquaculture policies are a recipe for the development of the sector, meaning that they are only a means to an end. The government has a role of creating an enabling environment to support various players engaged in profitable aquaculture venture. Although government has developed the aquaculture strategic plan which is enshrined with the description of best aquaculture management practices, the benefits of such management tools have not been translated into enhance fish production. The capacity by government to implement best aquaculture management practices is limited and therefore requiring consolidated collaboration with relevant stakeholders.

6. Conclusion

Zambia has enormous potential for aquaculture development. The dwindling catches of fish from capture fisheries calls for concerted efforts to revitalize the aquaculture sector by addressing the critical areas outlined herein. There would be need to undertake a paradigm shift from routine aquaculture to a more comprehensive research in development approach which is sustainable and in tandem with farmer needs. Researchers and extension agents will be required to articulate relevant aquaculture technologies meeting the nutritional,

economical and food security needs of the people. Two critical inputs variables in aquaculture are quality feed and seed and therefore there will be urgent need to align aquaculture development agenda toward formulation of cost effective fish feed and supply of quality fish seed targeting especially the resource poor fish farmers. Fish farmers are not a dumping ground for technology instead are an integral part of the developmental process starting from the planning stages. Community-based aquaculture projects must be encouraged and supported in a sustainable manner in order to empower the poorest of the poor. The future of aquaculture in Zambia depends on the commitment by various stakeholders to avert the bottlenecks associated with the aquaculture sector. In addition the Department of Fisheries and collaborating partners would be required to expend considerable resources on on-farm research using indigenous fish species and recommend species which will adapt to on farm feed resources, species which are resilient to adverse environmental conditions and best suited to a particular agro ecological zone in the country.

7. Acknowledgement

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