African Journal of Fisheries Science Vol. 1 (7), pp. 045-051, December, 2013. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Small-holder aquaculture and Water bodies Contribution to poverty mitigation and enhancing household food security in Zambia

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Accepted 26 November, 2013

A study was conducted between January and May 2011, through administration of questionnaires and personal interviews in 6 of the 10 provinces of Zambia (namely: Lusaka, Eastern, Central, North Western, Copperbelt, and Southern) in order to assess the contribution of small water bodies (SWBs) and small-holder aquaculture towards poverty alleviation and enhancing household food security. Using simple random sampling method, a total of 120 respondents were selected. Results indicated that, a total of 1,082 SWBs were constructed throughout the country covering a total area of 5,410 ha. Most of them were constructed for irrigation purposes and as sources of drinking water for livestock. At the same time, aquaculture adoption at household and intra household levels had increased by 4.7% in all the districts over the years. There were more than 11,327 small-holder farmers who owned 21,658 ponds, covering 578.86 ha of land. There was also a 10% increase in number of learning institutions and the hospitality industries that had adopted aquaculture activities either for recreational or learning purposes. Existing statistics indicated that, there were 11,327 small-holder farmers who owned 21,658 ponds, covering 578.86 ha of land with an annual fish production of 3,985.16 metric tonnes, while that from SWBs stood at 2,705 metric tons. It was however noted that, the majority of these farmers (65%) produced less than 0.5 tons of fish per hectare/year, which was considered to be very low. However, fish production from SWBs remained almost unchanged because extension support had remained very inadequate and the designed programme to enhance productivity in community small-water bodies was not being implemented. Most of the fish harvested comprised mainly of: *Oreochromis andersonii, Oreochromis macrochir*, and *Tilapia rendalli*, which were readily acceptable to the consumers.The study also revealed that, adoption of small-holder aquaculture helped in poverty alleviation, improved rural household food security and better nutritional status compared to non-fish farming families. Most of the small-holder farmers cultivated various agricultural crops through irrigation and were also involved in livestock rearing, from which extra income was realized.

Key words: Contribution, small-water bodies, small-holder aquaculture, poverty alleviation, food security, Zambia.

INTRODUCTION

Poverty levels in Zambian are very high especially among the rural communities. This can largely be attributed to the economic downturn of the 1980s and early 1990s when Copper prices plummeted to their lowest levels ever, causing most citizens to become poverty stricken. According to CSO (2009) and Aquaculture Development Plan (ADP) 2008 – 2011 (2009), the country's poverty levels stood at 64% of the population, of which the

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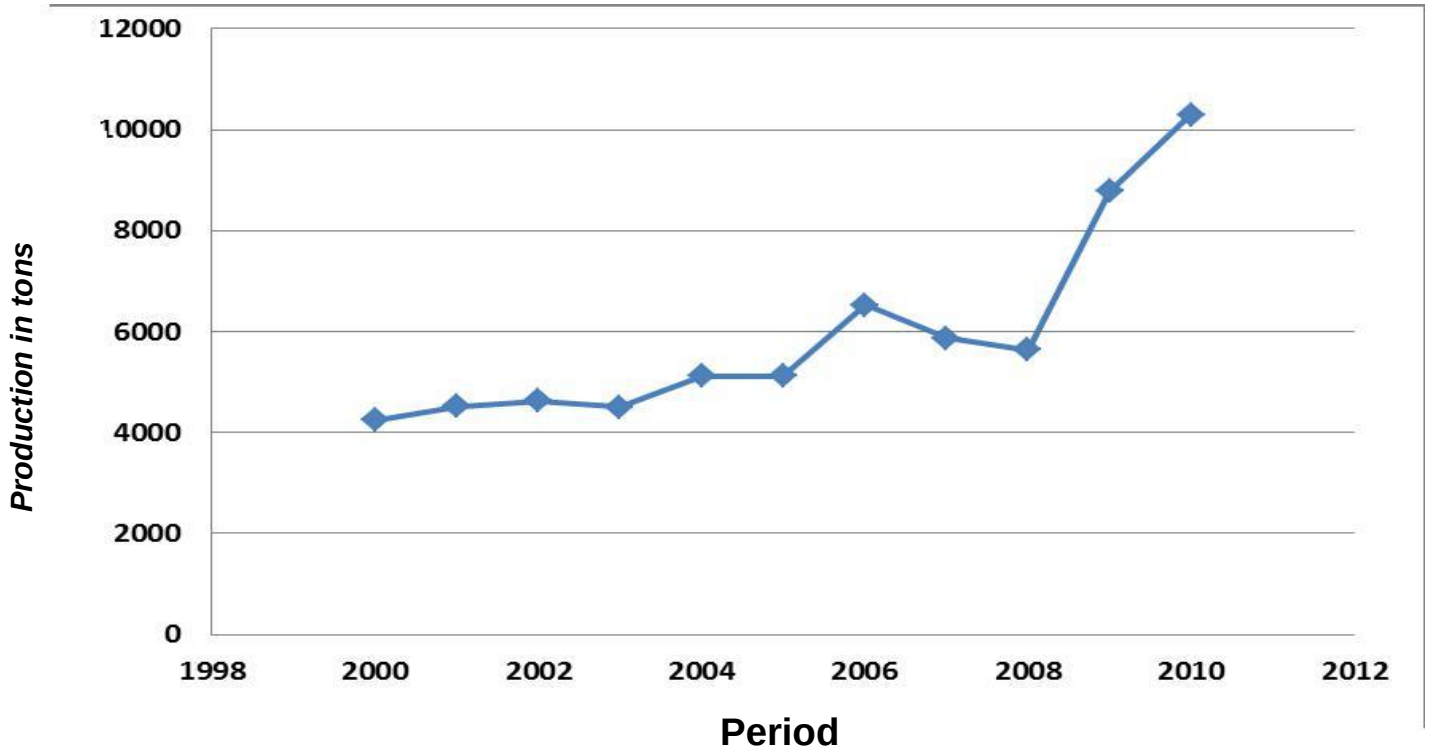

Figure 1. National Aquaculture production in Zambia (2000 to 2010) in metric tons (Source: DoF).

majority were those residing in rural areas. However, in 2010, the Civil Society for Poverty Reduction (CSPR) also observed that, poverty levels in Zambia were still on the increase, with an average of 85% of the 7,978,274 people who resided in the rural areas and 34% of the 5, 068, 234 in the urban areas were still living under the poverty datum line (Lusaka times.com 2010 and CSO report, 2010). Poverty and food insecurity in Zambia generally stem from over-reliance on rain-fed agriculture, and associated effects of frequent unfavorable climatic conditions, along with inadequate incomes, access to markets and transport facilities to enable the transfer or purchase of food, compounded by low economic diversification into sectors such as fisheries that could supplement crop production (Musumali et al., 2009).

The fisheries sector contributed between US$51 and 135 000 000 per annum to GDP over the period of 2002 to 2007, averaging around 1.24% of GDP at current prices (Musumali et al., 2009). Zambia has the potential of supplying 70 metric tons of fish from the natural fishery per annum (The New Nation, 2009). Fish makes up 40% of animal protein in the diet of Zambians (ACF/FSRP, 2009). It was undisputable that, the demand for fish in Zambia was very overwhelming and almost of all the fish produced in the country was intended for human consumption. In fact, the demand for fish by the local market was in excess of 100,000 tons. As such, there was a shortage of over 30,000 tons, which was being supplemented through fish imports from Asia and neighboring countries. Fish imports from Mozambique (Kapenta), Namibia (Horse Mackerel), Zimbabwe (Tilapia) and China (Tilapia) have gradually increased in order to meet the ever increasing demand (DoF, 2010; Musumali et al., 2009). More than 50% of fish imports, especially those from China were gutted and filleted fresh tilapias (breams), packaged in 50 kg boxes.

Aquaculture or fish farming as was popularly known in Zambia, was in the range of extensive to more intensive (commercial) and integrated systems relying on organic manure and formulated feeds (ACF/FSRP, 2009). Production from aquaculture was between 7,000 and 10,000 tons (DoF, 2010), although Aquaculture Development Plan (ADP) 2008 – 2011 (2009) estimated that, only 4,549 tons valued at US $20.9 000 000 per annum was what was produced, which was way below their potential. The sector was reported to only represent 8.8% of total fish production; a level that was not sufficient to arrest Zambia's declining national fish per capita consumption of 5.8 kg (Figure 1).

There were however, enormous opportunities and potential to increasing production 10-fold (Table 1) in existing aquaculture facilities (that is, ponds, community small water bodies (SWBs) and cages) by expanding into new areas (DoF, 2010). It was estimated that, 40 000 ha in Zambia could be brought under pond culture and further million hectares of land from lake areas was

Table 1. Potential fish pond development sites by Province.

Province	Fish pond (ha)	Location	Inlet	Water M^3/day
Central	1.400	Luswishi River	Pump	97.000
Copperbelt	1.200	Run-off Machiya River	Pump	80.000
Eastern	8.000	Luangwa River, Petauke	Pump	581.000
Luapula	4.105	Samfya and Bangweulu Lake	Gravity	273.000
Lusaka	800	Chanyanya	Gravity	53.600
Northern	2.250	Mutale-mukonge, Chandamali	Pump	150.000
Northwestern	4.140	42 dispersed small scale areas on tributaries of Kabompo River	Weir pump	275.000
Southern	15.875	Large scale development on Kafue River	Gravity	1,097.000
Western	1.790	179 Dispersed small scale areas	Seepage	124,000
Total	39.560	165 Locations		2,730.600

Source: DoF (2010).

potentially suitable for aquaculture use DoF (2010).

MATERIALS AND METHODS

A study was conducted between January and May 2011 in 6 of the 10 provinces of Zambia (namely: Lusaka, Eastern, Central, North W estern, Copperbelt, and Southern) in order to assess the contribution of SW Bs and small-holder aquaculture towards poverty alleviation and enhancing household food security. Using simple random sampling method, a total of 120 respondents (90 males and 30 females), thus 25% of the total population of small-holder farmers were randomly selected for the study. A representative sample for the study from each fish farming area was based on Boyd's formula as follows:

$n/N \times 100 = C$

Where C-represents a figure greater or equal to 5% of the fish farmer population, N-overall population (total number of Ffsh farmers), n-number of selected fish farmers (Sample size) as by Boyd et al. (1981), required sample size: $n/N \times 100 = C$, $n = 480 \times 25/100$, $n = 120$.

Data collection from the field was obtained using semi-structured questionnaires, which were administered to randomly sampled respondents with the help of fisheries officers. In addition, data was gathered from focus group discussions and participant observation.

This assisted in capturing some extra information that was not captured by the questionnaires. The major data items collected included the following: aquaculture production statistics and collection methods used; fish feed/seed availability and cost and available capacity building programmes. Statistical Package for Social Sciences (SPSS) 12.0 was used to analyze data from the field. Being categorical data, descriptive statistic were done to analyze the data and summarized in tables and figures using Microsoft Excel.

RESULTS

Figures 2, 3, and 4 show the distribution, size, and production from SWBs in each of the provinces, while Table 2 gives a summary of small-holder aquaculture national statistics, and Figure 5 shows small-holder aquaculture production in metric tons.

DISCUSSION

The study observed that a total of 1,082 SWBs were constructed throughout the country covering a total area of 5,410 ha (Figure 2). Most of these SWBs were constructed for irrigation purposes and as sources of drinking water for livestock. Southern Province had the highest number of SWBs in the country with over 700 recorded (Figure 2), representing an estimated 3,500 ha (Figure 3), although a report by "The New Nation" of February, 2009, put the figure at 800 dams and slightly above 250 earthen fish ponds. The SWBs was stocked with fish, whose annual production was 2,705 metric tons, with Southern province still taking the lead at 1,750 metric tons and Luapula produced only 7.5 metric tons (Figure 4). During the study, the authors learnt that, the Department of Fisheries in Southern Province undertook fish restocking programme of Cichlids in 2010 under the Poverty Reduction Programme (PRP), where a total of 36 reservoirs were stocked with 22,299 fingerlings. According to Mudenda (2006) the stocking rate of 1.5 fish/m2 of small water body was recommended.

An earlier report by Mudenda et al. (2005) revealed that, fisheries management of community reservoirs was almost non-existent in most areas where it was introduced. The authors called for urgent measures to be put in place to redress the situation. However, during this study, it was established that, in order to sustain fishing, especially in communally owned reservoirs, committees were formed to provide a suitable management system required to control fishing activities and also to discourage the rampant use of mosquito nets that had far reaching consequences in harvesting fish stocks.

The bulk of aquaculture in Zambia was concentrated in the small-holder category, which relied on family labour

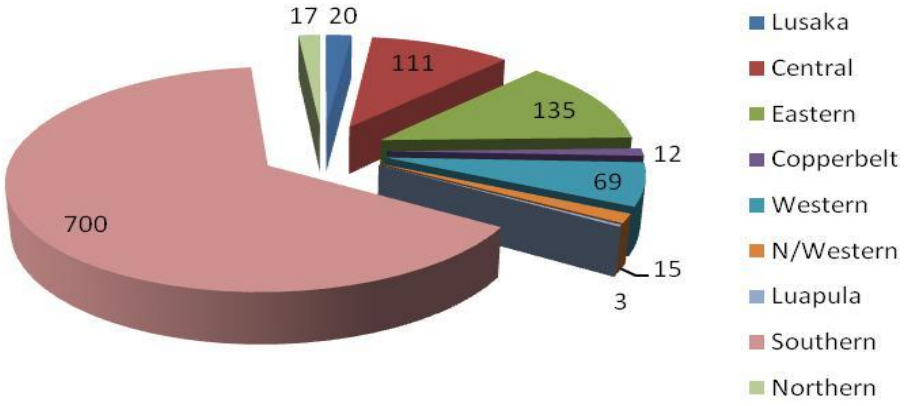

Figure 2. Distribution of SWBs per province.

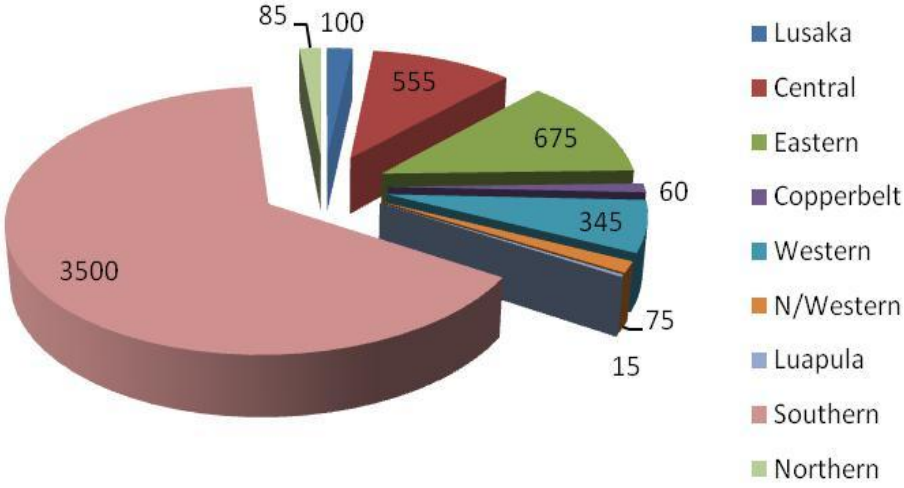

Figure 3. Coverage area in hectares (ha) of SWBs.

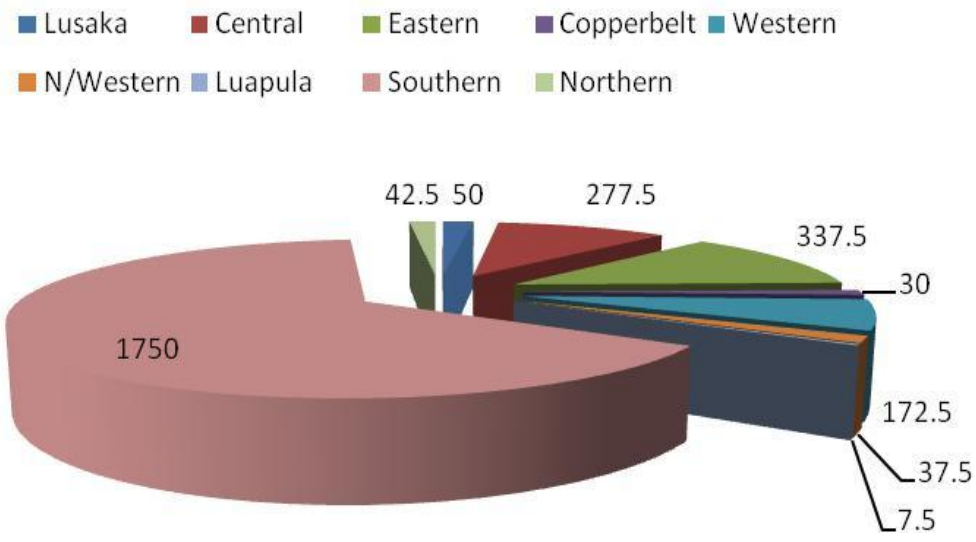

Figure 4. Fish Production in metric tons from small water bodies.

Table 2. Summary of small-holder aquaculture national statistics.

Province	Number of fish farmers	No. of ponds	Area of ponds (ha)	Prod (tons)
Central	698	925	19.69	133.3
Copper belt	597	1.436	54.07	365.96
Eastern	1.826	5.252	158.00	1125.75
Luapula	789	1.274	37.92	256.63
Lusaka	254	1.305	22.00	159.66
Northwestern	2483	4134	99.82	675.68
Northern	3771	6.457	172.07	1164.71
Southern	226	304	4.92	33.27
Western	683	571	10.37	70.2
Total	11.327	21658	578.86	3,985.16

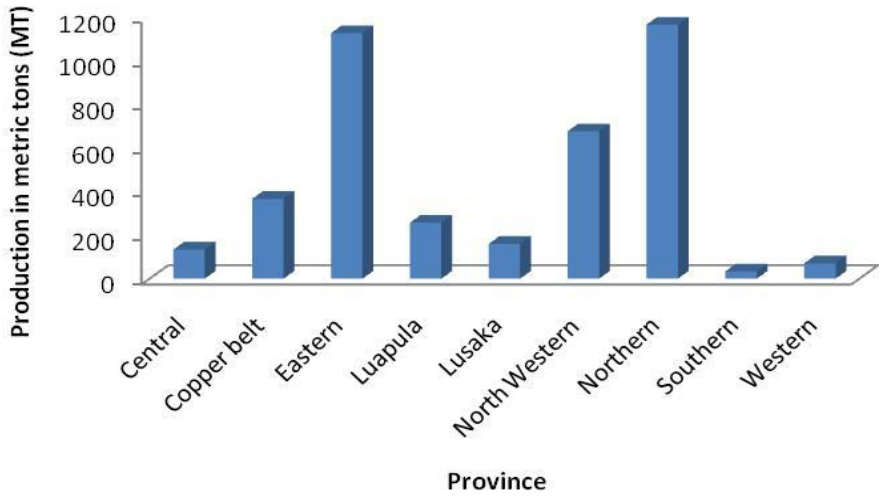

Figure 5. Small-holder aquaculture production (MT) per province.

and practised extensive culture too (ACF/FSRP, 2009). Most of them, if not all, cultivatedvarious agricultural crops and were also involved in livestock rearing. Small- holder ponds and SW Bs were the main source of irrigation water for other agriculture produce, from which extra income was realized. The adoption of small-holder aquaculture helped in improving rural household food security and better nutritional status compared to non-fish farming families. Machena and Moehl (2001) further observed that, small-scale systems tended to be "rural", if not in location then in the sense that they did not rely upon urban markets for their product, with most consumed by the family or sold on the pond bank. Mudenda (2006) also reported that, small-scale farmers generally produced fish for consumption and very few of them produced for the market. In such situations farmers did not sell fish on weight basis using a balance or scale but on numbers. The author further reported that, most fish farmers did not keep performance records due to low education levels, they harvested intermittently for household consumption and sold what was produced to the neighbourhood at the end of the season while keeping some fish ponds as "banks" where they only went to harvest when need arose. The study further revealed that, with the availability of disposable income, there was a drastic reduction in poverty levels among the small-holder aquaculture communities, which in other words implied them being food secure. Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (SPFS, 2003).

In Zambia, small-holder aquaculture contributed significantly to household food security through provision of cheap fish as food, nutrition (protein), income, diversification of rural livelihood and employment generation, thus stimulating the rural economy (Mudenda, 2006;DoF, 2010). Many related institutions

such as Non governmental organizations (NGOs) collaborated very well with the department of fisheries in ensuring that, the sector improved household food and nutrition security for vulnerable groups through the promotion of integrated group and livestock and fisheries production by marginalized people living under a dollar per day. Such kind of collaboration significantly contributed to the local and national economy, and provided goods and services that enhanced the social well-being for the current and future generations without compromising environmental integrity by 2030 (DoF, 2010). This was contrary to IBRD/W orld Bank (2006) report, which indicated that, aquaculture provided only 2% of the Sub-Saharan Africa region's supply and made only a minor contribution to economic growth, employment and foreign exchange. The authors noted that, the number of farmers taking up small-holder aquaculture in various districts had increased by 4.7% over the years; the majority of whom were retirees, youths and women's groups. The study also noted a 10% increase in number of learning institutions and the hospitality industries that had adopted aquaculture activities either for recreational or learning purposes. Existing statistics indicated that there were 11,327 small-holder aquaculturists who owned 21,658 ponds, covering 578.86 ha of land (Table 2) with an approximate total fish production of 3,985.16 metric tonnes (Figure 5). Fish harvested comprised mainly: *O. andersonii, O. macrochir*, and *T. rendalli*.

The males dominate the aquaculture sector as owners of fish farming enterprises and as workers (Mudenda et al., 2005). The study observed that, males constituted 81% while females made up a partly 19% of the existing number of small-holder farmers. This study also revealed that, 85% of the farmers were married with 8 to 10 children while the other 15% relied on either hired labour or dependants that lived with them. It can further be inferred that 52% of the existing small-holder farmers were above 50 years old. Most of the new entrants in the sector had education standards above secondary school level. For example, in Lusaka province alone, 89.5% of the respondents had attained tertiary level of education while the remainder had either primary or secondary school level of education.

It was however noted that, the majority of these farmers (65%) produced less than 0.5 tons of fish per hectare/year, which was considered to be very low. DoF (2010) also reported a reduction in production of 3.5% coming from the small-holder farmers in the same period although the overall aquaculture production and numbers of small scale fish farmers was increasing. A similar situation was observed in Malawi where 80% of farmers produced less than 18 kg of fish per annum (Britz and Hecht, 2005).

Fluctuations in production could be attributed to the attitude of farmers and government policy (Kefi et al., 2010). The fisheries law was to some extent very weak and did not in any way compel farmers to submit data on their production activities to the department of fisheries on their own resulting in disjointed or inadequate information regarding the sector. At the same time, farmers in most cases were not honest enough to disclose how much fish they were producing to avoid paying tax to the government. The situation was further compounded by shortage of qualified personnel in the department of fisheries with statistical skills.

Most small-holder producers abandoned production due to diminishing enthusiasm and in some cases produced seasonally in spite of available suitable natural conditions. The situation was also attributed to inadequate extension delivery during the year under review as a result of both reduced numbers of extension staff and zero release of funds. In most cases, small- holder farmers perceived aquaculture to be a secondary economic activity coming after crops and livestock rearing. They alleged that, aquaculture was not productive and created an impression that it was just a by-the-way activity. As a result of that notion they attended to it when they were done with their mainstream agricultural activities that were equally very involving. In some cases, aquaculture activities were relegated to other family members like women and children while men attended to what was perceived to be very serious activities.

ACF/FSRP (2009) reported that, long standing constraints in aquaculture included: inadequate extension services, lack of comprehensive training packages and materials, chronic shortages of quality fish seed and fingerlings, high cost of fish feed, and poor marketing support. Utsugi and Mazingaliwa (2002) and Mudenda et al. (2005) identified the following as the main constraints to the development of aquaculture in Zambia: inadequate quality fingerlings; insufficient animal manure, lack of affordable fish feed; lack of appropriate technology; poor rural infrastructure; lack of marketing strategy; insufficient comprehensive extension packages; insufficient extension staff; lack of data centre; inadequate operational fund for research; insufficient donor support to 10 aquaculture research station; untimely government support after project support gets discontinued; and weak research extension link. The sector's heavy reliance on hand-outs was cited as not being sustainable. Whenever there was a project aquaculture thrived but as soon as that project ended the activities declined or stopped completely. Most farmers never felt as owners of their own activities since they suffered from donor fatigue. Such successive failures discouraged potential investors and caused delayed development (DoF, 2010).

Similarly, IBRD/The World Bank (2006), Simumba (2007) and ACF/FSRP (2009) observed that, past aquaculture development efforts largely failed because of weak institutions, poor access to finance, and a heavy reliance on failing government extension services and seed production. The focus on subsistence aquaculture may have been misguided, because it often lacked the driving force of market demand and impetus provided by

commercial reality (IBRD/The W orld Bank, 2006). Another study conducted to identify the constraints to aquaculture in Akwa Ibom State, Nigeria, Akpabio and Inyang (2007) identified lack of high yielding fingerings as one of the production constraint to fish production. Meanwhile, Kefi et al. (2010) reported that, aquaculture would be helped if those factors that derailed it were given attention by the government and by the farmers themselves.

According to FAO (2006), aquaculture management seeks to create an environment which will encourage private sector led growth so as to achieve the objectives of increased total fish production, increase per capita consumption of fish, improving nutrition and to increase income made. For example, in 2009, the government launched a five years (2010 to 2015) Sixth National Aquaculture Development Plan (SNDP) that was more precise in describing specific priority systems to promote with cluster of operators in specific high potential zones. The plan's immediate outcome was: investments in economically, socially and environmentally sound aqua businesses. These enterprises were in turn expected to contribute to a diversification of livehoods, improved nutritional status, increase income generating capacity,as well as improved employment opportunities.

The authors learnt that, the project selected fish farmers who received technical support in form of pond stocking with all-male sex-reversed indigenous *Oreochromis andersonii* produced by Revendel Tilapia

Enterprise hatchery at 5 fish/m^2. *O. andersonii* was selected on the basis of it being indigenous as well as its suitability for commercial aquaculture production in ponds because of its superior quality in terms of feeding, breeding habits, attractiveness, growth and hardiness. The fish were fed with: fry booster (1 to 4 weeks), starter crumble (at 4 weeks) and grower (from 3 months up to harvest). Lessons learnt from the project were expected to be replicated countrywide, implying that, the strategy of small-holder farming clusters was likely to impact positively in other parts of the nation.

Conclusion

The authors noted an increase in number of farmers taking up small-holder aquaculture throughout the country. Aquaculture activities were also being done at community level, thus empowering an entire community. The majority of these farmers (65%) however, produced less than 0.5 tons of fish per hectare/year, which was considered to be very low; hence the need to upscale their production in order to realize some profits from the sector.

Some producers abandoned production due to inadequate extension delivery and diminishing enthusiasm. In some cases they produced seasonally in spite of available suitable natural conditions. Others perceived aquaculture not to be very productive and viewed it as a secondary economic activity coming after crops and livestock rearing. As a result of that notion, they attended to it when they were done with their mainstream agricultural activities that were equally very involving.

Enhanced statistical data collection on aquaculture required to be improved for the better. At the same time, the government should quickly deal with land use conflicts that have been arising as farmers in rural areas grow their fish.

The adoption of small-holder aquaculture helped in improving rural household food security and better nutritional status compared to non-fish farming families. With the availability of disposable income, most families were able:

(a) To pay school fees for their children
(b) To construct decent houses with roofing sheets
(c) To buy bicycles to ease their mobility
(d) In some cases owned animals, which they used for ploughing their fields.

ACKNOWLEDGEMENTS

The authors wish to acknowledge financial and material support rendered to the team by the Copperbelt University without which this project would not have been undertaken. Special thanks to go to all members of staff in the department of fisheries throughout the country and all those who helped us in one way or another.

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