

Aquaculture production and its contribution to development in the Rwenzori region Uganda

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Abstract

The purpose of this study was to estimate aquaculture production and its contribution to development in the Rwenzori region. A survey questionnaire administered to 116 active fish farmers found that most were males, aged 48-57 years, with primary education. Men dominated fish pond ownership, management, marketing and spending of the proceeds. The average yield was estimated to be 14 t ha⁻¹ from small ponds (mean = 524 m²) and 30t ha⁻¹ from large ones (mean = 6,188 m²) in Kasese and Kamwenge districts respectively. Most farmers used yam leaves and avocado fruits as feed, preferred Nile tilapia (*Oreochromis niloticus*) for farming, sourced fish seed from local producers, belonged to a farmer association and used their own capital. Major challenges were the cost of feed and fish fingerlings, while most farmers used aquaculture income to pay school fees.

Keywords: Fish farming, Livelihoods, Nile tilapia, Yield

Introduction

In Uganda, fish exports are second to coffee, although the contribution from capture fisheries is declining because of increasing fishing pressure (DFR, 2012). Aquaculture provides employment, food and income (Rutaisire *et al.*, 2009), and earns foreign currency through the export of fishing bait to Kenya and Tanzania and seed to Tanzania, Democratic Republic of Congo and Rwanda (FAO, 2005). The sub-sector also plays an important role in providing food security and household incomes (Kasozi *et al.*, 2014).

Despite the importance of the sector, the only study on the socio-economics of aquaculture has been done in the West Nile region of Uganda (Kasozi *et al.*, 2014). Some economic analyses were carried out in the Sironko, Manafwa and Mbale districts in Eastern Uganda (Gidongo *et al.*, 2012) and profitability analysis in the central Uganda districts of Mpigi, Mukono and Wakiso (Hyuha *et al.*, 2011). The only study from the Rwenzori region reported that small scale tilapia farming was unprofitable (Lulijwa and Busobozi, 2015). This study focused on farmers who were growing-out Nile tilapia *Oreochromis niloticus* in ponds in the

Rwenzori region. It was intended to give a broad picture of aquaculture productivity in the region and assess the performance of pond-based aquaculture. It is hoped that information provided by this study will help to guide development projects and potential investors in Uganda's aquaculture and direct government agencies to formulate policies for stimulating aquaculture development.

Methods

Purposive sampling of active fish farmers in the study districts of Kasese and Kamwenge was used to establish the required number of respondents. Lists of farmers were obtained from District Fisheries Offices and individual farmers identified for face-to-face interviews using a survey questionnaire. Data collected included farmer demographics, gender roles, cultured fish species, preferred culture species, pond size and production, sources of capital and challenges faced. Data were collected on gross revenue, variable costs and fixed costs in order to determine cost-benefit ratios, while the contribution of aquaculture to development was assessed by data on farm characteristics, the number of jobs generated and the use of fish sales income.

Regression analysis of important yield factors was done at $\alpha = 1\%$ in Minitab 16, and cost-benefit estimated in Microsoft Excel 2010.

Results

Characteristics of farms and farmers

Most farmers (83.6%) were males, with the largest group (25.0%) being aged from 48-57 years (Table 1). Additionally, most respondents (49.1%) had achieved primary education and were married (89.7%). Most farms (73.3%) were started and owned by male household heads, predominantly directed by men (51.7%) and as was the marketing (56.9%) of fish and in spending the proceeds (48.3%) (Table 2).

The average pond size in Kasese and Kamwenge was 524 m² and 6,188 m², respectively with the average fish yield being 14 t ha⁻¹ and 30 t ha⁻¹ over an 8-month season. Half of the farmers (50.0%) used green yam leaves and avocado to feed fish, while only 8.6% could afford the recommended formulated floating fish feed. Most farmers (50.9%) obtain fish seed from local fry producers although a significant number also obtain seed from a local supplier (24.1%) (Table 3). The major cultured fish was *O. niloticus* (52.6%), which was also the preferred species for aquaculture by a majority of farmers (56.9%) ahead of the African catfish (*Clarias gariepinus*).

A regression analysis relating yields (expressed as Uganda shillings) to production costs found significant correlations only with feed and seed used (both positive), and labour and maintenance expenses and loan servicing (both negative) (Table 4). The majority of fish farmers (59.5%) were organised into associations and groups (23.3%). Additionally, 23.3% of the respondents interviewed were found to have more than ten years of experience of fish farming, with most fish ponds being personal enterprises (71.6%). Most of them (77.6%) used their own savings to establish fish ponds and the majority (49.1%) of them used streams as the water source for their ponds (Table 5).

Contribution to development

As a measure of aquaculture's contribution to development, employment at fish farms was investigated and the majority of farmers (43.1%) engaged one individual, mostly among family members, to carry out general management activities connected with the fish pond (Table 6). Aquaculture

was second to crop farming (39.1%) as a contribution to household incomes of small-scale fish farmers in Kasese (Figure 1). A cost-benefit analysis above 1.0 was observed among 41.3% of the farmers interviewed. An important economic consequence was that most fish farmers (60.3%) used the income from fish farming to pay school fees for their children (Table 7).

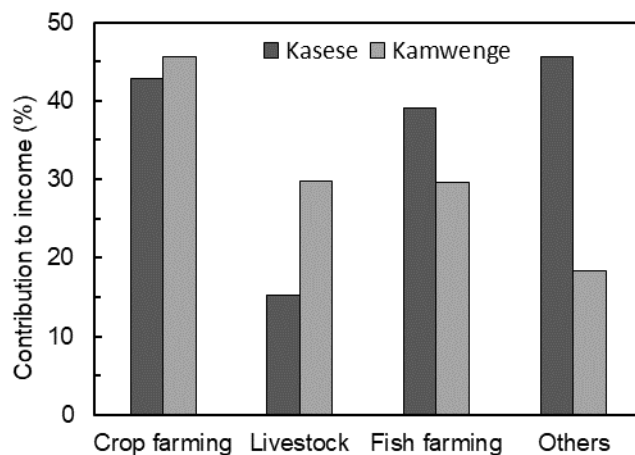


Figure 1. The contribution of aquaculture to the annual income of small-scale fish farmers in the Rwenzori region.

Fish farmers regarded the main challenge that they faced was the cost and quality of feed, followed by the cost and quality of fingerlings, while the challenge of least concern was the water supply (Table 8).

Discussion

The fact that most fish farmers were males is similar to the situation in other areas of the country, such as the Kigezi and West Nile regions (Kasozi *et al.*, 2014; Papius, 2014). This is probably typical of most households in Uganda and elsewhere in Africa. In Ghana, for instance, family-run units are usually headed by men because of customary practices which give exclusive rights to men, while women have such rights only when a household head is female, but not in a mixed-sex family entity (Moehl, 2003).

In Rwenzori, as elsewhere in Uganda (Kasozi *et al.*, 2014; Papius, 2014) the ponds were mostly managed by men who were also involved in marketing fish and controlled the disposal of income from sales. An exception was in the West Nile region where decision on using proceeds from fish sales were jointly taken by men and women (Kasozi *et al.*, 2014). With respect to labour, most

aquaculture enterprises in Africa rely heavily, if not exclusively, on family labour and fish farming is generally a family affair in where men do construction and women conduct marketing, with all family members participating in pond management and harvesting (Moehl, 2003). The fish farms in Rwenzori do not fit this pattern entirely since men seem to do most of the marketing as well.

This gender imbalance may partly be associated with land ownership since men own land in traditional African households, which influence decisions such as starting up an enterprise, harvesting, marketing and spending the proceeds. Also, the lack of mechanization, strenuous nature of the work and lack of protective gears in Uganda's extensive aquaculture may also limit women's participation in fish farming. In contrast, women reportedly conduct 42-80% of all aquaculture activities in other countries such as Indonesia, Cambodia and Vietnam, (DFID, 2000; Kaing and Ouch, 2002)

Age greatly influences production on fish farms according to reports from Zambia (Mbozi, 1991) where fish farming was seen as an activity for young men who, by implication, are still active and therefore more productive. Although the age bracket 31-50 years is reportedly innovative, motivated and adaptive (Yunusa, 1999) farmers in the Rwenzori region were rather older than this but it is unclear if this has affected productivity. The level of education (primary) was similar to Kigezi (Papius, 2014) but higher than in West Nile (Kasozi *et al.*, 2014). These educational levels are much lower than in Nigeria where 53% of fish farmers in Osun State had achieved tertiary education. Good education is believed to enhance innovation and business practices in farming (Olasunkanmi, 2012), which could partly explain low production by small scale farmers in the Rwenzori districts.

Most farmers use yam leaves and avocado to feed fish, which is in line with findings in the West Nile region where farmers used cassava, potatoes, maize grain, vegetable leaves and kitchen leftovers (Kasozi *et al.*, 2014). On the other hand, more farmers in West Nile used the recommended formulated floating fish feed (21% compared to (8.6% in Rwenzori). The use of green leaves and unprocessed plant material as the sole source of food reduces fish growth because of its high cellulose and low protein content. The preference for cultivating *O. niloticus* is similar to the West Nile and Kigezi regions in

Uganda, where farmers also prefer this fish (Kasozi *et al.*, 2014; Papius, 2014).

Although a significant number of farmers obtain fish seed from a local supplier, most of them sourced it from neighbouring fish farmers, whose technical capacity and skills are limited, thus compromising seed quality which could reduce fish growth and production. This study found that feed and seed costs were major production variables and similar findings have been reported in the central region of Uganda, where fish farming experience and record keeping, along with the cost of fish and feed, and fish productivity were found to be major factors in aquaculture profitability (Hyuha *et al.*, 2011).

The majority of fish farmers were organised into associations and a similar trend was reported from the central region and Kigezi (Hyuha *et al.*, 2011; Papius, 2014). In contrast, data from Nigeria indicated that 72% of farmers did not belong to any farmer's association despite recommendations to join one in order to strengthen their ability to access financial services (Olasunkanmi, 2012). Farmer experience can improve the competitiveness and profitability of fish farming operations (Gidongo *et al.*, 2012; Hyuha *et al.*, 2011; NARO/MAAIF, 2000). Thus, the fact that many farmers in this study had more than 10 years of experience and were running their own farms may be attributed to donor-funded projects that initiated aquaculture activities in the study area. Elsewhere, in Nigeria and central Uganda, 70% of farmers were reported to have 5-10 years of working experience (Hyuha *et al.*, 2011; Olasunkanmi, 2012).

Most farmers used their own savings to establish fish ponds, which is similar to the Nigerian situation (Olasunkanmi, 2012). Indeed, none of the farmers in Rwenzori had bank loans for fish farming, a situation that calls for development of credit services such as cooperative savings, microfinance institutions and banks, to facilitate aquaculture investment and development. The ability of farmers to use natural gravity flow water sources for their fish ponds in the Rwenzori region is an important cost-saving factor that would not be available to farmers living in drier areas or towns.

The constraints imposed by the cost and quality of feed and fingerlings were the main challenges faced by farmers in the study area as well as in central, West Nile and Kigezi regions of Uganda, and in Nigeria (Hyuha *et al.*, 2011; Kasozi *et al.*, 2014; Olasunkanmi, 2012; Papius, 2014).

The economic impact of fish farming on employment in the study area was relatively small. Most farmers (58%) employed no one or else only one person on their farm, which reflects the small-scale nature of aquaculture in this region. Large-scale operations provide more benefit to rural poor through employment and wage earnings, in contrast to small operations, which mostly use the labour of family members (Ahmed and Lorica, 2002).

Importantly, however, aquaculture was second in importance to crop farming as a major source of income for the farmers. This is a particularly important finding that reveals the impact of small-scale fish farming on agrarian communities in hilly areas where the major cash crop is coffee. Fish grown on these farms finds a ready market in highland communities as an alternative protein source since there is a lack of pastures for livestock in such areas. Thus, aquaculture has contributed to food security and income generation in Rwenzori, as it has in many parts of the world (Ahmed and Lorica, 2002; Bouis, 2000; Subasinghe *et al.*, 2009).

The finding that the cost-benefit ratio exceeded 1.0 for 40% of the farmers, suggests that aquaculture is viable as a business enterprise, but the fact that in 60% of them it is less than 1 should be a matter of concern and suggests that appropriate advice from technical personnel is needed. Finally, most farmers in Rwenzori use income from fish farming to pay school fees for their children, which is a direct contribution to development and society, especially in fishing communities where other economic activities are limited.

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Table 1. Demographic characteristics of fish farmers in the Rwenzori region. Data from 116 respondents.

	Category	Frequency	Percentage
Gender	Male	97	83.6
	Female	19	16.4
Age (years)	18-27	10	8.6
	28-37	16	13.8
	38-47	28	24.1
	48-57	29	25.0
	58-67	22	19.0
	68-77	10	8.6
	78-87	1	0.9
Education	None	8	6.9
	Primary	57	49.1
	Secondary	27	23.3
	Tertiary	17	14.7
	Others	7	6.0
Marital status	Single	7	6.0
	Married	104	89.7
	Widowed	4	3.4
	Widower	1	0.9

Table 2: Gender roles in fish farming in the Rwenzori region. Data from 116 respondents.

	Category	Frequency	Percentage
Proprietorship	Man	85	73.3
	Woman	15	12.9
	Both	12	10.3
	Others	4	3.5
Daily pond management	Man	60	51.7
	Woman	18	15.5
	Both	26	22.4
	Children	4	3.5
	Others	8	6.9
Marketing	Man	66	56.9
	Woman	17	14.7
	Both	23	19.8
	Children	3	2.6
	Others	7	6.0

Spending proceeds	Man	56	48.3
	Woman	13	11.2
	Both	43	37.0
	Others	4	3.5

Table 3: Characteristics of fish farms in the Rwenzori region. Data from 116 respondents.

	Category	Frequency	Percentage
Feed used	Formulated feed pellets	10	8.6
	Agricultural by-products	24	20.7
	Own formulated feed	22	19.0
	Leaves (yam, avocado)	58	50.0
	Natural feed	2	1.7
Cultured fish	Nile tilapia	61	52.6
	Mixed tilapia	46	39.7
	African catfish	5	4.3
	Others	4	3.4
Preferred species	Nile tilapia	66	56.9
	African catfish	40	34.5
	Others	8	8.6
Source of fish seed	Local fry producer	49	42.2
	Neighbouring farmer	28	24.1
	Government agencies	20	17.4
	Own ponds	3	2.6
	Wild capture	2	1.7
	Others	14	12.1

Table 4. A general regression analysis of seasonal yield versus production costs for fish farmers in the Rwenzori region. Data

were all expressed in Uganda Shillings (UGX). Values marked ** are highly significant with $p < 0.01$. None of the other values were significant.

Production Factors	Coefficients	Standard Error
Feed used	9.036**	2.000
Seed used	30.188**	1.000
Fertiliser used	1.780	8.000
Lime used	83.533	60.000
Labour and maintenance	-26.658**	9.000
Harvesting	42.265	27.000
Marketing	28.812	64.000
Professional fees	-261.871	246.000
Miscellaneous expenses	-37.705	26.000
Loan servicing	- 8.512**	2.000
Security	2.367	15.000

Table 5: Characteristics of fish farms in the Rwenzori region.

Category		Frequency	Percentage
Association membership	None	20	17.2
	Group	27	23.3
	Association	69	59.5
Experience (years)	0-1	26	22.4
	1-3	25	21.6
	4-6	24	20.7
	7-9	14	12.1
	>10	27	23.3
Farm ownership	Personal	83	71.6
	Family	20	17.2
	Group	8	6.9
	Cooperative	2	1.7
	Community	2	1.7
	Organisational	1	0.9
Source of capital	Own savings	90	77.6
	Commercial bank	2	1.7
	Cooperative savings	1	0.9
	Friends and relatives	3	2.6

	Loan from friends	9	7.8
	Donor funding	7	6.0
	Others	4	3.4
Water source	River	15	12.9
	Stream	57	49.1
	Swamp	11	9.5
	Reservoir	2	1.7
	Underground water	19	16.4
	Spring	12	10.3

Table 6. The number of people employed at fish ponds, other than the proprietor, in the Rwenzori region.

Number	Frequency	Percentage
0	17	14.7
1	50	43.1
2	20	17.2
3	14	12.1
4	4	3.4
5	7	6.0
6	3	2.6
8	1	0.9
Total	116	100

Table 7. Main use of income from sale of farmed fish.

Category	Frequency	Percentage
Health care	2	1.7
School fees	70	60.3
Food purchases	7	6.0
Re-invested in fish farming	18	15.5
Others	19	16.4
Total	116	100.0

Table 8. The major challenges faced by fish farmers in the Rwenzori region. Farmers ranked a list of 11 common challenges from a scale of 1 as the most pressing to 11 as the least pressing. Data are presented as the percentage of respondent who ranked these challenges experienced in fish farming.

Challenge	Ranking										
	1	2	3	4	5	6	7	8	9	10	11
Feed cost & Quality	58.6	22.4	7.8	3.4	4.3	0.9	0.9	0.9	0.9		
Fingerling cost & quality	12.9	26.7	19.8	10.3	9.5	4.3	2.6	7.8	5.2		0.9
Predators	2.6	10.3	6.9	12.1	9.5	12.1	10.3	12.9	6.0	11.2	6.0
Marketing	0.9	5.2	4.3	3.4	5.2	0.9	5.2	4.3	17.2	25.0	28.4
Theft of fish	4.3	10.3	19.8	6.9	2.6	9.5	10.3	12.1	8.6	9.5	6.0
Water shortage	2.6	1.7	4.3	4.3	3.4	6.0	8.6	5.2	16.4	16.4	31.0
Labour costs	2.6	7.8	7.8	16.4	18.1	17.2	12.1	6.0	3.4	5.2	3.4
Transport costs	1.7		2.6	0.9	8.6	8.6	13.8	19.0	16.4	17.2	11.2
Lack of extension services	1.7	0.9	8.6	11.2	19.0	12.1	12.1	9.5	13.8	6.9	4.3
Maintenance costs	2.6	2.6	6.0	14.7	12.9	19.0	14.7	12.9	6.9	4.3	3.4
Limited government support	9.5	12.9	12.1	17.2	6.0	9.5	10.4	9.5	4.3	4.3	4.3