Technical Report

COSTS-BENEFIT ANALYSIS OF GROW OUT FISH FARMING ENTERPRISES: CASE STUDY OF EASTERN UGANDA



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Acronyms

ATAAS	Agricultural Technology, Agri-business and Advisory Services
BEP	Break-Even Point
DFO	District Fisheries Officer
DSIP	Development Strategic Investment Programme
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MFEP	Ministry of Finance and Economic Planning
NaFIRRI	National Fisheries Resources Research Institute
NARO	National Agricultural Research Organisation
NFP	National Fisheries Policy (),
PBP	Pay Back Period

Abstract

The purpose of the study was to estimate economic returns for Aquaculture enterprise and develop strategies for enhancing market access for fish farmers. The study would contribute to improved enterprise selection among fish farmers, resulting in increased returns on investments in fish farming. The methodology involved a sample survey of 59 pond owners in the Districts of Iganga, Tororo and Kaberamaido. The results showed small pond sizes of average of 459 M^2 and average pond construction cost of Shs 871,874. Majority of pond owners had stocked only one of their ponds and their last harvests were in 2013. Only 30% fed their fish using manufactured feed and only 26.2% carried out complete harvest of their ponds at the end of a production cycle. Average quantities harvested were 268 kg and 418 kg., selling at Shs 6,500 and Shs 6,000 per kg. for tilapia and catfish respectively. Gross profit per production cycle was Shs 1,704,367 for mixed tilapia/ catfish ponds while losses were reported for tilapia and catfish single species ponds. Break-even points were 425 kg for mixed ponds and 292 kg and 333 kg. for tilapia and catfish single species ponds. Payback period was 1.5 production cycles, which rounded up to 2 production cycles for the mixed species ponds. The poor economic performance was attributed to small sizes of ponds, low stocking densities, low quality fingerlings, inadequate feeds, prolonged rearing periods, high costs of fingerlings and feeds and poor management skills. The recommendations include increased investments in ponds, training to farmers on pond management, access to credit capital and improved supply of fingerlings and feeds for the region.

Key words: species enterprises, economic returns, break-even points, payback periods

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1. INTRODUCTION

1-1.Background

Uganda is striving for a competitive, profitable and sustainable fisheries sector envisaged in the National Fisheries Policy (NFP), in line with the National Development Plan (NDP) 2010/11 – 2014/15 and the Agricultural Sector Development Strategic Investment Programme (DSIP) 2010/11-2014/15 (MAAIF 2004, 2010; MFEP 2010). However, as a result of increasing pressure on fish stocks resulting from increased population and use of unsustainable fishing gears and methods, there has been a significant reduction in fish catch, resulting in decline in fish exports from 36,614 to 23,967 tonnes in 2005 and 2010 respectively (DFR 2012). In order to meet the demand from increasing population and export markets, Uganda's medium term production target has been set at 300,000 tonnes by 2016, to be met largely through aquaculture development (MAAIF 2010).

Aquaculture is the rearing of aquatic organisms under controlled conditions. This is in contrast with capture fisheries which depend largely on natural breeding and feeding of fish in small or large water bodies. Aquaculture is globally considered to be among the fastest growing food producing sectors and, therefore, an important contributor to food security.

Aquaculture was started in Uganda in the mid 1940s with the aim of improving household food security, nutritional status and people's incomes (MAAIF 2004). The sector is estimated to have about 25,000 ponds operated by subsistence, small scale progressive and emerging commercial fish farmers, with estimated farmed fish annual production of 100,000 tonnes (DFR 2012). The sizes of fish ponds have improved from 200 m^2 to 805m^2 but it is reported that most of these ponds are under-stocked or abandoned. Tilapia, catfish and mirror carp are the main cultured species among fish farmers.

Aquaculture has the potential to supply the local and regional markets but its ability to meet the production target will depend on increased levels of investment and use of improved production technologies. These investments will be attracted to the sub-sector if cost-effective and productive technologies that yield high returns at the end of each production cycle are availed.

The major constraints to this development are, however, the limited understanding of profitability levels from the different production systems like ponds, tanks and cages and weak marketing systems. Estimates of economic returns are considered essential for intending investors and financial institution like banks to ascertain the risk involved in investing in aquaculture enterprises vis-a-vis other enterprises (Hyuha *et al* 2011). Establishment of the costs and earnings, marketability and the value chains will directly contribute to addressing the above constraints.

It was against this background that the study was conducted in Eastern Uganda to determine economic returns for optimum production within the aquaculture sub-sector through increased investment, develop enterprise budgets for catfish and tilapia producers for improved profitability and develop strategies for improved marketing systems.

1.2 Objective

The objectives of the study were as follows:

i) To estimate economic returns for aquaculture enterprise for optimum production of commercially farmed fish species.

ii) To develop strategies to improve marketability of farmed fish species locally, nationally and regionally.

1.3 Expected outputs

i) Profitability indices, namely annual profits, break-even points and payback periods for commercially farmed fish species determined.

ii) Drivers of profitability identified.

iii) Market characteristics, namely fish prices, main fish markets, fish transportation and transactions costs established.

1.4 Expected outcomes

The expected outcomes of the project would include:

i) Improved enterprise selection among fish farmers, resulting from knowledge of profitability and market for the different enterprise options.

ii) Increased economic returns from aquaculture enterprise, due to understanding of the factors affecting profitability.

iii) Improved market access for farmers as a result of better information on market opportunities.

iv) Improved interventions and investments along the value chains in aquaculture, resulting from clear understanding of the sub-sector constraints and opportunities.

1.5 Expected impacts

i) Improved livelihood indices for fish farmers' households resulting from increased production.

ii) Improved profits for fish farmers as a result of engaging in profitable aquaculture enterprise.

2. METHODOLOGY

The study was conducted using the following methods:

i) Literature review of theoretical concepts and methodological approaches appropriate for the study.

ii) Secondary data search to establish existing data and information required for the analysis and identify gaps that would be filled through field data collection.

iii) Field data collection, which has so far covered 59 pond owners in Iganga, Tororo and Kaberamaido Districts. Additional data are to be collected in the highland Districts of Sironko and Kapchorwa for data on mirror carp enterprises.

iv) Key Informant Interviews with 3 DFOs.

Data analysis involved the use of SPSS Ver. 17 and Excel 2007 as follows:

i) Data was entered into SPSS, for numeric and string variables.

ii) Capital costs were computed as depreciation on the capital items, namely pond costs, and hatchery equipments.

iii) Labour was computed for stoking, feeding, and harvesting, considering hired and permanent labourers.

iv) Other operational costs included fingerlings, feeds, fertilizers and transportation of inputs and harvests.

v) Sales were computed from the harvests and prices, considering farmers who practiced total harvest methods.

vi) Gross profits per production cycle were computed as the difference between total revenues and total costs.

vii) Break even points were computed as the quantity of harvest at which the revenues equal to costs.

viii) Pay-back period were computed as the number of years in which the annual profits add up and equal to the investment costs.

3. RESULTS

3.1 Characteristics of fish farmers

Most of the fish farmers sampled regarded their farms as being functional (94.7%) and only 5.3% were not. They were mostly males (96.6%) and 67.3% of them belonged to groups. Their most common educational level was incomplete secondary (42.1%), followed by incomplete primary (21.1%).

3.2 Pond information and costs

Most of the ponds were stocked with both tilapia and catfish (54.3%), followed by catfish only (28.6%) and tilapia only (17.1%). Pond owners who stocked only one of their ponds were (37.2%), followed by those who stocked two (25.6%) and three (18.6%). Those who last stocked their ponds in 2013 were 39.7%, those who stocked in 2012 were 19.0% and those who stocked in 2014 were 15.5%, among others. Majority last harvested their ponds in 2013 (41.4%) followed by 2014 (25.9%).

The average pond size was 505 M^2 but poly-culture ponds stocked with tilapia and catfish were larger, with average of 706 M^2 (Table 1). Farmers used their ponds for 2.3 years before they began to repair them. The average pond cost was Shs 871,874 and the average life time of the pond was 11.2 years. Average annual depreciation per pond was, therefore, Shs 87,413. The average repair cost was Shs 359,333 per production cycle.

Table 1: Average pond size, costs of construction and repair, years before repair, lifetime and depreciation

	Tilapia/ catfish	Tilapia only	Catfish only	Average
1. Pond size (M^2)	568	505	304	459
2. Pond cost (Shs)	661,176	1,240,000	714,444	871,874
3. Years before repair begins	2.2	3.5	1.2	2.3
4. Repair costs per production cycle (Shs)	258,000	710,000	110,000	359,333

5. Pond life time (Years)	16.2	10.0	7.3	11.2
6. Pond cost per M^2 in Shs (2/1)	1,163	2,455	2,350	1,990
7. Annual repair cost per M^2 in Shs (4/1)	454	1,406	362	741
8. Annual depreciation per pond (2/5)	40,813	124,000	97,424	87,413

3.3 Cost of fingerlings

The average numbers of fingerlings stocked per pond were 1,007 for tilapia and 1,431 for catfish (Table 2). In the mixed tilapia/ catfish ponds, fingerlings stocked were tilapia (961) and catfish (1,488).

The average cost per tilapia fingerling was Shs 298, giving a value of Shs 299,414 for the tilapia fingerlings stocked. The average cost per catfish fingerling was Shs 392, giving a value of Shs 561,924 for the catfish fingerlings stocked.

The average costs of delivery and packaging of fingerlings per production cycle were Shs 125,000 and 28,800 respectively.

Table 2: Average numbers of fingerlings stocked, their unit costs and values and delivery and packaging costs.

	Tilapia/ catfish	Tilapia only	Catfish only	Average
1. Number of tilapia fingerings stocked	961	1,054		1,007
2. Cost per tilapia fingering	327	270		298
3. Number of catfish fingerings stocked	1,488		1,374	1,431
4. Cost per catfish fingering (Shs)	397		388	392
5. Value of tilapia fingerings stocked (1x2)	314,247	284,580		299,414
6. Value of catfish fingerings stocked in Shs (3x4)	590,736		533,112	561,924
7. Cost of delivering seeds on farm (Shs)	99,000	131,667	180,000	125,000
8. Cost of packaging materials (Shs)	21,500	38,500	24,000	28,800

3.4 Cost of manufactured feeds

Farmers who used manufactured feeds obtained their supplies from the feed factories (88.2%) or shops dealing in feeds (11.8%). The average quantities of feeds used per production cycle was 249 kg., at an average cost of Shs 2,492 per kg, giving an average value of Shs 620,508 (Table 3). On average, feeds were delivered on farm 3.8 times during a production cycle. The average cost of delivery of feeds on farm was Shs 67,320.

Table 3: Average quantities, cost and values of manufactured feeds and delivery costs by species of pond

	Tilapia/ catfish	Tilapia only	Catfish only	Average
1. Quantity of maunfactured feeds used (kg)	255	195	297	249
2. Cost of manufactured feeds (Shs per kg)	2,245	2,676	2,554	2,492
3. Value of manufactured feeds used (Shs) (1x2)	572,475	521,820	758,538	620,508
4. Cost of delivering feed on farm	60,909	101,250	39,800	67,320
5. Number of times feeds are deliverd on farm	4.2	3.8	3.5	3.8

3.5 Labour costs

On average, the labour costs per pond during a production cycle were stacking (Shs 11,042), feeding (Shs 70,037), harvesting (Shs 48,900) and other related activities (Shs 37,643), totaling to Shs (Table 4)

Table 4: Average labour costs for stocking, feeding, harvesting and other related activities per pond per production cycle (Shs)

	Tilapia/ catfish	Tilapia only	Catfish only	Average
1. Stocking labour	13,125	5,000	15,000	11,042
2. Feeding labour	50,111	75,000	85,000	70,037
3. Harvesting labour	50,700	24,000	72,000	48,900
4. Other related labour costs	45,286	30,000		37,643
5. Total labour costs (1+2+3+4)	159,222	134,000	172,000	155,074

3.6 Other production costs

On average, farmers who applied chemical fertilizers used 23.6 kg per production cycle, at a cost price of Shs 2,333 per kg, giving a value of Shs 43,625 (Table 5). Harvesting nets were hired at Shs 34,667 per harvest.

Table 5: Average quantities and costs of chemical fertilizers and cost of hire of harvesting nets per production cycle

	Tilapia/ catfish	Tilapia only	Catfish only	Average
1. Quantity of chemical fertiliser (kg.) used	40.7		6.5	23.6
2. Cost of chemical fertiliser (Shs/kg)	1,666		3,000	2,333

3. Values of chemical fertilizers in Shs (1x2)	67,751		19,500	43,625
4. Cost of hired harvesting net (Shs)	19,333		50,000	34,667

3.7 Marketing costs

On average, the fish farmers marketed their harvests four times during a production cycle. The marketing costs incurred were packaging (Shs 11,813), transportation (Shs 42,286), municipal charges (Shs 8,722) and other charges (Shs 9,500) and these amounted to an average of Shs 178,448 (Table 6).

Table 6: Average number of times fish was marketed during the last production cycle and costs of packaging, transportation, municipal and other charges

	Tilapia/ catfish	Tilapia only	Catfish only	Average
1. Number of times fish was marketed	4.3	4.8	3.0	4.0
2. Cost of packaging (Shs per unit)	19,875		3,750	11,813
3. Cost of transport (Shs per unit)	42,286			42,286
4. Municipal charges (Shs per unit)	8,722			8,722
5. Other charges (Shs per unit)	9,500			9,500
6. Total marketing costs in Shs (1x{2+3+4+5})	345,647		11,250	178,448

3.8 Fish marketing

All the respondents preferred to market their fish harvest in fresh form due to ready market availability (97.7%) or lack of processing skills (2.3%). The buyers of fish were direct consumers (86.4%), local traders (9.1%) and regional traders (4.5%). The farmers sold their harvests at pond side (71.4%), local market not near the pond (26.2%) and on regional markets (2.4%). The means most used to transport fish to the main markets were bicycles (46.7%), motorcycles (40.0%) and hired trucks (13.3%). With respect to the business environment, the fish farmers regarded the market as stable (86.4%), prices as lucrative (61.4%) but credit not easily accessible (81.6%).

3.9 Sales revenues

The proportion of ponds where complete harvesting was carried out was 26.2% while partial harvesting was done with 73.8% of them. Complete harvesting was done for mixed tilapia/ catfish ponds (18.5%), tilapia only (20.0%) and catfish only (40.0%).

On average, 1,372 kg of tilapia was sold per production cycle, at Shs 6,500 per kg, giving a value of Shs 9,458,500 (Table 7). Catfish sold was 418 kg, at an average price of Shs 6,000 per kg, giving a value of Shs 2,508,000.

Table 7: Average quantities, prices and values of fish sold per pond by target species

	Tilapia/ catfish	Tilapia only	Catfish only	Average
1. Quantity of tilapia sold (kg)	291	245		268
2. Prices of tilapia (Shs/kg)	6,000	7,000		6,500
3. Quantity of catfish sold (kg)	418		300	418
4. Prices of catfish (Shs/kg)	6,000		6,000	6,000
5. Value of tilapia sold in Shs (1x2)	1,746,000	1,715,000		1,730,500
6. Value of catfish sold in Shs (3x4)	2,508,000		1,800,000	2,508,000

3.10 Gross profits per production cycle

The average gross profit was Shs 392,642 per production cycle. Mixed tilapia/ catfish ponds showed gross profits of Shs 1,704,367. Losses were reported for tilapia and catfish single species ponds (Table 8).

Table 8: Average gross profits per production cycle per pond by species stocked

	Tilapia/ catfish	Tilapia only	Catfish only	Average
Sales revenues				
1. Value of tilapia sold	1,746,000	1,715,000		1,730,500
2. Value of catfish sold	2,508,000		1,800,000	2,508,000
3. Total sales revenues (1+2)	4,254,000	1,715,000	1,800,000	2,589,667
Production and marketing costs				
4. Pond repairs	258,000	710,000	110,000	359,333
5. Pond depreciation	40,813	124,000	97,424	87,413
6. Tilapia fingerings stocked	314,247	284,580		299,414
7. Catfish fingerings stocked	590,736		533,112	561,924
8. Seed delivery on farm	99,000	131,667	180,000	125,000
9. Seed packaging materials	21,500	38,500	24,000	28,800
10. Manufactured feeds	572,475	521,820	758,538	620,508
11. Feed delivery on farm	60,909	101,250	39,800	67,320
12. Labour costs	159,222	134,000	172,000	155,074
13. Chemical fertilizers	67,751		19,500	43,625
14. Hired harvesting net	19,333		50,000	34,667

15. Marketing costs	345,647		11,250	178,448
16. Total costs (sum {3:15})	2,549,633	2,045,817	1,995,624	2,197,025
17. Gross profits (3-16)	1,704,367	-330,817	-195,624	392,642

3.11 Break-even points

The average break-even point per production cycle for a tilapia only pond was 292 kg., for a catfish only pond 333 kg. and for a mixed tilapia/ catfish pond, it was 425 kg. of fish, to be contributed between the two species (Table 9).

Table 9: Break-even points per pond by species stocked

	Tilapia/ catfish	**Tilapia only**	**Cat fish only**
1. Total costs (Shs)	2,549,633	2,045,817	1,995,624
2. Prices of tilapia (Shs/kg)	6,000	7,000	
3. Prices of catfish (Shs/kg)	6,000		6,000
4. Break even point for tilapia (kg) (1/2)	213	292	
5. Break even point for catfish (kg) (1/3)	212		333

3.12 Payback period

On average, only mixed species ponds of tilapia and catfish would be able to pay back the investments in fish farming and this would be within two production cycles. Other pond types were unable to pay back due to losses returned on the investments (Table 10).

Table 10: Payback periods per pond by species stocked

	Tilapia/ catfish	**Tilapia only**	**Cat fish only**
1. Pond cost (Shs)	2,549,633	2,045,817	1,995,624
2. Gross profits (Shs)	1,704,367	-330,817	-195,624
3. Payback periods (years) (1/2)	1.5	--	--

3.13 Record keeping

More than 95.5% of the sampled farmers kept records on the different aspects of fish farming business (Table 11)

Table 11: Proportions of respondents who kept the different business records on farming activities

Type of record	Proportion	Type of record	Proportion
1. No of ponds	100.0%	1. Amounts paid per work	95.5%
2. Pond size	100.0%	2. Feed quantities	100.0%
3. Species stocked	100.0%	3. Feed cost	96.2%
4. No. of fingerlings	100.0%	4. Harvest dates	95.8%
5. Cost of fingerlings	96.4%	5. Harvest quantities	95.8%
6. Date of stocking	100.0%	6. Sales quantities	95.5%
7. No. of labourers	100.0%	7. Sales price	100.0%

Requirement to improve fish farming as a business

Majority of the farmers considered access to feeds or machines for local feed formulation as the most important requirement for improving their fish farming as a business (38.3%). Other important requirements identified were training (31.9%), capital (8.5%) and technical advice (8.5%) (Table 12).

Table 12: Respondents and their requirements for improving fish farming as a business

Type of requirement	Proportion
Access to feeds/ machine	38.3%
Training	31.9%
Capital	8.5%
Technical advice	8.5%
Quality fingerlings/ hatchery	4.3%
Equipments	4.3%
Predator nets	4.3%
Total	**100.0%**

4. DISCUSSION

Low or negative economic returns were found on investments in fish farming in Eastern Uganda. This explains the high rate of pond abandonment among the fish farmers in the region. The data reveals a number of factors contributing to the poor economic performance of the ponds. The pond sizes were small, averaging 459 M^2, compared to the 1,000 M^2 pond size recommended for profitable fish farming. Furthermore, the stocking density of 2.0 fingerlings per M^2 was below the recommended 3.0 per M^2. This meant that the farmers were rearing inadequate fish populations to make profit. The quality of fingerlings was also reported to be poor.

Production costs were generally high. The cost per fingerling of Shs 298 and Shs 392 for tilapia and catfish respectively were too high compared to the national market rate of Shs 200 and this was attributed to the scarcity of fingerlings in the region. Feeds were not so readily available in the region and most farmers had to obtain them from manufacturers in Kampala. The average feed price of Shs 2,492 per kg. on the other hand, compared favourably with the Kajjansi feed price of Shs 2,850 per kg. Fish were also kept in the ponds beyond the seven to nine months recommended for economic production, resulting in high costs of feeding. Some farmers did not feed their fish adequately due to challenges of feeds, thus realizing low production weights. Additional costs were experienced in transportation of fingerlings and feeds from distant sources outside the region.

Other challenges included limited credit facilities to obtain capital and the high interest rates charged. Most farmers had not been adequately trained and were unable to deal with the different pond management challenges that frequently arose. Farmers lost considerable proportions of their production to predators, including human beings.

5. RECOMMENDATIONS

In order to take advantage of the suitable natural resource endowments for fish farming in the region, particularly water supply, recommendations to address the poor economic performance would include improved pond construction, training to farmers on pond management, access to credit capital and improved supply of fingerlings and feeds for the region.

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7. REFERENCES

DFR (Department of Fisheries Resources), 2012: Annual report.

Hyuha S. T, O..J Bukenya, J. Twinamasiko and J. Molnar, 2011: Profitability analysis of small scale aquaculture enterprises in Central Uganda.

MAAIF (Ministry of Agriculture, Animal Industry and Fisheries), 2010: Agriculture for Food and Income Security. Agriculture Sector Development Strategy and Investment Plan: 2010/11 – 2014/15

MAAIF (Ministry of Agriculture, Animal Industry and Fisheries), 2004: The National Fisheries Policy

MFEP (Ministry of Finance, and Economic Planning), 2010: National Development Plan, 2010/11-2014/15.