PROFITABILITY OF ECONOMIC STIMULUS PROGRAM (ESP) FISH FARMING ADOPTERS IN MAKUENI COUNTY, KENYA

Wesonga, P.W1*+ , Mukoya-Wangia, S2*; Njoka, J.T3*; and Maina, J.G4*.
Affiliation *: University of Nairobi (UON), Kenya
1. Department of Land Resource Management and Agricultural Technology. UON
2. Senior Lecturer, Department of Agricultural Economics.UON
3. Senior Lecturer, Department of Animal Production.UON
4. Director and Associate Professor, African Drylands Institute of Sustainability. UON.
+correspondence author pswesonga@yahoo.com Phone +1254722848523/+254733640031

ABSTRACT: *Fish farming in Kibwezi is a recent livelihood alternative that was propelled by government funding under the Economic Stimulus Programme (ESP) between 2009 and 2012. This study evaluated the profitability and sustainability of fish farming in Kibwezi, Makueni County, Kenya using a sample size of 146 fish farmers. Fish production of finfish specifically Nile Tilapia (Oreochromisniloticus) and African Catfish (Clariasgariepinus) respectively were the species cultured. Twenty seven percent of farmers had an annual gross margin average of KES. 30,333.95 from a 300M^2 fish pond with a gross margin ratio of 0.35. Net fish income was positive for 8.9 percent of farmers and averaged KES. 24,707.14. Farmers with a stocking density of 5fish/m^2 and above serviced their total variable costs. Hatchery owners did better with 57.1 percent of them showing positive returns on both measures of gross margin and net fish income. Fingerlings, feeds and labour costs constituted 67% of total variable cost. Underweight of tilapia fish was a common problem among the sampled farmers. Adopters with the highest gross margins paid employees or committed themselves to pond management activities. Adopters made their own feeds. It is recommended that farmers be trained to make their own feeds*
KEYWORDS: profitability, Economic Stimulus Program (ESP), fish farming, Makueni County, Kenya

INTRODUCTION

The objective of this paper was to determine the profitability of fish farming three years after expiry of ESP in Kibwezi, Makueni County, Kenya. While the research question to be addressed was: Is fish farming profitable in Kibwezi? It sought to identify what percent of adopters were profitable. Secondly, it analyzed the variable cost that impacted on fish farming in the Arid and Semi- Arid Lands (ASALs). The study provides relevant information on profitability measures that can be used to promote aquaculture adoption and as an alternative livelihood in ASALs.

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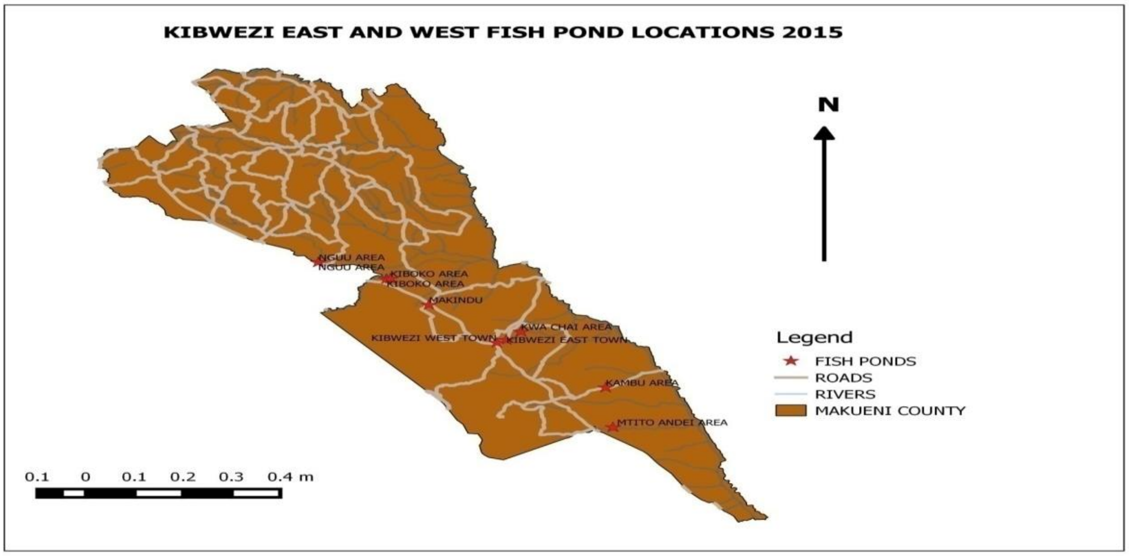
MATERIALS AND METHODS

Study Area

The study area was Kibwezi that now consists of Kibwezi East and Kibwezi West (Makindu) Sub-Counties of Makueni as shown earlier. A sample size of 146 fish farmers was located along the MtitoAndei to Nguu corridor as shown in Figure 1



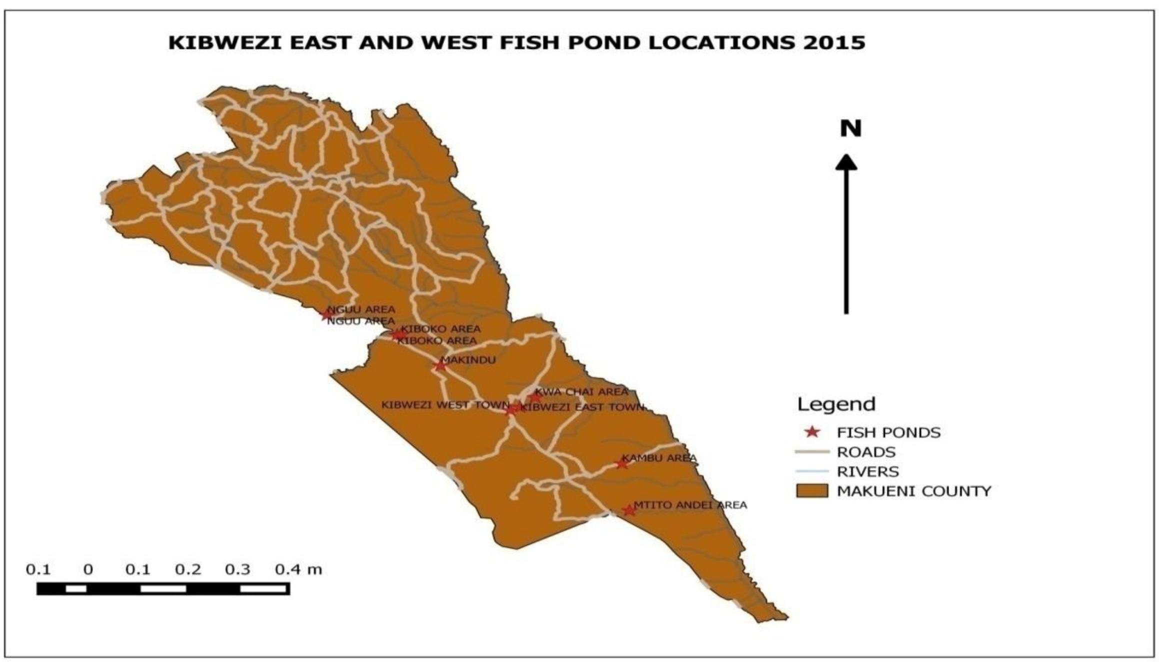


Figure 1: Study site Mtito Andei to Nguu Corridor. ***(Source: Authors, 2015)***

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Sampling Framework

To determine a representative sample size for active/inactive fish farmer, Cochran (1963) Formula for cross sectional studies was used. The formula is presented as follows:-

Desired Sample Size

$n_o = z^2pq/d^2$

Where

n_0 = Desired sample size

z = standard deviation (1.96) which corresponds to 95% confidence level

p= Expected probability of success. In this case is 0.1 of respondents in the study who have fish ponds.

q = 1- p

d = Degree of desired accuracy set at 0.05 significance level

$n_o = 1.96^2 \; X0.1 \; X0.9/ \; 0.05^2 = 138.2976$

$n_o = 139$

A total 80 active and 66 inactive farmers were selected and interviewed. Active farmers are those farmers who had stocked their ponds in 2014 and planned to stock them in 2015. Inactive farmers are those who had not stocked their ponds in 2014 and no potential to stock in 2015. A farmer who did not stock for two consecutive cycles was presumed to be an abundant farmer.

Data collection

Data was collected in February and March 2015 using a semi-structure questionnaire that were administered to the respondents. The collected primary data included the cost of production and income generated from the sale of the fish. Regarding the amount of funds utilized by the government to support the projects secondary data was acquired from the government officers.

Data analysis

Data was entered into Excel and SPSS 22 spreadsheets. The quantitative analysis used gross margins, net fish income, benefit-cost ratio and profit analysis. Descriptive analysis used frequencies and percentages for key variable.

Data on the Profit and Loss statement section of the questionnaire was entered and analyzed using Excel 2007 to get total revenue, gross margins. Total variable costs, total fixed cost, total cost and net fish income.

Gross margin (GM) for fish farming was the difference between the total revenue (TR) and the total variable cost (TVC) of fish farming (GM = TR – TVC) while the gross margin ratio (GMR) is equals to (TR-TVC)/TR. A ratio of 0.35 or higher is more desirable (Olasunkami, 2012).

In profit analysis, Profit was the positive difference between total revenue and total cost of the fish enterprise (Profit = TR – TC), if negative then it was considered a loss.

Profit-cost ratio (PCR) was equals total cost divided by total revenue (PCR= TC/TR), a ratio of 0.65or less is preferable (Olasunkami, 2012). Net Fish Income (NFI) was profit less non–cash adjustments to income plus gains/loss on capital assets sale. Benefit-cost ratio (ROR) was equal to total revenue divided by total cost (ROR=TR/TC)

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RESULTS AND DISCUSSION

Adopters

Adopters were fish farmers who had reared fish for over five years continuously (that is, since the inception of the ESP in the year 2009 and the enterprise is sustainable). Sustainability is evident if a farmer generates a profit (benefit).

Of the 146 fish farmers surveyed, 43.2% were adopters. Details are shown in Table 1.

Table 1: Adoption by ESP member

			Adoption		Total
			Adopters	Non adopter	
ESP Member	Yes	Count	53	80	133
		% within memberESP	39.8	60.2	100.0
		% within adoption	84.1	96.4	91.1
		% of total	36.3	54.8	91.1
ESP Member	No	Count	10	3	13
		% within memberESP	76.9	23.1	100
		% within adoption	15.9	3.6	8.9
		% of total	6.8	2.1	8.9
Total		Count	63	83	146
		% within memberESP	43.2	56.8	100
		% within adoption	100	100	100
		% of total	43.2	56.8	100

Source: (Authors, 2015)

Non- ESP members adopted fish farming at 76.9 % as compared to 39.8 % of ESP members. The implication is that non-ESP Members might have been prepared to undertake fishing farming in resources and expertise. A majority of ESP members were non-adopters as illustrated by 96.4% of the total non-adopters.

Total Revenue

Table 2 gives the costs and returns of an average fish farmer in Kibwezi.

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Table2: Gross Margin and Net Fish Income for 300m^2 Earth Pond in KES

VARIABLE		KES.
Total Revenue (TR)	236Kg@400	94,400.00
Fingerlings		10,000.00
Feeds		24956.10
Labor	400mhrs@60man-hour	24000.00
Fertilizer(manure)		550.00
Transport		1810.00
Total Variable Cost		61,316.10
Gross Margin		33,083.90
Equipment		900.04
Commissions		5100.00
Fuel		2490.86
Total fixed costs		8490.90
Total Costs		69,807.00
Net Cash Income		24,593.00
Depreciation		5000.00*
Loss on machinery		2412.14
Net Fish Income		17,180.86

Source: (Authors, 2015)

Gross revenue was KES 94,400.00 per 300 M^2. average quantity of harvested fish was 236Kgs sold at an average price of Kes.400.00 per Kg. The average weight of fish was 0.24kgfor Tilapia and 1.7kg for catfish. This average weight is important because it directly impact on total output as observed in Adebayo *et al.* (2008) study in Nigeria. Hatchery owners also sold fingerlings at average price of KES 7.00 for tilapia and KES 10.00 for catfish. Fish eaten at home or given in kind was included in total fish output as done by Asimah (2008).Other implicit benefit from fish farming if the manure derived from pond water waste.

Total Variable Cost

Total variable cost included fingerlings, feeds, labor fertilizer, fuel repairs and Dyke/levee repairs. Farmers did not use lime in their ponds. A farmer used on average 60 liters of fuel (about KES 6,000)to pump water to the earth fishpond per season. Comparable figures for Liner and concrete pond were available due to poor record keeping. On average a farmer spent KES 5,000.00 to rehabilitative repairs an earth pond in preparation of the new season.

Previous studies of cost and return analysis (FAO, 2010; Olaoye *et al.*, 2013) showed that variable cost accounted for the highest proportion of total variable cost with fish feeds and fingerlings being the dominant variable cost items. In Olaoye *et al.* (2013), a study of catfish in Oyo State, the proportion cost spent on feed and fingerling was as high as 87.26 percent. A frame survey of fish farmers done by FAO (2013) in the following Kenyan counties Busia, Bungoma,

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Kakamega, Vihiga, Siaya, Kisii, Nyamira and Migori, found that the cost of feeds and fingerlings constituted 76 percent of total cost.

Fingerling Cost

The unit cost of a tilapia was KES 10.00 for mono-sex and KES 7.00 for mixed-sex fingerlings, while catfish unit cost was KES 15.00. Stocking density of fingerlings in Kibwezi varied as presented in table 3. A majority of tilapia farmers 53.2%) stocked 3fish/M^2, while 20% of farmers stocked 10fish/M^2. Catfish stocking density was 5fish/M^2 for farmers with earth ponds, while one farmer with concrete ponds stocked 15fish per M^2.The farmers with higher stocking density were based along river Kiboko 3km north east of Kiboko market. These stocking densities are not within the recommended 3fish/M^2 by fishing experts Engel and Ngugi (2007). This high stocking density was not supported by intensive production system. Thus farmers with a higher stocking density might be maximizing on unit output yield instead of profit as was noted in Loosinger *et al.*(2000) study. The fingerling cost ranged between 7.7 to 33.9 percent of TVC. This is inconsistent with Neira *et al.* (2009) that had a range of 21 to 31 percent.

Table 3: FingerlingStocking Density by Farmers

Type of fish	Fish/M^2	Frequency n=146	Percent
Tilapia n=77	3	41	53.2
	5	20	26.0
	10	15	20
	15	1	1.3
Catfish n= 9	3	1	1.3
	5	5	6.5
	10	2	2.6
	15	1	1.3

Source: (Authors, 2015)

Feed Cost

Feeds utilized accounted between 7.7 and 75. 9 percent of total variable cost (TVC) for the 146 sampled fish farmers, while their TVC values were between 35.9 to 61.9 percent. Sixty-six percent of farmers used commercial feeds bought at an average price of KES67.50 per Kilogram. Fifty percent of the farmers ordered the required feeds to meet their fish food needs. Table 4 gives a summary of feed type used by farmers.

Table 4: Feed Type used by Fish Farmers.

Types of feeds	Frequency n=80	Percent
Commercial	53	66
Homemade	8	10
Combination	19	24

Source: (Authors, 2015)

Fish farmers who owned and managed hatcheries relied more on homemade feeds using cereals such as wheat and sorghum as the primary energy sources while soya beans, sunflower and omena were used as protein sources. Eight percent of the farmers who relied on homemade feeds

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indicated that their feeds had a crude protein content of 26 to 36 percent and the average cost of raw materials was KES 32.00 per Kilogram. In Neira *et al*. (2009) study of tilapia production, the total variable cost (TVC) was between 28 to 71 percent. The feed cost ranged 51-53 percent of TVC was for farmers who used pellet feeds. The production cycle was 9 months due to improved growth rate that generated a higher profit. Farmers who had a TVC of 28% -50% used rice bran or formulated feed and fish matured in 11 months.

Labour Cost

Fish farmers managed their fish farming activities using one or combination of the following: family labor, hired monthly labor, hired monthly security labor, and labor in fertilizer application as in Table 5

Table 51: Type of Labourused and its Frequency

Labor type used	Frequency n=119	Percent
Family members	44	37.
Hired monthly	63	52.9
Monthly security	10	8.4
Fertilizer	2	1.7

Source: (Authors, 2015)

Fifty three percent of farmers used hired monthly labor who performed daily activities of fish farming. Another 37% of farmers involved family members to do daily operations of fish rearing. Average monthly wage was KES 7,500 with KES 6,000 being the minimum and KES 25,000 maximum. The labor cost ranged from 12.7% to 51.6% of TVC was inconsistent with that of Neira *et al* (2009) that is 28 to 31 percent.

Gross Margin

The results of gross margin analysis revealed that 26.7%of the respondents had a profit as shown in Table 6

Table 6: Gross Margins of Sampled Fish Farmers

			Adoption		Total
			Adopters	Non adopters	
Gross margins	Profit	Observed	26	12	38
		% within GMs	68.2	31.6	100
		% within adoption	41.3	14.5	26
		% of the total	17.8	8.2	26
	Loss	Observed	37	71	108
		% within GMs	68.7	65.7	100
		% within adoption	58.7	85.5	74
		% of the total	25.3	48.6	74
	Total	*Observed*	63	83	146
		% within GMs	43.2	56.8	100
		% within adoption	100	100	100
		% of the total	43.2	56.8	100

Source：(Authors, 2015)

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Farmers' yield was 0.5-1.8 Kg/m^2 for tilapia production and 1.5- 8 Kg/m^2 for catfish production. These yields are within 0.5-1.5Kg/m^2 found by Neira *et al*.,(2009). Also farmers who operated four (4) or more ponds had a better gross margin than those who had one pond due to the economies of scale. This finding concurs with Okechi *et al.*(2004) in the Lake Victoria Basin where he noted economies of scale in operating twelve ponds instead of one pond. The gross margin ratio of farmers (51.2 %) with positive gross margin was 0.35.

Adopters were more likely to be profitable than non-adopters. Table 7 shows gross profits in relationship with adoption.

Table 7: Cross tabulation of adoption vies gross profit

			Grossprofit		
			grossprofit	loss	Total
adoption	adopters	Count	26	37	63
		% within adoption	41.3%	58.7%	100.0%
		% withingrossprofit	68.4%	34.3%	43.2%
		% of Total	17.8%	25.3%	43.2%
	non adopter	Count	12	71	83
		% within adoption	14.5%	85.5%	100.0%
		% withingrossprofit	31.6%	65.7%	56.8%
		% of Total	8.2%	48.6%	56.8%
Total		Count	38	108	146
		% within adoption	26.0%	74.0%	100.0%
		% withingrossprofit	100.0%	100.0%	100.0%
		% of Total	26.0%	74.0%	100.0%

Second comparison is gross profit breakdown by gender as shown in Table 8

Table 8.Gender vis Gross Profit

			Grossprofit		
			grossprofit	Loss	Total
Gender	male	Count	28	58	86
		% within Gender	32.6%	67.4%	100.0%
		% withingrossprofit	73.7%	53.7%	58.9%
		% of Total	19.2%	39.7%	58.9%
	female	Count	10	50	60
		% within Gender	16.7%	83.3%	100.0%
		% withingrossprofit	26.3%	46.3%	41.1%
		% of Total	6.8%	34.2%	41.1%
Total		Count	38	108	146
		% within Gender	26.0%	74.0%	100.0%
		% withingrossprofit	100.0%	100.0%	100.0%
		% of Total	26.0%	74.0%	100.0%

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Fixed Costs of Fish Ponds

The profitability of fish farming is dependent on the medium of production by Ross *et al.* (1995). In this study, the mediums of production systems were concrete, earthen and liner ponds. The Construction fixed costs per square meter was lowest with earth at KES84.00, compared to KES 4,000.00 for concrete and KES 500.00 for liner ponds (author, 2015). The cleaning and repair cost after harvest had earth lowest at KES 10.00. Fish ponds are fully depreciated during the first years. These cost elements had a significant effect on net fish income and caused 58 percent of the farmers to incur a loss

Net Fish Income

Table 9 below showed that 8.9 percent of fish farmers surveyed had a positive net fish income. The average net income was KES 24,707.14.

Table 9: Net Fish Income for Fish Farmers

Net fish income	Frequency	Percent
Farmers	9	6.2
Hatchery operators	4	2.7
Loss	133	91.1
Total	146	100

Source: Authors (2015)

Profitability in fish farming in rural areas has been very elusive due to “inefficiency and obstructionism by part of the host institution caused by internal structural weakness (Harrison *et al.*, 1993). In Kibwezi, farmers were not selected by merit and suitability of pond sites was done poorly due to political influence (A 2015). This might have contributed to the low mean net fish income and higher dropout rate of ESP members. Abandoned ponds became habitats for malaria vectors as documented by Howard *et al.* (2008) in Kisii County. In Kibwezi abandoned ponds are used as livestock sheds (“bomas”) or for fruit crop production.

The influence of whether a farmer was ESP member or non-ESP over net fish income shows that non-ESP members was statistically significant at $\alpha = 0.01$as noted in Table 10.

Table 10: The Influence of ESP over Net Fish Income

ESP member	N	Mean	Std dev.	P-value
Yes	136	3460.77	19578.77	0.007***
No	9	23681.11	43689.67	

*** Significant at 1 %

Source: (authors, 2015)

The implication is that non-ESP members organize and mobilized their operational resources with a profit motive, while ESP members did not utilized government resources with a profit-maximizing goal.

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Profit Analysis and Benefit-Cost Analysis

A profit cost (PCR) and benefit cost ratio (ROR) was done using data of the 39 farmers with positive gross margins. It was found 30,8 % of them had a profit cost ratio of less than 0.65. While 35.9% of them had benefit cost ratio of greater than 1.A farmer with a ROR of greater than 1 implies that farmers met their costs and was left with some income. These profit indicators are good because it means that the enterprise is sustainable. In studies done in Nigeria by Olasunkami (2012) and in Egypt by El-Naggar *et al*., (2010) found that ROR must be greater than 1 and PCR must be less or equal to 0.65 for an enterprise to be sustainable.

Fish Farming Profitability

Fish farming is profitable, the answer as indicated by 52.4 percent of adopters who had a positive gross margins and yields of 0.5-1.8Kg/m^2. This is supported by Mbugua (2002) study that indicates a yield of .05-1.5 Kg/m^2 is what can sustain a profitable fish production that is reliant on cereal bran as primary feeds. The remaining 47.6 percent have potential if the can manage their variable costs. Security labor and feed cost being the main impediment to them. The cost and returns of the adopters averaged as follows: feed 56% fingerling 24.5 %, labor 19.1 % and gross margin (60.9%). These results differ with Boateng *et al*., (2013) on fingerling (12%), labor (13%), and gross margin (72%); however, there is collaboration on Feed cost at 56 percent

Conclusion and Recommendations

The study findings established that fish farming is a viable enterprise for 8.9 percent of 146 interviewed fish farmers. Three factors that greatly contributed to improved gross margins and net fish income of fish farmers are as follow: First, ability to make their own feed meals. Secondly, use of regularly paid labor, which translated into experience or better pond management practices. Finally, stocking density also improved profits with farmers stocking 5/M^2 and above showing a positive net fish income. From the above, it is recommended that farmers be train on appropriate methods of producing fish feeds locally. The Government through Fishery Extension Offices could facilitate clusters of farmers to use one common locally made feed that can be analyzed at a government laboratory. Farmers or prospective investors need proper information relating to managerial skills and the commitment, which is required in fish rearing.

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