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Assessment Of The Value Of The Small Scale Fish Farming Enterprises In Nyamira County, South West Kenya

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Abstract: ***Fish farming is relatively recent compared to subsistence crop farming in Nyamira County. It is becoming significant due to its contribution to nutrition, self employment and income generation. A Cost Benefit Analysis was conducted from March-October 2016, to estimate its viability. Semi structured questionnaire was used to collect data from 320 farmers using simple random sampling technique. Focused group discussion schedules were administered to three groups of ten farmers to collect extra data. Further information was collected on data returns of harvests from farmers and from interview schedules of fifteen key informants. Data were analysed using Statistical Package for the Social Science (SPSS) version 20.0 and Excel spreadsheet programme. Chi square (χ^2) was used to test if there were significant differences between profits obtained by farmers at p=0.05. Results indicated that the mean input cost per farmer ranged from Ksh 46.08±0.08-Ksh 50.34±58m^{-2}. A positive correlation between total feed costs and net income (R) ranged from 0.479-0.519. Cost Benefit Ratio indicated that Borabu had the highest (4.66) followed by Manga (1.51) and by Nyamira North (1.31). A similar trend was observed on Rate of Returns on Investment with Borabu having 3.64, Nyamira North 0.44 and Manga 0.75. New farmers obtained low net income due to costs incurred on construction of new ponds. Most commonly used feeds were vegetables, kitchen remains and Rastrineobola argentea. This study demonstrates that small scale aquaculture can be profitable when appropriate inputs are provided.***

Keywords: Benefit Cost Ratio, net income, Rate of Returns on Investment, subsistence crop farming.

I. INTRODUCTION

Fish plays an important role in the provision of food security, self employment, medicine, foreign exchange and recreation. It has unique protein properties whose nutritive values surpass those of plants, for example essential amino acids such as methionine, tryptophan and lysine (Osondu & Ijioma, 2014). With increase in the world population, fish supply from natural sources have stagnated and are projected for a decline (World bank 2014). There is need to improve and diversify aquaculture production to bridge the gap of demand that will be occasioned by the ever expanding world population (Tacon, 2001). Fish is further regarded as a tradable commodity which can spur the economic growth and development (Rutaisire et al., 2009).

Small scale subsistence aquaculture is the main form practised in Kenya to provide a cheap source of proteins and income to rural community. However, production levels have been extremely low due to the fact that farmers have little experience and aquaculture has been existing for a short period. Despite its widespread promotion as an additional source of livelihood, there is limited research that has been conducted to determine the production efficiency and income levels of small scale farmers in Nyamira County. Most investors in this enterprise have limited knowledge on input-output characteristics and are unable to make appropriate

decisions to maximize profits. In rural Nyamira County, there are no long term aquaculture production trends due to lack of established data collection, archiving systems and research. It is therefore necessary to undertake studies on the viability of small scale fish farming enterprises to establish its profitability.

II. MATERIALS AND METHODS

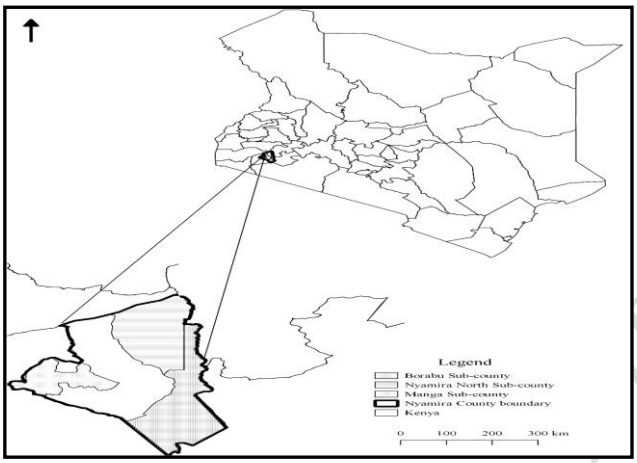
A. STUDY AREA

The study was conducted in South West Kenya in Nyamira County. It lies between latitudes 0^o 30' and 0^o 45' South and longitudes 34^o 45' and 35^o 00' East at an altitude of 1420 - 2200 metres above sea level (Fig 1).

Source: Kenya National Bureau of Statistics-Cartography

Figure 1: Map of Nyamira County

The temperature is favourable with mean minimum of 6.2^0C - 18^0C and mean maximum of 20^0C - 27^0C. It has an annual rainfall ranging from 1,200 - 2,100mm (MOLFD, 2015). It has a surface area of 896.4 km^2 and a population of 598,252 with a population density of 656 persons per km^2 (MOP, 2009). The County is endowed with plenty of water resources and is a source of many rivers draining into the North Eastern sector of Lake Victoria, making it suitable for fish farming. It has considerable number of fish farmers and aquaculture is becoming more prominent as indicated by the recent increase in the number of fish ponds (MOLFD, 2015).



B. SAMPLING DESIGN

A stratified random sampling design was employed to select three sub counties and 320 small scale farmers from a total of 1,556 for sampling. To determine the numbers of farmers to be sampled, a list of small scale farmers was obtained from the County Fisheries Extension Office. The formula by Mugenda & Mugenda (2008) was used as a general guide to calculate the sample size from each sub county. Consequently, using a random number generator in Excel spreadsheet programme, 150, 90 and 80 farmers were selected from Borabu, Nyamira North and Manga sub counties respectively. In the field, the localities of the fish farmers were assessed and those which were not accessible were replaced with the nearest assessible ones.

Open and closed ended questionnaire was used in data collection. Its major data requirements were input costs, value of fish yields and information on fish sales. Further, prices of pond inputs for non commercial products such as kitchen remains, vegetable wastes and blood from slaughterhouses were based on prices the farmers were willing to pay per unit of volume (Surrogate prices - the willingness to pay method). This is because these commodities are not traded and have no market value since they are treated as wastes. The questionnaire also included an interview schedule for fisheries extension officers, focused group discussion (FGD) schedule and direct observation guides. The FGD guide was targeted at groups of 10 farmers. The Questionnaire was piloted in the adjacent Kisii Central Sub County where like in Nyamira County, small scale fish farming is practised. This was administered to 30 fish farmers during the first week of January, 2015 and the same procedure was carried out with the same farmers after a period of two weeks. The Cronbach's index of reliability (alpha) was calculated to establish the reliability of the research tool for data collection. Thereafter; the questionnaire was modified to improve its quality based on the findings of the pilot study. A Cronbach's coefficients of at least 0.70.was used as a threshold for a good research instrument (Oso & Onen, 2009). Prior to analysis, the data were cleaned using SPSS routine for removing outlying data.

Measures of central tendency for value of fish pond inputs, quantities of fish harvested, consumed at home and sold were calculated using Excel spreadsheet programme. Differences in the value of fish yield and net income characteristics of farmers among the three sub counties were tested using χ^2 at $p=0.05$. Profitability ratios such as Benefit Cost ratios (BCR) and Rate of Return on Investment (RRI) and Net income were used to establish whether the farmers were making any profit. Cost and returns technique were used to calculate Gross Margin (GM), using the model in Oluwasola et al (2010):

$$GM = TR - TVC \quad (1)$$

$$NR = TR - TC \quad (2)$$

Where NR is Net Revenue;

TR is Total Revenue (Calculated from total quantity of fish (pieces) $\times$ unit price);

TVC is Total variable cost;

TC is Total Cost of all inputs (Calculated from the summation of total variable (TVC) cost and total fixed costs (TFC).

The economic viability of the small fish farming were determined using profitability ratios as shown

$$BCR = TR/TC \quad (3)$$

$$RRI = NR/TC \quad (4)$$

Regression analyses were conducted to establish the relationships between pond input costs for feeds, labour, fingerlings and fertilizers against value of fish yield, gross and net income. Information collected from personal observations and FGD guides were summarized and deductions were made to enrich those obtained from statistical analyses.

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III. RESULTS

A. FISH PRODUCTION CHARACTERISTICS

The yields and income characteristics of small scale farmers in the three sub counties of Nyamira are presented in Table 1. The gross and net income realized increased with increasing costs of inputs. Regression of input cost on Net income showed positive correlation of R ranging from 0.13 to 0.49 (Figs 2-4).The calculated χ^2 values for Mean input cost, Gross and Net incomes were 198.36, 32,038.25 and 34,259.56 respectively, which were much higher than the tabulated χ^2 value at 2 degrees of freedom of 5.991, indicating that the differences of the mean values of the three characteristics were significantly different at *p=0.05*. This indicates that farmers faced market challenges, due to unstructured prices in relation to fish sizes, for example a 500g fish could sell at the same price as a 300g in different localities. This indicated that the local demand for fish outstripped the supply.

Sub county	Input cost (Ksh)	Qnty of Fish harvested (pcs)	Average price/piece (Ksh)	Qnty of fish consumed (Pcs)	Value of Fish harvested (Ksh)	Value of fish consumed (Ksh)	Gross income (Ksh)	Net income (Ksh)
Borabu	11,561.44	1,633	164.83	116	269,167.40	19,120.28	140,023.41	128,461.97
Nyamira North	9,516.35	644	98.33	55	63,324.52	5,408.15	65,026.33	55,509.98
Manga	10,624.85	678	118.00	94	80,004.00	11,092	82,735	72,110.15
Average	10,567.55	985	127.05	88.33	137,498.60	11,873.48	95,928.25	85,360.70

Table 1: The Yields and income characteristics of small scale Fish farmers in three sub counties of Nyamira

B. FISH MARKETING

Fish were sold in pieces rather than units of weight. The market price of mature fish was set by individual farmers indicating that there is no common bargaining power. Farmers who set their prices according to prevailing market prices obtained higher income compared to those who set prices arbitrarily. In some circumstances when the demand was low, farmers sold their fish at lower prices than the prevailing market prices. Large fish were sold at higher prices mostly to traders who marketed them in urban centres while small fish were commonly sold to low income household since they are cheaper.

The income for fish sales were grouped into two categories: income based on the value which the farmers could obtain if they sold the fish using the prevailing market prices and income based on the actual value of all the fish harvested. The market prices in the former were based on fish sale by weight at Ksh 400 kg^{-1}, while the actual value realised was based on the value of fish sold in pieces. For Borabu Sub County, the market value per farmer ranged from Ksh34, 680 - 2.6 million with a mean of Ksh193,230.64, while the actual value for fish realised by farmers ranged from Ksh 29,000 - 3.9million with a mean of Ksh 140,023.41, hence farmers lost their income by selling the harvest in pieces. The most preferred size of fish for sale was 300g, which was offered by 82 (55%) farmers. Its price ranged from Ksh 80 - 120, with a mean of Ksh 100.57 ± 0.96.The number of farmers offering 100g fish was insignificant (2%), at a price range of Ksh 50 - 80 with a mean of Ksh70 ± 10. The 500g fish was offered by a significant number of farmers 15 (10.07%) at a price range of Ksh150 - 200 with a mean of Ksh 175.00 ± 9.45. Only one farmer (0.67%) sold fish weighing 700g at a cost of Ksh 400 per fish. The price variation for this size of fish is due to the differences in demand and accessibility to the different localities where the fish were harvested.

The market and realized values of fish sold in Nyamira North and Manga sub counties were much lower than those of Borabu. For Nyamira North, the total market value of fish harvested per farmer ranged from Ksh17,600 - 170,000 with a mean of Ksh 77,247.11 ± 3,506.09, while the actual value realized ranged from Ksh20,000 - 405,000 with a mean of Ksh 65,026.33 ± 4,719.15. Thus farmers in Nyamira North also made losses when they sold fish in pieces. As in Borabu, the most common fish sold was 300g which was offered by 46 farmers (51.11%). Its price ranged from Ksh 80 - 150 with a mean of Ksh 94.00 ± 1.34. Other sizes of fish featured insignificantly in the sales, with 100g fish being offered by only 2 farmers (2.2%) at a price range of Ksh 50 - 75 with a mean of Ksh 60.00 ± 10. The 500g fish was offered by two farmers at a price of Ksh150 per fish. The market value of fish harvested in Manga ranged from Ksh 14,000 - 295,000 with a mean of Ksh 82,390 ± 5,726.79 per farmer, while its realized value ranged from Ksh 18,000 - 492,000 with a mean of Ksh 82,735 ± 7,439.13.

Contrary to the other two sub counties, farmers who sold their fish in pieces did not incur losses. As in both Borabu and Nyamira North, the most common size sold was the 300g offered by 25 farmers (31.25%), at a price range of Ksh 80 - 120 and a mean of Ksh 94.40 ± 3.85. The 500g fish was offered by 5 farmers (6.25%) at a price range of Ksh150 - 200 with a mean of Ksh 176.00 ± 11.22. Thus farmers who sold the 500g fish made much higher profits than those who offered the 100g and 300g fish.

a. COST BENEFIT ANALYSIS

The net income from the sale of fish in Borabu ranged from Ksh 383,536 - 6,312,448 with a mean of Ksh 247,141.44 ± 61,030.58 per farmer while it ranged from Ksh -48,039.10 - 258,769 with a mean of Ksh 17,444.57 ± 3,884.80 for Nyamira North whereas it ranged from Ksh 47,981.60 - 374,421.80 with a mean of Ksh 30,964.70 ± 6,180.49 for Manga. These mean net incomes are much lower than expected due to inclusion of pond construction costs. From the ranges given above, a larger percentage of farmers obtained positive net income: 87.92%, 73.33% and 77.5% for Borabu, Nyamira North and Manga sub counties respectively. The smaller percentage of farmers who obtained negative net incomes was due to a number of factors e.g., negligence of the ponds, poor knowledge of aquaculture husbandry and lack of income to purchase inputs. What is significant is that the mean net incomes for the three sub counties were all positive indicating that fish farming was profitable. Total labour cost per farmer for the three sub counties were on average Ksh 4,067.26 ± 4,062.77 for Borabu, Ksh 1,419.28 ± 1,414.65 for Nyamira North and Ksh 5,535.38 ± 5,532.06 for Manga. Manga had a higher labour cost than the other two sub counties. The estimated BCR were 4.66, 1.33 and 1.51 for Borabu, Nyamira North and Manga sub counties respectively.

The estimated GM were Ksh 211,360.20; Ksh 15,742.76 and Ksh 26,879.75 for Borabu, Nyamira North and Manga respectively. Profits were Ksh 187,703.20; Ksh -13,701.68 and Ksh -4,057.70 for Borabu, Nyamira North and Manga when total fixed costs were factored. The Rates of Return on investments were 3.65, 0.44 and 0.75 for Borabu, Nyamira North and Manga respectively. These are greater than the National base banking rates of 14.5%

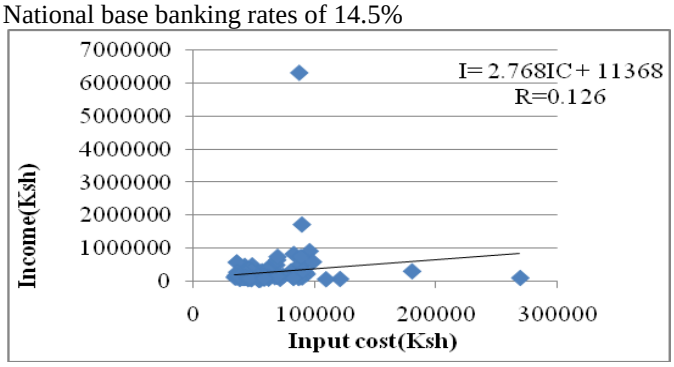

Figure 2: Relationship between total input cost and net income realized by fish farmers in Borabu Sub County

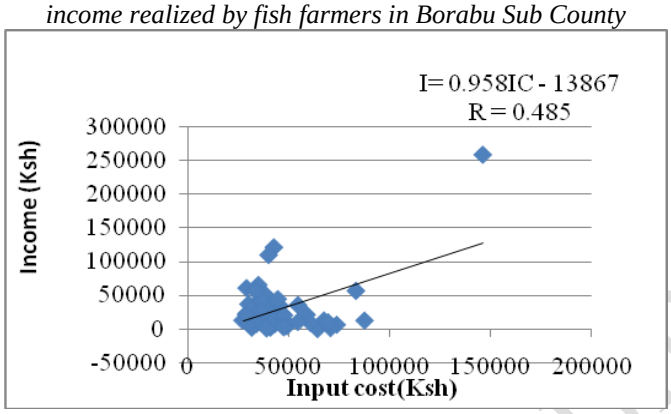

Figure 3: Relationship between total input cost and net income realized by fish farmers in Nyamira North Sub County

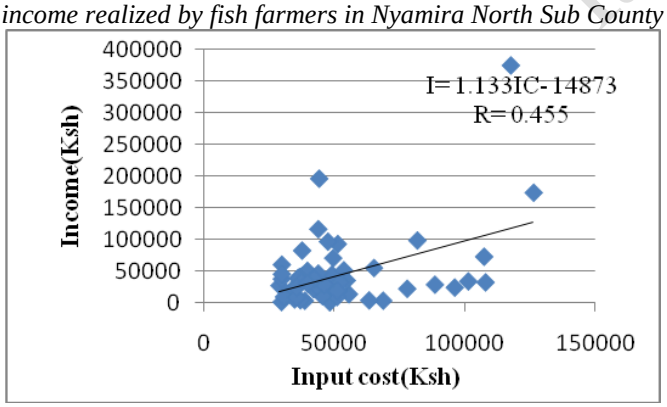

Figure 4: Relationship between total input cost and net income realized by fish farmers in Manga Sub County

IV. DISCUSSION

The variable nature of sizes of harvested fish can be attributed to the different culture periods adopted by farmers, quality of pond husbandry practices offered such as feeding and management of the water regimes, stocking and target harvest fish sizes and local prices quoted at harvest. Raufu et al (2009) indicated that the choice of culture period is influenced by factors such as timing of harvest towards festive period or due to lack of fish feeds. These factors affect the quantity and value of fish harvested. The optimum size of fish harvested is commonly 300grammes under standard aquaculture husbandry practices (Okechi 2004). Some farmers were observed to prefer harvest sizes of higher weight between 500 - 700g which take a longer time to attain than standard table sizes. This was reflected in the sizes of fish harvested which ranged from 50g to 700g. For example farmers who harvested at 500g sold at higher average prices than those who harvested at 300g. This is in agreement with Kawarazuka (2010), who observed that large sized fish were sold as a strategy to meet the daily needs while small sized fish are consumed at home.

It is uneconomical to grow fish beyond the standard table size because the input costs per unit weight increase making the practice unprofitable. However, farmers offering the 500 g fish made more profits because, consumers preferred bigger fish. Secondly some farmers are forced by circumstances such as lack of school fees or lack of funds for medical care to harvest fish of less than the table size, hence the presence of significant numbers of farmers who sold their fish at smaller sizes. Lastly, other circumstances such as floods, theft and predation can force farmers to harvest fish at smaller sizes to avoid losses. There has been a long standing tradition of selling fish in pieces rather than in terms of units of weight in the local markets in the region, particularly those harvested from Lake Victoria. This during the earlier days, was due to lack of weighing balances and poor understanding of how they are used. Most of the local farmers then were illiterate and did not have prior knowledge as to whether fish needed to be weighed before they are sold. Still, this tradition is practised by fish farmers who commonly sell their fish in pieces. Most of the farmers are poor and cannot afford to buy weighing balances and have therefore preferred the status quo.

Fish farming technology has recently been introduced hence its marketing is poorly developed. There are no standard prices of selling fish in the county. Farmers are not organized into groups or societies that can bargain or fix prices, therefore each farmer quotes his own price for a particular size, thus the amount of income obtained by farmers who harvest fish of the same species and sizes is variable, with some making profits while others making losses. This is the reason why the positive relationship between income and yield is not strong, with R ranging from 0.13 to 0.49. Despite this, the relationship predicts that the higher the yield the higher the income. Of greater significance is the high demand of fish from aquaculture which makes it difficult for organized marketing. It is therefore not unusual that farmers flock around the fish ponds to take advantage of buying the harvested fish when it is due. During such occasions all harvested fish are sold within a very short period. For the few that manage to leave the pond sites, most of them are purchased on their way to the market. This denies the government the tax revenue from fish originating from aquaculture. There is therefore need for Fisheries policy to address this issue. Occasionally, farmers incur losses due to non availability of buyers due to poor creation of awareness on the actual occasions where fish are harvested. Under such circumstances, farmers give away fish since they don't have any knowledge on how to preserve them. This concurs with observations of Omasaki et al.,

(2013), that some farmers harvested and sold fish at a low price or give them away for free to prevent post harvest losses. Therefore there is need to educate farmers on post harvest technology and value addition of their fish product to improve their marketability. For those farmers who have some knowledge on how to preserve fish, they are deterred to do so due to lack of finances to purchase processing facilities and cold storage. The calculated BCRs for farmers in the three sub counties of Nyamira were greater than one, indicating that small scale fish farming was profitable. An investment that has a Benefit cost ratio greater than one, equal to one or less than one implies a profit, break-even or a loss (Oke 2014).

V. CONCLUSION

Based on the results it is concluded that aquaculture in the three sub counties of Nyamira is low input in nature , which does not translate into high yields and incomes for the farmers. Therefore it does not contribute towards self employment and revenue collection by the government**.**

There is a great potential for aquaculture to contribute towards improved nutrition and income to the farmers in the three sub counties as observed by a few who have taken up semi intensive aquaculture. These farmers had stocking rates of above subsistence level (above 3 fingerlings m^{-2}) and moderately supplemented feeding using artificial diets. This was reflected in Borabu Sub County where farmers were using three extra supplementary fish feeds namely; rice bran, blood and growers mash, even though the latter is not specifically formulated for fish feeding.

The study recommends that farmers should be sensitized on the need to move from low input level of fish farming to more supplemental feeding level in order to increase their yields hence boost their income.

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