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Research Paper

Impacts of Artisanal Fishing to the Livelihoods of Small Scale Fishing Communities in Lake Victoria in Ukerewe District, Tanzania

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Abstract : *Fisheries play an important role in the livelihoods of riparian communities in Tanzania. However, changes in biodiversity and commercialization of the sector in recent decades have adversely affected fishing communities. Most studies on the sector have focused mainly on the biological and technical aspects and less on the socio-economic impacts of these changes to local communities. This paper analyses the impacts of Nile perch fishery to small scale fishing communities in Lake Victoria using a case of selected villages in Ukerewe district. Specifically, the paper examines profitability of Nile perch fishery to small scale fishing communities and its contribution to household income and non-income poverty reduction in comparison to other fishery. A cross section survey was employed to collect primary data from 140 respondents using a structured questionnaire. Descriptive analysis included the use of means, percentages, and cross tabulation using the Statistical Package for Social Sciences (SPSS). Gross margin analysis was used to examine profitability of Nile perch and other fishery to small scale fishing communities. Results show that Nile perch fishery was far more profitable than fishery of other species. Comparison of means using paired T-test indicated that profit from Nile perch fishery significantly exceeds that of other species. Results further indicate that Nile perch contributes significantly to household income by 59% for fishers, 62% for traders and 40% for processors. While more than half of respondents have good quality houses and can afford health services, majority of them are food insecure. It is concluded that Nile perch fishing has an important role in reducing both income and non-income poverty, hence the need to promote more pro-poor policies to improve livelihoods of small scale fisher communities.*

Keywords: Nile perch, fisheries, lake Victoria, income poverty, non-income poverty.

Introduction

Fisheries sector plays an important role in the economy of Tanzania. It contributes around 10% of the national Gross Domestic Product (GDP)[22] and is an important source of livelihood for many Tanzanians. The sector provides food security, employment and income for the people and is an important source of revenue in the form of export royalties and foreign exchange[28]. Many Tanzanians engaged in fishing activities earn income from the activity which has been increasing over the years, although distribution is increasingly becoming more inequitable, with the export-oriented fish processing sector taking the lion's share [5,28]. Employment is another avenue through which fishing provides a livelihood to Tanzanians. Onyango *et al*., (2005) report that fisheries have continued to be a source of employment to a substantial proportion of the population including fishermen, fish processors and fish traders. In the early 1990s, it was estimated that various activities in the fisheries sector employed about 50,000 people on full time basis and that another 100,000 worked part time [36]. Bagachwa *et al.*, (1994) report that fish output grew faster than the population. By the late 1990s, the estimated sector employment rate of 4% was greater than the population growth rate which was estimated at 2.6% [29]. By 1995, the reported number of full time employees in the sector had increased to 75,516 and by 1997 over 80,000 full time employees were reported[20,22].

Lake Victoria is the second biggest fresh water lake in the world. With its 69,000sq.km, the lake has the same size as Ireland[5]. Tanzania's share on this Lake is 49% of the total surface area which is equivalent to 35,000

sq.km. Mgaya (2005) reports that the lake contributes about 60% of the total fish production and is estimated to contribute over 250,000 metric tons in Tanzania annually. Historically, Lake Victoria was a source of a wide range of fish species.

Fishing was mainly done by small scale fishermen on part-time or full time basis using an assortment of techniques, but depending heavily on canoes and gill nets and fish processing was by smoking or sun drying [15,27]. Small-scale fish mongering was generally done by women and fish trading was predominantly done in the villages and towns surrounding the lake [2,11]. Although East African governments formulated regulations for fishing, the regulations were largely not enforced. Fishing communities developed and enforced their own rules to regulate fishing gears, fishing rights, fishing grounds and fishing seasons [2,10].

Over the past few decades, the fisheries of Lake Victoria have undergone substantial changes, owing to a number of factors. These include environmental variations, increased fishing intensity, and stresses arising from the implantation of exotic species like Nile perch that has major dramatic consequences and has stirred much concern [18,27]. Before the 1980s, the catches were dominated by species which were of less commercial value compared to the three highly commercial species now dominating the fishery of the lake Victoria namely Nile perch, tilapia and sardines (*dagaa*) [13,14,23,26].

Following an increased demand of Nile perch in the world market, growth in the production of the perch has increased and most of the demands for Nile perch fish is export demand of the markets in the West where white meat is preferred over red meat for health reasons [27,28]. In the year 2004, Nile perch and its products exported from Lake Victoria in Tanzania amounted to 47.3 million metric tones that generated US $ 100 million in foreign exchange earnings[21,38]. On average Lake Victoria fisheries in Tanzania has been contributing about 2.5% to the GDP and Nile perch has been the major contributor [26,33].

Despite these developments, the livelihoods of the people have been adversely affected by a wide range of factors including declining access to and availability of fish resources, declining catch per unit effort (CPUE) and the associated switch to destructive fishing technologies. The loss of control by local fishers to industrial investors over the means of production as well as processing, pricing and marketing has generated substantial costs [5]. There is a diminished access due to investments in such modern technologies such as trawling and motorized boats. In the harvesting sector, newcomers have introduced motorized boats, modern fishing equipment and hiring of fishermen to do the fishing. The local fishers have thus, lost control of the means of production [5].

According to Wilson *et al*., (1995), Tanzania's harvesting capacity is now concentrated in the hands of a smaller number of fishers and into a less diverse set of gears and techniques. Bokea and Ikiara (2000) argue that, local fishers have no say in pricing. In addition, each local fisher accounts for an insignificant portion of the total fish supply and is therefore a price taker. In the processing and marketing sectors, large actors with substantial capital have edged out traditional sellers and processors. Wilson *et al*. (1995) estimated that in the accessible, central, landing beaches of Tanzania, more than three quarters (77%) of all the Nile Perch landed was sold to the processing factories, leaving little for other fishery participants. This has increased stratification within the industry and changed production relations. Gibbon (1997) estimates that half (50%) of all Nile perch that landed in Tanzania for year 1996 went to filleting factories. For Kenya in the same year, Abila and Jansen (1997) put the estimates at about 48% of all the Nile perch that was taken by the filleting factories.

These changes have in turn reduced the availability and affordability of fish to local consumers, leading to food insecurity [5]. A number of studies show that, lack of fish from domestic markets has led to malnutrition particularly amongst children in the lake zone [5,18,27]. This is because other fish species that were traditionally consumed have become scarce leading to an increase in the price paid by local consumers [1,24].

While one of the main goals of the Tanzania's national policies and strategies is to improve the living conditions of its people including fishers and their families by maximizing economic benefits to them, there is little evidence on how small scale fishing communities have achieved such a goal. The demand of Nile perch has been threatening huge number of small-scale fishermen and traders due to the reduction of other fish stocks and domination of the richer and bigger operators in fish industry.

Further, there is loss of jobs by the traditional small-scale processors and marketing agents who have been pushed aside to pave the way for larger investors. Studies show that while only 2,400 jobs were created by the firms, 15,000 workers were displaced from traditional processing and marketing sectors in the early 1990s [2,5]. Many studies on this aspect have focused on the biological and technical issues related to the rapid spread of *Lates spp* in Lake Victoria. However, little attention has been paid to analyzing the socio- economic impacts of the rapid spread of the Nile perch to small-scale fishing communities.

Against this background, the present study was undertaken to assess the impacts of Nile perch fishery in Lake Victoria to the small scale fishing communities in Ukerewe district. The study was built on the assumption that the spread of Nile perch in Lake Victoria has had an

impact on the livelihoods of small-scale fishing communities and the local consumers. Specifically, the study sought to examine the profitability of Nile perch fishery, and its contribution to household income and non-income poverty reduction in comparison to other fishery in the study area. To measure these objectives, two hypotheses were developed and tested. First, Nile perch fishery is economically profitable, and second, Nile perch contributes significantly to the total household income.

Material and Methods

The present study was undertaken in four selected villages in Ukerewe district in Mwanza region. The district is composed of 38 islands, the biggest of which is Ukerewe in Lake Victoria. Out of these, only 15 are permanently inhabited while the rest are only inhabited temporarily by fishing communities. The district covers an area of 6,400km^2 out of which 640km^2 is land mass and the rest of the area is covered by Lake Victoria water. Fishing is an important economic activity in the study area and is done along the lakeshore and the islands. A total of 19,000 people are estimated to depend partially or wholly on fishing and/or trading in fishing products. Fishing is done on both small and large scales. The types of fish caught include among others the Nile perch, Tilapia and sardines (*dagaa*).

Fishing methods include gill netting, *dagaa* seining, long lining, hand lining and Beach seining which is prohibited by law. Fishing activities are mostly artisan characterized by predominance of labour, low capital, use of small craft beach seines, few and small mesh size nets, hooks and traps. Artisanal fishing is limited to near-shore waters and boats propelled by paddles, sail and small outboard engines. Fish from artisan fishing is used for subsistence, sold locally to wholesalers/transporters and/or processing and marketing agencies. The semi-industrial fishing operations are characterized by higher capital to labour ratio, the use of larger vessels powered by more powerful outboard engines with boats generally being under ownership of entrepreneurs and managed by salaried crew. Vessels of this type mostly compete directly with artisan fisher folk in the inshore waters in order to cut down operation costs. Harvests from this group are sold to fish wholesalers, processors or packers [30].

A cross-sectional research design was used in this study because it allows data to be collected at a single point in time and can be used for a descriptive study as well as for determination of relationships between variables [3]. The design was considered appropriate for this study because of limited time and resources for data collection [6]. Multistage sampling technique was used to select fishers and non-fishers because of its convenience in studying large and diverse populations as well as populations whose list of actual individuals to be studied is hardly available [8].

From the four divisions in the district, one ward from each division was purposively selected based on their involvement in fishing activities. Simple random sampling was used to select one village from each ward and the same technique was employed in selection of fishing and non-fishing households in such a way as to have 15 respondents as fishers from each village, 10 fish traders and processors and 10 non-fishers households. Thus, a sample of 140 respondents was involved in the study comprising 100 households involved in fishing activities and 40 non-fishing households. The sample size was found to be convenient for statistical analysis.

Primary data were collected using structured questionnaire designed to collect both qualitative and quantitative data from fishing and non- fishing household heads. Secondary data were collected through documentary review of various relevant reports and other documents from institutions and organisations such as Sokoine National Agricultural Library (SNAL), Tanzania Fisheries Research Institute (TAFIRI), Ministry of Natural Resource and Tourism, Fisheries Division and National Bureau of Statistics- Mwanza region. Other information were obtained from electronic sources in the Internet. The collected data were summarized and processed using Statistical Package for Social Science (SPSS).

Descriptive and quantitative analyses were employed in this study based on the objectives. For descriptive analysis, percentages, means, frequencies, and cross tabulation were employed. Quantitative analysis was mainly based on gross margin analysis to establish economic profitability of Nile perch fishery that competes with other fishery. According to Makeham et al., (1986), gross margin is the difference between the gross income earned and the variable costs incurred. Variable costs are those costs that increase or decrease as output changes, while fixed costs do not change as output is changed [7]. Gross margin analysis is a simple, but in many cases a sufficiently powerful tool for economic analysis. In this study, the average fish fished per week and the costs incurred in a week were considered. The amounts were then converted into a year in order to know the amount that respondents got from their fishing activities in a year. Since the price of the produce varied between respondents, average prices were calculated and used. Comparison of means was done by using paired T-test to establish statistical significance between Nile perch actors and other species actors. Gross margin was calculated as follows:-

$GM = X_iP_i - U_i$

Where,

GM = Gross Margin (Tshs)

X_i = Output in kg

P_i = Product price (Tshs)/kg

Ui = Total variable cost (Tshs)

Paired sample T-test was employed in this study to test the hypothesis that Nile perch fishery is economically profitable to small-scale fishers' and other actors in the Nile perch fishery. Means for fishers, traders and processors involved in Nile perch fishery versus those involved in other fishery after being determined by gross margin analysis were therefore compared using paired sample T-test.

Results and Discussion

Analysis of profitability of Nile Perch and other fishery: Small scale fishing community involves many people. In this study, only fishers, traders and processors were considered in assessing the profitability of Nile perch fishery that competes with other fishery such as tilapia and dagaa. Both the average operating costs and the net revenues accrued by fishers, fish traders and fish processors were calculated using gross margin analysis. The results show that fishers, traders and processors in the Nile perch fishery received the higher gross revenue and net revenue, but also incurred higher operating costs per year than those involved in other fishery (Table 1, and Appendices 1and 2).

The higher revenues among the Nile perch actors can largely be attributed to good price offered for the species as opposed to other species, mainly because of its high demand in the international market. Means comparison results using paired T-test in Table 2 indicate that gross margins of fishers, traders and processors involved in Nile perch fishery and those involved in other fishery differ significantly at $p<0.05$ and therefore the null hypothesis is rejected and the alternative hypothesis accepted. Therefore, Nile perch fishery is more economically profitable compared to other fishery.

Indeed, these findings can be supported by MNRT (2004)'s observation that, Nile perch is the major export commodity in the international market. The exports consist mainly of several Nile perch products including belly flaps, dried fish, fishmeal, fillets, fish chests, fish frames, fish maws, fish offals, fish skins, heads and guts, Nile perch chips, Nile perch steak, off-cuts, fish oil, and Nile perch carcass. Other studies show that Nile perch is by far the Tanzania's major fish export whereas in 2003, exports of Nile perch fillets amounted to $81 million constituting over 80% of all fish exports in the country [12,38].

Contribution of Nile Perch and other fishery to household income : Findings on the analysis of the contribution of Nile perch to household income for fishers, traders and processors in comparison to other fishery are presented in Table 3. The results show that income from Nile perch is supplemented by income earned from other species and other income generating activities. What is interesting is the observation that Nile perch is the major contributor to household income as opposed to other sources by 59%, 62% and 40% for fishers, traders and processors respectively.

This implies that household income is relatively higher in households involved in Nile perch fishery than those involved in other fishery and other economic activities. One possible explanation for this observation is the high demand of Nile perch in the market hence fetching higher prices in comparison to other fishery.

It was established that average selling price for a kilo of fresh Nile perch was Tshs. 1,500 and 1,900 for fishers and traders respectively while for sardines (dagaa) the price was Tshs. 500 for fishers and Tshs. 800 for local traders per kilo. A study by Bokea and Ikiara (2000) observed that, price of Nile perch has improved in real terms, a development that has benefited the local fishers.

However, Abila and Jansen (1997) caution that, even though fishermen now fetch better prices per kilo than was the case before, there is insufficient evidence to suggest that this income is re-distributed to reduce poverty and improve protein intake and living standards to a wider community. In fact, close to half of fishers (47%) in this study reported that prices of their produce were determined by fish industry agents suggesting that fishers have limited bargaining power to determine market prices, a situation which undermines their potentials to earn higher incomes.

Contribution of Nile perch and other fishery in reducing non-income poverty: In an attempt to the measure the contribution of Nile perch fishery in reducing non-income poverty, the following variables were considered: quality of housing, access to health services and household food security. With regard to quality of housing, respondents were asked to indicate the type of materials used to construct their house(s) and houses were assigned scores according to the type of materials used to construct walls, roofs and floors.

Based on these scores, the quality of a house was rated into three groups as excellent, good and poor. Households rated as having excellent quality houses, had houses constructed with burnt/cement bricks, roofed with corrugated iron sheets and had their floors cemented, while households rated as having good quality houses had their houses constructed with mud bricks roofed with corrugated sheets and had their floors not cemented (mud floor), and households with poor quality houses had their houses constructed with trees (walls) roofed with grasses and had their floors not cemented (mud floors).

Table 1
Average annual gross income, operating costs and net revenue for fishers/traders and processors (n=140)

Type of Fishery	Category of actors	Gross revenue Tshs/year	Operating costs Tshs/year	Net revenue Tshs/year
Nile Perch	Fishers	8 740 500	6 560 000	2 180 500
	Traders	11 020 000	8 101 476	2 918 524
	Processors	271 950	200 000	71 950
Other fishery	Fishers	5 412 500	4 380 000	1 032 500
	Traders	8 653 800	6 660 000	1 993 800
	Processors	246 300	196 300	50 000

Table 2
Means comparison results of gross margins between fishers, traders and processors involved in Nile perch fishery and other fishery (n=140)

Variables	Average gross margins	Mean difference	Standard deviation	t-value
Nile perch fishers	2 180 500	1 148 000	3 897 143.0	2.282*
Other species fishers	1 032 500			
Nile perch traders	2 918 524	924 724	938 708.8	4.406*
Other species traders	1 993 800			
Nile perch processors	71 950	21 950	8 502.1	5.297*
Other species processors	50 000			

*Significant at $p<0.05$

Table 3
Proportion of household income from Nile Perch and other fishery (n=140)

Type of fishery	Category of fishery actors (%)		
	Fishers	Traders	Processors
Income from Nile Perch fishery	59	62	40
Income from other fishery	41	35	38
Income from other non-fishery activities	0	3	22

Table 4
Distribution of respondents by quality of housing and health services (n=140)

Variables	Occupation				χ^2-value
	Fishers n=60	Processors n=20	Traders n=20	Others n=40	
House quality					
Excellent	35.0	30.0	45.0	10.0	
Good	53.3	50.0	45.0	57.5	14.56*
Poor	11.7	20.0	10.0	32.5	
Availability of health facility within the village					
Yes	71.7	100.0	75.0	75.0	
No	28.3	0.0	25.0	25.0	7.103
Ability to meet health costs					
Totally yes	31.7	15.0	40.0	15.0	
Partially yes	66.7	45.0	60.0	47.5	
Totally no	1.7	40.0	0.0	37.5	34.817*

*Significant at $p<0.05$

As far is access to health services is concerned, respondents were asked if there were health facilities within their villages and the ability to afford for health services costs in a year. Results show that more than three quarters of respondents (77.1%) admitted that there were health facilities within their villages whereas slightly above one fifth (22.9%) of the respondents reported absence of health facilities in their villages. This implies that majority of respondents live near the health facilities and therefore do not have to walk long distances to access health services. Moreover, the results show that ability to meet health services costs differed among the respondents interviewed in the study area.

According to URT (2009), a large proportion of the population live within 6km of a dispensary or health centre. Only 31.7% of fishers, 15% of processors, 40% of the traders and 15% of the farmers were able to meet all health service costs in a year indicating that fish traders have more ability to afford for health service costs than their counterparts in the other groups (Table 4). The comparison on the respondents ability to meet health services was significant at $p<0.05$.

Another aspect that was considered important in measuring household non-income poverty is household food security particularly because food is a basic need for all people and therefore one of the measures of household welfare. Food security refers to accessibility by all people at all times to enough food for an active and healthy life. Access to food depends upon income levels of the household, the distribution within the household and the price of the food. According to Abila (2003), a household will have food security if there is sufficient food available, it has the necessary purchasing power or means of exchange to acquire it, and their social relationships allow them to access it within the household. In this study, food security was assessed by indicating the number of meals taken by the household members per day. Respondents whose families took two meals or less were regarded as food insecure while those who took three meals or more were regarded as food secure. In fact, other scholars consider eating less than three and five meals for children and adults, respectively as a cause of poor health status and general body weakness [7]. Findings in Table 5 show that an overwhelming majority of respondents (83.6%) were eating two meals per day.

Eating three meals per day, which is the normal number of meals per day, was reported by only 16.4% of the respondents. Comparatively, a higher proportion of fish traders (40%) indicated to be eating three meals per day (40%) than their counterparts in the other groups. The results from chi-square show a significant difference in terms of number of meals taken per day among the four categories of respondents at $p<0.05$. When respondents were asked why they were not taking three meals per day they said that many of them could not meet the costs for food mainly because what they produce was not enough to meet their requirements. A study by Matunga *et al.,* (2009) in Chamwino district indicated that household income has a significant effect on food security.

Households employ various coping strategies in order to cope with food insecurity. In this study, respondents were asked what was done when there was food shortage in the household. Results show that, 83.6% of the respondents buy food when faced with food shortage whereas 3.6% exchange fish with food. Depending on the quantity of fish caught and income earned which are at times not very stable, these findings suggest that the coping strategies used are not sufficient to minimize food insecurity problem in the study area.

Table 5
Distribution of respondents by number of meals, food deficit and solutions to food deficit

Variables	Occupation				Total n=140	χ^2-value
	Fishers n=60	Processors n=20	Traders n=20	Others n=40		
Number meals per day						
Two	83.3	90.0	60.0	92.5	83.6	11.021*
Three	16.7	10.0	40.0	7.5	16.4	
Food shortage coping mechanism						
Buying food	81.7	85.0	70.0	92.5	83.6	
Food shift	3.3	0.0	0.0	0.0	1.4	8.595
Fish exchange	3.3	5.0	5.0	2.5	3.6	
None	11.7	10.0	25.0	5.0	11.4	

*Significant at $p<0.05$

Conclusion

Based on the findings of the study it can generally be concluded that, Nile perch fishery provides higher returns and therefore contributes significantly to total household income. However, it is evident that small scale fishers in the area are unlikely to benefit fully from the potentials of Nile perch fishery since the price of the fishes are determined by fish industry agents. On the other hand, findings on non-income poverty dimensions show a mixed picture. Although more than half of respondents have good quality houses and can afford health services, majority of them are food insecure indicating that the impact of Nile perch fishery in reducing non-income poverty seems to be limited. It is recommended that pro-poor policies should be formulated aiming at promoting and strengthening fisher groups/societies in order to improve the welfare of small scale fishers in Nile perch fishery sub-sector through enabling fishers to become price-makers and not price takers. In addition, the government and development partners should discuss and agree on how income, employment and food security can be ensured for small scale fishers and poor people who depend solely on fisheries for their livelihoods following the modern fish export industry.

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Appendix 1: Gross margin for fishers/traders and processors involved in Nile perch fishery

Fishers	Item	Amount (Tshs/year)
	Gross revenue	
	Average fish fished/year 5827kg - A	
	Average price/kg 1500/= - B	
	Total Revenue(TR) – C = A* B	**8,740,500**
	Variable costs	
	Average annual crew food - a	2, 400, 000
	Salary for crew - b	3, 480, 000
	Cook salary - c	120, 000
	Maintenance -d	500, 000
	Tax - e	35, 000
	Vessel registration -f	25, 000
	Total variable costs – D = a+b+c+d+e+f	**6, 560, 000**
	Gross Margin (Net revenue) = C - D	**2, 180, 500**
Traders	**Gross revenue**	
	Quantity of fish sold/year 5800 kg	
	Average price/kg 1900/=	
	Total Revenue(TR)	**11, 020, 000**
	Variable costs	
	Value of fish bought	6, 581, 476
	Transport	950, 000
	Tax/levies	320, 000
	Packaging material	250, 000

	Total variable cost (TVC)	**8, 101, 476**
	Gross Margin (Net revenue)=TR-TVC	**2, 918, 524**
Processors	**Gross revenue**	
	Average fish sold/year 1813pieces - A	
	Average price/piece 150/= - B	
	Total Revenue(TR) – C = A* B	**271, 950**
	Variable costs	
	Value of fish bought - a	100, 000
	Cooking oil - b	70, 000
	Fire wood - c	30, 000
	Total variable costs – D = a+b+c	**200, 000**
	Gross Margin (Net revenue) = C - D	**71, 950**

Appendix 2: Gross margin for fishers/traders and processors involved in other species fishery

Fishers	**Item**	**Amount (Tshs/year)**
	Gross revenue	
	Average fish fished/year 2165tins - A	
	Average price/tin 2500/= - B	
	Total Revenue(TR) – C = A* B	**5, 412, 500**
	Variable costs	
	Average annual crew food - a	1, 200, 000
	Salary for crew - b	2, 400, 000
	Cook salary - c	120, 000
	Fuel - d	240, 000
	Maintenance - e	360, 000
	Tax - f	35, 000
	Vessel registration - g	25, 000
	Total variable costs- D= a+b+c+d+e+f+g	**4, 380, 000**
	Gross Margin (Net revenue) = C - D	**1, 032, 500**
Traders	**Gross revenue**	
	Average fish sold/year 2163.45 tins - A	
	Average price/tin 4000/= - B	
	Total Revenue(TR) –C = A* B	**8, 653, 800**
	Variable costs	
	Value of fish bought - a	5, 240, 000
	Transport - b	900, 000
	Tax/levies - c	320, 000
	Packaging material - d	200, 000
	Total variable costs – D = a+b+c+d	**6, 660, 000**
	Gross Margin (Net revenue) = C - D	**1, 993, 800**
Processors	**Gross revenue**	
	Average fish sold/year 1642 pieces - A	
	Average price/piece 150/= - B	
	Total Revenue(TR) – C = A* B	**246, 300**
	Variable costs	
	Value of fish bought - a	100, 000
	Cooking oil - b	70, 000
	Fire wood - c	26, 300
	Total variable costs – D = a+b+c	**196, 300**
	Gross Margin (Net revenue) = C - D	**50, 000**