International Journal of Fisheries and Aquatic Studies 2016; 4(3): 367-371

ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2016; 4(3): 367-371

www.fisheriesjournal.com
Received: 06-03-2016
Accepted: 07-04-2016

Chifuniro Somanje
Department of Horticulture, Jomo Kenyatta University of Agriculture and Technology

Kavoi M Muendo
Department of Agriculture and Resource Economics, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya.

Correspondence
Chifuniro Somanje
Department of Horticulture, Jomo Kenyatta University of Agriculture and Technology

Socio-Economic determinants of profitability of capture fisheries trade in Barotse floodplain of Zambia

Chifuniro Somanje and Kavoi M Muendo

Abstract
This paper was set to assess profitability and its socio-economic determinants in Zambia. 192 traders from Mongu and Senanga districts were sampled. Profitability of fish trading was determined using gross margin analysis and socio-economic determinants of profitability were quantified using translog profit function. 82.3% of the respondents were female and 60% were of 26-40 years. Bream was most common traded fish. Gross margin analysis showed that trading is profitable with average gross margin of 7.25 Zambian Kwacha per kilogram per day. Profitability was affected by costs of capital, materials and how price capital, storage and labor interact. In conclusion, capture fisheries is a profitable enterprise and is affected by costs of capital, materials and how price capital, storage and labor interact. This implies that to increase profitability, traders should target high value markets that a less sensitive to changes in selling price and capacity building in cost management.

Keywords: Socio-economic determinants, Profitability, Capture fisheries, Translog profit function

1. Introduction
Fisheries provide income for many people in Zambia though its contribution to economic growth is undervalued. Capture fisheries has an annual production of 65,000 to 80,000 tons per annum and aquaculture produces 5,000 metric tons per annum [1]. It is used as subsistence and cheap source of protein [2, 3]. Capture fisheries is a source of foreign exchange and revenue to government through taxes and fishing agreements [4]. Though fish is of much importance to economic growth and nutrition, profitability of capture fisheries in Zambia is not known. Therefore it is important to quantify profitability of capture fisheries and its determinants to ensure efficient use of fisheries resources.
Developing and developed countries have studied profitability and factors affecting profitability of aquaculture. The studies have emphasized on the importance of fisheries in different economies and how improving profitability would increase efficiency and fishery contribution to agriculture [5, 6]. New Economic Partnership for African Development (NEPAD) through Comprehensive African Agricultural Development Programme (CAADP) is working to promote fisheries as a contributor to agricultural development in Africa. It recognizes that fisheries contributes to food security, income, poverty reduction and economic development [7]. This emphasizes the importance of improving efficiency through improved profitability. Profitability of fisheries is affected by several factors. In a recent study [8], profitability of fish is significantly affected by output price, capital cost and cost of materials. Another study [9] revealed that fish business is a profitable enterprise that can be a sufficient source of household income. It is also noted in previous studies [10]. That profitability is also affected by level of education attained, age and experience in addition to the aforementioned factors. Considering that limited research has been carried in fisheries particularly on determinants of profitability of fish in capture fisheries trading in Zambia, government did not invested much resources towards fisheries [11]. This led to a slow realization of contribution of fisheries sector to economic growth. As such the problem that this study sought to address was the lack of empirical evidence on socio-economic determinants of profitability of capture fisheries trade in Barotse floodplain of Zambia.

2. Methodology
2.1 Study Area
The study used a survey approach. The study was conducted in Mongu (GPS location S15°16.422' E23°07.804') and Senanga (GPS location S16°07.427' E23°17.335) district markets of Barotse floodplain in Western Province of Zambia. Barotse floodplain lies north western of Zambia and southward of Angola with a population of 225,000 people [12]. The floodplain covers four districts (Mongu, Limulunga, Senanga and Kalabo) and an area of 550,000 hectares of land. 280,000 hectares is arable agricultural land. The floodplain support over 300,000 people through fish related activities [13].

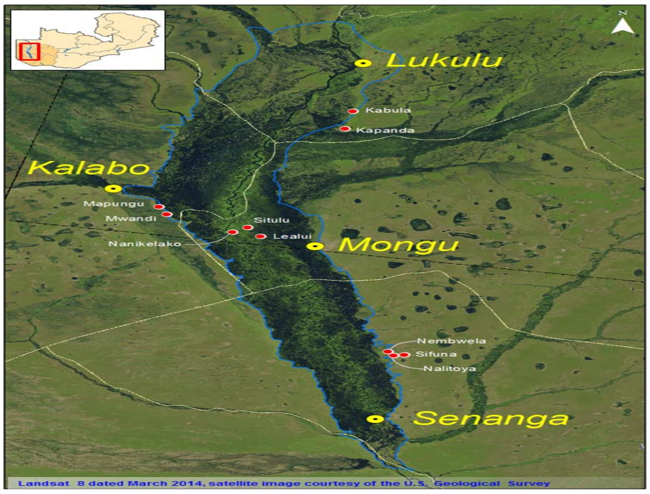

Fig 1.1: Map of Barotse Floodplain

2.2 Data Collection
Several data collection methods were used to collect data. Structured questionnaire, focus group discussions and observations were used. A sampling unit for this study was an individual fish trader randomly sampled from 2 district markets. The sample size was calculated using infinite population approach [14]. This approach was used because the population of traders in the markets was not known. Before data was collected, approval was sought from University of Zambia-Humanities and Social Sciences Research Ethical Clearance Committee. A total of 192 traders were interviewed with their signed consent in Mongu and Senanga market in the months of July to September. Quantitative data was collected on quantity of fish bought; price at which fish was bought; related cost; type and form of fish bought; where fish was sold and the selling price.

2.3 Data Analysis
Quantitative techniques were used to analyze the data. Descriptive statistics and tables were used to present results. In order to assess profitability, gross margin analysis was used[15]. Quantity of fish sold was valued in order to quantify the gross income. Cost of taking the fish from the place fish is bought to the final consumer was collected. Gross margins were calculated per kilogram using the formula given below:

$$GM = P_Y Y - \sum P_i X_i$$

GM- gross margin in Zambian Kwacha per respondent
P_Y – price of fish per Kg
Y- Quantity of output in Kgs
P_i –price for each i^{th} input unit
X_i – quantity of input used/respondent unit for each i^{th} input

Determinants of profitability were assessed using translog profit function and Cobb Douglas. A translog profit function and Cobb Douglas were employed to quantify how different cost related variables and socio-economic factors affect gross margins of traders [16]. A Cobb Douglas functions measures the relationship between inputs and level of output [17]. Translog profit functions can be used to address several issues. They look at impact of factor price on the total cost or profit, economies of scale, scope and density and technology on cost structure.

In a general form of Cobb Douglas function[19] can be written as:

$$Y = \beta_0 X_1^{\beta_1} X_2^{\beta_2}$$

Where Y= output
X_1 and X_2 = input factors
β_1 and β_2 = output elasticity

From the Cobb Douglas production function we can derive a profit function as

$$\Pi = \beta_0 PX_1^{\beta_1} PX_2^{\beta_2}$$

Where Π is gross margin/Kg
PX_1 and PX_2 are price of input factors
β_1 and β_2 are price elasticity

The function is linearized to:

$$\text{Log}\,\pi = \log\beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \varepsilon$$

According to scholars[20-21-22], translog profit function using Shephard's Lemma approach is given as:

$$\ln \Pi^* = \alpha_0 + \sum \alpha_j \ln pw^* + \gamma_y \ln py + \frac{1}{2}\gamma_{yy} \ln py^2 + \frac{1}{2}\sum_j \sum_k \beta_{jk} \ln pw_j^* \ln pw_k^* + \sum \gamma_{jy} \ln pw_j^* \ln py + v$$

Where Π^* is profit α_0 is the intercept β_{jk}, γ_y, γ_{yy}, γ_{jy} are parameters to be estimated pw and py are input price factors

In this study, gross margin was modeled as a function of price of capital per kilogram which reflected investment. Price of materials/ item, price of labour/ day, price of transport/ trip and price of storage/day were independent variables used in the model as variable costs in fish trading. Other variables include education level, sex of respondent, age group and experience in fish trading.

3. Results and Discussion
3.1 Socio-economic Characteristics of Traders
The study found that fishing was seasonal in Barotse floodplain. The fishing season was determined by floods. Fishing was at its peak from the month of August to November. During this time, flood water receded and fish were confined in small pools of water. Low season was from the month of March to June. This period was when water levels were high and fish had more area to move hence difficulty in catching fish. The Department of Fisheries enforced a closed fishing season from early December to end February the following year to allow fish to breed. The closed months were also rainy season when the water rose in the floodplain. Seasonality of fishing influenced price fluctuations of fish and settlement patterns. At peak season, price of fish was relatively low due to abundance of fish on the market. During this period, some temporary fishing camps were established. Price of fish was relatively high over low season due to scarcity and high demand of fish. Over this period, households moved to upland areas. Table 1 shows the socio-economic characteristic of traders. It shows that 82.3% of the

respondents were female. This suggested that fish trading is a female dominated activity in the study area. 60% of the respondents were within 26-40 years of age suggesting that most of the respondents were within the productive age group. The respondents had an experience of 1-10 years in fish trading (78.1%). Considering the age and experience, it was implied that most of the respondents have reasonable knowledge in fish trading. On average, the respondents had attended primary education (grade 7), revealing that they have basic literacy and numeracy skills that are relevant in business. In the study area, most of the respondents (84.9%) trade breams while 10.4% and 4.7% trade in bulldog and catfish respectively.

Table 1: Socio-economic characteristics of fish traders in Barotse floodplain

Variable		Frequency	Percentage
Sex of respondent			
	Female	158	82.3
	Male	34	17.7
Fish groups			
	Bream	163	84.9
	bulldog fish	20	10.4
	Catfish	9	4.7
Education level			
	no education	7	3.6
	Primary	96	50
	Secondary	89	46.4
Age group			
	<25	41	21.4
	26-40	116	60.4
	41-55	25	13
	>55	1	0.5
Experience			
	1-10	150	78.1
	11-20	34	17.7
	21-30	5	2.6
	>31	3	1.6

3.2 Gross Margin Analysis

Profitability of fish trading enterprise was examined using gross margin analysis[23]. Table 2 shows distribution of fish trading variable costs for fish trading per day in monetary terms and as a percentage. Cost of buying fish (i.e. cost of capital) was the largest cost component for traders per day. Cost components such as labor, transport, storage, levies and packaging materials formed the smaller proportion of total variable costs.

Table 2: Cost Distribution of Fish Trading

	ZMW	% cost of TVC
Mean Direct costs		
Buying fish	523.05	74.25
Insecticides	22.58	3.2
Transport	43.19	6.13
Packaging material	12.43	1.76
Storage	16.11	2.29
Accommodation	24.09	3.42
Fish levies	6.44	0.91
Market levies	10.31	1.46
Association fees	9.75	1.38
Mean Labor Costs		
Grading	10.14	1.44
Packaging/stockpiling	12.05	1.71
Lifting, loading and offloading	14.44	2.05
Total Variable Cost (TVC)	704.58	100

Table 3 shows summaries of gross margins for capture fish traders per day. On average, traders sold 26.43kg per day at an average price of ZMW 33.91 per kilogram. Average gross output per trader was ZMW 896.24. Variable costs were deducted from gross output leaving a balance of ZMW 191.66 as gross margin per trader per day. This was also expressed as ZMW 7.25 per kilogram per day. This revealed that capture fisheries trading is a profitable business. These findings were consistent with literature on fish farming [9].

Table 3: Summary of Efficiency measures of Fish Trading per Day

Item	Trader
Average Yield(Kg)	26.43
Average Price (ZMW/Kg)	33.91
Average Gross Output (ZMW/Individual)	896.24
Average Gross Margin (ZMW/Individual)	191.66
Average Gross Margin (ZMW/Kg)	7.25

3.3 Determinants of profitability of fish trading

The extent at which various independent factors influence profitability of fish trading was quantified using a Cobb Douglas and translog profit function. The results are presented in table 4.

Table 4: Estimates of Translog Profit Function and Cobb Douglas Function

		Translog profit function		Cobb Douglas	
Variable	**Parameter**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Constant	α_0	-1.74	0.051^c	-0.47	0.48
Normalized price of capital	α_1	2.02	0.032^b	0.5	0.002^a
Normalized price of labor	α_2	-0.33	0.555	-0.09	0.341
Normalized price of transport	α_3	0.72	0.184	-0.13	0.232
Normalized price of storage	α_4	0.29	0.969	0.17	0.212
Normalized price of material	α_5	1.01	0.056^c	0.13	0.172
Normalized price of capital squared	α_6	-1.51	0.073^c		
Normalized price of labor squared	α_7	-0.62	0.045^b		
Normalized price of transport squared	α_8	-0.46	0.058^c		
Normalized price of storage squared	α_9	0.06	0.909		
Normalized price of material squared	α_{10}	-0.179	0.574		
Normalized price of capital X normalized price of labour	α_{11}	0.44	0.311		
Normalized price of capital X normalized price of transport	α_{12}	-0.4	0.381		
Normalized price of capital X normalized price of storage	α_{13}	-0.003	0.996		
Normalized price of capital X normalized price of material	α_{14}	-0.84	0.052^c		
Normalized price of labor X normalized price of transport	α_{15}	-0.8	0.015^b		
Normalized price of labor X normalized price of storage	α_{16}	0.18	0.679		
Normalized price of labor X normalized price of material	α_{17}	0.93	0.005^a		
Normalized price of transport X normalized price of storage	α_{18}	0.66	0.101		

Normalized price of transport X normalized price of material	α_{19}	0.21	0.465		
Normalized price of storage X normalized price of material	α_{20}	-0.34	0.243		
Sex of respondent (Male)	α_{21}	0.15	173	0.14	0.201
Normalized age	α_{22}	0.74	0.064[b]	0.45	0.255
Normalized Experience	α_{23}	-0.16	0.238	-0.2	0.14
Education					
primary	α_{24}	0.14	0.546	0.02	0.926
secondary	α_{25}	0.12	0.611	0.0055	0.981
Fish group					
bulldog fish	α_{26}	-0.19	0.155	-0.17	0.219
catfish	α_{27}	-0.43	0.029[b]	-0.53	0.007[a]
Fish form					
sundried	α_{28}	-0.068	0.54	-0.017	0.875
smoked	α_{29}	0.017	0.877	0.07	0.5
log likelihood			-137.5	-154.17	
AIC			1.76	1.77	

Note: [a] implies significant at $p<0.01$, [b] implies significant at $p<0.05$ and [c] implies significant at $p<0.1$

In order to decide which model fits the data best, a likelihood ratio test was conducted. It tested the null hypothesis whether additional variables in the Cobb Douglas function were equal to zero against the alternative hypothesis that additional variables to the Translog Profit function were equal to zero. The Likelihood Ratio Test gave the following results:
LR chi2 (15) = 33.30
Prob> Chi2 = 0.0043
Based on the results the study rejected the null hypothesis that states that additional variables to the Cobb Douglas function were equal to zero. Translog profit function was a better fit for the data than Cobb Douglas function. Considering this, the results of the fitted translog function are presented in table 5.

Various socio-economic factors were tested to check whether they affect gross margins of fish traders in Barotse floodplain. Age had a positive influence on gross margins (1 to 0.75). Since most traders were within the productive age group of 26-40, they likely explored different markets hence positively affecting gross margins. This result collaborates with other studies[10] that found that age affects flexibility in decision making which is important in fish trading.

Profitability in Barotse flood plain was positively affected by the price of capital whereby a unit increase in price of capital resulted in proportional increase in gross margin (1 to 2.35). It also shows a positive relationship between cost of materials and gross margin (1 to 0.92). These findings were in agreement with another study [8]. Which revealed that cost of capital affect profitability positively.

The findings on squared estimates of price of capital, price of labor and price of transport indicated a negative effect on gross margin (1 to -1.78; 1 to -0.68; and 1 to -0.48 respectively). These results contradict finding of another study [24]. Which revealed that squared estimates of price of labor had a positive influence of profitability as a measure of efficiency. This may be because price of labor may not necessarily translate to labor efficiency.

Table 5 shows effect of an interaction of independent variables on gross margin. The interactions explained partial responses of gross margin to various independent variables. The results show that an interaction of price of capital and price of material; price of labor and price of transport; and price of labor and price of material had a negative effect on gross margin (1 to -0.8; 1 to -0.75; and 1 to 0.96 respectively).

Table 5: Estimates of Translog Profit Function

Dependent Variable=Gross Margin	Parameter	Coefficient	p-value
Constant	α_0	-1.67[b]	0.035
Normalized price of capital	α_1	2.35[a]	0.008
Normalized price of labor	α_2	-0.34	0.53
Normalized price of transport	α_3	0.61	0.25
Normalized price of storage	α_4	-0.03	0.971
Normalized price of material	α_5	0.92[c]	0.077
Normalized price of capital squared	α_6	-1.78[b]	0.023
Normalized price of labor squared	α_7	-0.68[b]	0.024
Normalized price of transport squared	α_8	-0.48[b]	0.044
Normalized price of storage squared	α_9	0.017	0.974
Normalized price of material squared	α_{10}	-0.24	0.424
Normalized price of capital X normalized price of labour	α_{11}	0.47	0.261
Normalized price of capital X normalized price of transport	α_{12}	-0.33	0.463
Normalized price of capital X normalized price of storage	α_{13}	0.039	0.945
Normalized price of capital X normalized price of material	α_{14}	-0.8[c]	0.059
Normalized price of labor X normalized price of transport	α_{15}	-0.75[b]	0.018
Normalized price of labor X normalized price of storage	α_{16}	0.19	0.653
Normalized price of labor X normalized price of material	α_{17}	0.96[a]	0.003
Normalized price of transport X normalized price of storage	α_{18}	0.59	0.129
Normalized price of transport X normalized price of material	α_{19}	0.26	0.354
Normalized price of storage X normalized price of material	α_{20}	-0.33	0.242
Normalized age	α_{21}	0.73[c]	0.06
Normalized Experience	α_{22}	-0.19	0.138
Fish group			

bulldog fish	α_{23}	-0.17	0.186
catfish	α_{24}	-0.47[b]	0.014
log likelihood			-139.46
AIC			1.71
BIC			-829.95

Note: [a] implies significant at p<0.01, [b] implies significant at p<0.05 and [c] implies significant at p<0.1

4. Conclusion

Fish trading is a profitable enterprise in Barotse floodplain. It is a common source of income to traders within the 26-40 year age group. Profitability of fish trading is positively influenced by price of capital and price of materials. Gross margin are determined by price of capital and price of materials. Gross margin is also affected by an interaction of price of capital and price of storage; price of labor and price of materials; and price of storage and price of materials. There is a need therefore for traders to target high value markets that are less sensitive to price changes. There is also need to build capacity of capture fish traders on how to manage costs to realize maximum profits.

Suggested future works include quantification of profitability of fishing and processing considering various factors that may affect these activities in capture fisheries. Studies should also be done to develop a business model that would reduce costs and promote benefits generated from capture fisheries.

5. Acknowledgements

The research work was supported by WorldFish and Department of Fisheries of Zambia with funding from International Development Research Centre and Australian International Food Security Research Centre under Cultivate Africa's Future programme.

6. References

1. Musumali M, Heck S, Husken S, Wishart M. Fisheries in Zambia: an undervalued contributor to poverty reduction. Work Pap. 2009; 26:171. Available at: http://ideas.repec.org/b/wfi/wfbook/38677.html.
2. Kumolu-Johnson CA, Ndimele PE. A Review on Post-Harvest Losses in Artisanal Fisheries of Some African Countries. J Fish Aquat Sci. 2011; 6(4):365-378. doi:10.3923/jfas.2011.365.378.
3. Beveridge MCM, Thilsted SH, Phillips MJ, Metian M, Troell M, Hall SJ. Meeting the food and nutrition needs of the poor: The role of fish and the opportunities and challenges emerging from the rise of aquaculturea. J Fish Biol. 2013; 83(4):1067-1084. doi:10.1111/jfb.12187.
4. Graaf G De, Garibaldi L. The value of African fisheries; 2014. Available at: www.fao.org/documents/card/en/c/.
5. Tunde AB, Mp K, Oladipo AA, Olasunkanmi LH. Economic Analyze of Costs and Return of Fish Farming in Saki-East Local Government Area of Oyo State, Nigeria. J Aquat Res Dev. 2015; 6(2). doi:10.4172/21559546.1000306.
6. Hassan Nazmul Nahmrm. Post-harvest Loss of Farm Raised Indian and Chinese Major Carps in the Distribution Cahannel from Mymensingh of Rangour of Bangladesh. Pakistan J Biol Sci. 2013; 16(12):564-569. doi:10.3923.
7. Bene C. CAADP and Fisheries Policy in Africa : are we aiming for the right reform?; 2011. Available at: www.future-agricultures.org.
8. Okeke-Agulu NA, Chukwuone K. Profitability of Catfish Production in JOS Metropolis of Platateau State, Nigeria: A Profit Function Approach. Agric J 2012; 7(3):226-229.
9. Abdul WO, Caaaoaito. Fish Trading: A Tool for Socio-economic Enhancement and Poverty Alleviation. J Fish Aquat Sci. 2013, 202-207. doi:10.3923/jfas.2013.202.207.
10. Jatto N, Alkali A, Galadima Z, Gunu U, Maikasuwa MA. Estimating the Factors Influencing Catfish Farmers' Interest in fish Production in Ilorin, Kawara State. Eur Sci J. 2013; 9(13):99-106.
11. Musole M, Musumali Simon Heck, Saskia MC, Husken MW. Fisheries in Zambia : An undervalued contributor to poverty reduction. FAO, 2008.
12. Cole SM, Puskur R, Rajaratnam S. Exploring the Intricate Relationship between Poverty, Gender inequality and Rural Masculinity: A Case Study from an Aquatic Agricultural System in Zambia. Cult Soc Masculinities. 2015; 5591(37417):154-171. Available at: http://www.mensstudies.info.
13. Mwima H, Mandima J. AWF's Experience in the Management of Fisheries in Two Southern African Landscapes. 2005. Available at: www.awf.org/resources/books-and-papers.
14. Israel GD. Determining Sample Size. Univ Florida IFAS Ext. 2013, 1-5. Available at: http://edis.ifas.ufl.edu.
15. Adepoju AO. Post-harvest losses and welfare of tomato farmers in Ogbomosho, Osun state, Nigeria. J Stored Prod Postharvest Res. 2014; 5(2):8-13. doi:10.5897/JSPPR2014.0160.
16. Hall BH. Production and Cost Function Estimation. 2005.
17. Biddle J The Introduction of the Cobb – Douglas Regression. *J Econ Perspect*. 2012; 26(2):223-236.
18. Verdugo LEB. on Translog Cost Functions : An Application for Mexican Manufacturing Translog Cost Functions : An Application for Mexican, 2007.
19. Cheng ML. A modified Cobb – Douglas production function model and its application. IMA J Manag Math. 2014; 25:353-365. doi:10.1093/imaman/dpt012.
20. Daglish T, Robertson O, Tripe D, Weill L. Translog Cost Function Estimation : Banking Efficiency. 2015. Available at: http://ideas.repec.org/vuw/vuwcsr.
21. Singh K, Dey MM, Rabbani AG, Sudhakaran PO, Thapa G. Technical Efficiency of Freshwater Aquaculture and its Determinants in Tripura, India. Agriculural Econ Res Rev. 2009; 22:186-195. Available at: http://www.researchgate.net/publication/202226014_Technical_Efficiency_of_Freshwater_Aquaculture_and_its_Determinants_in_Tripura/file/ceb80e1e197ab52884647e4cc534cbe1.pdf.
22. Onoja A, Achike AI. Resource Productivity in Small-Scale Catfish (Clarias geriepinus) Farming in River State, Nigeria: ATranslog Model Approach. J Agric Soc Res. 2011; 11(1):1-5. doi:10.1007/s13398-014-0173-7.2.
23. Barros AF De, Inez M, Geraldo E. Performance and economic indicators of a large scale fish farming in Mato Grosso, Brazil. Rev Bras Zootec. 2012; 41(8464):1325-1331.
24. Tanko L. Determinants of Profit Inefficiency among Small Scale Yam Farmers in Nasarawa State, Nigeria : A Stochastic Translog Profit Function Approach. J Emerg Trends Econ Manag Sci. 2015; 6(7):244-251.