AQUACULTURE AND FISHERS’ LIVELIHOOD DIVERSIFICATION IN UGANDA – AN EMPIRICAL ANALYSIS

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ABSTRACT
Under economic diversification policy, Uganda embarked on promoting fish exports. With increase in the fish prices due to access to global markets such as European Union, there has been a four-fold increase in the fish retail prices. This has led to increase in fishing pressure and number of fishers on Uganda lakes. This has resulted into over fishing and illegal fishing. Promotion of Aquaculture as alternative to open access to Lakes has been implemented. There are challenges with aquaculture that need to be addressed to make it an effective rural poverty reduction strategy.

With decrease in fish catches, fishers have diversified their livelihoods. Factors that influence diversification include endowment with assets such as land and buildings, livestock, human capital development such as having attended school and fish related training.

KEY WORDS
Aquaculture, Uganda, fishing, diversification.

1. INTRODUCTION
Fisheries are natural resources that can be affected by human and environmental factors. Among the human factors include overexploitation of the fisheries as source of livelihoods, pollution from industrial and agricultural sectors. Among the environmental factors include climate variability where that habitants and breeding grounds of marine ecosystems like fisheries varies significantly due to changes in temperatures and rainfall. The effects of climate change on fisheries have been reported by the Intergovernmental Panel on Climate Change (IPCC). This paper will mainly focus on aquaculture and the effect of changes on retail price of economic fish species on fishers’ livelihood. It explores the factors that influence livelihood diversification among fishers on the shores of Lake Victoria in Uganda. The plan of the paper is the first section will explore the economics of fisheries and the concept of diversification. This is followed by brief overview of the fisheries sector in Uganda and challenges thereof. Aquaculture is examined in light of the challenges on open access fishing. The empirical analysis of livelihood diversification of fishers on the shore of Lake Victoria is discussed.

2. FISHERIES ECONOMICS
Fishery is a natural renewable resource which is an open access for everyone. There is a danger of over exploiting the fishery as explained by the tragedy of the commons [1]. In open access, many fishers harvest very few fish leading to collapse of the fishery. [2] bio economic model proposes an equilibrium catch and fishing effort so that fishing effort can be regulated to achieve maximum sustainable yield (MSY). In open access equilibrium, fish industry will be determined where total revenues equal to total costs. Firms will enter fishery under open access as long as price exceeds average cost. Fishing effort rises as price increases and this can be seen in case of market liberalisation in the fish trade. This would result into fish catches declining hence stock could be depleted. Mechanism for regulating fishing effort includes limiting the number of and size of fishing vessels, size of fishing gear, the number of days, which they are allowed to fish to avoid fish stock depletion [3]. For African countries trying to diversify their economies, fisheries is one of the viable export commodities but these are faced with increasing fishing effort due to increased private sector investment yet with poor regulatory framework to ensure sustainable fisheries management [4]. There are factors that make fisheries different from other agricultural activities namely: biological renewability, open access, the absence of reliable data of fish stocks at every given time [3, 5].

3. LIVELIHOOD DIVERSIFICATION
Individuals or households may diversify into on-farm, off-farm and non-farm enterprises with improvement in their
incomes [6, 7]. [8] defined rural livelihood diversification as: ‘The process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and improve their standard of living’.

There are pull and push factors associated with the diversification. The pull factors include high income generated; potentially lower risk and greater social status [9]. The push factors are lack of access to productive resources such as land, malfunctioning land rental markets, entry barriers such as minimum requirements of physical and human capital [10].

4. THE FISH SECTOR IN UGANDA
4.1 Importance of the Fish Sector in the Uganda Economy

The fisheries sector contributes to national economic welfare with overall contribution to the livelihood of nearly 5.3 million people [11]. The sector has benefited from the economic reform programmes under the promotion of non-traditional exports and the sector is a major contributor to national economic growth [12]. The sector is the second highest foreign exchange earner after coffee [13].

The most important economic fish species are Nile perch (Lates niloticus) and Nile tilapia (Oreochromis niloticus). The major destinations for fish and fishery products being Europe (73%), United States (7%), United Arab Emirates (6%), Australia (3%), Japan (2%), Hong Kong (2%), Singapore (1%), Israel(1%), Kenya (1%) and other 22 countries in Asia and Africa (6%) [14]. Furthermore, it has poverty reducing impacts through increase in household incomes of fishing communities with backward and forward linkages leading to income multipliers and employment multipliers [15]. The increase in fish exports is closely linked to improved household income resulting into poverty reduction [16].

Following liberalisation, the price of Nile perch at the landing site has shown a steady 9 fold increase over the last 15 years from a meagre 0.4USD/Kg to 3.6 USD/kg by 2011 [16, 17]. This increase in price translated to increase in average income of fishers including boat owners and boat crew. The increase in average income was due to increase in private sector investment that led to 20 fish processing plants being established countrywide [18].

4.2 Challenges of Uganda Fisheries: Illegal Fishing and Over Fishing

Despite Uganda government efforts to stop illegal fishing practises, illegal fishing gear still poses considerable threat to the sustainable management of lake resources. An increase in illegal and unconventional fishing methods has become more prevalent due to high incomes from the fishing industry. Immature fish have been harvested hence having adverse impacts on fish population [19].

This could result in total collapse of the fisheries if the situation continues to get worse. The fishing effort has increased tremendously. The number of fishing vessels increased from about 3470 in 1988 to 23,455 vessels in 2010 [17, 20]. The number of fishers operating in the Uganda side of lake Victoria increased from 34,899 in 2000 to 56,957 in 2010 [17, 21]. The number of fishing boats as well as maintaining a national

4.3 Control of Open Access in Ugandan Lakes and Fish Exports

The Uganda government has controlled the open access to Lake Victoria by having regulations on the fishing gear. There are proposals and studies on having closed seasons and fishing areas. The Department of Fisheries Resources (DFR) is responsible for enforcing fisheries regulation, licensing, fishing boats as well as maintaining a national fish inspection and a quality control system. The DFR had come up with co-management system called beach management units (BMUs) [18]. They have had challenge of rising illegal fishing since 2005 as number of fishers went up with the increasing fish prices. In the context of fish exports, DFR is the Uganda's Competent Authority for ensuring and ascertaining quality and safety of fish both for domestic consumption and for export.
There are contradictions between poverty reduction and natural resource management. Market liberalisation of the fish sector had led to reduction in rural poverty with the increasing fish prices and access to global markets but has also contributed to the increase in depletion of the lake fisheries with increase in illegal fishing practices. [25] predicted that the effects resulting from economic reforms that may produce opposite incentive effects, potentially even outweighing the beneficial impacts. He noted that price incentives after liberalisation in Ghana and Mexico could lead to resource degradation. This paper suggests that the way forward will be to provide alternatives for fishers thus reducing the fish effort and having friendly private sector policies that will enhance local investment. Aquaculture and investments in rural infrastructure can provide alternatives to lake fisheries hence reduce fishing pressure.

4.4 Aquaculture in Uganda
Prompting fish farming is a good alternative but it is only viable for those who own land. Lack of functioning land markets has affected investments in fish farming for resource poor farmers. The rural poor are very natural resource dependent and would easily resort to lake fisheries to escape the poverty trap with the rising fish prices. In 2004, aquaculture was identified and promoted by the Ugandan government as viable for processing and therefore could be a feasible alternative source of raw material fish for export industry amidst the declining fish catches [26]. The Uganda government has made aquaculture a priority in Agriculture Sector Development Strategy and Investment Plan [13]. This has been trough promoting fish ponds, cage farming and fish hatcheries. Aquaculture production rose from 285 metric tons in 1999 to 100,000 metric tons in 2011, with 2500 ponds existing throughout the country. Currently there are over 2000 emerging commercial farmers with over 5000 ponds [11]. The fish farmers have focused on the production of two species; Nile tilapia (20%) and African catfish (80%) and farming for the Nile perch, being more difficult to cultivate, is probably several decades away [14]. Aquaculture has not complied fully with the international food safety standards and this would be one of the limiting factors for the export of the products to lucrative international markets such as the EU and the US [27]. [27] recommended reviewing existing legislations for aquaculture and incorporate provisions that introduce risk analysis in the controls, develop the technical capacity and invest more resources in infrastructure for quality assurance for the growing aquaculture sector. They also noted that institutional and legal frameworks for quality assurance were established for capture fisheries but not for aquaculture. Aquaculture became priority due to the challenge of tremendous fishing pressure on the various lake fisheries in Uganda and increasing fish prices after market liberalisation. The Uganda government has promoted aquaculture with little success. The major constraints are low level of skills of farmers and advisory service providers, Competition in market place from cheap (often illegal) fish from capture fisheries, low investment in seed and feed due to high cost of capital [18]. With these challenges and poor adoption of aquaculture, fishers have resorted to diversifying their livelihoods. What are the factors that influence their diversification and what do they diversify into? The answers are explored in the study that was done on the shore of Lake Victoria in Uganda.

5. THEORETICAL FRAMEWORK FOR ANALYSIS
Using logistic regression, determinants for fishers’ livelihood diversification were analysed [28]. This is used in qualitative responses that are binary.

5.1 Empirical Model Specification
The econometric model for determinants for fishers’ diversification is specified as follows:

\[ Y_i = f(H,I,O,A,S) + \varepsilon \]  

Where:
- \( \varepsilon \) is the error term
- \( Y_i \) are the dependent variables in this study which are diversification, crop farming, livestock farming and petty trade.
- The explanatory variables include:
  I. Household characteristics (H): attended school, age, marital status, has dependants
  II. Institutional characteristics (I): Involved in decision making on lake utilization,
  III. Ownership of assets (O): ownership of land, building, fishnets, boat, local cow
  IV. Social capital(S): belonging to social group , fishers group
  V. Access to finance (A): savings, bank loan

5.2 Explanation of Variables
5.2.1 Dependent Variables
Diversification refers to fishers who had others sources of livelihoods apart from fishing. Crop farming refers to respondents who diversified and obtained their livelihoods from of crop farming while livestock farming refers to fishers who diversified and obtained livelihoods from livestock activities. Petty trade refers to fishers who diversified and obtained livelihoods from petty trade. All these were dummy variables.

5.2.2 Independent Variables
Age is the years of respondent in completed years.
- Attended school is those who have ever gone to school excluding those who did not attend school at all.
- Dependents refer to people who are involved in the livelihood activities of the respondent and are not biological children or spouse. They offer labour to various livelihood activities. Landlord refers to people
who own land. Fishnet refers to fishers’ who won fishing nets while boat owner refers to fishers who own fishing boats. Fish training refers to fishers who attending training in fish related aspects such as quality control, safety on water, regulations. Owns building refers to fishers who own building (apart from their home) and use it as livelihood source. Local cow refers to fishers who own local livestock. Savings refers to money the respondents used in running or starting the livelihood activities from the savings while bank loan refers to credit obtained from financial institution such as bank or micro finance institution to start or run the livelihood activities. Employers refers to people that are engaged in the livelihood activities but are paid and not dependants. Single refers to fishers with no spouse while married refers to fishers with spouses. Belong to fisher group refers to fishers who take part in activities of fishers group at the landing site while belong to social group refers to fishers who are part of any social grouping including the fishers group, credit group, religious group. Social groups are used for sharing information on livelihood activities. Involved in decision making on lake utilization refers to fishers who take part in the fora such as beach management units meetings that make decisions that affect access to fishing in the Lake. Apart from age, the rest of the independent variables are dummies.

6. AN EMPIRICAL ANALYSIS
A cross sectional study of 149 fishers was conducted from June to August 2005 at Kanseero landing site on Lake Victoria in Rakai district in Uganda. There were randomly selected including boat crew (68) and boat owners (81). Fishing is the leading economic activity at the landing site. Nile Perch is one of main fish exported from the landing site. Data were analysed using Statistical Package for Social Sciences (SPSS). Binary logistic regression was used to determine the factors that influence livelihood diversification of fishers. Results are in the table 1 below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>z</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership of land</td>
<td>0.47</td>
<td>0.12</td>
<td>3.95</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Being landlord</td>
<td>0.36</td>
<td>0.11</td>
<td>3.23</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Bank loans</td>
<td>0.34</td>
<td>0.10</td>
<td>3.34</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Education</td>
<td>0.32</td>
<td>0.10</td>
<td>3.23</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Fishing related training</td>
<td>0.31</td>
<td>0.10</td>
<td>3.12</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Being landlord, owning buildings, having dependants positively and significantly influenced the probability of diversifying for fishers. Being endowed with resources such as land, building enhances diversification for fishers. Bank loans negatively and significantly influenced the probability of diversifying for fishers.

7. CONCLUSION AND POLICY IMPLICATIONS
Increase in human capital development such as education training and fish related training influences fishers’ investment in small and microenterprises. Government policies on universal primary education and universal secondary education should be enhanced. The fisheries department should have on-going training. Ownership and access to land influences diversification into crop and livestock farming. Effective land tenure and functional land markets should be promoted in the land policies. Livestock policies with effective agricultural extension are critical for diversification into livestock farming.

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Table 1 Determinants of livelihood diversification for fishers on Lake Victoria in Uganda (Rakai district)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Diversification</th>
<th>Livestock farming</th>
<th>Crop farming</th>
<th>Petty trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>0.993</td>
<td>-0.069</td>
<td>0.160</td>
<td>0.4006</td>
</tr>
<tr>
<td>landlord</td>
<td>2.198</td>
<td>0.890**</td>
<td>2.140</td>
<td>2.1403**</td>
</tr>
<tr>
<td>Owns building</td>
<td>2.052</td>
<td>0.855***</td>
<td>0.674</td>
<td>0.3792</td>
</tr>
<tr>
<td>fishnet</td>
<td>1.374</td>
<td>0.807</td>
<td>3.401</td>
<td>-6.278**</td>
</tr>
<tr>
<td>Boat owner</td>
<td>0.669</td>
<td>0.6685</td>
<td>1.94</td>
<td>0.443</td>
</tr>
<tr>
<td>Belong to social group</td>
<td>1.531</td>
<td>2.7662</td>
<td>1.532</td>
<td>0.553</td>
</tr>
<tr>
<td>Belong to fisher group</td>
<td>1.228</td>
<td>3.251</td>
<td>0.636</td>
<td>0.3949</td>
</tr>
<tr>
<td>single</td>
<td>1.232</td>
<td>0.790</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>1.115</td>
<td>0.706</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attended school</td>
<td>0.873</td>
<td>0.530</td>
<td>1.024</td>
<td>1.0242</td>
</tr>
<tr>
<td>Fish training</td>
<td>1.200</td>
<td>0.754</td>
<td>0.927</td>
<td>0.5247</td>
</tr>
<tr>
<td>savings</td>
<td>-1.292</td>
<td>6.119</td>
<td>-1.394</td>
<td>-1.3940</td>
</tr>
<tr>
<td>Bank loan</td>
<td>-2.703</td>
<td>75.767***</td>
<td>-0.979</td>
<td>-0.9794</td>
</tr>
<tr>
<td>Local cow</td>
<td>5.304</td>
<td>5.3037***</td>
<td>1.609</td>
<td>0.7819</td>
</tr>
<tr>
<td>Has dependants</td>
<td>1.762</td>
<td>0.880*</td>
<td>0.505</td>
<td>0.333</td>
</tr>
<tr>
<td>Involved in decision making on lake utilization</td>
<td>-1.083</td>
<td>4.500</td>
<td>0.839</td>
<td>-0.8394</td>
</tr>
<tr>
<td>_cons</td>
<td>0.018</td>
<td>1.041</td>
<td>3.080</td>
<td>3.0795</td>
</tr>
</tbody>
</table>

No of obs: 135, 71, 103, 59
R adjusted square: 0.282, 0.495, 0.191, 0.359
R squared: 0.609, 0.660, 0.369, 0.481
Prob: 0.000, 0.000, 0.000, 0.000

* Significant at 10% (p < 0.10). ** Significant at 5% (p < 0.05). *** Significant at 1% (p < 0.01).

REFERENCES