ISSN 0378 – 9721

Special Edition 2018 - Fish and Fisheries Product Trade and Marketing

African Union
Inter-African Bureau for Animal Resources

Bulletin of

Animal Health and Production

in Africa

Bulletin de la

Santé et de la Production Animales

en Afrique

Union Africaine
Bureau interafricain des Ressources Animales

ISSN 0378 - 9721

INTER-AFRICAN BUREAU FOR ANIMAL RESOURCES
BUREAU INTERAFRICAN DES RESSOURCES ANIMALES
P.O Box 30786, NAIROBI, KENYA

BULLETIN

Special Edition 2018
Fish Trade and Marketing for Food Security and Livelihoods in Africa

AFRICAN UNION
UNION AFRICAINE

IBAR PUBLICATION
PUBLICATION DU BIRA

BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA
BULLETIN DE LA SANTE ET DE LA PRODUCTION ANIMALES EN AFRIQUE

Special Edition 2018
Fish Trade and Marketing for Food Security and Livelihoods in Africa

Annual subcription: US$ 100.00

ISSN 0378-9721

Revue trimestrielle contenant des articles originaux et des résumés d'études en anglais et en français

Abonnement pour un an : 100$

BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA

Special Edition 2018 - Fish and Fisheries Product Trade and Marketing

PREAMBLE

In this Bulletin of Animal Health and Production in Africa, we are proud to feature a Special 2018 Edition on Fish and Fisheries Product Trade and Marketing. One of the policy arenas of the Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa (PFRS) is dedicated towards 'Responsible and Equitable Fish Trade and Marketing' through harnessing significantly the benefits of Africa's fisheries and aquaculture endowments through accelerated trade and marketing. Concerned about the low level of intra-regional trade, the African Union Heads of State and Government, during their 23rd Ordinary Summit in Malabo, Equatorial Guinea in June 2014, committed themselves to Boosting Intra-African Trade in Agricultural Commodities (including fisheries) and Services though harnessing markets and trade opportunities, locally, regionally and internationally, and resolved to (i) triple, by the year 2025, intra-African trade and, (ii) create and enhance policies and institutional

Trade can serve as a catalyst for sustainable economic growth and poverty alleviation. However, despite major commitments by Africa policy makers to promote cross-border commodity trade, Africa still faces challenges in boosting intra-regional trade, especially fish trade. Complexity of rules and regulations governing intra-regional trade, lack of business and marketing skills, exporting of raw (low value) fish, and inadequate infrastructure, all these hamper Africa from optimizing the benefits from fish trade. Compounding these challenges is inadequate knowledge or evidence to inform policy development and implementation as well as practical conduct of cross-border fish trade.

While there is a wide appeal to label policy-making process as being "research" or "evidence" based, observation in reality show a general lack of understanding of these two terms. Conventional understanding of evidence-based policymaking often misses other important sources of information that are actually used to inform policy. "Whose science is informing policy?" and "who is presenting the evidence?" therefore, become critical questions in understanding the role of research-based evidence in policy dialogue. It was in a bid to answer these two important questions that during the launch of the FishTrade Program in Nairobi, Kenya in March 2014, a consensus was built among national and regional stakeholders on the need to involve national universities and research institutions in the corridor analysis research for the program. It was argued that because of their expertise as national centers of knowledge, and the potential for their involvement in research to lead to capacity strengthening that the universities could be the source of science and evidence to inform policy on intra-regional fish trade. It was further asserted that these universities would continue their role of providing evidence to policymakers, long after the project phased out.

In this present Special edition, we feature a set of research findings on informal cross-border fish trade. Recently, informal economic activities have gained a lot of attention in Africa. However, informal cross-border fish trade has not featured highly in policy discourse. Findings in this special edition show that informal cross-border fish trade is an important economic activity, but invisible as such not reported in national accounting. Therefore, this issue aims to bring forward notable theoretical and methodological works on informal cross-border fish trade; to provide an overview of the status of this economic activity in some of the regions of Africa; as well as inspire future research. Amongst other key deliverables of the Fish Trade Program is to improve access to market of fisheries product through identification and prioritization of policy options for promoting inter and intra-regional fish trade. These include analysis of fish trade corridors and assessment of regional fish trade policies on the continent. These have been complemented

with activities piloting the One Border Stop Post approach in East and Central Africa, a fish trade caravan in West Africa, and several capacity strengthening activities to enhance regional trade of fish and fish products in Africa. A lot of the research in this Special Edition was initiative by the FishTrade Program (a partnership among WorldFish, AU-IBR and NEPAD Agency, funded by the European Commission). The Bulletin Editorial Board sincerely acknowledged all contributors.

The Editor in Chief

THE ROLE OF STATE AND NON-STATE ASSOCIATIONS IN FACILITATING TRADING OPPORTUNITIES IN FISH - THE CASE OF GHANA

Abbey* E N[1], Appiah S[1], Antwi-Asare T O[1], Sloans Chimatiro[2]
[1]University of Ghana, Department of Economics, Box LG57, Legon
[2]WorldFish, Africa Regional Office, Lusaka, Zambia

Abstract

This study explored the role of state and non-state associations in facilitating domestic and cross-border trading opportunities for fish. Issues such as the awareness of the association about certification procedures as well as standards and regulations for trade are also explored. Results for the study are based on interviews as well as discussions with nine state and non-state associations of fish producers, processors and traders in the major fishing communities in Ghana. Generally, it was observed that these associations serve as a unifying voice in coordinating the relationships between authorities and traders. By this, small-scaled traders are more likely to receive some form of support when they are part of an association than otherwise. In addition, the more experienced members of the association advices new members on the standards and regulations pertaining to both domestic and cross-border trade. While these associations do not frequently receive supports from organizations, the few are in improving health and safety standards at the market place. This is usually supported by their own efforts such as membership dues. In addition, it was observed that cross-border trade involves much more marine fish products than inland fisheries, with the former more incline to opportunities to trade with Asian countries because of restrictions in Europe. For cross-border trade, the identified routes are mostly from Accra to neighbouring countries and some fish traders bringing in other goods to sell in Accra and at their return, they buy some fish products for their home countries.

Keywords: Ghana, Associations, Standards, artisanal cross border fish trade

LE RÔLE DES ASSOCIATIONS ETATIQUES ET PRIVÉES DANS LA CRÉATION DES OPPORTUNITÉS DANS LE COMMERCE DU POISSON- LE CAS DU GHANA.

Résumé

Cette étude a été faite pour déterminer le rôle joué par les associations étatiques et privées pour créer des opportunités dans le commerce frontalier et les échanges domestiques du poisson. Des problèmes relatifs à la connaissance des procédures d'obtention de l'autorisation et des règlements du commerce par les associations ont été également discutés. Les résultats de l'étude ont été bases sur des consultations aussi bien que des entretiens avec neuf associations étatiques et privées des producteurs, des processeurs et des revendeuses dans les grandes communautés de pêche au Ghana. Généralement, on a remarqué que ces associations constituent un front uni ayant une seule voix dans la coordination des relations entre les autorités et les commerçants. Ce faisant, les petits commerçants ont plus d'avantages de recevoir des aides quand ils font partie d'une association que d'être seul. En plus, les membres des associations qui ont plus d'expérience conseillent les nouveaux à s'adhérer aux règlements relatifs au commerce frontalier et à la vente domestique. Bien que ces associations n'obtiennent pas régulièrement des aides des organisations, quelques-unes œuvrent à améliorer les normes en matière de sante et de sécurité dans le marché. Ceci est souvent fait par leurs propres efforts tels que les cotisations d'adhésion. En outre, il a été remarqué que le commerce frontalier exige beaucoup plus de produits maritimes que des viviers car le premier offre plus d'opportunités au commerce avec les pays asiatiques à cause des limitations du commerce en Europe. Concernant le commerce frontalier, les destinations reconnues sont pour la plupart d'Accra vers les pays limitrophes et quelques commerçantes qui apportent d'autres marchandises

*Corresponding author email: enabbey1@gmail.com

à leur retour pour les vendre à Accra ou ils achètent quelques produits poissonneux destinés à leurs pays d'origine.

Mots Clé : Ghana, Association, Critères, Main d'œuvre, Commerce frontalier du poisson

Introduction

There are several reasons why cross-border trade in fish has been inadequate in stimulating large scale fishery activity in Ghana. These reasons include the constraints on market infrastructure, product certification, inadequate storage facilities, depleting fish stock, restrictive standards and the general informal nature of fishery activities. While this concerns have been explored (or studied) in one way or the other, the important role that the 'association' of fish producers, processers and traders play in addressing these constraints in order to facilitate both domestic and intra-regional trade, at least within the West African corridor, has not been adequately explored.

Theoretically, the role associations' play in facilitating business operations or opportunities is mixed. For instance, negative connotations have been connected with the role of associations in facilitating business operations or opportunities in the Olson's theories of collective action and their extensions in the New Institutional Economics (see Doner and Schneider, 2000). In Olson's theories of collective action, business associations (just like any other interest group) are seen as entities that always pursued distributive objectives, seeking unproductive rents rather than the common or public interest. In the New Institutional Economics, the worst has been assumed about business associations, with very few scholarly works paying systematic attention to them. Yet, latter empirical studies, especially those from the developing world, where government's involvement in the provision of public good has (totally) failed and where community groups are organised along kinship lines, have shown ways in which such associations in a wide variety of contest have improved business operations or opportunities not only for members, but the society a large (see McMillan and Woodruff, 1999a, b and Woodruff, 1998).

In Ghana, there are many associations in the fishery sector. For instance, there is the Ghana Aquaculture Association, the National Fisheries Association of Ghana, the Ghana Industrial Trawlers Association, the Ghana Canoe Fishermen Association, the Ghana Inshore Fisheries Association as well as several other smaller cooperatives of fishmongers, processors and traders at the various fish landing sites (in localities) and market centres throughout the country. Though these associations have very different purposes, they have a common agenda of protecting the welfare of their members through the settlement of internal disputes, addressing market constraints as well as relating to fishery authorities on several issues of interest for their members. They therefore have a potential role to play in facilitating trading opportunities for their members.

For instance, the associations of fish producers are often committed to the process of liaising between fishery authorities and their members in terms of regulations, standards and advocacy. The associations of fish processors and traders attempt to provide a unifying voice for their members at the national level with respect to how trading opportunities could be supported, while settling market disputes and ensuring members abide by the necessary market regulations. There are other types of associations of processors or traders along some form of kinship lines that also perform several functions like obtaining credit or travelling to various market centres together.

This notwithstanding, the fisheries sector in Ghana is itself plagued with several difficulties. For instance, for the production stage, there are too many vessels exploiting the fish resource without any efforts at increasing the fish stock or protecting marine biodiversity (Antwi-Asare and Abbey, 2011). There is inadequate information on fisheries biology

as well as inadequate regulations and weak enforcement of existing regulations (Antwi-Asare and Abbey, 2011). For the processing and distribution stages, there are inappropriate and unclear procedures in processing and certifying of fish products for export. In the light of all these challenges, this research report focusses on the role association of fish producers, processers and traders play in addressing these constraints in order to facilitate both domestic and intra-regional trade. The specific objectives of the report are to:

- explore the role of associations of fish producers, processors and traders, in facilitating domestic and external (intra-regional) trading opportunities within Ghana's fisheries sector
- understand the structure of associations, the specific advantages offered members, links to international/local organizations and whether they receive any governmental support
- explore the awareness of associations about any certification procedures, standards and regulations pertaining to fish production and trade in Ghana
- recount any success stories of an association identifying trading opportunities for its members and any challenges thereof.

The motivation for this research report is drawn from the fact that the fishery sector in Ghana provides an important case study of the extent to which associations' can facilitate economic opportunities. In addition, it provides an important context for testing the validity of the theoretical propositions that have negative conjectures about the role of associations in facilitating trade. The fish sector is one of the oldest in the country and is characterised by high labour market flexibility, low level of formal government support for associations, but not for the sector in general.

The results of the study suggest that associations play an important role in facilitating trade, both domestic and cross-border trade. Especially for cross-border trade, these associations are good sources of advice about the standards that have to be met, the markets to visit and what products to send (by traders) as well as in the settling of internal disputes. The study also uncovered that most fish products traded outside the borders of Ghana are usually of high quality than that left for domestic purposes, and this is basically because of the market, the pricing as well as standards.

The set-up of the rest of the report is as follows: the method of selecting the associations as well as the data collection techniques are described in Section 2. Section 3 presents a brief report on the activities of the Associations and a SWOT analysis is undertaken to identify the strengths, weaknesses, opportunities and threats of trading opportunities for these associations. Finally, some conclusions are drawn with the proposal of some issues for future research. Examining these issues is very important for the longer-term sustainability of the entire fishing industry in terms of boosting networking activities as well as stimulating capacity within the fisheries sector. Results obtained from the survey will therefore be used to make conclusions and policy recommendations to facilitate production and trading opportunities for actors within the fisheries sector of Ghana.

Data Collection

The data collection method employed was the interview of executives of the association of fish producers, processers and traders and focus group discussions (FGDs) with some other members (when participants were available). In terms of getting a relevant list of 'active' fish associations in Ghana, the Fisheries Commission was contacted since they deal directly with such associations. We were unsuccessful in getting a list on time, but we got information about two major associations (the Ghana Aquaculture Association and the National Fisheries Association of Ghana). We contacted these two associations and we obtained information about the others. In total, we got information about 12 major associations of fish producers, processors and traders, mostly in Accra, Tema, Denu, Yeji and Techiman. There are several other smaller associations, located especially at the landing

sites, mostly unregistered and operating as a community or area association. From the process of selecting these associations, we observed that the association of fish producers were well established and structured, while only a few of those into fish processing and trading had a well-recognized structured. Particularly for the latter, the well-structured associations were in major fish markets or landing sites such as Techiman, Denu, Yeji and Accra. We also got information about a sizeable number of producers, processors and traders who do not belong to any of these associations, but are actively involved in fish trade. Only the well-structured associations were consulted (see Appendix for a list of those contacted).

In total, seven interviews and two focus group discussions were successfully completed. Three other interviews were commenced, but abandoned because of the busy schedules of the respondents. Most of the information obtained was qualitative in nature. Therefore, the analysis of results was purely descriptive, making useful comparisons where necessary. Later a SWOT analysis was performed to examine the strengths, weaknesses, opportunities and threats of the activities of such associations in facilitating trading opportunities.

Presentation of Findings

The following sub-sections briefly summarize the main activities of the associations contacted: their demographic information (membership, gender composition and activities), their specific role in the fish industry and their knowledge on key issues such as standards and requirements.

The Ghana Aquaculture Association

The Ghana Aquaculture Association, a predominantly male dominated association (membership in only Accra was estimated around 90), was established in 2009 as an association of fish producers with its main office located at the Fisheries Commission. The association has nine other affiliate associations throughout the country and is managed by an executive council that meets monthly. The main purpose for the establishment of the association is to promote the business of aquaculture in Ghana through advocacy and the communication of government policies to its members. In terms of direct benefits, the association provides information, training and support to its members in the areas of marketing and advocacy (promoting the government's fishery agenda of increasing domestic production to meet the country's current fish deficit). The association does proper bookkeeping of all its activities. In terms of trading, most of the member's trade at their landing sites, with a few at other market centres. Cross-border trade is unpopular in this association since domestic prices of aquaculture products are higher than in neighbouring countries. The association is aware of regulatory standards regarding fish production (the Fisheries law – Act 625 of 2000) and their major challenge is competition from imports from Asia which undercuts their prices.

The Eastern Region Fish Farmers Association

The Eastern Region Fish Farmers Association is relatively new and registered as a subsidiary of the Ghana Aquaculture Association in 2015. It has about 120 members and predominantly male dominated. Specifically, the association was established to serve as a mouthpiece for all fish farmers in the eastern region of Ghana and currently has about 120 members. Although relatively new, the specific benefit that accrues to members of the association is in respect to finance through the West Africa Regional Fisheries Programme funded by the World Bank. The formation of the association was motivated by the huge deficits between domestic aquaculture production and consumption (current aquaculture production is estimated at 450,000MT but consumption is estimated at 900,000 MT) and this is seen as an important opportunity for its members. Members do not engage in cross border trade because of the high price of Tilapia in Ghana as compared to those in neighbouring countries. The Local Assembly, the Volta River Authority, the Environmental Protection Agency and the Fisheries Commission play various roles in regulating their activities (see appendix for the

roles played by these agencies and institutions).

The National Fisheries Association of Ghana

The National Fisheries Association of Ghana was established around 1971 and has five other subsidiary groups: Ghana Tuna Association, the Ghana Industrial Trawlers Association, the Ghana Inshore Fishery Association, the Ghana Inland Canoe Fisheries Association and the Ghana National Marine Association. These associations are predominantly male dominated and mainly an association of fish producers. Its secretariat is located at Tema Fishing Harbour and the association basically coordinates the activities of the marine fisheries by liaising between the Ministry of Fisheries and the fishermen. Cross border trade is popular with this association as its members do travel or do business with people from Abidjan, the European Union, Britain and France. Accordingly, the association is aware of the standards and requirements of such trade and liaises with the appropriate authorities (Ghana Standards Board and the Fisheries Commission) in meeting such standards. Currently, the association is trying to encourage its members to start trading with other sub-Saharan African Countries because of the strict regulations especially coming from the European Union.

The Ghana Industrial Trawlers Association

The Ghana Industrial Trawlers Association is a subsidiary group of the National Fisheries Association of Ghana (NAFAG). It used to be the main group doing the activities of NAFAG until other members (the Ghana Tuna Association, the Ghana Inshore Fishery Association and the Ghana Inland Canoe Fisheries Association) joined and later, the group had to be reformed in 2007, to ensure that the activities of Industrial Trawlers are properly coordinated. The current membership is estimated at 36 (male dominated) and their main office is located at Tema. Unfortunately, there are a lot more owners of industrial trawlers that do not belong to this association. This, according to the association, hampers their coordinating activities since they have no power to enforce decisions taking in consultation with the relevant sector ministry. Members of the association do sometimes trade outside the borders of Ghana and are therefore aware of the numerous standards and practices that needs to be adhered to; specifically, with regards to certification of products for export. They also have their own small shops with storage facilities at various market centres. Their current focus is to explore trade with the East and other Sub-Saharan African countries giving the many restrictions on trade with the European Union.

The Ghana National Canoe Fishermen Council

The Ghana National Canoe Fishermen Council was established in 1981 and has an office at James Town. It coordinates the activities of all fish folks along the coast of Ghana, which includes canoe owners, local fishermen and fish mongers. The association was formed because of the absence of a body to coordinate the activities of such fish folks in terms of getting appropriate inputs, settling conflicts at the beaches and making the voice of its members heard at the national level. The association also do advocacy to its members in terms of them abiding by the necessary rules and regulations of fishing in the country. So far, the association has been successful in getting inputs (such as outboard motors) for its members at subsidized prices while ensuring sanity at their beach sites. Trade mostly takes place at the landing sites, though some traders move their products to major market centres. Mostly, the fish processors and traders are females who are married or are in some form of relationship to canoe owners or fishermen.

The Techiman Market Co-operative Fish Mongers Association

The Techiman Market Co-operative Fish Mongers Association was established around 1991 to settle disputes and promote the welfare of members in the Techiman market, to assist the Chiefs in the management of the market, and to support women to earn a living through fish trade and in times of dire needs. It is by far, the well-structured

association of fish traders (production stage) in the country that does proper bookkeeping. The Association is dominated by women, with only one male who is their leader and does most administrative activities. Though women in the market do not engage in fish trade outside the country, their counterpart women from Ivory Coast bring beans and other foodstuffs to sell in the Techiman market and in return, buy fish to their home country. However, the women at the Techiman market do send fish to other places such as Tamale, Bolgatanga and Sampa for sale. In terms of standards and regulations, the association liaises with health officers, herbalists, sanitation officers and fire services officers, and do proper bookkeeping of all its activities. Even though members of the association do have some problems, especially with credit, their well-established structure allows them to engage in several informal financing schemes. For instance, they buy their fish from other fish folks on credit, sell and pay back in weekly instalments.

The Greater Accra Market Association

The Greater Accra Market Association was established in 1976 with its main office located at the Tuesday Market in Accra. It has about 60 permanent members who trade both in the main Tuesday Market and other neighbouring markets. These members are both women (who trade in fish) and men (who pack, load and transport fish). Fish traders from some neighbouring countries, especially Benin and Togo, bring dried or smoked shrimp and lobsters to sell at the market and purchase cured fish for their home country market. The main purpose for the establishment of the association was to foster unity in the market. It needs to be stated that this association is for the entire market, unlike that of the Techiman Market where there is an association of fish traders. Occasionally, the leadership of the association provides some form of advocacy to traders in marketing. The association is also planning to introduce fishmongers to other products that they can sell in the market to complement their fish trade especially in the lean season for fish. In terms of regulations and standards, the association liaises with health officers and sanitation officers; while support comes from the fire services officers in terms of market safety.

The Kumasi Asafo Market Association

The Kumasi Asafo Market Association was established in 1966 and has an office at the Asafo Market in Kumasi. The association has about 200 members with six males (the executives) and the rest are females. The association was formed to ensure regular supply of fresh and frozen fish at all times to the Asafo market, build a foundation of unity and love among members, assist members in times of need, being it financial, bereavement and in distress and to promote the welfare of members. Currently, the main activities of the association was to settle disputes among members, solve problems in the Asafo market, meet with members every two weeks to discuss their trading activities and how to improve their trade and assist members in times of needs. The association do proper bookkeeping of its activities with most trading activities (both buying and selling of fish) carried out in the country. In terms of standards and regulations, the association laisse with health officers, herbalists, sanitation officers and fire services officers.

SWOT Analysis

Tables 1 and 2, presents a SWOT analysis of domestic and cross border trade in Ghana based on the responses provided by the associations interviewed. What seems remarkable from the tables is the evidence of high prospects for fish trade (both domestic and cross-border), which is underpinned by a generally growing demand for fish and fish products, the current high deficits between production and consumption, and governments support to increase domestic fish production. More importantly, Ghana has adequate water borders (both inland and offshore) to facilitate fish production and has a youthful population that can explore this opportunity to address its high unemployment problems.

This notwithstanding, domestic producers, processors and traders are often faced with many threats (see Tables 1 and 2). For instance, regarding the producers, there are concerns about high production costs, lower producer value share of fish products and the difficulties in the ensuring that standards are abided with. The latter is especially typical for individuals who do not belong to any recognized association of fish producers.

For processors and traders engage in domestic trade, there is a legal uncertainty with respect to decision making at the various market centres. For instance, one association expressed concern about local authorities collecting taxes from market women, but paying little attention to their market infrastructure. More importantly, there is the suggestion that taxes and utility bills are excessively high, making the fish trade sometimes unattractive. Especially for those that do cross-border trade, there are concerns about safety (armed robbery attacks and bad roads), poor mobile communication networks at some localities where fish is bought or sold and the difficulties in coordinating the activities of traders who do not belong to any recognized group and therefore do trade in unrecognized ways. For cross-border trade outside Africa, the major weakness has to do with the restrictive standards especially from the European Union. Interestingly, some associations are beginning to encourage trade with the East and other Sub-Saharan African countries to address such concerns. This is not to suggest their standards are lower (or poor), but that it is favourable. Yet, there are concerns about the inability of authorities to coordinate such trade, simply because of the transfer of fish at sea and vessels landing in other countries.

Table 1: SWOT Analysis of Domestic Trade

Strengths	Weaknesses	Opportunities	Threats
New markets (demand) for fish	Lack of storage facilities at Market Centres	High demand for Tilapia	Legal uncertainty and bureaucracy with respect to decision making at market centres
Increased availability of Tilapia through aquaculture	High electricity bills and taxes	Possibilities of increasing market infrastructure	Competition from imported fish products
Support from authorities to reduce cost of production and increase domestic aquaculture products	Dishonesty on the part of suppliers (fishes packed in cartoons sometimes are of bad quality)	Address high unemployment of the youth	Higher cost of production especially for aquaculture farmers
Conducive land and available water resources	High production cost (fish feed)	Address the high domestic deficit of fish production	Non-enforcement of standards and regulations
	Multiple roles of different regulatory authorities		Difficulties coordinating activities of non-members
			Producers obtain a lower share of the total value of fish products

Source: Field Interviews and FGDs

Table 2: SWOT Analysis of Cross Border Trade

Strengths	Weaknesses	Opportunities	Threats
New markets for fish	Restrictive Standards for instance from the European Union and other Advanced Countries	Increased fish consumption in the East and other Sub-Saharan African Countries	Attack from armed robbers; Accidents due to bad road network; Poor security on the roads
Increased availability of fish throughout the year in other Sub-regions	Vessels catching fish in one country and landing in another	Earn foreign exchange	Poor mobile networks at some areas
Conducive land and available water resources	Illegal Fishing (light fishing, use of chemicals and the violation of IEU)	Address high unemployment of the youth	Transfer of fish at sea or vessels landing in other countries thereby not recorded in official statistics
	Fish with low quality left for domestic market		Transport of processed fish to market centres outside the country
			Difficulties coordinating activities of non-members

Source: Field Interviews and FGDs

However, some few measures were proposed to boost both domestic and cross-border fish trade by the associations. For instance, the establishment of storage facilities at various market centres was mentioned a critical in preserving the volumes and the quality of fish. In addition, the associations indicated they needed to be empowered to be able to make demands from local authorities who collect taxes and yet pay little attention to market infrastructure. In terms of the restrictive standards, the associations indicated there is virtually little that could be done than for their members to abide since they have no control over such matters but will rather urge trade with countries in the East and other Sub-Saharan African countries.

Table 3: Institutions and their Roles

Institution	Role
Environmental Protection Agency	The Environment Protection Agency (EPA) grants licenses based on environmental impact assessments required by fish farmers. The Environment Protection Agency Act of 1994 ensures that aquaculture projects do not damage the environment. The Environment Assessment Regulations of 1999 require both land-based and cage aquaculture activities to undergo impact assessments.
Volta River Authority	The Volta River Authority is in charge of hydro-electricity production and management of the Lake and its catchment area. Transportation on the lake is a subsidiary activity of the Volta Lake Transport Company.

Institution	Role
Fisheries Commission	The Fisheries Commission has produced the Ghana National Aquaculture Development Plan (GNADP) with contributions from the private sector-led Aquaculture Advisory Group and technical support from the FAO regional office for Africa based in Accra.
Water Resources Commission	The Water Resources Commission regulates and manages the use of water for any activity.

Source: Adopted from Rurangwa, Agyakwah, Boon and Bolman (2015)

Conclusion

This study explored the role of state and non-state associations in facilitating domestic and cross-border trading opportunities in fish in Ghana. Altogether, the views of nine associations that are into fish production, processing and trading were solicited. The association of fish producers was included as some also sell their fish products directly to consumers. Generally, it was observed that domestic production of fish trade is being boosted by the increasing domestic demand for fish, the high deficit between production and consumption and government's supports (particularly through the World Banks Facility). For processing and trading, the associations of market women, who in a quest to have a unifying voice to coordinate their relationships with authorities, are facilitating both domestic and cross-border fish trade. In addition, it was observed that cross-border trade involves much more marine fish products than inland fisheries. For cross-border trade, the identified routes are mostly from Accra (Tuesday Market) to neighbouring countries and a reciprocal of fish traders bringing in other goods to sell and return buy some fish products for their home countries. The role associations' play in coordinating such cross-border trade is to advice traders to abide by required standards or suffer the punishments in the form of trade refusals. However, there was the observation that the fish traded outside the borders of Ghana are usually of high quality than that left for domestic purposes though the quality of the latter is not very bad.

Acknowledgement

Special thanks to WorldFish Center, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under the Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa", following the Malabo Declaration. The funding was made possible through the assistance from the European Union.

References

Abobarin, M. O, Drammeh, M. O. K. L, and Nije, M (1996) Improvement of Dried Shark Trade between Brufut in The Gambia and Mankessim in Ghana, West African Regional Programme "Improvement of Post Harvest Utilisation of Artisanal Fish Catches in West Africa", Bonga Technical Economic Report No. 028-96, 13 pages

Antwi-Asare, T. O., & Abbey, E. N. (2011). Fishery value chain analysis—Ghana. Food and Agriculture Organization, Fisheries.

Delgado, C., Wada, N., Rosegrant, M. W., Meijer, S., and Ahmed, M. (2003) Fish to 2020: Supply and Demand in Changing Global Markets. International Food Policy Research Institute (IFPRI) and WorldFish Center. -226

CSF (2002) Report of the Study on Problems and Prospects of Artisanal Fish Trade in West Africa., International Collective in Support of Fishworkers, Chennai, India. 92p..

Rurangwa, E., Agyakwah, S. K., Boon, H., & Bolman, B. C. (2015) Development of Aquaculture in Ghana.

SOCIOECONOMIC FACTORS INFLUENCING PROFITABILITY OF INTERNATIONAL ARTISANAL CROSS BORDER FISH TRADE IN PARTS OF WEST AFRICA

Ayilu* R[1], Antwi-Asare T O[1], Abbey E N[1] and Chimatiro S[2]
[1]University of Ghana, Department of Economics, Box LG57, Legon
[2]WorldFish, Africa Regional Office, Lusaka, Zambia

Abstract

This study examined the socio-economic determinants of profitability of international artisanal cross border fish trade in Ghana. Results are based on a survey conducted in different market locations in Ghana in 2015. About a third of the traders made a gross profit of between US $263.00 and US $ 1578.68 a month. An amount which was far above the minimum wage of US $64 per month in Ghana in 2015, Togo (US $108.7 per month) and Benin (US $108.7 per month). In terms of the overall profitability of the cross-border fish trade, the study obtained the gross profit margin figure of 20.4%. The analysis also showed that the main socio-economic determinants that significantly affect profitability include the number of years in cross-border trade, information dummy, belongingness to an association and distance. While all these factors increased profitability, distance does not. These results have several implications for policy. For instance, it is imperative for policymakers to ensure associations that are involved in cross-border trade are supported as this does not only increase their profitability but also provides a medium for traders to share their experiences from such cross-border trips. In addition, it is important for some form of specific education to be provided as the study did not find formal education in facilitating profitability in the industry.

Keywords: Ghana, Profitability, artisanal cross border fish trade

LES FACTEURS SOCIO-ECONOMIQUES DETERMINANTS DE LA RENTABILITE DE LA MAIN D'ŒUVRE INTERNATIONALE DANS LE COMMERCE FRONTALIER DU POISSON DANS CERTAINES LOCALITES DE L'AFRIQUE DE L'OUEST

Résumé

Cette étude a eu pour but d'examiner les facteurs socio-économiques qui influencent la rentabilité de la main d'œuvre internationale en matière du commerce frontalier du poisson au Ghana. Les résultats ont été basés sur une enquête menée dans de différents marchés du territoire ghanéen en 2015. Presque le tiers des commerçants ont réalisé un profit brut de de $ 263.00 à $ 1578.68 par mois ; un montant qui a largement dépassé le salaire minimum de $ 64 par mois au Ghana dans le courant de l'année 2015. Au Togo, c'était $ 108.7 par mois et au Benin c'était aussi $ 108.7 par mois. Concernant la rentabilité globale du commerce frontalier du poisson, le rapport a indiqué un profit marginal brut de 20.2%. L'analyse a aussi montré que les principaux facteurs qui ont plus favorisé la rentabilité sont le nombre d'années dans l'activité du commerce frontalier, l'information factorielle, l'appartenance à une association et la distance. Tandis que les trois premiers facteurs ont contribué considérablement à l'augmentation de la rentabilité, la distance ne s'était pas fait sentir. Ces résultats ont eu plusieurs effets sur les principes et théoriques envisagés. Par exemple, il est impératif que les décideurs s'assurent que les associations soient parties intégrantes du commerce frontalier et qu'elles aient du support, puisque cette pratique augmente non seulement leur rentabilité mais aussi leur donne-t-elles une opportunité de se partager leur expérience dans le domaine. En plus, il est nécessaire, à ce niveau de donner une formation formelle adéquate et spécifique puisque le rapport n'en a pas fait mention. Cela facilitera la rentabilité dans le secteur.

Mots clé : Ghana- Rentabilité, Main d'œuvre, Commerce frontalier du poisson

Corresponding author email: antwiasare@gmail.com

Introduction and Background

Cross-border trade (henceforth, Informal Cross Border Trade, ICBT) as a special form of international trade, has greatly contributed to cooperation and economic integration at the regional level (Ngoc and Wang, 2011). According to Pania (2006), ICBT has improved the quality of the relationship among nations, in the direction of more integration. It has the great potential to positively influence bilateral, political and social-economic relations between neighbouring countries.

There is no exact straightjacket definition for ICBT in international trade studies. The World Bank (2007) defines ICBT as the flow of goods and services across international frontiers within an area of up to 30 sq. km. According to the World Bank, ICBT is statistically counted as part of national import and export activities. However, it is unique because of its specific features, which are market proximity, the variety of goods and services and vulnerability to governmental restriction. When properly organized, cross-border trade can promote and foster economic relations between neighbouring countries.

According to the OECD (2009), informal cross-border trade has been categorised into three components (Table 2.1), which include:

i. Informal (unregistered) traders or firms operating entirely outside the formal economy;
ii. Formal (registered) firms fully evading trade-related regulations and duties (e.g., avoiding official border crossing posts);
iii. Formal (registered) firms partially evading trade-related regulations and duties by resorting to illegal practices (e.g., under-invoicing).

Another understanding of ICBT was given in Ogalo (2010, pp 11) as referring "to imports and exports of legitimately produced goods and services (i.e., legal goods and services), which directly or indirectly escape from the regulatory framework set by the government and avoid certain tax and regulatory measures, hence go unrecorded or incorrectly recorded into official national statistics of the importing or exporting countries".

For this study, we agreed with the definition used by Ogalo (2010) and further simplified by FAO (2017) that "ICBT refers to traders who both import and export goods from/to retail and wholesale outlets in a neighbouring country to trade without paying due duties or registering those goods with the customs" FAO (2017, pp. 6).

The main motive of this paper is to examine the socio-economic determinants of profitability in the international artisanal cross-border fish trade between parts of Ghana, Togo and Benin. Any business entity that fails in profit making will find it difficult to meet its fixed and variable cost in the long term to ensure its sustainability. In discussions with fish traders involved in ICBT many of them were glad with the outcome of their business.

Literature Review

Ama *et al.* (2013) in a study on informal cross border trader's profitability for four selected border posts in Botswana, found that the monthly profit generated by informal cross-border traders were over ten times the monthly minimum wage of workers in Botswana. They estimated the gross profit margin from this trade to be about 55%. Ama *et al.* (Ibid), noted that about two million dollars was generated as profits from the export of goods annually. Macamo's (1999) study on Mozambique also observed that on average monthly net income for small-scale traders in ICBT was equivalent to more than four times the minimum salary paid in the formal sector.

According to Bassey *et al.* (2014), the average wholesale and retail traders profit for captured fish traders in Nigeria per kilogram of fish were N596.53 and N645.3 respectively. The gross margin for both wholesalers and retailers were N145.83 and N147.00 with a total marketing margin of 28.10% and 25.7%, respectively. The two most significant variables and predictors of profit generated from informal cross-border trade were the initial start-up capital and the number of years in the informal cross-border business (this result

was similar to that of Ama *et al*, 2013). Bassey *et al* (2014) also found access to credit as a positive and significant determinant of fish marketer's profit. Among the factors which impacted significantly on fish trader's profit were marketing experience, access to credit, storage cost, transportation cost, fish buying prices and age of marketers.

As to why some traders trade informally across borders, Lyakurwa (2007) found that high tax rates in Sub-Saharan Africa were an important factor. The study found that exporting Companies pay an average of 71.2% of their profits as taxes. This is argued to play a part in the 'informalization' of cross border trade. In addition to this, were document requirements, high cost of transportation and several different border officials with cumbersome procedures. Ackello-Oguttu and Echessah (1997) found that ICBT involves business entities with low amounts of capital. They therefore transact in small quantities of goods and will alter the items traded in accordance to the demand of the products or seasons. Furthermore, the sources of financing ICBT business were mainly from own sources, contributions and credits from kinsmen or close associates.

The cross-border trading was highly labour intensive. Skill requirements was low, traders were self-employed or made use of family members to maintain low costs of doing the business. Afrik and Ajumbo (2012) investigated Informal Cross Border Trade in Africa and their findings revealed that limited access to finance also played a prominent role since transactions were cash based or sometimes operated under barter. Most traders lacked working capital and tangible business assets making it difficult for them to get financing from banks.

In all, studies on ICBT for various agricultural commodities and goods reveal common characteristics that influence the returns from such trading. These include socioeconomic factors, financial variables, distance, border-related issues, relationship variables and infrastructure.

Methodology

The Sample

The study surveyed informal fish traders across major international fish markets in Ghana, Togo and Burkina Faso. In Ghana, the markets visited include the Tuesday market (in the Greater Accra region), Techiman market (Brong Ahafo region), Denu market (Volta Region) and Dambai market (Volta Region). The other significant locations visited as part of the study were Ouagadougou and Po (both in Burkina Faso) and Lomé (the capital of Togo). These were among the major fish markets for the sale of processed fish products in West Africa (ICSF, 2002). Other markets observed were Paga, Bawku, Aflao and Hamale. These markets and places were mainly selected because of their relative importance in cross border trade. In addition key informant interviews with border officials and other government personnel were conducted. The survey was conducted from November 2015 to February 2016.

The Fish Trade Project Manual developed by WorldFish was adopted to estimate the volumes and value of the informal flow of fish in the study area. The profitability model for informal cross-border fish traders used a heteroscedasticity corrected cross-sectional regression model. To calculate for the profit and the measurement of profitability for fish traders, revenue minus cost formula and gross profit margin were used respectively. Data was collected through questionnaires from Techiman, Tuesday, Denu and the Dambai while the qualitative data was collected from Lomé, Po and Ouagadougou.

Sampling procedure

A multi-stage sampling method was used to select the respondents. The first phase involved obtaining an estimate of the number of traders in the various markets from the market leadership (market queens). The second phase dealt with the proportional allocation of the sample size 192 among the four markets. In the final phase, a simple random sampling technique was employed to select the appropriate

number of cross border fish traders. A total of 223 traders gave appropriately completed questionnaires.

First, a proportional allocation of traders for the study was done for each market using their population size. Secondly, quotas were assigned to both cross-border and non- cross-border traders in each market through a disproportional allocation. Finally, a simple random sampling method was used to select the participants. Both the quantitative and qualitative data were collected in Techiman, Tuesday, Denu and Dambai markets. However, only qualitative data were collected from Ouagadougou and Lomé markets, this is because these markets were mainly to help trace the flow and movement of fish products in the study area. Purposive sampling procedure was used for the key informants from government institutions at border.

Table 1: Sample Size

Market	Estimated Membership	Allocation based on sample size
Tuesday	2000	44
Techiman	2500	55
Denu	2500	55
Dambai	1750	38

Source: Authors survey, 2015

Profitability Measure

To estimate the profit, gross profitability of fish traders and determinants of profit for cross-border fish traders, we used the essential definition for profit in equation 1.

Gross Profit ($\prod$) = Sales (R) – Costs (C) (1);
with $C = fc + vc$ (2);
and $R = y * p$ (3):

Where $\prod$ is the profit, C refers to total costs, fc is the fixed costs, vc are variable costs, R is the revenue, y is the quantity of fish and p is the price per kg.

The cost items include payments made for labour, transport, official tolls and fees, communication, accommodation and other items used for the packaging of fish products. Thus, profit of informal cross-border fish traders was measured in terms of the margin on sales generated less the overheads incurred by the traders in conducting their businesses. The margin is represented by the money generated from the sale of each basket of fish less its cost price. The profitability of cross-border fish traders was derived using the gross profit margin formula. This formula was also adopted by Ama *et al*. (2013) and Bassey *et al*. (2014) in their study on fish marketers in Nigeria.

Gross profit margin %=(*Revenue-Cost of goods sold*)/ Revenue X 100……(4)

The Regression Model

A cross-sectional regression model was fitted with the profit from informal cross-border fish traders as the dependent variable and the key socio-economic regressors, namely: Primary/Basic Education, Senior/ High Education, Frequency of trips per year, Number of Years in Cross Border Fish trade, Radio as a source of Information, Access to Communication, Married Trader, Membership of Fisheries Association and Distance.

These variables have been widely used in the literature to identify the main socio-economic determinants of profitability (see for instance, Ama *et al*., 2013 and Bassey *et al*., 2014). More important, most of these variables have been found to be significant determinants of profitability. For instance, most studies have found distance, age and frequency of trips to be very important determinants of profitability (see the works of Ama *et al*., 2013 and Bassey *et al*., 2014).

Discussion of Results

Survey Results

In summary, to generate the necessary data for the quantification of the profitability of the fish traders, the traders were asked a number of questions. These questions range from the number of trips they embarked on per month, the total cost of transportation for both the fish products and personal transportation during each trip. Other associated costs were accommodation, feeding, tips and communications during each trip. There were, however, certain cost elements that were not easily quantified. Most of these costs were associated with the risks of conducting business informally. They included: risk related to the possibility of armed robbery, police harassment and payment of unofficial charges in the form of unofficial rents to public officials; and the possibility of rejecting goods on price grounds.

The demographic characteristics of the respondents are presented in Table 2. The sample comprised of mostly females in markets of the following towns: Accra, Denu, Techiman and Dambai markets. This confirmed the study of Overa (1998) in her study on Ghana when she noted that, long distance trade in fish in the country was almost a female dominated occupation.

The majority of the female fish traders (44.4%) were between ages 41 to 50 years. Supporting the studies by Bassey *et al*. (2014), this revealed that 50% of fish marketers in Nigeria were in their 40s and above. But the result disagrees with the studies of Peberdy (2002), Little (2007), COMESA (2007) and UNECA (2009) that noted that most small-scale cross-border traders range between the age of 25 and 39. This was followed by those between 51-60 years (30%).

The survey indicated that, the majority of the fish traders were married, constituting 81.2% while 11.2% were widows. Divorced and single traders represented 4.0% and 3.6% respectively. In terms of the educational background of the traders, the majority of them (52.9%) had some form of primary/ basic school education. About 35% of them had formal education while only 12.1% had a secondary education. There were no tertiary certificate holder's respondents from the survey. In contrast, the results of Bassey *et al*. (2014) revealed that 60% of fresh fish marketers in Nigeria had formal education up to secondary level. In terms of the religion of the traders Christians are in a majority of 57.8%, followed by Muslims of 32.7%. About 36.8% of the females had a household size of six and above. Only 2.2% had household size of two.

The majority of the respondents (47.5%) had been in the business between 11-20 years while 25.6% of the respondents have been in the trade between 0-10 years. Only 0.9% of the respondents had been in the trade for more than 40 years.

Table 2: Key Socio- demographic characteristics of Cross Border Fish traders

Socio-demographics	Frequency (n)	Percentage (%)
Sex		
Male	0	0%
Female	223	100%
Age		
51-60	67	30%
41-50	99	44.4%
31-40	51	22.9%
21-30	6	2.7%

Socio-demographics	Frequency (n)	Percentage (%)
Educational level		
Primary/basic	118	52.9%
Secondary/high	27	12.1%
Tertiary	0	0%
No formal education	78	35.0%
Marital status		
Married	181	81.2%
Single	8	3.6%
Divorce	9	4.0%
Widow	25	11.2%
Religious background		
Christian	129	57.8%
Muslim	73	32.7%
Buddhist	2	0.9%
Traditionalist	19	8.5%
Nationality		
Ghana	167	74.9%
Togo	51	22.9%
Benin	5	2.2%
Household size		
>Six	82	36.8%
Five	59	26.5%
Four	46	20.6%
Three	31	13.9%
Two	5	2.2%
Total	**223**	**100%**

Source: Authors survey, 2015

Value addition to fish purchased by traders

Packaging is the commonest method and form of value addition in the fish trade. 77.6% of traders indicated that they only repackaged the fish after purchase from the processors; this was followed by smoking (19.3%) and drying (3.1%). Traders explained that they were only required to repack their fish. Those traders who add value in the form of smoking were respondents who trade in freshwater fish products from the Volta Lake. Re-smoking and warming of fish is mainly used during the raining season to avoid spoilage and bad odour.

The mode of transportation for fish traders

The results suggest that majority (58.7%) of fish traders used hired vehicles. This involves several traders contracting a truck owner to transport their fish products to destination markets. Respondents indicated that they arrange for the vehicle in advance and payment is mainly per trip. Fish traders who used public transportation represented 40.8%. This involves the traders packing their fish in the back or on carriers on top of passenger buses. The remaining respondents of 0.9% hired their own vehicle. Traders often travelled separately using hired passenger buses while the hired cargo vans transported the fish.

Table 3: Mode of Transportation of Fish Products across the Border

Mode of transport	Frequency (n)	Percentage (%)
Hired vehicles (group)	132	59.2
Public transport	91	40.8
Total	**223**	**100**

Source: Authors survey, 2015

The acquisition of fish by traders

Three major means of acquiring fish by cross border fish traders were observed in the study (see Table 4). These include purchasing:

i. from any trader in the market with a good negotiated price;
ii. directly from fish processors; and
iii. purchasing from fish sellers with whom the fish trader has established a bilateral trusted relationship.

The results showed that 59.1% of the traders had a mutual trusted relationship built with the regular supplier while 38.2% of the traders bought their fish products from any fishmonger they met selling at the market during the time of the visit. Only 2.7% of the traders went directly to fish processors to purchase the fish. Thus, a majority of the respondents acquired fish products from suppliers with whom they had established a trusted relationship. The reason given was that mutual trust helped the cross-border traders acquire the right quantities of fish always even on credit. The amount being retired by the traders on their next trip across the border.

Mode of transacting fish business among fish traders

The traders rely essentially on credit as a means of selling their fish products. Wholesale traders sell the fish on credit to their customers and partners. The process is done in such a way that the debtors have to return the cash on the next market day in return for a new consignment. Table 5 shows that 50% of the respondents transact their cross-border business basically using credit while 47.9% reported that due to past experience they transact business only on cash basis. Only 2.1% of the traders use bank transfers.

Table 4: Mode of Fish Acquisition by Cross Border Fish Traders

Mode of acquiring fish	%
From any suitable trader found in the market	38.3
Directly from fish processors	2.7
From traders with whom there is a mutual trusted relationship	59.1
Total	**100**

Source: Survey, 2015-2016

Table 5: Modes of Transaction by Fish Traders

Mode of acquiring fish	%
Credit	50
Bank transfers	2.1
Cash	47.9
Total	**100**

Source: Survey, 2015

A high percentage of fish traders used credit because majority of their customers are small retailers who do not have the capital to purchase all their required fish volumes. The result confirms studies by Assaad (1996) and Muzvidziwa (2005) which assert that the rules and regulations that govern informal transactions are constructed largely by social context; emphasizing the importance of networks, kinship, regional origin and ethnicity, for the accomplishment of these market transactions.

Source of Business Credit

Access to credit was generally a major concern to most respondents. The results in Table 6 indicate that over half of the traders (59.2%) did not have access to any form of financial assistance. They relied mainly on their own private saving. The rest of the traders (40.8%) had some form of credit to support their businesses. Out of those traders who had access to credit, 28.5%, got credit from their family members while 26.2% of them got credit from a micro-finance scheme (through a ROSCA, or Tontine). The rest (19.2%) had credit from friends and other acquaintances. Only 2.3% of traders had credit from a formal bank.

Price formation by fish traders

Fish was sold mainly using woven palm frond baskets with an average weight of 8kg and price largely agreed on, based on negotiations between the buyer and the seller. Table 7 suggests that during the purchase of the fish from the source markets, 98.2% cross border traders resort to negotiating with the fish wholesaler. 1.3% percent of the traders were able to dictate the price during the purchase. This happen during the fish season when there is bumper harvest and the fish sellers struggle to have their fish sold. Only 0.4% of the traders purchase their fish products from sellers with fixed prices.

During the lean season, it is the buyers (cross border traders) who struggle for the lower quantities on the market. Sometimes it took cross border traders about a week to aggregate enough fish for a trip. Therefore, the fish monger takes advantage of the scarcity to dictate and manipulate the prices.

On the other hand, during the sale of the purchased fish at the destination markets, a good number of the respondents (38.4%) set fixed prices. Even though the majority of the respondents (58.9%) resort to price negotiation, tlt is only a few of the respondents (2.6%) whose customers were able to dictate the price. The reason given for the majority of the traders having the power to dictate the price was attributed to the fact that the fish products are sent to markets where the consumers have fewer alternatives. Another reason was that those destination markets were far from the source of the fish. Furthermore, the cross-border traders behaved as oligopolies being among few market suppliers.

Determinants of fish price at the destination market

The majority of the respondents (22.7%) reveal that the price they set was influenced by the operational costs (Table 8). The season is also very important factor due to the fact that during the lean season fish is scarce, and prices were higher. The other determinants are: type of fish species (21.6%), fish size (17.1%), 10.5% of traders compare with other traders before setting their price; and, fish quality (5.0%). The quality of fish was measured based on the fish scent or odour and whether they were broken or not.

The operational cost had the highest strong impact on the fish price at the destination market. This was followed by the season and type of fish species. Some of the fish species where considered more tasty than others and it reflected in the prices. According to Muzvidziwa (2006) most of the informal cross-border traders price their products by considering formal economic factors such as fuel price, operational cost and other input costs.

Table 6: Sources of Credit for Fish Traders who obtained it

Source	Frequency (n)	Percentage (%)
Family members	37	28.5
Micro finance	34	26.2
Money lender	31	23.8
Friends	25	19.2
Bank	3	2.3
Total	**130**	**100**

Source: Author's survey, 2015-2016

Table 7: Nature of Price Setting during Purchase and Sale of Fish by Fish Traders

Item	Frequency (n)	Percentage (%)
Price set during the purchase (source market)		
We negotiate	219	98.2
I set the price	3	1.3
Dictated by the seller	1	0.4
Price set during sales at destination markets		
We negotiate	132	58.9
I set the price	86	38.4
Dictated by the buyer	5	2.6
Total	**223**	**100**

Source: Author's survey, 2015-2016

Table 8: Determinants of Fish Price from Survey

Determinants	Percentage (%)
Operational cost	22.7
Season	22.3
Type of fish species	21.6
Fish size	17.1
Price of other traders	10.5
Fish quality	5.0
Weight	0.8
Total	**100**

Source: Author's survey, 2015-2016

Volume and Value of Small Scale Cross Border Fish Trade

The following categories of costs which were associated with the fish trade: i) transfer costs, including handling, packaging and transport, ii) labour costs, iii) housing and feeding costs of the cross-border trader.

Expenditures in Table 9 were those prevailing at the time of the survey and which could be easily quantified by traders. Because the traders keep memory of operational cost, it expenditure was easily quantified by the traders. Traders from Togo, Benin and Ivory Coast complained about continued harassment by police and custom officers at various

checkpoints, leading to the payment of bribes in the form of cash and kind.

The cost of transportation for fish products as well as personal transportation constitutes a major cost of the cross-border fish trade representing 81% of total transaction cost. The reason for this high cost is attributed to the fact that majority of cargo truck drivers from Ghana do not have the international driver's licenses required to have a direct transit to the destination countries of Togo and Benin. It was observed that fish traders going to neighbouring countries in Togo and Benin pay for their products to be transported from the markets in Ghana across to the border and then transfer to new cargo trucks due to lack of international licenses by most of the Ghanaian drivers. This was a new cost borne by the traders for transporting the products to their final destination.

Table 9: Average annual expenditures of Cross Border Fish traders exporting fish from Ghana to West Togo and Benin

Expense	Average Annual Cost	Percentage of total Expenditure	Rank
	In GH¢		
Traders personal transportation	4626.9	10.30%	2
Transportation of fish products	32029.2	71.0%	1
Accommodation for fish traders	238.5	0.50%	10
Feeding during business activities	905.7	2.0%	5
Communications	208.5	0.50%	10
Payment of unofficial charges	67.2	0.10%	12
Tax or market tolls	848.4	1.90%	6
Labour (packers, loaders)	3677.25	8.10%	3
Palm Baskets	608.925	1.30%	7
Twines	522.525	1.20%	8
Brown Paper	1188.3	2.60%	4
Net	212.25	0.50%	10
Total	**45,133.65**	**100%**	

Source: Authors survey, 2015-2016

The next highest cost is for labour (8.10%) is attributed to fact that the cross-border fish traders (women mostly above 40 years old) relied heavily on labour from men to assist them in the entire process, such as packaging, sorting and loading. In a way this gave the women Cross Border traders enhanced social status and economic power in relation to males. Table 9 shows that averagely a cross border fish trader spends about Ghc 4626.9 annually on the transport sector and Ghc 3677.25 is spent on the services of casual works (labour). Each trader spent Ghc 608.93 on baskets and GhC 1,144.20 for accommodation and feeding.

Volume and value of informal cross-border fish trade

The price of fish varies according to fish type, price per basket even though most have an average weight of 8 kg each for anchovies. The valuation is based on prices in the markets, specifically, the price paid by the small scale cross-border traders to purchase the cured fish products from Ghana. Average quantities of fish products per basket were collected from the respondents by weighing. The total value of fish trade was estimated by multiplying the average price per basket by the number of baskets each trader purchased per a visit to the market. The average weight

of a basket (kg) of fish was used as a standard of measurement before conversion into tons (refer to Table 10).

Approximately 6.4 thousand metric tons of different fish species valued at about GH¢ 71 million or $18.6 million were exported into Togo and Benin from Ghana per annum. Out of the total volume, 5.0 thousand metric tons of different fish species valued at GH¢ 54 million (or about $14.2 million) were exported to Togo whilst 1.0 thousand metric tons of fish, valued at GH¢ 16 million (or about $2 million) was exported to Benin per annum.

ICBT fish exports to Togo and Benin remain important and have more than doubled since the 1990s when Tettey (1992) made his estimates. This may be accounted for due to increase in the demand for fish. The Tuesday and Denu market's supply of fish to Togo is almost of the same quantity as in Tettey's study. However, there is a huge disparity in the value. This is due to the difference in the species of fish purchased at the various markets. It was noted that the majority of the traders at the Tuesday market purchased anchovy and herring which was less expensive as compared to the fish species purchased in the Denu market, which were mostly of the round sardinella species with associated higher prices. The Dambai market was associated with cured river fish which is of higher price than marine fish. While there were direct movement of fish from Dambai to Togo, no direct fish trade from Dambai to Benin was reported during the survey.

Profitability of International Cross Border Fish Traders

The profit margin per each trip was also ascertained. The traders were asked to state their average monthly profit from ICBT. The results which are summarized in the Table 11 show that 33.3% of the traders made a profit of between GH¢1000 (about US $263.00) and GH¢ 5, 999.00 (about US $ 1578.68) monthly while 21.3% of them made profits of between GH¢ 6, 000.00 (about US $ 1578.95) and GH¢ 10, 999.00 (about US $2894.47). Only 10% made profit below GH¢1000 (about $263.12) while many traders (28.8%) made profits of over GH¢ 21, 000.00 (about US $5526.32) in a month of active trading.

The average monthly profit from fish business per the survey result is GH¢ 15,140.92 (about US $ 3,984). This amount is far above the minimum wage of GH¢ 240 (US $64) per month in Ghana, Togo (US $108.7 per month) and Benin (US $108.7 per month) (World Bank Doing Business, 2016). In terms of the overall profitability of the cross-border fish trade, the study obtained the gross profit margin figure of 20.4%, which suggests that for every one dollar the traders have, 0.86 dollars goes into direct purchase of the fish products and 0.24 dollars constitute gross profit.

This result is justified by the study of Macamo (1999) in Mozambique that observed net monthly income obtained from informal traders was estimated, on average, to be equivalent to many more times the minimum salary paid in the formal sector. The result also affirmed the study of Ama and Mangadi (2013)

Table 10: Estimated quantity and values of fish products exported from Ghana West African neighbours

Destination countries	Major fish Markets	Annual Quantities	Values	Value
		(tons)	(in GH¢)	(U$)
Togo	Tuesday	1857.618	11,814,702	3,109,132
	Denu	1851.528	30,210,600	7,950,158
	Dambai	1558.2	11,977,200	3,151,895
Benin	Tuesday	261.135	2,037,600	536,210.5
	Denu	819.21	14,709,900	3,871,026
	Total	**6,347.691**	**70,750,002**	**18,618,422**

Source: Authors survey, 2015-2016

Table 11: Average Monthly Profit of ICBT Traders

Average Monthly Profit (Ghc)	Percentages
< 1000	1.3
1000 -5999	33.8
6000 -10999	21.3
11000 -15999	10
16000 -20999	5
> 21000	28.8
Total	**100%**

Source: Survey

that observed that cross-border traders are able to buy food for their households, pay school fees for their children and relatives and still reinvest in the business and improve their general welfare.

Gross Profit Margin

The gross profit margin is a key financial indicator used to assess the profitability of economic activity, excluding fixed cost.

From Table 12, the total average sales for fish traders per annum was valued GH¢ 1,111,200.10. Total average value of the cost of exported goods mounted to GH¢ 884,375.03.

Substituting these results into Equation 6 yielded the results below:

Gross profit margin=
(1,111,200.1-884,375.03)/1,111,200.1x
100=226,825.07/1,111,200.10 x100
Gross profit margin=20.41%

This percentage shows that the cross-border fish trade is profitable. It suggests that traders spend 80.6% of the total revenue to pay for direct costs of the business and retain 20.4%.

Table 13: Socioeconomic Factors influencing profits of Small Scale Cross Border Traders

VARIABLES	(1)	(2)	(3)
Primary/Basic Education	-0.050		
	(0.159)		
Senior/High Education	0.402		
	(0.282)		
Frequency of trips per year	0.007		
	(0.007)		
Married Trader	-0.240		
	(0.174)		
Radio as a source of Information	0.567**	0.496*	
	(0.226)	(0.270)	
Access to Communication	-0.723**	-0.716**	
	(0.296)	(0.326)	
Number of Years in Cross Border Fish trade	0.039***	0.036***	0.038***
	(0.009)	(0.008)	(0.008)
Association Dummy	0.971***	0.846***	0.855***
	(0.233)	(0.221)	(0.219)

VARIABLES	(1)	(2)	(3)
Distance	-0.001***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)
Constant	11.400***	11.624***	10.892***
	(0.500)	(0.401)	(0.199)
Observations	223	223	223
R-squared	0.234	0.212	0.203
F-Statistics	11.63	15.90	19.99
Prob>F	0.000***	0.000***	0.000***

Source: Regression results based on survey data

Socioeconomic Determinants of Cross-Border Fish Traders' Profit

The use of Ordinary Least Squares (OLS) on Cross Sectional data is normally prone to heteroscedasticity problems. We corrected the problem of heteroscedasticity by conducted a robust standard regression.

The main socioeconomic determinants of profit at least at a 5% level of significance are the number of years in trade, the use of radio as a source of market information, access to communication (Mobile Phone), the Membership of a Fish Traders Association and distance from Source market to destination market. Almost all these factors increase profitability with the exception of distance and the use of radio as a source of market information; where the farthest the destination market, the smaller the profit and the possibility of not getting radio transmission or not even understanding the language.

The coefficient for the number of years a trader was involved in cross border fish trade was positive and significant at the 5 percent level. Experienced traders are perceived to have gained enormous experience due to their prolonged participation in the fish trade. Traders would have also accumulated enough marketing information to understand the marketing strategies that increase profit. This result validates the study of Ama *et al.* (2013) that revealed that the number of years in the informal cross-border business in Botswana is a significant determinant of profit. This also confirmed the assertions of Bassey *et al.* (2014). Access to information by radio has a positive and significant relationship with cross border fish traders' profitability. The use of the mobile phone as a communication accessory, allows traders access to personal communication. It was significant and positively related to profits. The better information and the ability to communicate directly with stakeholders significantly raise the knowledge of traders on prices and exchange rate changes or general economic conditions in destination markets. This increases the likelihood of traders making gains.

Conclusions

This study examined the socio-economic determinants of profitability of international artisanal cross border fish trade in Ghana. Results are based on a survey conducted in different market locations in Ghana. In the end, the main socio-economic determinants that were found to affect profitability include the number of years in cross-border trade, information dummy, belongingness to an association and distance. While all these factors increased profitability, distance does not. More importantly, these finding are similar to the works by Ama *et al.* (2013), Bassey *et al.* (2014) and Ayilu *et al.* (2016).

These results have several implications for policy. For instance, it is imperative for policymakers to ensure associations that are involved in cross-border trade are supported as this does not only increase their profitability but also provides a medium for some traders to share their experiences from such cross-

border trips. In addition, it is important for some form of specific education to be provided as the study did not find formal education in facilitating profitability in the industry.

Acknowledgement

Special thanks to WorldFish Center, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under the Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa", following the Malabo Declaration. The funding was made possible through the assistance from the European Union.

References

Ackello-Ogutu, C. (1996). Methodologies for Estimating Informal Crossborder Trade in Eastern and Southern Africa: Kenya/Uganda Border, Tanzania and Its Neighbors, Malawi and Its Neighbors, Mozambique and Its Neighbors. USAID. Bureau for Africa. Office of sustainable development.

Ackello-Ogutu, C. and Echessah, P. N. (1998) Unrecorded Cross-Border Trade Between Tanzania and Her Neighbors Implications for Food Security. SD Publication Series Office of Sustainable Development Bureau for Africa. Technical Paper No. 89 September 1998 TechnoServe Inc.

Ackello-Ogutu, C., & Echessah, P. (1997). Unrecorded cross-border trade between Kenya and Uganda. Technical Paper, 59.

Afrika, J. G., and Ajumbo, G. (2012). Informal cross-border trade in Africa: implications and policy recommendations. Africa Economic Brief, 3(10), 1-13.

Ama N. O., Mangadi K.T., Okurut F.N., and Ama H. A., (2013). Profitability of the informal cross-border trade: A case study of four selected borders of Botswana. African Journal of Business Management. Vol. 7(40), pp. 4221 -4232.

Ama N.O., Mangadi K.T. (2013). Informal cross-border trade between Botswana and the neigbouring countries (South Africa, Namibia, Zimbabwe, Zambia). A Research Report Submitted to the Office of Research and Development, University of Botswana, Gaborone

Ayilu RK. 2016. Informal cross-border artisanal fish trade in West Africa. MPhil. Thesis, Economics Department, University of Ghana

Ayilu, R. K., T.O. Antwi-Asare, P. Anoh, A. Tall, N. Aboya, S Chimatiro, & S. Dedi. (2016). Informal Artisanal Fish Trade in West Africa: Improving Cross-Border trade. Penang, Malaysia: WorldFish 2016-37.

FAO .2017. Formalization of informal trade in Africa; Trends, experiences and socio-economic impacts, FAO Regional Office for Africa, Accra, 2017

Fisher, Andrew A, James R Foreit with John Laing, John Stoeckel, and John Townsend. Designing HIV/AIDS Intervention Studies. An Operating Research Handbook. The Population Council, NY, NY 2002. http://www.popcouncil.org/pdfs/horizons/orhivaidshndbk.pdf

Lesser, C. & E. Moisé-Leeman. 2009. Informal Cross-Border Trade and Trade Facilitation

Reform in Sub- Saharan Africa, OECD Trade Policy Working Papers, No. 86, OECD Publishing.

Little, P. (2005). Unofficial trade when states are weak: The case of cross-border commerce in the Horn of Africa (No. 2005/13). Research Paper, UNU-WIDER, United Nations University (UNU).

Little, P.D. (2007), "Unofficial Cross-Border Trade in Eastern Africa", paper presented at the FAO Workshop on Staple Food Trade and Market Policy Options for Promoting Development in Eastern and Southern Africa, March 2007, FAO Headquarters, Rome.

Macamo JL (1999). Estimates of unrecorded cross-border trade between Mozambique and her neighbours (Technical Paper No. 88). Maputo: SD Publication Series, Office of Sustainable Development, Bureau for Africa, World Vision International – Mozambique

Macamo, Jose Luis (1999) "Estimates of unrecovered cross-border trade between Mozambique and her neighbours", World Vision International-Mozambique, SD Publication series. Technical paper

No.88, June. p10

Morris GA and Dadson JA, (2000). Ghana: Cross-Border Trade Issues. African Economic Policy Paper, Discussion Paper No. 22.

Muzvidziwa VN (1998). Cross Border Trade: A Strategy for Climbing out of Poverty in Masvingo, Zimbabwe: Zambezia, http://archive.lib.msu.edu/DMC/African Journal. Accessed on 20 July 2007.

Muzvidziwa VN (2006) Women without borders: Transborder movements as a coping and investment strategy. Africanus 36(2):180-188

Muzvidziwa, V. N. (2005). Women without borders: Informal cross-border trade among women in the Southern African Development Community Region (SADC). Ossrea.

Mwaniki J (1998). The Impact of Informal Cross Border Trade on Regional Integration in SADC and Implication for Wealth Creation. IRED-ESA, p.42

Nsikan Edet Bassey, E. Okon Uwemedimo, Umoh Idaraesit Uwem and Nyong Eteyen Edet. (2015). Analysis of the Determinants of Fresh Fish Marketing and Profitability among Captured Fish Traders in South-South Nigeria: The Case of Akwa Ibom State. British Journal of Economics, Management & Trade 5(1): 35-45, 2015, Article no.BJEMT.2015.003 ISSN: 2278-098X, SCIENCE DOMAIN international

Ogalo, Victor. 2010. Informal Cross Border Trade In East Africa: Issues for EAC Regional Integration and Economic Growth. CUTS-CITEE. OECD 2009

Organisation for Economic Co-operation and Development. (2005). OECD factbook: economic, environmental and social statistics. OECD.

Overa R, (1998). Partners and Competitors: Gendered Entrepreneurship in Ghanaian Canoe Fisheries, Dissertation for the Dr. Polit. Degree, Department of Geography, University of Bergen, Norway. Pania 2006.

Peberdy, S (2002) Hurdles to trade? South Africa's immigration policy and informal sector cross-border trade in the SADC. Paper presented at the SAMP/LHR/HSRC workshop on regional integration, Pretoria 23 April 2002.

Peberdy, S. & Rogerson, C. M. (2000). Transnationalism and non-South African entrepreneurs in South Africa's small, medium and micro-enterprise (SMME) economy. Canadian Journal of African Studies, 34, 20-40

Quynh Cao Thi Ngoc and Xun Wang (2011): Sino-Vietnamese Trade Relation-with a focus on cross-border trade (Master's degree). Retrieve from University of Gothenburg Bibliography database (Project No. 2011:5).

Schneider F., (2006), -Shadow Economies and Corruption All over the World: What Do We Really Know?" Discussion Paper No. 2315, Institute for the Study of Labour (IZA), Bonn

AN ANALYSIS OF THE EFFECT OF EUROPEAN UNION FISH STANDARDS AND REGULATIONS ON GHANAIAN FISH EXPORTS

Avogbedor B E[1], Seini W[1], Kuwornu J K M[1], Antwi-Asare* T O[1] and Chimatiro S[2]
[1]University of Ghana, Legon
[2]WorldFish, Africa Regional Office, Lusaka, Zambia

Abstract

The reduction in tariffs over the years as a result of Regional Trade Agreement has led most countries to the use of technical regulations or non-tariffs measures to regulate trade. In addition, the increase in consumers' income, taste and preferences for quality and safe food has led to the introduction of product standards through sanitary and phytosanitary (SPS) measures to ensure that the consumers' safety and demands are met. However, the measures put in place have effects on trade especially in developing and middle-income countries in Africa, of which Ghana is not an exception. Ghana has to meet the European Union stringent standards and regulations as a requirement to get access to their market. This study analyses the effects of the EU Fish standards and regulations on Ghanaian fish exports. The standard gravity model was used with time series data spanning from 1986 to 2015 for the empirical analysis. The study found that standards for fish have had a positive effect on the volume of fish exports. In the short run the effect was statistically significant and but insignificant in the long run. The study suggests that Ghana and other African countries must ensure full compliance to EU standards, through improved handling, ensuring awareness of the standards and regulations and any updates as they come up. Local authorities could also have the Competent Authority train local stakeholders to ensure compliance. The cost relating to such compliance enhancing activities could be subsidized at the national or local level. Compliance to standards and regulations would then catalyze the improvement of fish exports to the EU and other African markets.

Keywords: Competent Authority, Standards, Regulations, Fish Exports, Gravity Model, EU

UNE ANALYSE DE L'EFFET DES CRITERES ET DES REGLEMENTS DE L'UNION EUROPEENNE SUR L'EXPORTATION DU POISSON GHANEEN

Au fil des ans, la réduction des tarifs due aux accords régionaux sur le commerce a amené plusieurs pays à adopter des règlements techniques ou des mesures non tarifaires pour régulariser le commerce. En plus, les augmentations dans le revenu du consommateur, le gout et les préférences pour la qualité et la sécurité alimentaires ont abouti à l'introduction des critères sur la norme des produits par le biais des dispositions sanitaires et phytosanitaires en vue de satisfaire aux besoins et à la sécurité des consommateurs. Cependant, les mesures mises en place ont eu des effets sur le commerce surtout dans les pays en voie de développement et les pays aux revenus moyens en Afrique y compris le Ghana. Le Ghana est contraint de se conformer à ces exigences de l'Union Européen afin d'accéder à leur marché. Cette étude a fait des analyses de la décision de l'Union Européenne sur l'exportation du poisson ghanéen. Concernant les analyses empiriques, le modèle de la norme gravité a été utilisé avec des données de séries chronologiques de 1986 à 2015. Cette étude a trouvé que la valeur requise de poisson a eu un effet positif sur la quantité de poisson destinée à l'exportation dans un temps soit peu. Le rapport suggère donc que le Ghana et d'autres pays africains n'ont qu'à satisfaire aux critères et aux exigences de l'Union Européenne par le biais d'un maintien adéquat, l'application de la science et de la technologie. Ces critères les aideraient à améliorer les exportations vers les marches africains et ceux de l'union Européenne.

Mots clé: Ghana, Exportation du poisson, Critères de l'Union Européenne du Poisson, Règlements

Corresponding Author Email: antwiasare@gmail.com

Introduction

Several attempts have been made to sanitize and monitor fishery activities through the introduction of standards and regulations by the EU. The non-compliance of these standards and regulations resulted in Ghana being partially banned from exporting fish to the European Union (EU) in 2013 and this lasted until 2015 when Ghana's yellow card was lifted (Kareem, 2014). This may have had some effects on exporting companies as well as the fish processing industries. Indeed, the EU Commission was said to be considering imposing the ban again on Ghana in 2016 due to Illegal, Unreported and Unregulated (IUU) fishing activities in its waters. Being the largest importer of fish and fishery products in the world, the EU has instituted stringent measures to reduce IUU fishing and enforce phytosanitary standards. Indeed, the EU rejects fish and fishery products if exporters fail to fully comply with its standards and regulations.

Standards and regulations are considered to be a technical barrier to trade. To most developing countries of which Ghana is no exception, these barriers are probably trade restrictive. Exporters have to incur additional costs in order to comply with these regulations. These standards and regulations serve as non-tariff measures (NTMs) which invariably increase the trade barrier effects imposed by tariffs for some products (Moise and Le Bris, 2013).

According to a report by Joint Integrated Technical assistance Programme (JITAP) Cluster 12 (2002), the exporting companies dealing in smoked fish fall in the micro and small size category with annual turnover of less than $50,000. In year 2001, 56 exporting companies in this category in Ghana were exporting to the European Union. As at 1996, close to 200 small companies were exporting smoked fish to various countries in the European Union. Most of these have gone out of business or diversified into other markets or products since the passing of the EU legislation (IP/B/PECH/IC/2012-07) on requirements for fish imports. Meeting the high standards and regulations of the EU has been challenging for many Ghanaian fish exporters.

On the other hand, apart from the view that there are additional costs and negative effects of these EU measures on fish exporters (Henson and Jaffee, 2008), there is an alternative argument. Compliance and improved handling of fish along the value chain resulted in better internal and border food safety controls so the exporters in compliance benefitted by exporting greater fish volumes to the EU (European Commission, 2006). Thus, there was the need for more research in the area to unravel the underlying issues. The issue that has not been answered for Ghana was whether we could have a quantifiable estimate of the effects of standards and regulations on fish exports to the EU. This study therefore sought to investigate the issue.

In order to do this analysis, the specific objectives pursued were; to discuss the characteristics of fish exporting companies in Ghana; estimate the effect of the standards and regulations on the volume of Ghanaian fish exports to the EU; examine factors influencing the Ghanaian fish exporting companies' compliance to EU fish trade standards and regulations and finally come up with recommendations beneficial to intra-regional fish trade in West Africa.

The study was organized in five sections. The second section provides the literature review which focuses on standards and regulations regarding fish exports and its effects on fish exports. Section 3 highlights the methodology used and the results of the analysis are presented in Section 4. Finally, Section 5 gives the conclusions and recommendations of the study.

Literature Review

The gravity model is one possible way to get quantitative information on determinants of trade flows in value chains. In the literature, the model has been used to evaluate the impact of bilateral or multilateral trade agreements on the amount of trade flows. The linkage between the gravity model and value chain analysis can be illustrated by the

fact that the majority of tradable commodities are not processed or consumed completely in the country of production for several reasons. One important reason is probably because the majority of tradable commodities are not processed or consumed completely in the country of production. Indeed, many products are traded internationally giving rise to global value chains.

In the majority of applications, the gravity equation is modified to include additional variables depending on the question of interest, e.g. exchange ratios, tariffs, common language, shared border, colonial history as a proxy 'cultural distance', or transaction costs. The model has often been used to evaluate the impact of treaties, alliances, and regional trade agreements on international trade flows. For example, Martinez-Zarzoso (2003) applied the gravity model to test the effectiveness of preferential agreements.

The gravity equation has also been used, for estimating the impact of transaction costs on bilateral trade. Hausman *et al.* (2005) applied the gravity equation to access the impact of logistics on bilateral trade. Tran, N., Wilson, N., Hite, D. (2013) in: Beghin, J.C. (ed.), gravity models to test the hypothesis that food safety (chemical) standards act as barriers to international seafood imports. Ardakani, I.Z. S. Yazdani and O. Gilanpour (2009), used the gravity model to estimate the trade effect of non-tariff barriers imposed by importer countries on pistachios, raisins and shrimp exported by Iran.

The question of whether there exists any effect of fish standards and regulations on fish exports to the EU, has been investigated for some countries. The impact of the non-compliance of sanitary and phytosanitary issues have had negative effects for livelihoods when bans are imposed. When bans are not imposed the impact has not been conclusively proven. Empirical studies from many countries have given conflicting results on the effect of fish standards and regulations on fish exports. Kareem (2016) investigated this issue for coffee and fish exports from Africa to the EU. The study recognises that tariffs have generally declined due to regional and multilateral trade agreements while non-tariff and technical barriers to trade have increased. Some studies such as, McCullough, Pingali, and Stamoulis (2008); Swinnen Maertens (2008) and Henson and Jafee (2007) have argued that the impact of standards and regulations could have conflicting effects depending on the degree of adjustment by institutions regulating trade.

Henson *et al.* (1999) in two related studies on Ghana and Vietnam analysed the effect of the introduction of standards and regulations on fish exports to the EU. Following the introduction of fishery regulations in 1997 by the EU, frozen and fresh fish exports had been suspended by the Ghana Standards Authority. This development led to bilateral negotiations that resulted in the provision of technical assistance by the EU to ensure effective implementation. Kareem (2014) investigated the impact of EU standards imposed on high-value products on food exports to developed economies. The study used fish and vegetables export as two high-value commodities to analyse the impact of EUs sanitary and phytosanitary requirements. Results from his study shows that, at the extensive margin of trade, EU standards has a positive effect on fish exports and positive association with the export of vegetables as well. Results from his study showed that standards imposed on fish and cocoa were trade enhancing at the wide margins but trade inhibiting at the intensive margins. Kareem (2014) concludes that standards imposed on Africa's exports were product specific and that Africa must ensure sufficient compliance to these standards through enhancement in science and technology in order to minimize the costs associated with border rejections. Also, African countries must ensure that international partnerships are included in their agricultural policies to aid enhance the compliance of standards.

Marquez-Ramos *et al.* (2010) investigated the effect of trade barriers on sectorial trade using panel data involving 42 countries. Employing the gravity model in their analysis, they found the distance between

countries, transport costs and tariffs to have negative impact on trade activities. However, technological innovation and income were found to have positive influence on trade activities.

Another study by DaSilva (2010) on the impact of United States of Americas' Hazards Analysis Critical Control Point (HACCP) requirements on exports of fish and fishery products from Guyana to the US (1970-2008) was investigated using a standard gravity model. The study concluded that other factors that affect trade had greater influence on exports than the perceived negative impacts of standards and regulations as also noted by Anders and Caswell (2009). The study notes that standards and regulations may serve as a catalyst for trade competitiveness and that the benefits quite outweigh the perceived costs.

Neeliah *et al*. (2011) examined the effect of sanitary and phytosanitary concerns for fishery exports to the EU from Mauritius. Results from their study indicated that these sanitary and phytosanitary measures have not been a significant impediment for Mauritius fishery exports to the EU. They conceded that institutional strategies had been put in place to ensure effective compliance to the EU standards and regulations. They however identified that Mauritius had predominantly employed a reactive approach to the compliance with EU standards and recommended that more proactive approach to secure their export markets.

Many studies have found that the short run effects of standards/regulations being imposed by the EU since 1995 to be negative on fish export volumes (Yunus, 2009; Alavi, 2009; Hossa and Verpoorten, 2012). However, the medium and long-term impact have generally been found to be positive (Yunus, 2009; Henson and Mitullah, 2004). The case for Ghana was a question addressed in the study.

Methodology

The study adopted two different analytical frameworks. The first used interviews and questionnaires to examine the effects of EU measures on fish exporters and the factors that affect their compliance to standards and regulations. The second used a gravity model to examine the effect of standards and regulations on the volume of fish exported to the EU.

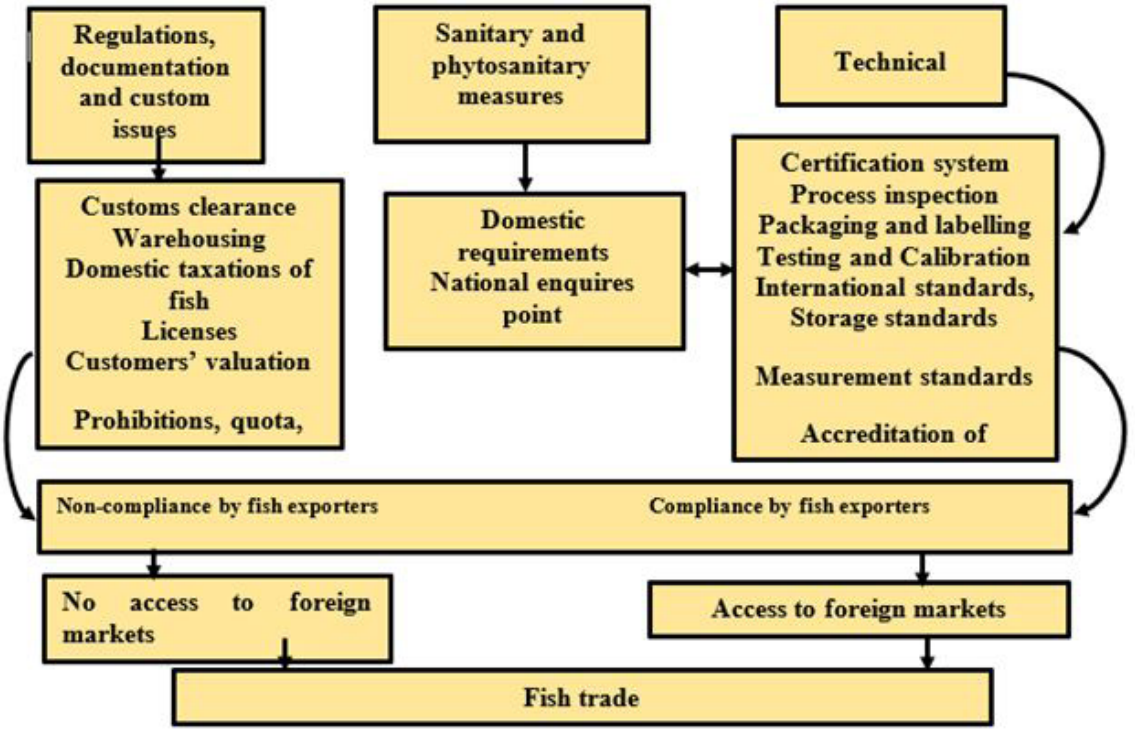
The Sample Data and Model

For the survey, we had data from twenty (20) fish exporting companies. The respondents were asked to share their thoughts on compliance to EU's standards and regulations and the likely effect it had on their operations. There were fewer formal sector fish exporting companies; the majority of the respondents' export to the EU, and few to Asia and USA. Those traders who export fish to other African countries were mainly operating in the informal sector and were not registered members with the Ghana Standards Authority (GSA). This second group of exporters used traditional means and methods in their business. As at the time of this study, the registered fish exporters according to GSA and Ghana Export Promotion Authority were thirty (30), out of these twenty (20) of them were available and willingly took part in the study

In order to have more insight on the issues the Fish exporters' data were collected through questionnaires while those for trade and regulatory institutions were collected through interviews of key informants of these institutions. The results of the interviews helped to explain the gravity model results in a better manner.

Data was collected in the Greater Accra Region. Most of the fish exporters to the EU are located near the Tema Fishing Harbor area due to easy access to the raw materials and input supplies. The data was collected on the fish exporters' companies profile, export levels, markets, information on awareness of fish export standards and regulations and the factors influencing their compliance. In addition, secondary data was obtained from the World Development Indicators (WDI), Ghana Export Promotion Authority, Fisheries Commission of Ghana and Ghana Statistical Service. Annual time series data spanning the period from 1986 to 2015 was used for the quantitative study.

The study also employed the gravity model of international trade to explore the effect of standards and regulations on Ghanaian fish exports. The fundamental assumption underlying the gravity model is that, the volume of trade between any two countries is an increasing function of their national incomes and a decreasing function of the geographical distance between them (Head and Mayer, 2013). The study used the conceptual framework espoused in Figure 1 to demonstrate the effect of standards and other measures on fish exports.



Source: Bernice Avogbedor M. Phil Thesis Fieldwork, 2016

Figure 1: Conceptual Framework

We follow the literature and used a gravity model that has been augmented to include other variables which affect international trade. The augmented gravity model is thus expressed as:

$$\ln TTGHEU = \beta_0 + \beta_1 \ln PRFISH + \beta_2 \ln GDPEU + \beta_3 \ln GDPGH + \beta_4 EXRATE + \beta_5 INFLAT + \beta_6 STDS + U_{it}$$

Where ln TTGHEU denotes the logarithm of fish export volume from Ghana to EU, ln PRFISH denotes logarithm of the average price of fish; ln GDPEU denotes logarithm of GDP per capita of the EU, and ln GDPGH denotes the log of GDP per capita of Ghana; EXRTE denotes the cedi euro exchange rate; INFLAT is for inflation; and STDEU denotes imposition of Standards and Regulations of the EU which is captured as a dummy.

Results

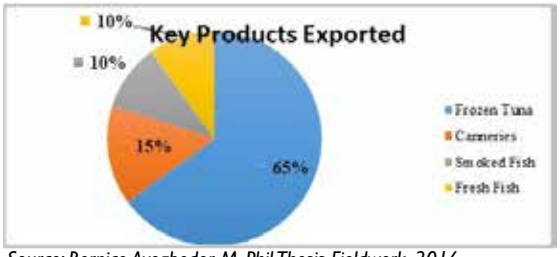
Survey Results

This gives the characteristics of the respondents; followed by the results on effects of fish standards and regulations on volume of fish exports. Finally, discussion on the factors influencing the Ghanaian fish exporting companies' compliance to EU fish standards and Regulations are discussed.

Characteristics of key officials of fish exporting companies

Most of the key officials for the fish exporting companies were aged between 30 and 49 years, representing 70 percent of respondents. All the respondents are males. 60 percent of these CEOs or key officials of the fish exporting companies had attained tertiary education (that is hold Higher National Diploma, Degree, or a post graduate degree). Furthermore, 60 percent of fish exporting companies have been in business for over 15 years while 25 percent have been in business for one to five years (1-5 years). Thus, the majority of them have been in business before the implementation and enforcement of the fishery standards by the EU since 1998.

Products Exported



Source: Bernice Avogbedor M. Phil Thesis Fieldwork, 2016

Figure 2: Key export products

Figure 2 presents the key products that are being exported by the fishing companies. 65% of the companies export frozen or chilled tuna and 15% percent exported canned tuna. The smoked fish and fresh fish were exported by 10% each. The EU community in 2004 passed a regulation (Council Regulation (EC) No 379/2004) opening and providing for the running of autonomous tariff quota for certain fishery products for the period 2004-2006. These regulations were put in place to get enough supply of raw material materials to feed their processing industries.

The exporters stated that they took advantage of these regulations since there were no tariffs on unprocessed fish products. However, Canned Tuna and Tuna loins (a semi-processed product for use in canning) attracted a Most Favoured Nation (MFN) import duty rate of 24% (Mensah, 2010).

The Ghana Export Promotion Authority data for all fish exports in 2015, showed that in terms of value, Fresh or chilled tuna was 78.4% of exports to the EU, while other fresh or chilled fish amouted to 10.4% this reflects the importance of frozen tuna in the sample examined. In terms of sources of the fish catch for export 75% of the exporters caught fish both in Ghanaian and foreign waters, the remaining 25% sourced from only Ghanaian sources.

Compliance Issues

It was revealed by the companies who have been in the business for a very long time that they incurred a high cost for complying with the EU fish standards in the short run but these have been beneficial in the long run. This confirms the observation by Kareem (2014) that the producers/exporters might incur some compliance costs in the short run, but in the long run, these costs will stabilize and thereby enhance their exports to these markets. The key costs to them were those for freezing, fuel and imported inputs. Another complaint was the directive given by the Customs division that fish caught in foreign waters were imported, so import duties had to be paid on them.

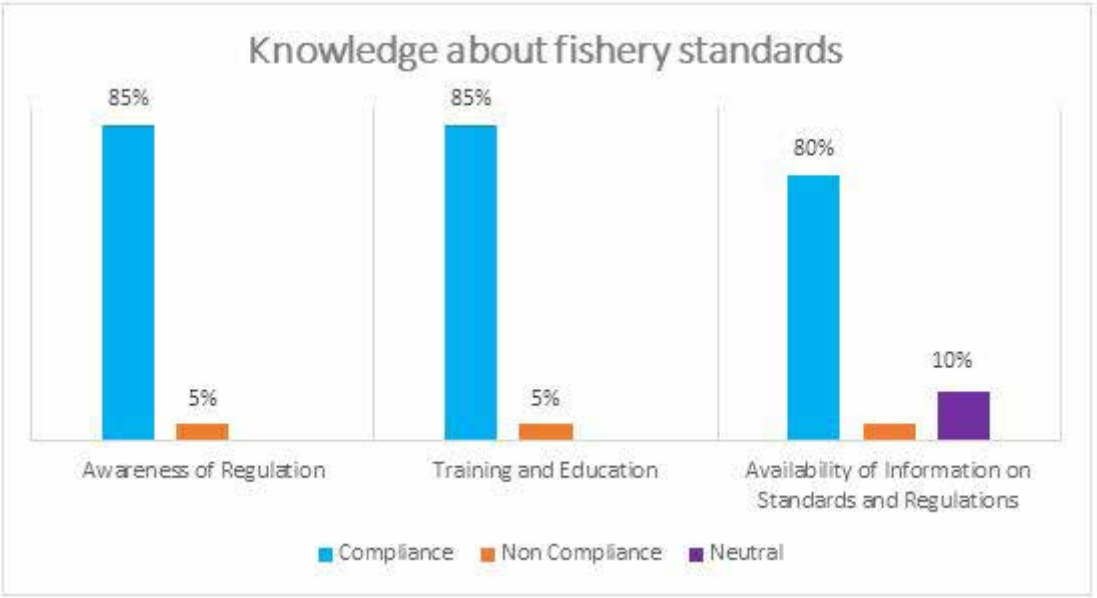
Respondents were asked about their knowledge of the existence of the Competent Authority (CA) the main one being Ghana Standards Authority in this case, and other institutions to help achieve compliance. 85 percent of the respondents which is the majority acknowledge the fact that the existence of these institutions helped them comply with the EU measures.

These institutions played a vital role when it came to ensuring fish exporters adhering and complying with EU standards and regulations with regards to fish exports. The CA for fish control was established to enforce the standards for fish exports. The CA control was established in 1998 under the Inspectorate Division as the Fish Control and Export Development Project within the GSA. The main institution is the Ghana Standards Authority (GSA) other institutions which play some roles are the Ministry of Trade and Industry (MoTI),

the Food and Drugs Authority (FDA), the Fisheries Commission (FC) and Customs. GSA was responsible for establishing and enforcing standards, conducting inspections, testing of accredited and proficiency proof equipment and certifying products and management systems.

All the respondents responded positively about the inspection of the activities carried out to enable them export their products. The exporters reported that the competent authority (GSA) carried out inspections regularly and effectively. One of the important factors that influence the fish exporting companies' compliance to the standards and regulations is the knowledge about the fisheries laws and regulations. Exporters are given training and education to create awareness of the existence of standards and regulations, why there was the need for fish standards and the consequences of not meeting those requirements.

The survey, as illustrated in Figure 3 below, showed that knowledge about the fisheries standards and regulations can influence exporters' compliance. 95 percent of the fish export companies interview stated that awareness is been created about the regulations and it made them comply with the rules. Awareness had also been created through training and education by the GSA. 95 percent of the respondents also agreed that, they have been trained and educated on the standards and the regulations which had been done regularly.



Source: Bernice Avogbedor M. Phil Thesis Fieldwork, 2016

Figure 3: Knowledge about Fishery Standards

80 percent of respondents stated that there was sufficient available information for them from the CA on the EU measures and their updates. The CA visited their various establishments and sometimes conducted workshops to update them on current issues particularly when new standards are put in place in a similar manner to what was done for Mauritius (Neeliah *et al*., 2011).

Punishment

The punishment that fish exporters received made them to comply with the standards and regulations. According to Ghana Standard Authority those who did not comply were given warning letters, if non-compliance continued after three warnings they were delisted and suspended. Sometimes there were border detentions and rejection of the

fish exported. Banishment of the exporting country is a punishment given for non-compliance. So for fear of being banished from exporting especially to the EU market, made the exporters to comply with the standards and regulations.

Ghana in 2013 was partially banned from exporting to EU due to non-compliance of the EU regulations especially on IUU fishing. In 2015 the banned was lifted and the Government of Ghana made undertakings to enforce overall fishery regulations including those on IUU fishing and install tracking mechanisms on fishing vessels.

The border rejection and detention was as a result of exporters not being able to meet the food safety and quality requirement. The Codex Alimentarius includes standards for all the principal foods, whether processed, semi-processed or raw, for distribution to the consumers. It includes general provisions in respect of:

i. contaminants; (chemical and biological contaminant)
ii. food additives;
iii. food hygiene;
iv. inspection and certification;
v. labelling and presentation;
vi. methods of analysis and sampling;
vii. pesticide residues;
viii. Veterinary drug residues.

Chemical and the biological contaminants in fish and the fishery products had their various limits and refusal to meet those limits led to the rejection of the product. Packaging, marking and labeling requirements were also to be met for the product to be allowed into the EU.

Cost of compliance

Table 1 shows how exporters reacted to cost incurred in complying or otherwise, with the EU standards and the regulations. The table shows that 45 percent agree that costs influence their decision to comply. If the cost of compliance is too high, exporters may turn out to or not to comply. This decision may be based on the amount of fine that has to be paid. If the amount is very high then the probability of not complying will be low but if charges are low or nothing is charged for non-compliance then, the probability of not complying will be very high.

There are issues whereby exporters may be taken to court for violations of the regulations and rejection or detention of the consignments. 30 percent of the fish exporters also argued that cost does not make them to comply or not to comply since the EU standards and regulations are mandatory and refusal to comply means no market access.

To conclude this section the results emanating from the survey are now summarized. The respondents pointed out the high cost of inputs for the domestic fishing companies. They noted the case that, fishing outside the demarcated waters of Ghana was currently considered as importation of fish and as such huge import duties were imposed by the Customs Service. This issue adds up to the exporters cost which invariably reduces export volumes.

The cost of compliance to EU's standards and regulations has been reported to influence the decision to comply. These costs are quite remarkable and tend to reduce compliance levels. However, non-compliance means no access to EU markets and thus, exporting companies with the financial resources adhere to them.

The study also found the existence, inspections, training and testing done by the competent authority influenced exporters compliance to EU's standards and regulations. Exporters are required to locally pass all standard tests by the Ghana Standards Authority (GSA) before exporting. In case of non-compliance, the goods are rejected and penalties are levied on defaulters.

Finally, there is a lag between when new standards are formulated and when exporters are acquainted with them. The EU periodically reviews these standards and regulations regarding the export of fish and fishery products. However, the Competent Authority periodically trained exporters on the emergence of new standards and regulations and how to comply with them.

Table 1: Cost of compliance

Compliance Costs	Number of Respondents	Percent
Influence compliance	9	45
Influence non-compliance	5	25
Indifference	6	30
Total	**20**	**100**

Source: Bernice Avogbedor M. Phil Thesis Fieldwork, 2016

Results from the Gravity Model

We follow the literature and use an augmented gravity model for the estimations. The augmentation involves the inclusion of additional variables that can also affect international trade; in this case, a dummy for standards and regulation. The augmented gravity model is thus expressed as:

$$\ln TTGHEU = \beta_0 + \beta_1 \ln PRFISH + \beta_2 \ln GDPEU + \beta_3 \ln GDPGH + \beta_4 EXRATE + \beta_5 INFLAT + \beta_6 STDS + U_{it}$$

where ln TTGHEU denotes the logarithm of fish export volume from Ghana to the EU, ln PRFISH denotes logarithm of the average price of fish; ln GDPEU denotes logarithm of GDP per capita of the EU, and ln GDPGH denotes the logarithm of GDP per capita of Ghana; EXRTE denotes the cedi euro exchange rate; INFLAT is for the inflation rate; and STDEU denotes a dummy for the imposition of Standards and Regulations of the EU.

Johansen Test for Co-Integration

Having verified that all the variables are integrated of order I (1) and the optimal lag length is two, the next step was to determine the number of co-integrating equations in the model. The Johansen cointegration method was used by examining the maximum eigenvalue statistic and the trace statistic. The results are presented in Table 2.

Both the maximum eigenvalue statistic and the trace statistic suggest that there is at least four cointegrating equation among the logs of TTGHEU, PRFISH, GDPEU, GDPGH, EXRATE and INFLAT. The null hypothesis of no co-integration on the fifth row is rejected at a 5% significance level for both the maximum eigenvalue statistic and the trace statistic. The decision rule here is that, we reject the null hypothesis if the trace statistic is greater than the critical value. We cannot reject the null hypothesis of no cointegration vector in favour of four cointegrating vector since both trace statistic and max statistic are less than the critical value at 5 percent significance level. The trace statistic (14.6883) is less than the critical value (15.41). We conclude here that there exists a long run relationship between the variables under consideration.

For the purposes of this paper, instead of considering the four separate cointegrating equations, only the one with the logarithm of fish export volumes from Ghana to the EU as the dependent variable is explored. Accordingly, the long run and short run results are presented in Table 3 and Table 4 respectively. In the long run all the variables are statistically insignificant with the exception of the logarithm of the average price of fish, which is statistically significant at 1%. The effect is negative. By implication, an increase in the price of fish decreases the volume of fish export to the EU. More specifically, one percent increase in the price will cause the volume of fish exported to reduce by 0.78 percent and is statistically significant. Intuitively, one would expect a country to export more of a product that has a high average international price. The negative effect of average prices on fish export to the EU may be due to the general decline in the volume of fish stock in Ghana. For the past few years, the stock of fish export from Ghana has not been declining.

Table 2: Johansen Test for Co-integration

Maximum				Trace	5% critical	Max	5% critical
Rank	**Parms**	**LL**	**Eigenvalue**	**Statistics**	**Value**	**Statistics**	**Value**
0	42	-125.72	.	161.98	94.15	47.66	39.37
1	53	-101.89	0.82	114.32	68.52	41.44	33.46
2	62	-81.17	0.77	72.88	47.21	30.24	27.07
3	69	-66.05	0.66	42.65	29.68	27.96	20.97
4	74	-52.07	0.63	14.69*	15.41	12.42*	14.07
5	77	-45.87	0.36	2.27	3.76	2.27	3.76

Source: Bernice Avogbedor M. Phil Thesis, 2016

Table 3: Long Run Cointegration Equation

Variables	**Coefficient**	**Std. Err.**	**T**	**P>|t**
Ln PRFISH.	-0.78	0.16	-4.92	0.00
Ln GDPEU	0.96	1.62	0.59	0.56
Ln GDPGH	-0.18	0.96	-0.18	0.86
EXRATE	-0.06	0.70	-0.08	0.94
INFLAT	-0.03	0.03	-1.10	0.28
STDS	0.92	0.92	0.79	0.44
Constant	9.46	13.70	0.69	0.50

Source: Bernice Avogbedor M. Phil Thesis, 2016

Table 4: Error correction model

Error Correction Model				
Variables	**Coefficient**	**Std Error**	**z-statistic**	**Prob.Value**
ECT1	-0.86	0.38	-2.25	0.02
D (Ln PRFISH)	0.02	0.34	-0.84	0.40
D(Ln GDPEU)	-1.32	4.18	-0.32	0.75
D(Ln GDPGH)	-3.06	2.00	-1.53	0.13
D(EXRATE)	-1.68	2.04	-0.82	0.41
D(INFLAT)	0.01	0.04	0.39	0.70
(STDS)	5.88	1.55	0.000	0.00
Constant	0.15	0.42	0.36	0.72

Source: Bernice Avogbedor M. Phil Thesis, 2016

In the short run, the only statistically significant variables are standards and regulations as well as the error correction term. Standards and regulations tend to have a positive effect on the volume of fish export to the EU. Standards and regulations increase the volume of fish export to the EU by 5.88 percent. This result was supported by the survey responses since the large fish export companies stated that they benefitted from compliance despite the initial costs. They were able to export to the EU market. The results also confirm the result of Kareem, (2014) that EU standards have positive effect on volume of fish export at the extensive margin. They attributed the reason for the positive impact

of standards on the volume of fish export to the assistance received from the Competent Authority. This result is not consistent with the conclusion made by Mangelsdolf *et al*. (2012), Xiong and Beghin (2011), Lui and Yue (2011), Reyes (2011) on the effect of standards on export.

The error correction terms (ECT1), it is correctly signed and statistically significant at 5%. The ECT1 shows that, the annual volume of fish exports converges or adjusts towards the long run equilibrium and the speed of adjustment is 86 percent, which is very rapid. Thus, in the short run exports adjusted by 86 percent of the previous year's deviation from equilibrium in case of disequilibrium.

Conclusions

Ghana has to meet the European Union standards and regulations as a requirement to get access to that market for its fish exports. We have analysed the effect of the EU Fish standards and regulations on Ghanaian fish exports. The standard gravity model was used with time series data spanning from 1986 to 2015 for the empirical analysis. The study found that standards for fish had a positive effect on volume of fish exports in the short run. In the short run the effect was statistically significant and but insignificant in the long run. The study suggests that Ghana and other African countries must ensure full compliance to EU standards, through improved handling and adherence to guideline provided by the competent Authority. The Standards would help them to improve exports to the EU and African markets.

Lessons on how to encourage Small-Scale Fish Traders and exporters comply with Standards and Regulations

Even though this study largely focused on large scale fish trading companies, valuable lessons can be drawn on how to regulate small-scale fish traders operating between Ghana and her neighboring countries.

Stakeholders benefit from being aware of the standards and the regulations that exist. Thus intensive training and education should be given on compliance issues and their long term and short term benefits. The small scale fish farmers, producers, and traders should also be educated and trained on safety standards and fishery regulations in order to take advantage of fish export markets.

Since food safety and handling should not be taken lightly. Local authorities could have the already existing fishery associations and stakeholders could be trained by the Standards Authority or Fisheries Commission staff to be aware of Standards and Regulations pertaining to fishery activities of the sub-region. With the existence of these groups, monitoring and evaluating the operations of scale-scale fish traders may become better and more widespread.

The cost of compliance to standards and regulations has been found to largely affect the persistence of complying with them. Government whether at the national or local level could subsidize the cost incurred in the short run for complying with standards and regulations regarding fish trade. This initiative will encourage small-scale fish traders to comply with these regulations.

Acknowledgement

Special thanks to WorldFish Center, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under the Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa", following the Malabo Declaration at the 2014 Summit African Heads of States and Governments in Equatorial Guinea. The funding was made possible through the assistance from the European Union.

References

Alavi, R. (2009) Sanitary standards in the EU: the impact of Malaysian fishing industry. Journal of Economic Cooperation and Development, 30 (4). pp. 51-86.

Anders J.A & Caswell S.M (2009). Standards as barriers versus standards as catalysts: assessing the impact of HACCP implementation on US seafood

imports. American Journal Agricultural Economics., 91(2), 310-321.

Ardakani, I.Z. S. Yazdani and O. Gilanpour, 2009, Studying the Effects of Non-Tariff Barriers on the Export of the Main Agricultural Products of Iran, American Journal of Applied Sciences 6 (7): 1321-1326, 2009

DaSilva, D.A. (2010). Impact of US HAACP regulation on export of fish and fishery products from Guyana. 7th Quest for Global Competitiveness Conference, San Juan, Puerto Rico.

European Commission. (2006). Food and Veterinary Office. European Commission, Brussels. Available from: http://europa.eu.int/comm/food/fvo/how_en.htm, Accessed on 17 November 2015].

Hausman, W.H., Lee, H.L. and U. Subramanian (2005): Global Logistics Indicators, Supply Chain Metrics, and Bilateral Trade Patterns. World Bank Policy Research Working Paper No. 3773. http://ssrn.com/abstract=869999.

Head, K., & Mayer, T. (2013). Gravity equations: Workhorse, toolkit, and cookbook. HAL CCSD

Henson, S. J., & Mitullah, W. (2004). Kenyan Exports of Nile Perch: Impact of Food Safety Standards on an Export-Oriented Supply Chain. A Case study for World Bank programme on the Challenges and Opportunities Associated with International Agro-Food Standards. World Bank, Washington, D.C.

Henson, S. (2008). International Food Economy Research Group, Public and private incentives to adopt enhanced food safety controls. University of Guelph.

Henson S. & Steven Jaffee (2007) Food Safety Standards and Trade: Enhancing Competitiveness and Avoiding Exclusion of Developing Countries, The European Journal of Development Research, 18:4, 593-621, DOI: 10.1080/09578810601070753

Henson, S., Loader, R., Swinbank, A., & Bredahl. M. (1999). Impact of sanitary and phytosanitary measures on developing countries. No. Folleto 434. University of Reading, Department of Agricultural & Food Economics, 2000.

Henson, S. J., Broberg, A., & Humphrey, J. (2009). The Impacts of Private Food Safety Standards on the Food Chain and on Public Standard-Setting Processes. ALINORM 09/32/9D Part II (Rome: Codex Alimentarius Commission).

Henson, S. J., and Jaffee, S. M. (2008). Understanding developing country strategic responses to the enhancement of food safety standards. The World Economy, 31(1), 1-15.

Joint Integrated Technical assistance Programme (JITAP) Cluster 12 (2002): www.jitap.org/

Kareem, O. I. (2016). European Union's Standards and Food Exports from Africa: Implications of the Comprehensive Africa Agricultural Development Programme for Coffee and Fish Journal of African Development (2016) 18:83–97

Kareem, O. I. (2014). The European Union sanitary and phytosanitary measures and Africa's exports.

Liu, L., & Yue, C. (2011). Investigating the Impact of SPS Standards on Trade Using a VES Model. European Review of Agricultural Economics, 2, 1-18.

Mangelsdorf, A., Portugal-Perez, A., & Wilson, J. S. (2012). Food standards and exports: evidence for China. World Trade Review, 11(03), 507-526.

Martinez-Zarzoso, I. (2003): Gravity Model: An Application to Trade Between Regional Blocs. AEJ, Vol. 31, No. 2, pp. 174-187

Martinez-Zarzoso, I. and Marques-Ramos, L., (2007), ☐The Effect of Trade Facilitation on Sectoral Trade☐, Discussion Paper No. 167, Dec. 2007, University of Gottingen, Germany.

Márquez-Ramos, L., Martínez-Zarzoso, I., & Suárez-Burguet, C. (2010). Trade Policy versus Trade Facilitation: An Application Using' Good Old' OLS. Economics Discussion Paper, 38.

Mensah, I. (2010). An analysis of the performance of Ghanaian canned tuna export to EU market (1999-2009). (A published Master's thesis). University of Tromso. Retrieved from http://hdl.handle.net/10037/2919

Moise, E., & Le Bris, F. (2013). Trade Costs-What have we learnt: A synthesis Report. Florence: OECD Publishing.

Neeliah, S. A., Neeliah, H., & Goburdhun, D. (2011). Sanitary and phytosanitary issues for fishery exports to the European Union: a Mauritian insight. Journal of Development and Agricultural Economics, 3(2), 56-68

Neeliah, S. A., Goburdhun, D., & Neeliah, H. (2014). Are Mauritian fishery exporters minding the standards gap? Agrekon, 51(1), 59-82. http://dx.doi.org/10.1080/03031853.2012.649539

Reyes, J. (2011). International Harmonization of Product Standards and Firm Heterogeneity in International Trade. Washington: World Bank Policy Research Working Paper

Tran, N., Wilson, N., Hite, D. (2013) In: Beghin, J.C. (ed.) Nontariff Measures with Market Imperfections: Trade and Welfare Implications. (Frontiers of Economics and Globalization) 12: 127-148

Swinnen J. and Miet Maertens .2008. Standards, Trade and Developing Countries,Note prepared for the World Bank, Trade and Research Departments, for the Project on Adjustment Costs to Trade, Version 4 June 2009, siteresources.worldbank.org/INTRANETTRADE/.../Standards_Swinnen.pdf

Xiong, B., & Beghin, J. (2011). Aflatoxin redux: Does European Aflatoxin regulation hurt groundnut exporters from Africa? Iowa State University, Department of Economics Staff Research Paper, 21-50

Yunus, M., (2009), EU Ban, HACCP Compliance and Shrimp Exports from Bangladesh. The Bangladesh Development Studies Vol. XXXII, No. 3.

TRADE MEASURES TO DETER ENTRY OF ILLEGALLY CAUGHT FISHERIES PRODUCTS INTO MARKETS IN TANZANIA

Jovice Mkuchu[1]***, Robert E. Katikiro[2]
[1]Fisheries Department, Ministry of Livestock and Fisheries Development. P.O.Box 2462 Dar es Salaam, Tanzania
[2]Department of Agricultural and Natural Resources Economics and Business. University of Dar es Salaam. P.O.Box 35091 Dar es Salaam, Tanzania

Abstract

Illegal, unreported and unregulated (IUU) fishing is globally considered as a serious threat to the health of fish stocks with negative impacts on food security for countries that depend on fish resources. In many countries of the world, operators of IUU are increasing their ill-gotten revenue by 'laundering' their catches through the market and Tanzania is no exception. To enhance efforts for sustainable management of fisheries resources, Tanzania has been implementing a number of additional regulatory measures specifically trade and market-place measures to address IUU fishing. The goal is to tackle the IUU problem from the perspective of trade related actions. This paper provides an overview of the current trade and market-place measures that are being implemented in Tanzania to reinforce international fisheries conservation and management provisions with the objective of thwarting IUU fishing activities to attain sustainable fisheries management. Information for this study was collected through review of numerous reports from both government and non-governmental agencies responsible for fisheries, environmental conservation, standards, revenue and trade. The information gleaned was corroborated and validated with interviews with key informants. The findings revealed existence of policies and practices to monitor and track fish and fishery products from the time they are harvested to when they reach final consumers. These trade measures to great extent complement existing regulatory approaches to curb IUU fishing and thus facilitate IUU operators to minimize the scope for their fishing operations. Interestingly, the study found that Tanzania is increasingly investing and is currently implementing trade and market place-related measures such as catch documentation scheme and traceability system that form core incentives to IUU operators to minimize the scope for their fishing operations. The findings imply that proper and cohesive mainstreaming of fisheries regulations that build partnership between government and non-government actors is of great importance towards actions to eliminate IUU and enhance traceability for legally caught fish in both local and international markets.

Keywords: IUU fishing; trade measures; sustainable fisheries; Tanzania; traceability; fish catch

*Corresponding author email: jovicemkuchu@gmail.com

Introduction

Fish and fisheries products in Tanzania are the most traded commodity in the food sector. Government records show that the trade in fish and fishery products has become increasingly important for the economy of the country whereby in 2016 exports amounted to about 39,691,462.0 Kg, valued at USD 257,257,100.48 and 40,540,950.7 Kg valued at USD 257,029,627.5 in 2015. Despite existing potential, the contribution of fisheries sector to the national economy is still low, standing at 2.5% (MLF, 2016). The immerse potential of fisheries sector in Tanzania is yet to be tapped attributed to a number of constraints that made the sector to lag behind in the overall contribution to the country's GDP. A vast majority of the fisheries products are exported to international markets in China, Hong Kong, Singapore, United Arab Emirates, the European Union and the United States of America. Regional markets on the African continent particularly Democratic Republic of the Congo, Rwanda, Zambia and Burundi also form the main destination for fisheries products from Tanzania.

While Tanzania is one of the fishing nations in Africa, fish production has not been able to meet the growing demand for its population. Currently, Tanzania imports fish for domestic consumption from China, Vietnam, Yemen, India, Portugal, Oman, South Korea, and Spain. In 2015 a total of 16,743.964.40 Tons, valued at USD 15,338,684.90 were imported into the country. Such a trading pattern is known to have adverse impact on management of fisheries in the country with a great likelihood to boost existence of illegal, unreported and unregulated fishing (IUU) activities.

Over the past years, Tanzania has waged a war against IUU and illicit fish trade. The scourge of IUU is widely recognised for undermining national and international efforts to ensure sustainability of fisheries resources (Agnew *et al*., 2009; Pomeroy *et al*., 2007; Sumaila *et al*., 2006). The aftermath of IUU includes among others damages to fish habitats and their ecosystems attributed to overfishing and irresponsible fishing practices and associated techniques as well as threats to aquatic biodiversity (Riskas *et al*., 2018). IUU practices also violate existing laws, international obligations as well as relevant conservation and management measures (Young, 2016). It adversely impact the fisheries and associated ecosystems, food security and livelihoods for coastal communities which mostly are dependent on fisheries (Pedroza, 2013). IUU fishing also contributes to unfair trade competition between fishers and operators who abide to the rules and those who do not (Stokke, 2009). Various studies (e.g. Agnew *et al*., 2008; Edyvane and Penny, 2017; Falautano *et al*., 2018) have shown that IUU cause major threats to the sustainable development of fisheries and aquaculture resources globally.

Globally, it is widely known that IUU fishing practices can have a major impact on livelihoods, food security and economic growth in many areas of the developing countries (FAO, 2016). In recognizing the magnitude of IUU fishing operations and its adverse effects on ecosystems and community livelihoods, Tanzania have in recent years introduced new strategies and actions to combat IUU and increased the use of trade measures initiatives to stamp out any actions that threaten sustainability of fisheries resources. This paper therefore, focuses solely on trade measures designed to eliminate IUU fishing in Tanzania. It aims to provide the state of art knowledge on how such measures have been practiced included the challenges facing them. It is envisaged that the findings of this paper carry message to decision makers and researchers on country based strategies to eliminate IUU.

Recorded trends of IUU in Mainland Tanzania

IUU fishing activities can be conducted in many forms, from the use of illegal fishing methods and gears, fishing without a licence to poaching in another countries´ waters. Most of the IUU activities in the Tanzania's artisanal fisheries include the use of illegal gears such as use of dynamite to catch fish, beach seines, under mesh sized fishing gears and fishing without registration or license. Table. 1

provides a trend of IUU recorded in artisanal fisheries. The reported trend however, does not give a representative picture of the actual situation because the data came only from officially known fish landing sites. Tanzania has a significant high number of fish landings sites some of which are not served and monitored by fisheries agencies leading to unknown magnitude and extent of IUU activities.

Trade measures to control IUU or entry of IUU catches in Tanzania

The International Plan of Action (IPOA-IUU) encourages states to take steps, consistent with international law to prevent fish caught by vessels identified by the relevant Regional Fisheries Management Organizations (RFMO) to have been engaged in IUU fishing being traded or imported into their territories (Lobach, 2006). Appreciating the importance of combating IUU fishing and to align with FAO Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated fishing, Tanzania has embarked on a range of trade measures to restrict access to markets for IUU fishery products as a means of ensuring the long-term conservation and enhancing sustainability of fisheries resources. Trade or trade-related measures currently existing in Tanzania include catch documentation schemes, traceability requirements, lists of IUU vessels, and import bans.

Catch Documentation Scheme (CDS)

A catch documentation scheme is one which uses certifications at the point of harvesting and applies to all fish which are caught, landed and/or trans-shipped (FAO, 2002). The Fisheries Development Division in Tanzania is the Competent Authority responsible for certifying fish and fishery products for export to international markets. The Division has an obligation to ensure that fishery products processed, transported and traded are caught using legally methods and gears and conform to the national laws, regional and international obligations as well as specific markets requirements with regard to safety of the products in question.

The European Union in response to the international call for fight against IUU fishing initiated a war against irresponsible fishing through Council Regulation (EC) No. 1005/2008- to prevent, deter and eliminate illegal, unreported and unregulated fishing effective on 1 January 2010 (Information Note, EC Regulation 1005/2008) The regulation requires that fish and fishery products exported to the EU are accompanied by a catch certificate verified and validated by the Competent Authority in the country of origin with information about the species, catch location, fishing vessel, date of capture, and any trans-shipments that have taken place.

In order to meet the EU Regulation for the IUU, Tanzania issues a Simplified Catch Certificate for the wild caught fish and fishery products from artisanal fishers in accordance with the Council Regulation (EC) No. 1005/2008 whose model is well prescribed in commission regulation (EC) No 1010/2009 of 22 October 2009. The simplified catch documents include details on registration particular(s) of the vessel, validity of the fishing license for the current year; species and quantity supplied per vessel Area(s) where fishing was carried out,

Table 1: Trends of IUU in artisanal fisheries of Tanzania

IUU event recorded	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Beach Sein	3,602	1,358	665,141	*****	1,342	544	968
Monofilament	1,186	3,158	1,046	*****	11,952	12,222	15,753
Dynamite	25	51	129	866	73	74	17
Boat	686	807	483	505	194	359	338
Under mesh gillnets	12,412	7,659	*****	*****	20,329	7,921	3,096

*****No records were made during this year*

Source: Compiled from various reports of the Department of Fisheries (Tanzania)

name(s) of the boat/owner.

Tanzania also instituted a Catch Documentation Scheme (CDS) for importers of fish and fish products to track origins, landings and trade flows of fish and fish products of the fish entering the markets; determine whether the fish were caught in a manner consistent with the conservation measures of the fisheries management agreement; and to reinforce the already adopted fisheries management. During importation, the importer must show the catch certificate from country of origin (Regulation 92 (2) of The Fisheries Regulations of 2009 of mainland Tanzania). With this scheme in work, a number of IUU events has gone down although the exact figure is not known due to lack of baseline data. So far, the current study uncovered that Tanzania has succeeded in implementing its CDS as per international requirements and obligations.

Traceability

The FAO IPOA□IUU calls on states to take steps to improve transparency of their markets to allow the traceability of fish or fish products. Tanzania has also put in place the traceability system in all the existing fish processing establishments which allows the factory to trace individual products to individual fishermen supplying product to collectors, this scheme ensure full traceability of fish and fishery products traded within and outside the country. This was also to comply with the Article 18 of Regulation (EC) No 178/2002 that establishes the general principles of traceability of food which aims to introduce a comprehensive traceability system to track all fish and fisheries products throughout the market chain. All fish/fisheries products landed at landing site are accompanied by traceability forms and movement permits to processing and consumption. Fish only from licensed fishers and boats which do not engage in IUU fishing are accepted and given movement permit for transport from landings to processing, markets or for export.

Measures by Regional Fisheries Management Organisation

In East Africa the three countries sharing lake Victoria, through Lake Victoria Fisheries Organisation of which Tanzania is a member, have committed to tackling IUU fishing in Lake Victoria through implementation and enforcement of the Regional Plan of Action(RPOA-IUU) which was adopted in 2004. The major goal of this plan is to develop and implement coordinated, harmonized, unified, and effective management measures to prevent, deter and eliminate IUU fishing in Lake Victoria and its basin. In line with this objective, the plan defined the scope and nature of IUU fishing activities which restricts use of certain fishing gear, as well as prohibits fishing in closed areas. Based on this plan, the countries put efforts to pin down the use of illegal fishing gears, practices and control the size of Nile perch fish in Lake Victoria. Recently, Tanzania has initiated special efforts to curb the IUU fishing. The operation dubbed as "Operation Sangara" began effectively early 2018 and is shown to have yielded remarkable results. It is too early however to comment on the long term outcomes of the operation taking into account the short span it has already taken place.

Tanzania has been a member of the Indian Ocean Tuna Commission (IOTC) — a regional Fisheries Management Organisation (RFMO) which is an intergovernmental organisation responsible for the MANAGEMENT of tuna and tuna-like species in the Indian Ocean since 2007. As a member of IOTC the country is required to abide with the several resolutions made by IOTC members partners. The implementation is done through the Deep Sea Fishing Authority (DSFA), covering the Exclusive Economic Zone (EEZ) and excluding the territorial sea. These trade-related measures includes:-

Vessel lists and the prohibition of transhipment of IUU fish product

IUU fishing Vessel lists have been drawn up by the IOTC with the aim of identifying legal operating fishing vessels and illegally operating. Tanzania as a member of the commission used

it to identify those vessels engaged in IUU fishing in order to smooth the progress of the prohibitions on landings and transhipment. Tanzania is often crosschecking the IOTC list to ensure that vessels prohibited are not plying in its EEZ.

Port and flag state control Port state measures to prevent, deter and eliminate illegal, unreported and unregulated fishing

The United Republic of Tanzania currently implement and enforce the Port State Measure (PSM) adopted by IOTC-resolution and port state measure. Tanzania has enacted a Deep Sea Regulation of 2017 which ensures inspection of fishing vessels is conducted before they get licensed according to IOTC PSM Resolution. The country has also upgrading the Vessel Monitoring System (VMS) from Met fishery to Themes System in order to expand a wide range for monitoring all fishing vessels entering its EEZ through AIS system and mirroring it to Tanzania Mainland.

In addition, Tanzania continues to conducting air patrol and sea patrol through joint venture with IOC SmartFish PRSP within the Regional Mission in order to combat and curb IUU Fishing within Tanzanian waters. Furthermore there is national Monitoring Control Surveillance (MCS) Committee for curbing IUU fishing within Tanzania waters namely Multi-Agency Taskforce (MAT) which include Ministry of Defence, Ministry of Home Affair, Ministry of Natural Resources and Tanzania Intelligent System.

Products Certification

Eco certification is an independent certifier which verifying that the products meet certain environmental criteria or standards, the schemes encourages sustainable fishing even though it does not directly target an IUU fishing. Tanzania is in the process of obtaining environmental labels of private standards from the Marine Stewardship Council (MSC) for the Octopus fishery. Tanzania has already developed management plans for octopus fishery and currently is at a stage of undertaking fish improvement programs (FIP). The MSC label will help the customs to verify that octopus products originating from fisheries have been certified according to the MSC Principles and Criteria for sustainable fishing which are line with FAO Code of Conduct for Responsible Fisheries. On the other hand there are fisheries management plans in place for prawns, small pelagic; and tuna and tuna like species. Besides the MSC certification, Tanzania has adopted certification from other sources. Currently, a number of fish processing establishments in Bukoba, Mwanza and Musoma are certified by Naturland in which their products bear an eco-label.

Legal measures and regulations

FAO IPOA-IUU necessitate national legislation to address all aspects of IUU fishing in an effective comportment. To address all these aspects, Tanzania mainland put in place a National Fisheries Policy and Strategy Statement in 2016. The overall goal of this policy statement is to promote conservation, development and sustainable management of the fisheries resources for the benefit of the present and future generations. The Tanzania Mainland Fisheries Act No. 22 of 2003 has put in place better regulation provisions related to the management and development of fisheries in the internal and territorial waters of Tanzania Mainland and matters connected therewith and incidental thereto The Fisheries Regulations 2009, provides measures regarding fishing activities in domestic waters, all vessels and fishermen shall, have a license to fish and Regular patrols will be conducted to inspect. Fisheries is not a Union matter thus the Legal system applied in Tanzania on fisheries is differed in terms of territorial water and EEZ. Each party managed its territorial water but in term of EEZ both Tanzania Mainland and Zanzibar collaborate on managing the EEZ through Deep Sea Fishing Authority Act No. 1 of 1998 (as amended 2007) and Deep Sea Fishing Authority Regulations which established the Deep Sea Fishing Authority (DSFA) to regulate deep sea fishing (and other uses) in the EEZ.

Stakeholders in combat of the IUU

IUU fishing is a dynamic and complex problem that cannot be effectively addressed by any single approach, its solution requires coordinated efforts of numerous different actors at multiple levels across the country. Many of such approaches at international, regional and national levels require involvement of stakeholders in fisheries sector. Tanzania have been carrying out many initiatives to address the challenges of illegal fishing predominantly in the area of monitoring, control and surveillance (MCS) both in inland and marine waters including the EEZ. This have been implemented together with several stakeholders among them including the international players like European Union (EU)-funded and IOC-through SmartFish programme which provides funding, training and expertise; and international NGO especially World Wide Fund for Nature.

At national level the country established a Governmental Multi-Agency Task Team (MATT) in 2014 under the lead of Tanzania's Police. The MATT is designed to address organized environmental crime including fishery crimes such as blast fishing and IUU fishing. On the other hand, the government, through the Fisheries Act Number 22 of 2003; Section 18 and its principal Regulations of 2009; Regulation 133–136, provides for establishment of participatory resource management approach by involving local fishing communities, a system commonly known as co-management through Beach Management Units. The government decided to involve local communities in fisheries management through Beach Management Units (BMU) as they are the beneficiaries, they have vast experience and indigenous knowledge on the behavior of the fishery resources and they are the first to suffer when the resource is completed. This brings advantage to them (BMU) to be involved in managing the resources, protect, conserve, utilize in a sustainable manner and involved in decision making, conservation and protection of fish in their locality in collaboration with the government (Sobo, 2012).

Outcome of the efforts to deter and control IUU

The country has good policies and practices in place to monitor and track fish and fishery products from the time the fish are caught to when they reach final consumers. It is revealed that, these trade measure to address IUU fishing in the country to great extent complement existing regulatory approaches to curb IUU fishing and thus facilitate IUU operators to minimize the scope for their fishing operations. More efforts is needed to have a proper and cohesive mainstreaming of fisheries regulations that will build partnership between government and non-government actors is of great importance towards actions to eliminate IUU and enhance traceability for legally caught fish in both local and international markets.

Conclusion

Tanzania like many other developing countries is known to have suffered disproportionally due to IUU. The wide spread impacts of IUU on Tanzania's economy and aquatic ecosystems are known. Implementation of trade measures as elaborated in this paper has in part, helped the country to forge and create environment to thwart new entry and expansion of IUU activities. Measures which are implemented, despite their inherent weaknesses as helped to stop coming of IUU catches. While other developing countries may borrow a leaf from Tanzania, it remain clear whether trade and trade based measures will offer long term solution to IUU as the operators are also changing their strategies every now and then. All in all, proactive actions are required and the measures discussed in this paper offer a theoretical background that could be adopted by other countries.

References

Agnew, D., Pearce, J., Peatman, T., Pitcher, T.J., Pramod, G., 2008. The global extent of illegal fishing, MRAG, London, UK, and FREE, Fisheries Centre, UBC, Vancouver.

Agnew, D.J., Pearce, J., Pramod, G., Peatman, T., Watson, R., Beddington, J.R., Pitcher, T.J., 2009. Estimating the worldwide extent of illegal fishing. PLoS ONE 4, e4570.

Council Regulation (EC) no. 1005/2008 of 29 September 2008 establishing a community system to prevent, deter and eliminate illegal, unreported and unregulated fishing.

Edyvane, K.S., Penny, S.S., 2017. Trends in derelict fishing nets and fishing activity in northern Australia: Implications for trans-boundary fisheries management in the shared Arafura and Timor Seas. Fish. Res. 188, 23–37. https://doi.org/10.1016/j.fishres.2016.11.021

Falautano, M., Castriota, L., Cillari, T., Vivona, P., Finoia, M.G., Andaloro, F., 2018. Characterization of artisanal fishery in a coastal area of the Strait of Sicily (Mediterranean Sea): Evaluation of legal and IUU fishing. Ocean Coast. Manag. 151, 77–91. https://doi.org/10.1016/j.ocecoaman.2017.10.022

FAO. 2004. "Report of the Twentieth Session of the Codex Committee on General Principles." Joint FAO/WHO Food Standards Programme, Codex Alimentarius Commission. ALINORM 04/27/33A. Paris, France. 3-7 May

FAO. 2016 The State of World Fisheries and Aquaculture 2016, Food and Agriculture Organization of the United Nations, Rome,p. 200

Information Note; EC Regulation 1005/2008. To Prevent, Deter And Eliminate Illegal, Unreported And Unregulated (IUU) Fishing;. https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/information_note01_en.pdf

Lobach, T., 2006. Port measures to combat IUU fishing: The FAO model scheme on port state measures (No. FAO/FFA regional workshop to promote the full and effective implementation of port state measures to combat IUU fishing). FAO, Nadi, Fiji.

Pedroza, C., 2013. Middlemen, informal trading and its linkages with IUU fishing activities in the port of Progreso, Mexico. Mar. Policy 39, 135–143. https://doi.org/10.1016/j.marpol.2012.10.011

Pomeroy, R., Parks, J., Pollnac, R., Campson, T., Genio, E., Marlessy, C., Holle, E., Pido, M., Nissapa, A., Boromthanarat, S., Thu Hue, N., 2007. Fish wars: Conflict and collaboration in fisheries management in Southeast Asia. Mar. Policy 31, 645–656. https://doi.org/10.1016/j.marpol.2007.03.012

Riskas, K.A., Tobin, R.C., Fuentes, M.M.P.B., Hamann, M., 2018. Evaluating the threat of IUU fishing to sea turtles in the Indian Ocean and Southeast Asia using expert elicitation. Biol. Conserv. 217, 232–239. https://doi.org/10.1016/j.biocon.2017.10.011

Stokke, O.S., 2009. Trade measures and the combat of IUU fishing: Institutional interplay and effective governance in the Northeast Atlantic. Mar. Policy 33, 339–349. https://doi.org/10.1016/j.marpol.2008.08.002

Sumaila, U.R., Alder, J., Keith, H., 2006. Global scope and economics of illegal fishing. Mar. Policy 30, 696–703. https://doi.org/10.1016/j.marpol.2005.11.001

Sobo, F. (2012) Community Participation in Fisheries Management in Tanzania. IIFET, Dar es Salaam,

Young, M.A., 2016. International trade law compatibility of market-related measures to combat illegal, unreported and unregulated (IUU) fishing. Mar. Policy 69, 209–219. https://doi.org/10.1016/j.marpol.2016.01.025

MARKETING OF SMALL PELAGIC SPECIES IN MALAWI AND ZAMBIA: A VALUE CHAIN ANALYSIS

Bonface Nankwenya*[1], Emmanuel Kaunda[2], Lisungu Banda[2], Sloans Chimatiro[3], Happy Mussa[2], Jabulani Nyengere[2] and Keagan Kakwasha[3]

[1]Department of Agriculture and Applied Economics, Lilongwe University of Agriculture and Natural Resources, Bunda College of Agriculture, Lilongwe, Malawi

[2]Nepad Regional Fishnode

[3]World Fish Center, Lusaka, Zambia

Abstract

The small pelagic species are very important in ensuring household food security and improving the nutrition status of the low income households, and providing business opportunities to thousands of people from rural communities. Usipa (Engraulicypris sardella) and Kapenta (Limnothris samiodon) are some of the small pelagic species that are produced and marketed in large quantities domestically in Malawi and Zambia respectively. The aim of this study was to conduct a value chain analysis of Usipa and Kapenta. Marketing margins of Usipa were calculated for the various actors and the results showed that Fishers had the highest marketing margins of MK 1753.4, while the processors, the majority of whom were women, were found to have negative net marketing margins of MK 437.2. For Kapenta, it was found that all the actors had a positive net marketing margin, with the highest net marketing margin being observed amongst the wholesalers (K 6.12) and fishers (K 6.05) and the lowest net marketing margin was observed among the retailers (K 0.8). The study recommends the development and/or facilitation of the adoption of appropriate technologies that will help reduce post-harvest fish losses especially among the processors. The study recommended that it is also important to empower the women traders, by among others, increasing their access to financial resources and mainstreaming gender in fisheries and aquaculture related policies.

Keywords: Value chain analysis, Usipa, Kapenta, Marketing efficiency, marketing margin

Corresponding authors email: bonnank@gmail.com

Introduction

Fish is an important source of subsistence and income for a large number of people in Africa. The fishery sector in Africa plays an important role in the areas of rural development, improved livelihood, food security and nutrition and trade. The sector contributes about 1.25% to the African Gross Domestic Product (GDP) and an estimated 6.0 percent to Agriculture (African Union Commission – New Partnership for Africa's Development (AUC-NEPAD, 2014). The fishery sector of most Member States consists of capture fisheries and aquaculture. Fishery production in Africa as of 2015 was estimated at 10.7 million tonnes of fish, comprising of 8.8 million tonnes from capture fisheries and 1.9 million tonnes from aquaculture (FAO, 2016).

Fish and fishery products are ranked among the most traded food commodities globally, with developing countries accounting for the bulk of the world's fish exports (Food and Agriculture Organization [FAO], 2012). Fish and fishery products exported from developing countries comprise 20% of all agricultural and food processing exports. About 40% of fish production is traded internationally, having an export value of US$58.2 billion. Collaboration amongst African countries on fisheries has been facilitated mostly at the sub-regional level, with a large number of Regional Fishery Bodies (RFBs) and RECs actively involved. The African Union (AU) established a fisheries unit within the African Union Commission, the Inter-African Bureau for Animal Resources (AU-IBAR), in order to support region-wide coordination and reform. The Fisheries Policy framework and Reform strategy for fisheries and Africa support the coherent and coordinated development of the sector in the African continent within the framework of the Africa fisheries reform mechanism.

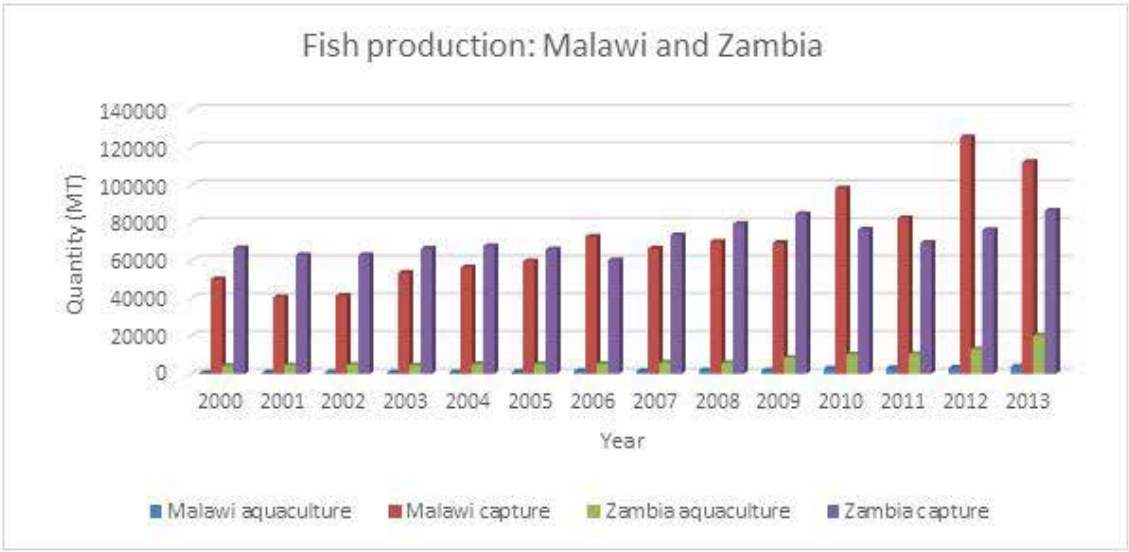
In Malawi, fishing is one of the sectors that greatly contribute to the livelihoods of rural population and economic growth. This is evidenced by the fact that close to 20 percent of the land is under water (Malawi Government, 2012). The fishing sector provides 4 percent of Malawi's Gross Domestic Product (GDP) and employs close to half a million people, directly through fishing and indirectly through other activities within the Fish value chain. Malawi is one of the countries with the highest dependency on fish as a source of animal protein in Africa. Fish accounts for an estimated 28% of the total animal protein consumed (Russell *et al*., 2008). Per capita fish consumption currently stands at 7.3kg per year, which is lower than the World average and that recommended by World Health Organization.

Similarly, the fisheries sector is one of the important sectors in Zambia, contributing one percent on average to the GDP (Musumali *et al*., 2009). The fisheries sector in Zambia supports more than 300 000 people in employment and income generation and reducing poverty (FAO, 2006). These people derive their livelihood directly as fishers and fish farmers, or indirectly as traders, processors and other service providers. With 48% of the Zambian population undernourished, and 15% of children under the age of five moderately or severely underweight, fish remains one of the important sources of animal protein. Fish and fish products account for more than 20 percent of animal protein intake in Zambia. The Per capita fish consumption in Zambia stands at 7 kg person (NFDS Africa, 2016).

On average, Malawi's capture production has been on the rise since the 1990s (Figure 1). The aquaculture sector, on the other hand, has been stagnant for Malawi while Zambia has made tremendous improvement in the recent years (Refer to Figure 1). Zambia is one of southern Africa's largest aquaculture producing countries, with a number of successful commercial enterprises. The aquaculture sector contributes negligibly to total fish supplies for both countries. Mapfumo (2015) noted that the aquaculture sector in Africa has been growing at about 10 percent per annum lately. The aquaculture sub-sector has potential for substantially increasing fish production for both countries.

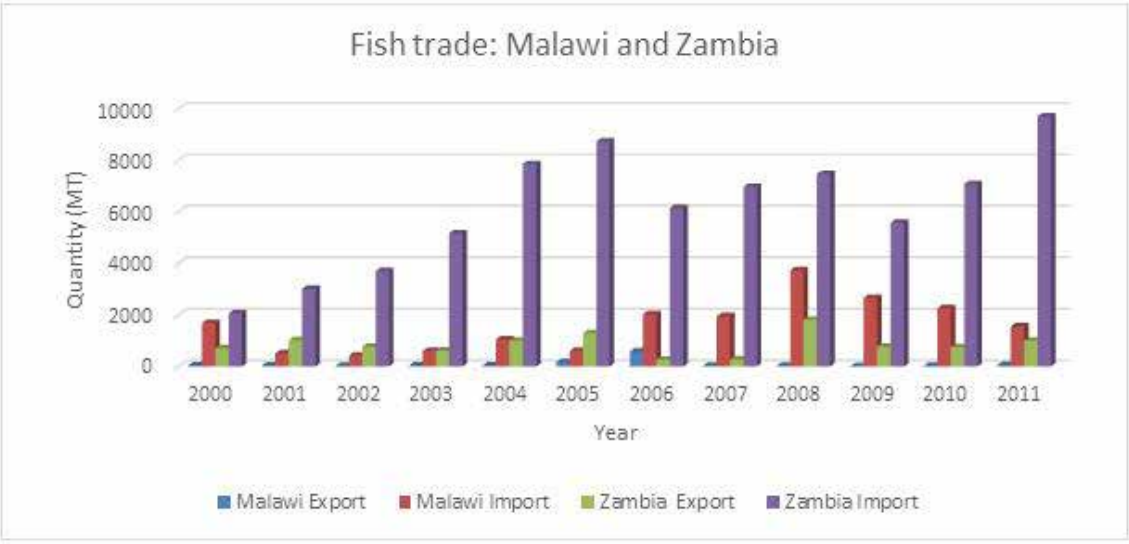
Figure 2 shows fish exports and imports for Malawi and Zambia. From the graph, it can be shown that both Malawi and

Zambia are net importers of fish. According to FAO (2006), the unsatisfied demand for fish in the local market has restricted the amounts of fish that can be exported. High population growth and increasing urbanization has resulted in high demand for fish in Zambia. The overall per-capita supply in the country has declined over the years from over 11 kg/annum in the 1970s to 6.5 kg today (Musumali *et al*., 2009). This could be one of the reasons for increased fish imports into Zambia. On the other hand, fish trade in Malawi is characterized by both formal and informal trade routes, with formal fish exports mostly limited to aquarium fish with major markets in Europe, Asia and within Africa (Malawi Government, 2011). The Malawi National Fisheries and Aquaculture Policy (2016) indicate that more than 500 tons of fish are exported annually.



Source: FAO FishStatJ, 2017

Figure 1: Fish production in Malawi and Zambia



Source: FAO FishStatJ, 2017

Figure 2: Fish Trade balance in Malawi and Zambia

Problem statement and rationale

Fish is one of the most important sources of animal protein for both Malawi and Zambia, providing more than 20 percent of animal protein intake in Zambia and an estimated 28% of the total animal protein consumed in Malawi. The sector is dominated by artisanal fishers and other small scale fish traders such as processors and wholesalers, the majority of which are women. The main species produced for Zambia include a number of small pelagic species known as 'Kapenta' (Limnothrissa miodon and Stolothrissa tanganicae) and 'Chisense' (Musumali *et al*., 2009). In Malawi, Usipa (Engraulicypris sardella) constitutes one of the species with most catch on Lake Malawi (Malawi Government, 2011). The small pelagic species have broad market acceptance in both countries and fish processing and marketing of these pelagics is dominated by artisanal operations. These small pelagics are very important for household food security and livelihoods of most rural households, who constitute the largest proportion of fish traders. The small pellagric species are also very important in ensuring household food security and improving the nutrition status of the low income households.

The importance of the small pelagics for the two countries necessitates the need to conduct a value chain analysis for Usipa and Kapenta. A value chain analysis can be a useful analytical tool to understand the policy environment in terms of efficiency in allocation of resources between individuals and organizations hence helping in maximizing revenue flow in the fisheries sector through judicious utilization of scarce resources, processing, value addition, efficient marketing and distribution. Value chain analysis can also help identify shortfalls in the processing of the small pelagics. This is very important if quality of the processed products is to be improved, through among others, use of improved post-harvest processing technologies. This ultimately increases the value of the product and the associated profit margins. Value chain analysis of these products, whose activities are dominated by the rural poor households, can also guide policy makers in the design and development of pro-poor initiatives and improve the linkage of small scale fish enterprises.

Objectives of the study

The overall objective of the study was to conduct a value chain analysis of the small pelagic species in Malawi and Zambia. Specifically, the study aimed at

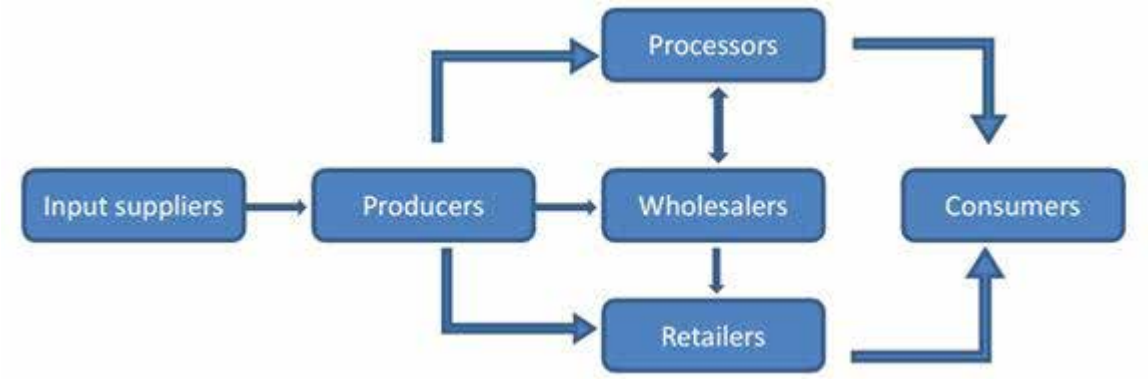
1. Identifying the main fish species marketed in Malawi and Zambia
2. Identifying the main actors in Usipa and Kapenta value chains
3. Estimating the market margins of fishers and fish traders for the Usipa and Kapenta
4. Identifying the main Usipa and Kapenta marking channels
5. Identifying the marketing constraints faced by the value chain actors in Malawi and Zambia

Materials and Methods

Value chain analysis

The importance of value chain analysis has been greatly recognized such that it is now mainstreamed in development circles (Macfadyen *et al*., 2011). Kaplinsky and Morris (2000) defined value chain as a full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use. In some cases, value chain participants collaborate to improve the overall competitiveness of the final product. At times, these participants may be completely unaware of the linkages between their operation and other actors in the chain (Tchale and Keyser, 2010). In principle at least, value is added at each stage of the chain, hence the term "value chain". Value chain analysis focuses on segmenting the different activities that add value in the production and sale of a product or service.

In the fisheries sector, value chain describes how fishery businesses receive raw materials as input to either captures or culture



Source: Chiwaula . (2012)

fisheries, add value to the raw materials through various processes and sell finished products to retailers or the final customers (De Silva, 2011). Value chain analysis in a fisheries sector is a powerful tool for fishers, processors, financiers, wholesalers, transporters, researchers, and retailers to identify the key activities within the industry which form the value chain for that industry and have the potential of a sustainable competitive advantage for an industry. A variety of value chain approaches have been utilized by both development practitioners and researchers to capture the interactions and to examine the inter-relationships between diverse actors involved in all stages of the value chain. A typical value chain map can be presented as follows.

Study sites and sample size

The study was conducted in the main fishing areas and fish markets in Malawi and Zambia. A sample size of 191 was used for Malawi and 600 was used for Zambia. The study adopted a multistage sampling technique. In the first stage, Stratified sampling method was used to select the landing sites as well as the major fish markets in the two countries. In the second stage, simple random sampling was used to sample and interview fishers and fish traders. This was done with the help of District fisheries officers in the study sites. Both qualitative and quantitative data were collected during the study using a semi-structured questionnaire, focus group discussions and Key informant interviews. Data analysis was done using Statistical Package for Social Scientists (SPSS) and Microsoft Excel.

Analytical techniques

The study used descriptive statistics to analyse the major fish species marketed and the main actors in the Usipa and Kapenta value chains. The profitability of Usipa and Kapenta for the various value chain actors in the two countries was analysed using marketing margins. The market margins for each actor determined the deference between the price paid by final consumers and that received by fish traders. An assessment of marketing margin helps to identify its components and their influence in marketing as well as to analyse if there are opportunities for reducing marketing costs and increasing marketing efficiency.

The marketing margins are presented as

$$MM = SP - BP$$

And the Net marketing margin is given by

$$NMM = SP - BP - MC$$

Where MM is Marketing Margin, SP is Selling Price, BP is Buying Price, and MC are the Marketing Costs

Results and Discussion

The value chain actors

Fish value chain actors are numerous in Malawi. They range from input suppliers, fishers, producers, processors, transporters,

wholesalers, retailers and final consumers. It has been noted that the length of the value chain depends on the economic importance of the fish species being traded. The more the economic importance of the specie, the more the actors in the value chain and the longer the length of the value chain. Both Kapenta and Usipa have a low economic value hence we should expect few actors along the value chain. The main actors in the fish value chain that were identified during the study include fishermen, processors, wholesalers and retailers. From a total of 191 respondents in Malawi, 25% were fishermen whose main water body was Lake Malawi, 32% were fish processors, 18% were wholesalers and 25% were retailers. In Zambia, the majority of the actors, however, were Retailers who constituted 54 percent of the total actors.

Gender and the value chain actors

In view of the presence of gendered roles in the fisheries sector, it is important to understand the position of women in the fish value chain. The majority of women are fish processors in the value chain while men dominate in fishing. This has been observed for both countries. The women were actively involved in sun drying the fish, smoking, and parboiling. Traditionally, these activities are mostly done in the kitchen hence one of the reasons why they were dominated by women. The dominance of males in fishing and aquaculture may be due to the fact that these activities require physical labour which is to the advantage of males. In some cases, fishing is done overnight and the strong currents at the lake at times create conditions that do not favour women. Fish wholesaling and retailing are also dominated by men. Table 1 shows the gender composition of the various value chain actors.

Figure 3: The value chain actors in Malawi and Zambia

Table 1: Value chain actors by gender

Actor	Malawi			Zambia		
	Male	Female	Total	Male	Female	Total
Fisher	45	2	47	37	3	40
Processor	21	39	60	90	102	192
Wholesaler	21	13	34	153	182	335
Retailer	33	15	48	18	20	38
Total	**120**	**69**	**189**	**272**	**277**	**549**

Fish species marketed

The Malawi fisheries policy (Malawi Government, 2012) outlines Chambo (Oreochromis spp), Kambuzi (Lethrinops spp), Utaka (Haplochromis spp) and Mbaba (Buccochromis spp), Mcheni (Ramphochromis spp), Usipa (Engraulicypris sardella), Mlamba (catfish) (Clarias gariepinus)) and Matemba (Barbus paludinosus) as some of the commonly traded fish species in Malawi. The findings of this study showed that Usipa is the most marketed specie, as it constituted 37 percent of all the fish species that were traded. The second most marketed specie was found to be Chambo (T. Rendali), comprising of 17 percent of all the fish marketed. According to the Malawi Government, the exploitation of Chambo has led to low catches, while efforts by the Malawi government to intensify offshore deep water fishing is one of the reasons that explains increased Usipa catches. Figure 3 shows the main species that were traded. Other commonly marketed fish species are shown in Table 2.

In Zambia, it was identified that Kapenta as the most marketed specie in Zambian markets. This shows the importance of the small pelagics as a source of livelihood and its importance on food and nutrition security for most low income households. The FGD results disclosed that there were various sources of the species traded in the Zambian markets. Other important species include as shown in Table 2 include Bream, Bukabuka (Lates stappersii), Milonge (Clarias theodorae) and Chisense (Poecilothrissa moeruensis).

Figure 2: Fish species marketed

Marketing Margins Analysis

Marketing margins for Usipa

Examining market margins is a common means of measuring market efficiency. Through analysis of marketing margins, the relative sizes of the different participant's margins can be determined. The relative size of various market participants gross margin can indicate where in the market chain value is added and/or profits are made. Table 2 shows results of marketing margins of Usipa for Fishers, processors, wholesalers and retailers. The buying and selling unit for all the actors is Mk/5 litre bucket. On average, fishers sold a 5 litre bucket of Usipa at Mk2616.67. The main marketing costs that they incurred include cost of fuel, cost of labour, and cost of food. The average marketing cost incurred was about Mk863.27. The net marketing margin was MK1753.4 and it was the highest among all the actors. Retailers had the second highest net marketing

margin of Mk1124.63. The retailers incurred the least costs. Their marketing costs included mainly the cost of packaging papers, which on average costed Mk208.7. Processors had the least net marketing margin of Mk-437.2. Much as the net marketing margin for the processors was positive, their net marketing margin was negative. One reason that explains the negative net marketing margin for the processors is that the study was conducted at the onset of the rain season when fish catches are the highest hence post-harvest losses also tend to be high.

Marketing margins for Dagaa

The analysis of marketing margins were also done for Kapenta. The unit of measurement for the calculation of all the species were Zambian Kwacha per Kg of Kapenta sold. The results of the marketing margins are shown in Table 3. The study found transportation, market fee, labour charges, packaging bags, and cost of meals as the main sources of marketing costs that were incurred. The study found a positive net marketing margin for all the actors involved in Kapenta value chain. The highest net marketing margin and share of consumer price were observed amongst the wholesalers and fishers. The lowest net marketing margin was, however, observed among the retailers.

Marketing channels

Fishers producing fish are mostly located in a few fish resource endowed areas. Consumers, on the other hand, are in rural, semi-urban and urban areas that are far away from the fishing sites. This fish has to reach consumers for its final use and consumption. A market channel therefore defines the route taken by the ownership of goods as they move from the producer to the consumer. These channels have great influence on marketing costs such as transport, and market margins received by the various actors along the chain. In order to identify the marketing channels for Usipa and Kapenta, the actors were asked to state the main buyers of their fish. These main buyers include Wholesalers, processors, retailers, and consumers. The identified marketing channels for Usipa and Kapenta are summarized below.

Table 2: Usipa Marketing margins for the different actors

Actor	Buying price	Selling price	Gross marketing margin	Marketing cost	Net marketing margin
Fisher		2616.67	2616.67	863.27	1753.4
Processor	2641.67	3285.71	644.04	1081.2	-437.2
Wholesaler	2833.33	4136.36	1303.03	462.5	840.8
Retailer	4166.67	5500	1333.33	208.7	1124.63
Consumer	5500		-	-	-

Prices in Malawi Kwacha (MK)/ 5 litre bucket
1US$ = 680 Malawian Kwacha at the time of the study

Table 3: Kapenta Marketing margins for the different actors

Actor	Buying price	Selling price	Gross marketing margin	Marketing cost	Net marketing margin
Fisher		12.7826	12.7826	6.72818	6.05443
Processor	6.33735	10.4857	4.14836	1.70375	2.44462
Wholesaler	11.5221	26.9402	15.4181	9.29922	6.11889
Retailer	11.0896	18.6245	7.53491	6.72818	0.80673
Consumer	18.6245		-	-	-

Prices in Malawi Kwacha (MK)/ 5 litre bucket
1US$ = 680 Malawian Kwacha at the time of the study

Kapenta marketing channels
Channel I: Fisher – Consumer

In this marketing channel, the fisher sold the Dagaa caught directly from the water bodies to the consumer. This is usually done at the landing site or at the local markets

Channel II: Fisher – Retailer – Consumer

This channel involved the fisher selling to the retailers who would wait for the fishers at the landing sites. The fishers in turn sold to the consumers either at the same landing sites or at the local markets.

Channel III: Fisher – Wholesaler – Retailer – Consumer

In this marketing channel, the fishers first sold their fish to the wholesalers who then sold to the retailers

Channel IV: Fisher – Wholesaler – Consumer

In this marketing channel, the fishers first sold their fish to the wholesalers who then sold the fish to final consumers.

Channel V: Fisher – Processor – Consumer

This channel involved three actors. The fisher selling to the processor, who in turn sold to the consumer. The fish is usually sold to members of the communities in which the processing is done.

Channel VI: Fisher – Processor – Retailer – Consumer

The sixth marketing channel involved fish passing from the fisher to the processor, the retailer and lastly the consumer.

Channel VII: Fisher – Processor – Wholesaler – Retailer – Consumer

This is the last and the longest marketing channel identified. It involves all the Dagaa value chain actors starting from the fisher to the consumer.

Usipa marketing channels
Channel I: Fisher – Consumer

In this marketing channel, the fisher sold the fish caught directly to the consumer. The selling was either done at the landing site or at the local markets

Channel II: Fisher – Retailer – Consumer

This channel involved the fisher selling to the retailers who happened to be vendors at the landing sites, who in turn sold to the consumers.

Channel III: Fisher – Wholesaler – Retailer – Consumer

In this marketing channel, besides having the retailer and the consumer, the fishers first sold their fish to the wholesalers who then sold the fish to retailers.

Channel IV: Fisher – Processor – Retailer – Consumer

The fourth marketing channel involved fish passing from the fisher to the processor, the retailer and lastly the consumer.

Channel V: Fisher – Processor – Wholesaler – Retailer – Consumer

This was the longest marketing channel identified. It constituted all the actors starting from the fisher to the consumer.

Marketing Constraints

The value chain actors along the different stages of the marketing channels face a number of constraints. Through focus group discussions and key informant interviews, the study identified a number of marketing constraints that are common to actors in both countries. These are outlined in Table 4. It was noticed that fishes and the rest of the fish traders do not have easy access to loans from either banks or non-government organization (NGO). This is possibly due to too much official paperwork and collateral arrangements. It was also observed that there is poor infrastructure in the markets and poor transport systems. This greatly affects fish handling at the markets. Table 4 summarizes the main marketing constraints.

Table 4: Marketing constraints

Key Actor	Constraints
Fishers	1. Lack of access to credit 2. Low fish catches 3. Global warming resulting in reduced fish stocks in the water bodies
Processors	1. Poor storage facilities 2. Lack of government support 3. Lack of market information
Wholesalers	1. Lack of capital 2. Poor transport networks 3. High transportation costs 4. Low fish supply
Retailers	1. Lack of capital 2. Low fish supply 3. Poor market structures

Conclusion and policy implications

Conclusion

The small pelagic species are very important for household food security and livelihoods of most rural households, who constitute the largest proportion of fish traders. The small pelagics are also very important in ensuring household food security and improving the nutrition status of the low income households. The study was aimed at conducting a value chain analysis of Usipa and Kapenta marketed in Malawi and Zambia respectively. The study identified fishermen, processors, wholesalers and retailers as the main actors operating in the fish value chain in both Malawi and Zambia. However, shorter value chains were observed due to the low economic value of both Usipa and Kapenta. With regard to gender roles within the actors, the study found that majority of the women are fish processors in the value chain while men dominate in fishing.

Results of marketing margins of Usipa for Fishers, processors, wholesalers and retailers showed that on average, fishers had the highest marketing margin in Malawi while the processors, who were mostly women, were making losses. This was attributed to high post-harvest losses. For Kapenta, it was found that all the actors had a positive net marketing margin, with the highest net marketing margin being observed amongst the wholesalers and fishers and the lowest net marketing margin was observed among the retailers. Fish marketing channels for Usipa and Kapenta were also identified. The study also identified the major marketing constraints in the two countries, with lack of access to credit being one of the major constraints to marketing of Usipa and Kapenta.

Policy implication

The results of the study have the following policy implications.

1. It is important to develop and/or facilitate the adoption of appropriate fish processing technologies among the small scale fish processors. This will help reduce post-harvest fish losses especially and improve the quality of processed fish, eventually leading to increased margins for the processors and the rest of the other actors in Malawi. It can also improve trade competitiveness on the international markets.
2. Considering the role women play in fish marketing in Malawi and Zambia at all levels of the value chain, it is important to come up with policies that will support and empower the women to effectively and efficiently carry out their operations. Such

policies include mainstreaming gender in fisheries related policies, increasing access to financial resources for the women, and promoting investments in the fisheries sector that will link women fish traders to the international markets.

3. The various value chain actors should form and operate in groups/associations. This can help them to efficiently carry out their marketing operations. The associations are also crucial in influencing policies and lobbying for improved services. These can also help them to easily access credit and other financial services.
4. It is important to address some of the key challenges that the various value chain actors face. This can include engaging the private sector in aquaculture can help address the challenges in low fish catches and seasonality in fish supply. Furthermore, privatization and/or PPP can also help improve the market infrastructure. This will ultimately improve fish marketing in Malawi and Zambia, and contribute to food security and poverty alleviation of many rural households.

Acknowledgements

Special thanks to WorldFish Center, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under the Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa", following the Malabo Declaration at the 2014 Summit African Heads of States and Governments in Equatorial Guinea. The funding was made possible through the assistance from the European Union.

References

African Union Commission – New Partnership for Africa's Development, 2014. Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa. Africa Union Commission –NEPAD, Addis Ababa, Ethiopia.

Chiwaula L, Jamu D, Chaweza R, Nagoli J, 2012. The Structure and margins of the Lake Chilwa fisheries in Malawi: A value chain analysis. The WorldFish Center, Penang, Malaysia. Project Report 2012-12.

De Silva D A M, 2011. Value chain of fish and fishery products: origin, functions and application in developed and developing country markets. Food and Agriculture Organization, Rome, Italy.

FAO, 2006. Food and Agriculture Organization of the United Nations: Fishery Country Profile, Food and Agriculture Organization, Rome, Italy.

FAO, 2012. State of World Fisheries and Aquaculture 2012. FAO Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations, Rome, Italy.

Republic of Zambia, 2011. Sixth national development plan 2011 – 2015. Ministry of Finance and National Planning, Lusaka, Zambia

Kaplinsky R, Morris M, 2002. A Handbook for Value Chain Research. Prepared for Institute of Development Studies, Brighton, UK.

Macfadyen G, Nasr-Allah A M, Kenawy D A R, Ahmed M F M, Hebicha H, Diab A, Hussein S M, Abouzied R M, Naggar G E, 2011. Value-chain analysis of Egyptian aquaculture. Project report 2011- 54. The WorldFish Center. Penang, Malaysia.

Malawi Government, 2011. Annual Economic Report 2011. Ministry of Development Planning and Cooperation, Lilongwe, Malawi

Malawi Government, 2012. Fisheries Policy 2012-2017. Department of Fisheries, Ministry of Agriculture and Water Development, Lilongwe, Malawi/

Malawi Government. 2016. The Malawi National Fisheries and Aquaculture Policy. Department of Fisheries, Ministry of Agriculture, Irrigation and Water Development, Lilongwe, Malawi.

Mapfumo B, 2015. Tilapia Markets in Sub-Saharan Africa. INFOFISH 4th International Trade and Technical Conference and Exposition on Tilapia Kuala Lumpur.

Musumali M M, Heck S, Husken M C S, Wishart M, 2009. Fisheries in Zambia: An undervalued contributor to poverty reduction. Policy Brief 1913. The World Bank and WorldFish Center.

NFDS Africa, 2016. Report of the Zambia Fisheries and Food Security Surveys, February 2016. SmartFish Programme of the Indian Ocean Commission, Food Security FAO component, Ebene, Mauritius.

Phiri L Y, Dzanja J, Kakota T, Hara M, 2011. Value Chain Analysis of Lake Malawi Fish: A Case Study of Oreochromis spp (Chambo). International Journal of Business and Social Science 4(2); 1- 18.

Russell A J M, Grötz P A, Kriesemer S K, Pemsl D E, 2008. Recommendation Domains for Pond Aquaculture. Country Case Study: Development and Status of Freshwater Aquaculture in Malawi. WorldFish Center Studies and Reviews No. 1869. The WorldFish Center, Penang, Malaysia.

Tchale H, Keyser J, 2010. Quantitative Value Chain Analysis. An Application to Malawi. Policy Research Working Paper 5242. The World Bank, Africa Region, Agricultural and Rural Unit. Lilongwe, Malawi.

THE VALUE CHAIN ANALYSIS OF DOMESTIC AND CROSS-BORDER FISH TRADE IN THE CENTRAL AFRICAN CORRIDOR: A CASE OF CAMEROON

Meke Soung Pierre Nolasque*, Sloans Chimatiro** Hamady Diop*** and Tomedi Eyango*

Abstract

This study was conducted within the European Union-funded Fish Trade Program, to evaluate the value chain of cross-border fish trade in Central Africa, targeting Cameroon and the neighbouring states. The constraints that prevent full reaping of fisheries wealth were also examined.

Assessment was made in terms of the value chain actors in the various sub-sectors, volumes of fish traded across-borders, employment and value addition. Quantitative and qualitative data were collected using structured questionnaires. Cameroon, due to the importance of its fisheries sector within the Central African region, was used as a pilot, with sampling sites selected in a number of zones. The study was carried out in two phases, from April to June 2015 and December 2015 to February 2016, to complete the full seasonal cycle of peaked fish production and trade in Cameroon. Approximately 1,607 value chain actors were surveyed, representing 10% of the total population of the main actors of the sites surveyed.

Findings of the study indicated that the Central African fisheries value chain is fairly simple but with complex interconnections, especially across the border. As expected, processors and wholesalers achieved the highest surplus compared to fishers and retailers. Women dominated the processing component (71.2%) and generated a value addition estimated at 908,911,418 CFAF. Generally, close to a total of 617 tonnes of fish products were traded for around 2.8 billion CFAF, with poor level of taxes levied. The value chain is influenced by critical factors of which poor post-harvest technology and infrastructures; non-official costs to informal trade; pricing structure, poor group organization and extension services as well as; limited investment financing.

The study recommends: to harmonize trade policies and invest in infrastructures to facilitate easy movement of fish products and improve product quality across the borders; review data collection protocols to improve fish trade statistics currently going on informally.

Key words: fish trade; net value added; surplus; wealth; nodes, taxes.

ANALYSE DE LA CHAINE DE VALEUR NATIONALE ET TRANSFRONTALIERE DU COMMERCE DU POISSON DANS LE CORRIDOR AFRIQUE CENTRALE: CAS DU CAMEROUN

Resume

Cette étude était conduite dans le cadre du programme Fish Trade financé par l'Union Européenne, pour évaluer la chaine de valeur du commerce transfrontalier du poisson en Afrique centrale en ciblant le Cameroun et les Etats voisins. Les contraintes qui minent la pleine exploitation de la richesse des pêches ont aussi été examinées.

L'évaluation était menée en termes d'acteurs de la chaine de valeur dans divers sous-secteurs, volumes de poisson commercialisés aux frontières et valeur ajoutée. Les données qualitatives et quantitatives étaient collectées à partir de questionnaires structurés. Le Cameroun, du fait de l'importance de son secteur des pêches dans la région Afrique centrale, a été utilisé comme pays pilote avec des sites d'échantillonnage sélectionnés dans un certain nombre de zones. L'étude a été conduite en deux phases, d'Avril à Juin 2015 et Décembre 2015 à Février 2016, afin de compléter le cycle saisonnier du pic de production et de commercialisation du poisson. Près de 1607 acteurs de la chaine de valeurs ont été enquêtés, représentant 10 % de la population totale des principaux acteurs des sites enquêtés.

Corresponding author e-mail: PierreMeke@gmail.com

Les résultats de l'étude montrent que la chaine des valeurs des pêches en Afrique centrale est quasi simple mais avec des interconnexions complexes, spécialement à travers la frontière. Comme escompté, les transformateurs et grossistes réalisent le plus grand surplus comparé aux pêcheurs et détaillants. Les femmes dominent la transformation (71,2 %) et ont généré une valeur ajoutée estimée à 908 911 418 FCFA. D'une manière générale, près de 607 tonnes de poisson produits furent commercialisés pour une valeur de 2,8 milliards de FCFA avec un faible niveau de prélèvement de taxes, moins de (3%). La chaine de valeur est affectée par certains facteurs critiques parmi lesquels des infrastructures et une technologie post capture inappropriées; des coûts non –officiels au commerce informel; une structure des prix; un faible niveau de structuration des acteurs, d'encadrement et d'investissement.

L'étude recommande: d'harmoniser les politiques commerciales et d'investir dans les infrastructures pour faciliter un trafic fluide des produits de la pêche et améliorer la qualité à travers les frontières; revoir les protocoles de collecte pour améliorer les statistiques du commerce du poisson qui se déroule présentement de manière informelle.

Mots clés: commercialisation du poisson, valeur ajoutée nette; surplus; richesse, nœuds; taxes.

Introduction

Angola, Cameroon, Congo Brazzaville, Democratic Republic of Congo, Gabon, Equatorial Guinea, Sao-Tomé and Principe comprise the seven coastal states of the Regional Fisheries Commission for the Gulf of Guinea (COREP), with a combined coastal line of 3,535 km, a continental shelf of 134 209 km2 and an Exclusive Economic Zone (EEZ) of 1032.455 km2 or 21.85 % of the area of all the countries. In addition, the region lies in the equatorial region of Central Africa. Therefore, both marine and inland fisheries are some of the main economic activities of the people in the region, with the region producing a total of 1,010,078 tons in 2014, with Cameroon being the largest producer (22.3%) (FAO, 2016). Much of the fish and fishery products are traded domestically with some going into regional markets. However, intra-regional trade is very low; with a total of 300,000 tonnes (comprising 55 fish species) of fish imported in Central Africa, only 6,000 tonnes coming from neighbouring countries (ACP FISH II 2013). Although the Regional Economic Community (REC) in Central Africa, Economic Community of Central African States (ECCAS) has made commitment on promotion of intra-regional trade in commodities and services, dedicated its development efforts, fish trade flows have not been properly addressed due to the lack of a focused regional economic program. Due to paucity of information status of trade, there has been a general lack of framework for investment despite regional and national policies making fish trade a priority.

However, the value chain of cross-border fish trade in Central Africa has not been mapped and the key actors have not been clearly identified and characterized. Although observers have reported movements of products across many countries in the region, the value chain performance of the region's cross-border fish trade is not well understood. Value chain analysis of the fish supply chain offers the opportunity to assess the efficiency of the value-added operations and services as well as systematic competitiveness along the supply chain in cross-border fish trade, in order to increase production, trade and income-generating potential of fishers, processors and traders in Central Africa. A value chain describes a whole range of activities required to bring a product or services from conception through the different phases of production (including a combination of transformation and inputs of various producer services), delivery to final consumers and final disposal after use (Kaplinsky and Morris 2001). Value chain analysis has been useful in the debate on globalization and international trade including (Kaplinsky and Morris 2001): (i) to identify the activities that are subject to increasing returns, and which are subject to declining returns, and (ii) as a result of being able to make these distinctions throughout the various links in the chain, policy makers are assisted in formulating

appropriate policies and making necessary choices. These may be to protect particularly threatened links (e.g. poor informal operators) and/or facilitate upgrading of other links in order to generate greater returns.

The use of value chain approach (VCA) in fisheries and aquaculture has been gaining prominence recently (Macfadyen *et al*., 2012; Nasr-Allah *et al*., 2014; El-Sayed *et al*., 2015). While many development programs use a value chain approach as an entry point to engage smallholders, individually or collectively, in local and high value export markets (GTZ, 2007) or agribusiness policy-related recommendations (Chagomoka *et al*., 2014); not much has been done to use VCA in trade in fisheries products, especially those that go into intra-regional trade. This value chain analysis was conducted in order to generate evidence to inform the regional trade integration agenda in Central Africa.

The specific objectives of the study were to (i) map the value chain for fish trade industry; (ii) describe the main value chain actors within the fish trade chain; (iii) determine value chain performance; (iv) identify the strengths and weaknesses of each link of the value-chain; and (v) propose policy interventions and development strategies. This paper presents the methodology followed during the two phases of data collection, and the main results, specifically, the trade flows, species, stakeholders, sources and destination of products.

Methodology

Study site

The study was conducted in six sites (i) Lake Chad (ii) Maga (iii) Lagdo dams (iv) Mbakaou (v) Mape and (vi) Limbe (Fig. 1). These sites represent the main fishing areas both for marine and inland fisheries. The fish trade sites located around Cameroon and other neighbouring countries; namely Limbe site, border between Cameroon and Nigeria, and Ambam site, border between Cameroon and Gabon and Equatorial Guinea were purposively sampled for the study in order to fully understand cross border fish trade in central Africa. For inland fisheries areas, information was examined on the trade between Cameroon, Nigeria and Chad in the Lake Chad Basin at Kousseri. Other inland fisheries sites were the Mapé, Lagdo and Maga dams. The trade between Cameroon and the Republic of Congo, on the Eastern border of Cameroon was monitored at the Sangha River. Another site, Mouanko, mainly for oyster production, was used to monitor exports to Nigeria.

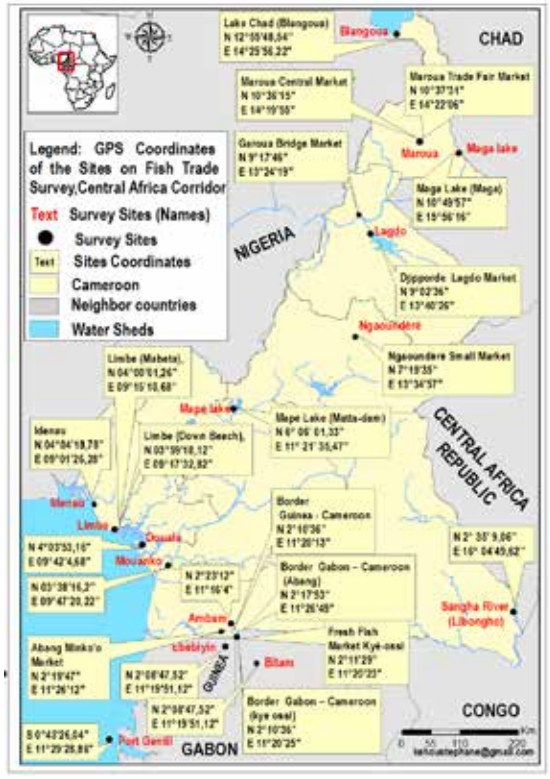


Figure 1: Map of Cameroon in Central Africa showing the Study Sites

Sampling methodology

The study adopted a multistage sampling technique. In the first stage, stratified sampling method was used to select the landing sites in all the six study sites. In addition, purposive sampling was adopted to select fish value chain actors. This method was used at this stage considering the diversity of the fish value chain actors and the unavailability of a

sampling frame for the fishers, processors and the traders in the study sites that were selected for the survey. Therefore, actors were selected according to their location and type of activities. Likewise, according to the diversity of fish species, fishing techniques and fishing grounds (inland and marine fisheries), processing sites and market places (local and foreign), it was necessary to adopt a flexible strategy to take into account all these specificities.

Sample size

The following standard formula for calculating sample size, n, was used to determine the total number of actors to be involved in this study.

$$n = \frac{z^2 (1 - p)p}{e^2} \quad \text{(Edriss, 2012)}$$

Where: n is the sample size; p is an estimate of prevalence. z is the z-value yielding to the desired degree of confidence; e is the absolute size of error allowed.

The maximum allowable error that this study used was 5%, at 90% level of confidence with a corresponding z-value of 1.64. An anticipated proportion of prevalence was to be 50%. Substituting the values in the formula gives us a sample size of 268 households. Inflating to account for non-respondents by 10% means that the sample size was adjusted to 295 respondents.

Data collection

Both qualitative and quantitative data was collected during the study. A semi-structured questionnaire was used to collect data from various formal fish value chain actors. The questionnaire covered areas such as the demographic characteristics of the respondents, the position of the respondent in the fish value chain, the costs incurred, the revenue generated, the main markets, the species traded, their source of capital, and the constraints they face, among others. Key informant interviews were also conducted and this provided an in-depth understanding of fish value chain in Cameroon and Central Africa. Further, key informants helped in capturing information that could not be collected by the household fish value chain questionnaire. Secondary data was collected through desk-based literature review including collection of import and export data and other existing information.

Survey methods and data processing

Both secondary and primary data were collected throughout the study. For secondary data, socioeconomic surveys in the sampling sites provide information on the number of fishermen; fish processors and mongers, etc. In the case of primary data for the value chain analysis, they were collected using the questionnaire. The financial indicators calculated included: gross output values; operational profits (sales value-operational cost) in CFA Francs (CFA-F) (CFAF= US$500) and as a percentage of sales; net profits (revenue- (operational + fixed cost)) in CFAF per kilogram of fish sold and as a percentage of sales; total value-added (net profit + wages) per kilogram of fish sold; and the percentage of the total operational profits, net profits, and value-added made throughout the chain derived from the different links in the value-chain. Value added was used as a measure of the wealth created by the activity (fish processing or fish trading) Bjorndal *et al.* (2014). As Bjorndal *et al.* (2014) put it, the term value addition within fisheries and aquaculture is used to characterize adding value in products through some type of processing method– essentially converting raw fish to a resulting finished or semi-finished product that has more value in the market place. It is the wealth produced which can be distributed as revenue. The gross value added is obtained by deducting intermediary consumption from raw material and services from the turnover. To obtain net value added or surplus, one should remove depreciation.

Results and Discussion

Value chain Actors in Cameroon

A total of 1,607 actors participated in the study, and results are displayed in table 1. The results showed that the majority, 40.41 percent of the actors along the value chain were fishermen and most of them were from Maga.

Stakeholders and socio demographic characteristics

The age of fishermen is between 25 and 35 years, representing 35.2 % of the population sampled. This confirms that fishing activities need strong and young persons (fig.2). Therefore the fishing sector can be used as a tool for job creation. People involved in sea food processing are aged between 25 and 45 years old and represent 71 % of this category. It can be explained that old persons due to the decline in their strength abandon fishing activities to younger ones. As for the fish processors, the nodes of wholesalers and retailers are represented mainly by people aged between 35 and 45 years old. In terms of gender, while fishing activities are dominated by men, (99.8 %), fish processing and retail activities are dominated by women (71.2%) (Fig 3 and 4) and 85.3 % respectively, while (41.8 %) are represented in wholesale activities.

Table 1: Fish value chain actors in Cameroon

Study site	Fishermen	Processors	Wholesalers	Retailers	Frequency	Percent
Lake chad	60	37	50	60	207	13.83
Maga	217	60	32	12	321	21.44
Lagdo	57	33	68	34	192	12.83
Mape	161	89	122	60	432	28.86
Limbe	110	90	85	60	345	23.05
Frequency	605	309	357	226	1,497	100.00
Percent	40.41	20.64	23.85	15.10	100.00	

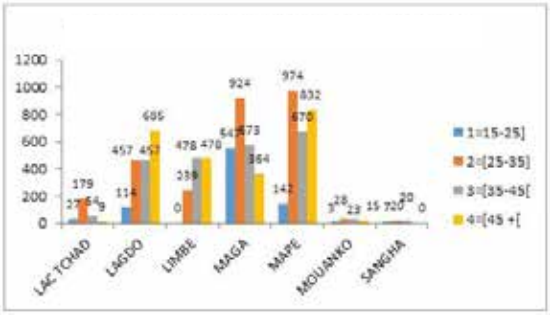


Figure 2: Distribution of fishermen by age and by site

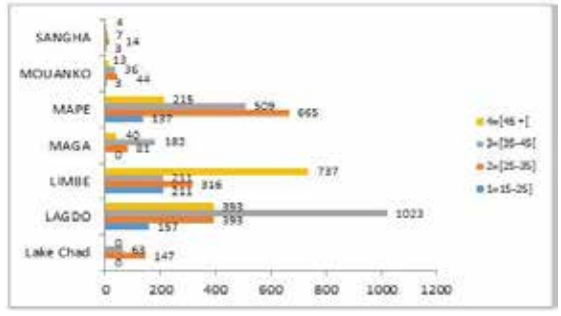


Figure 4: Distribution of processors by age

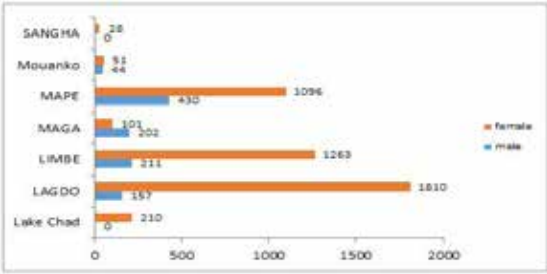


Figure 3: Distribution of processors according to Gender

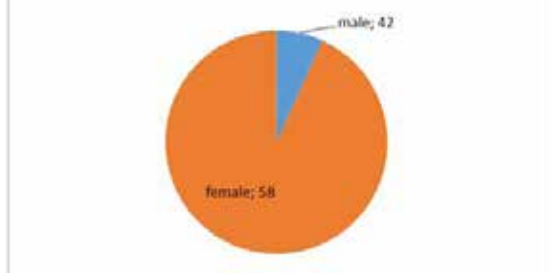


Figure 3: Distribution of processors according to Gender

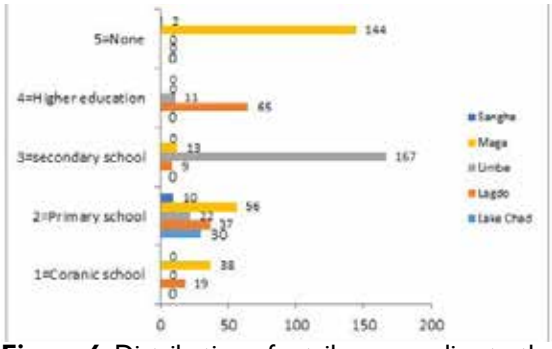


Figure 6: Distribution of retailers according to the level of education

Value chain mapping

The value chain is fairly simple but with complex interconnections, especially across the border (fig. 7). As shown in Table 1, four main actors are involved in the fish trade chain; namely:

1. *Fishermen,* undertake the fishing either at sea or in the inland waters. Fishermen sell their fresh products to fish processors, or wholesalers; but sometimes they also sell directly to consumers.
2. *Fish processors;* purchase raw materials (fish) from fishers and process them by mainly drying and smoking. The processors onward sell the products to wholesalers or to buyers who export the products.
3. *Wholesalers:* there are two types of wholesalers, those operating at the landing sites and the ones who are based in the port city. The ones at landing sites purchase fish from processors and on-sell to either retailers or take the fish across the borders to neighbouring countries. The ones in the port-city, they purchase imported frozen products from the port and sell to retailer or to processors.
4. *Retailers* buy the fish from wholesalers and sell the products to consumers.

Fish species

Table 2 shows the main species that were recorded in the domestic and cross-border trade. These included Ethmalosa fimbriata (Bonga), Sardinella maderensis, the Cray fish (Nematopalaemon hastatus), from marine sources and oyster (Ruditapes philippinarum); and Tilapia niloticus, catfish (Clarias sp), Heterotis niloticus, the Nile perch (Lates niloticus), from freshwater. In addition, there were frozen imported fish products such as croakers (Pseudotolithus sp.), Tilapia niloticus, sea catfish (Arius heudelotii), and Horse mackerel. All the fish in Ambam are imported fish products. All fish being traded at Ambam, through Kyeossi border with Gabon and Equatorial are imported frozen fish. This is done under the Cameroonian Head of State Ordinance n° 2008/002 of 7th March 2008, which suspended all levies of taxes and customs duties on some basic need products (fish, rice and salt). For the inland species, tilapia, catfish, Heterotis, the Nile perch are the main species sold fresh, dried or smoked, the oyster is sold with all its contents both the shell used for animal feed processing plants, and the muscle for its taste and human consumption.

Price formation along the nodes

At the level of fishermen, prices are fixed by the buyers, namely fish processors and wholesalers, since fishermen are afraid to lose their products; hence fishermen have a poor bargaining power. As a result, species like tilapia and catfish tend to be cheaper, selling at less than 500 CfaF per kg. The period is also important in the price formation. During the end of year festivals, there is a general rise of fish prices, which is an opportunity to fishermen for good business. Prices at retailer level are dictated by wholesale prices, the main suppliers, which in return are influenced by the price offered by the fish processors and at the point of landing (fishermen). Intermediary costs also affect the price, and these include transport costs and accessory expenditures such as packaging and storage at the markets. For the fishermen, the price of fish varies from 16.7 CfaF for the Oyster to 2500 CfaF per kg for Sinodontis spp. while at the level of fish processors, the fish price moves from one to three times of the fresh product: the price moves from 16.7 to 94 CfaF for the shell, 530 CfaF for the muscle; 530 to 1355 for the smoked Tilapia; 4355 for the Cray fish; fish prices keep the same trends for wholesalers and retailers (Tables 3 and 4).

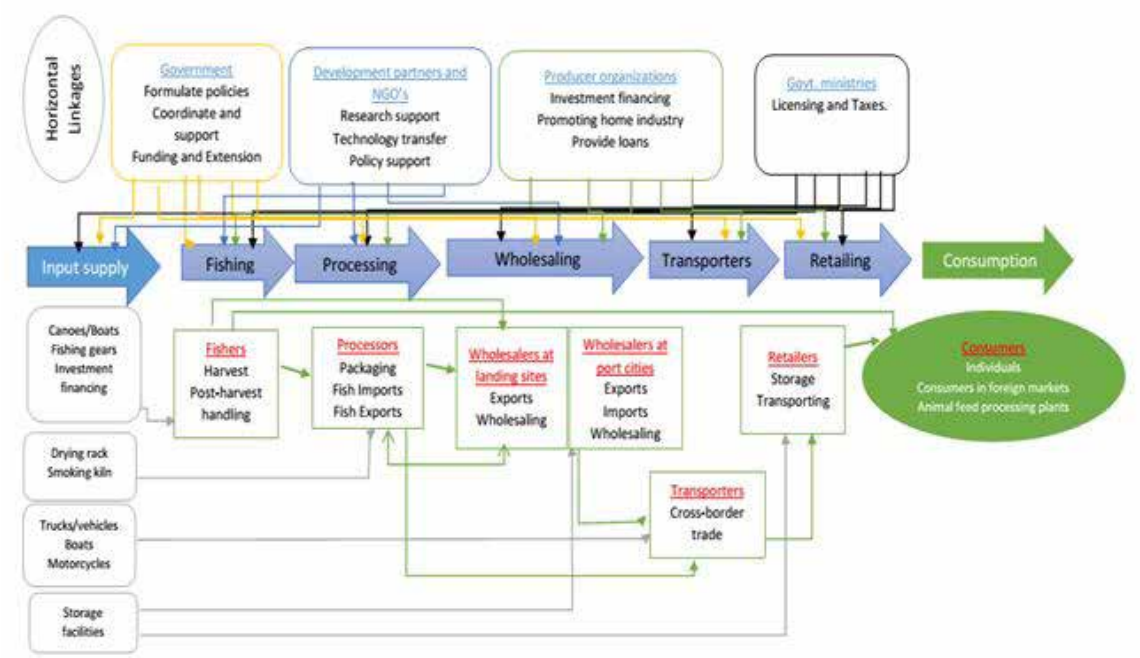


Figure 7: The value chain mapping in the central Africa region.

Table 2: Main fish species traded in the sample sites

Sites	Commercial and common names	Scientific name
Lagdo	Tilapia	*Oreochromis niloticus and Tilapia zillii*
	Nile perch	*Lates niloticus,*
	Synodontis	*Synodontis schall*
	Disque	*Citharinus citharus*
Mape	Tilapia	*Oreochromis niloticus and Sarotherodon galilaeus*
	Catfish	*Clarias gariepinus*
Maga	Tilapia	*Oreochromis niloticus*
	Catfish	*Clarias gariepinus*
	Kanga	*Heterotis niloticus*
	Nile perch	*Lates niloticus,*
Tchad	Machoiron	*Chrisichtys longidarsalus*
	Catfish	*Clarias gariepinus*
	Alestes	*Alestes longidarsalus*
	Tilapia	*Oreochromis niloticus*
Limbe	Ethmalosa (Bonga)	*Ethmalosa fimbriata*
	Sardinella	*Sardinella maderensis*
	Shrimp (cray fish)	*Parapenaeopsis atlantica*
Sangha	Nile perch	*Lates niloticus,*
	Catfish	*Clarias gariepinus*

Sites	Commercial and common names	Scientific name
Mouanko	(Oyster)	*Ruditapes philippinarum,*
Ambam/Kyé-ossi*	Frozen croaker	*Pseudotolithus senegalensis and Pseudotolithus typus*
	Frozen Red sea bream	*Lutjanus dentatus*
	Frozen ray	*Dasyatis margarita*
	Frozen Tilapia	*Oreochromis niloticus*
	Maquereau	*Horse mackerel*
	Catfish fish (livefish)	*Clarias gariepinus*
	Canned vegetal oil sardinella	*Sardinella rouxi*
	Smoked ethmalosa	*Ethmalosa fimbriata*

Source: Fish trade surveys 2015-2016

Table 3: Prices level offered fishermen for various fish species in CfaF

Species	Average price April-June 2015	Species	Average price December-January 2016
Tilapia	388.6	Tilapia	405.2
Heterotis spp.	504.5	Heterotis spp.	504.5
Catfish	903.5	Catfish	1173.8
Nile perch	1308.2	Nile perch	1162.9
Sinodontis spp.	2396.9	Sinodontis spp.	2500.0
Chrysichthys spp.	467.5	Sardinella spp.	733.2
Sardinella spp.	795.1	Ethmalosa spp.	545.5
Ethmalosa spp.	640.8	Alestes spp.	620.3
Citharinus spp.	756.3	Cray fish	980.3
Alestes spp.	621.6	Oyster	16.7

Table 4: Prices along the nodes during the two periods

Fish species / products	Average Price at fishermen level per kg	Average Prices at processor level	Average Prices at wholesale level	Average prices at the level of retailer
Tilapia	400	1817 (s)	667 (F)	812 (F)
		1429 (D)	1625 (D)	2130(D)
			2611 (S)	2300 (S)
Heterotis spp.	504.5	2636 (S)	4450 (S)	
Catfish	1038	2075 (S)	2679 (D)	3700 (D)
		2118 (D)	5833 (F)	2900 (S)
			3400 (S)	
Nile perch	1235	1569 (S)	2700 (F)	2000 (S)
			3886 (S)	2200 (F)

Fish species / products	Average Price at fishermen level per kg	Average Prices at processor level	Average Prices at wholesale level	Average prices at the level of retailer
Sinodontis spp.	2500	3044 (S)	1360 (F)	2400 (F)
			2767 (S)	3600 (S)
Chrysichthys spp.	470		2143 (D)	2500 (D)
Citharinus spp.	756	4830 (S)		
Sardinella spp.	765	3092 (S)	6000 (S)	5200 (S)
Ethmalosa spp.	592	1636 (S)	4100 (S)	3835 (S)
Citharinus spp.	756	3382 (S)	1750 (S)	4376 (S)
Alestes spp.	621	1325 (D)	3375 (D)	4000 (D)
		2222 (S)		
Cray fish	980	4345 (S)	5046 (S)	5826 (S)
Oyster	16.7		17	
Smoked oyster muscle		530		
Oyster Kebab		530		
Smoked Oyster shell		94	93	
Oyster shell Kebab		94		
Fresh Oyster shell			99	
Smoked Oyster		17		
Frozen sea catfish			1433	
Canned oil Sardine			2800	

Quantities and values of landed fish

The volumes of fish entering the value chain come from two sources, those caught and landed by local Cameroonian fishers from marine and inland fisheries; and the imports into Cameroon. An estimated total of 4570.786 tonnes were caught between April and June 2015, compare to the December - February 2016 period (2937.048 tonnes); making a total of 7507.834 tonnes of fish products for the two periods (Table 5). This landed fish fetched an estimated value of 3,018,361,860 CfaF. A total of 2995 tonnes of fish was processed, with December and January being the peak period that most of processed fish was recorded (2192 tonnes of fish), at a value of 4,908,911,418 CfaF. Wholesalers distributed 6318 tonnes of fish products for a value of 13,794,882,662 CfaF and the retailers sold 653 tonnes for a value of 1,995,306,891 CfaF.

Trade flows

As shown in fig 8, there is a huge trade flow of fish products all along the corridor D (Central Africa), domestically within Cameroon or between Cameroon and other countries within Central Africa. There are also exchanges of fish products between Corridor D and Corridor A (West Africa), mainly from Cameroon to Nigeria. These trade flows happen through Lake Chad to Maiduguri and Dimetta, in Nigeria; and through Lagdo, Maga and Mape dams to Nigeria; for fresh water species. As for marine fish species, the products flow from Limbe in Cameroon to Lagos Market in Nigeria. During the period of the study, an estimated total of 617 tonnes of processed fish was exported to Nigeria, for a value of 2 798 808 249 CfaF (Tables 6 & 7).

In addition to fresh and processed fish products produced in Cameroon, there are also fish products that are imported into

Cameroon, that are re-exported to other countries within the Central African region, especially to Equatorial Guinea, Gabon and Congo. These exports pass through the Ambam border between Cameroon-Gabon and Equatorial Guinea; where Cameroon also imports products from these countries. It was estimated that a total of 319.9 tonnes were imported from Equatorial Guinea and Gabon to Cameroon for a value of 442 650 000 CfaF through Ambam; while around 27,451 3 tonnes of fish products were exported to Equatorial Guinea, Gabon and Nigeria for a value of 1 545 594 293 CfaF (Table 8). The official export statistics reported an average of 560 tonnes per year between 2005 and 2011 (Department of Fisheries, 2015); and an average of 2,008 tonnes per year between 2011 and 2014 (FAO 2016). Compared to the official export statistics these results show that there are backward and forward flows of fish products in the sub region. While these flows are informal, the volumes are much higher than what is the officially recorded in export records.

Investments into the fish business

Setting up a business in fishing entails finding capital to buy the canoe or fishing boat, the fishing gears, such as nets and paying for the running costs. For a fish processor, capital is required for purchasing the processing equipment (drying racks or smoking kilns). As for wholesalers and retailers, initial capital is required for purchasing the fish from fish processors. In some instances, the wholesaler or retailer might need money to set up the storage facilities. Although it was not easy for the researchers to obtain accurate information on the investments from the questionnaire, the focused discussions assisted in soliciting this information.

Table 5: Quantities of fish caught by specie in metric tons (T)

		Sampling Period		
		April – June 2015	December 2015- January	
Products	**Species**	**Total weight for the period**	**Total weight for the period**	**Total weight for the two periods**
Fish species	Heterotis spp. (Kanga)	11.245	8.935	20.179
	Catfish (*Silure*)	210.107	208.268	418.375
	Nile perch (*Capitaine*)	26.317	15.941	42.259
	Sinodontis spp.	5.099	14.098	19.197
	Chrysichthys spp. (*Machoiron*)	577.576	562.020	1139.596
	Sardinella spp.	189.138	360.360	549.498
	Ethmalosa spp.	152.497	456.960	609.457
	Alestes spp.	283.628	93.496	377.124
	Citharinus spp.	5.070	//	5.070
Total weight		2296.747	2611.650	4908.397
Other species	Cray fish (*Nematopalaemon*)	//	79.968	79.968
	Oyster	//	245.430	245.430
Other species total			325.398	325.398
Grand Total (tonnes)		3,757.42	4,982.52	8,739.95

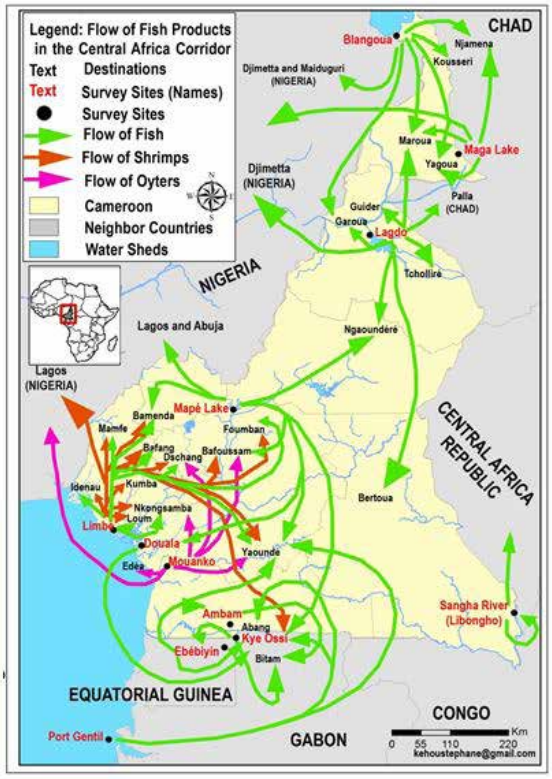


Figure 8: Map of Cameroon with arrows showing the trade flows of fish products between other countries in the Central and Western African corridor, fish trade surveys 2015-2016.

The margins achieved by the various nodes

Table 9 shows the summaries of the financial parameters. For fishermen who sell their products as such, it was not estimated at any margin. Gross margins achieved by fish processors are estimated at 2,408,213,179 CfaF, Wholesalers achieve gross margins of 2,717,648,318 CfaF; Retailers achieve gross margins estimated at 354,150,835 CfaF (Table 12).

Value added and Surplus achieved:

As Bjorndal *et al.* (2014) put it, the term value addition within fisheries and aquaculture is used to characterize adding value in products through some type of processing method – essentially converting raw fish to a resulting finished or semi-finished product that has more value in the market place. It is the wealth produced which can be distributed as revenue. Fishermen achieve a net value added of 139,045,458 and an average surplus of 216 129 CfaF the least one among the actors, followed by the retailers who achieve a net value added of 67,579,600 CfaF, against a surplus of 279 254 on average (Table 10). Fish processors and Wholesalers achieve respectively the highest net value added of 390,570,425 and 528,237,635 CfaF, with surpluses of 1 176 311 and 1 280 400 CfaF on average.

Net Value added and surpluses achieved by the four actors confirm the theory. Most of the fishermen usually operate without ice and therefore bring fresh fish, vulnerable to losses due to poor storage facilities and lack of landing infrastructures. Moreover, after one or two fishing days, fishermen need quick money to solve their problems with the hope of future catches at next outings. As a result, they easily release the fish to whole salers and processors at cheapest price. Since they don't have enough money to prepare for the next outing, they borrow money from the latter and therefore operate on a dependence vicious cycle.

Fish processors by taking the fish in these conditions can best appreciate the trend of the market and make their profit, while wholesalers who can buy (fresh or smoked) either from fishermen or fish processors feed on the two actors which explain their highest surplus. Retailers buy either from wholesalers or processors, scarcely from fishermen because of their relative poor purchasing power.

Taxes levied on fish products and fishing activities

For a turnover of 3,018,361,860 CfaF from fishermen, 103,300,982 CfaF of taxes are levied (3%); while looking at fish processors with a turnover of 4,908,911,418 CfaF, taxes levied are estimated at 32,515,950 CfaF (0.6%); wholesalers achieve a turnover of 13,794,882,662 CfaF and 280,946,731 CfaF represent the amount of taxes levied (2%). The retailers, with a turnover of 1,995,306,891 CfaF, only 40,345,750 CfaF of taxes are levied (2%). The results show that fishermen and the wholesalers are the nodes where taxes are most levied. This can be explained by the fact that fish processors usually perform their activities in the houses not always easy accessed by the

Table 6: Flow of exported fish products from Cameroon through fish processors

Origin	Destination	Product	Quantity in tonnes	Value in CfaF	Price in CfaF
Lagdo (Cameroon)	Maidougouri (Nigeria)-	Smoked Tilapia	1.5	3 900 000	2 518
		Fresh Nile Perch	19.9	64 260 000	3 228
		Smoked Synodontis	2.2	7 800 000	3 485
		Fresh Synodontis	19.6	56 000 000	2 857
Limbe (Cameroon)	Nigeria (Lagos)	Smoked Sardinella	14.7	172 034 601	11 725
		Smoked Ethmalosa	30.1	300 907 736	9 997
		Smoked Sardinella	14.2	223599375	15 787
	Nigeria	Smoked Ethmalosa	44.7	447 154 664	9 997
	Equatorial Guinea (Ebebeyin)		16.1	83 122 184	5 162
Rey bouba /Lagdo (Cameroon)		Smoked shrimp	62.9	298141584	4736
Mape (Cameroon)	Nigeria (Lagos)	Smoked tilapia	10.8	27 600 000	2 556
	Abuja (Nigeria)	Smoked catfish	4.2	21 250 000	5 000
Kyossi (Cameroon)	Equatorial Guinea (Ebebeyin)	Smoked tilapia	8.5	21 000 000	2 471
		Smoked catfish	4.5	12 000 000	2 667
		Smoked catfish	2.7	9 000 000	3 333
		Smoked tilapia	11.7	20 800 000	1 778
		Smoked Sardinella	2.3	16 375 385	7 246
		Smoked cray fish	35.4	179 262 720	5 067
Mape/ ngoun (Cameroon)	Nigeria (Maidougouri)	Smoked catfish	311.6	834600000	2679

Source: Fish trade surveys on fish value chain in Central Africa Corridor, 2016

Table 7: Flow of exported fish products from Cameroon to the Sub-region through wholesalers

Origin	Destination	Product	Quantity in tonnes	Value in CfaF	Price in CfaF
Kyé-ossi/ Ambam/Douala	Gabon (Bitam)	Frozen bream	9.9	12152000	3675
		Frozen croaker	20.7	26676500	1274
		Frozen Horse mackerel	81.1	99372000	3675
		Frozen Tilapia	2.4	2 640 000	3 300
Mape (Cameroon)	Nigeria (Lagos)	Dried Tilapia	8.6	21 580 952	2 500
		Dried catfish	4 664	22 552 500	4 835
		Smoked tilapia	7999.2	39 996 000	5000
		Smoked catfish	0.5	2 400 000	5000

	Destination	Product	Quantity in tonnes	Value in CfaF	Price in CfaF
	Abuja Market (Nigeria)	Dried tilapia	8.1	15208553.5	1878
		Dried catfish	4629.92	17507280	3781
		Smoked tilapia	4602	15340000	3333
		Smoked catfish	0.5	2997000	6000
		Smoked catfish	7635.6	25 452 000	3333
Kye-ossi (Cameroon)	Equatorial Guinea (Ebebeyin)	Dried tilapia	1.5	3 750 000	2500
		Dried catfish	1800	4 500 000	2500
		Smoked catfish	0.2	440 000	2750
		Live catfish	33.6	140 000 000	12500

Source: Fish trade surveys on fish value chain in Central Africa Corridor, 2016

Table 8: Flow of imported fish products to Cameroon

Origin	Destination	product	Quantity in tonnes	Value in CfaF	Price in CfaF
Equatorial Guinea (Ebibeyin)	Kye-ossi/ Yaoundé	Vegetal oil Canned sardine	117.5	253 800 000	6480
Gabon (Port Gentil)	Yaounde/ Ambam/Abang Minko'o	Smoked Ethmalosa	148.4	148 350 000	3000
	Yaounde	Frozen rays	54	40 500 000	2250

Source: Fish trade surveys on fish value chain in Central Africa Corridor, 2016

Table 9: Operational data of fish processors and traders in Cameroon

Operational data	Fisher		Fish processors		Wholesalers		Retailers	
Period	2015	2016	2015	2016	2015	2016	2015	2016
No of actors	192	440	112	212	116	286	90	152
Annual production	4570.786	2937.048	802.922	2192.698	3206.755	3111.265	323.618	330.313
Average gross margin			622,638,124	1,785,575,055	1,491,474,138	1,226,174,180	140,100,935	214,049,900
Average sale price			2094.5	2014.08	2909.25	2611.6	2716.56	3025.5
Taxes	43,026,820	60,274,162	10,189,950	22,326,000	50,249,900	230,696,831	6,432,250	33,913,500
Average net value added	5 418 920 118	2560034891	805,859	1,371,298	2,225,995	944,134	277,276	280,426
Average surplus	4 245 120 759	2317914145	799,492	1,369,023	2,211,239	902,858	464,765	275,190

Table 10: Net value added and surplus for different groups for the two periods

	Number of actors	Net value added	Average net value	Surplus	Average surplus
fishermen	632	139,045,458		136,593,672	216 129
Retailers	242	67,579,600		83,657,759	279 254
Fish processors	331	390,570,425		389,359,093	1 176 311
Wholesalers	402	528,237,635		514,721,006	1 280 400

Table 11: Tax levied

	Number of actors	Net value added	Average net value	Surplus	Average surplus
fishermen	632	139,045,458	136,593,672	103,300,982	163 451
Retailers	242	67,579,600	83,657,759	40,345,750	166 718
Fish processors	331	390,570,425	389,359,093	32,515,950	98 235
Wholesalers	402	528,237,635	514,721,006	280,946,731	698 872

tax agents in charge of collection. Meanwhile fishermen are encountered at the landing site just when they land, just like retailers can move from one place to another in the market to avoid payments to tax collectors (Table 11).

Role of producer organisations

Producer Organizations were common in many of the sites. These organisations helped the fish producers to better address issues of the sector, for example, search for investment financing and dealing with competition from imported products. This will enable them to also better express themselves. In terms of level of organization, in all the sites, 49.2 % of fishermen, 45.1 % of processors; 44.1 % of wholesalers and 81.1 % of retailers belonged to associations (Tables, 12; 13; 14). It was clear that women involved in processing and retailing were more involved in organizations. While in some sites like Maga dam and Lake Chad, all the fish processors were organized into associations, those in Mape dam and Sangha River, were not. However, it was observed that fishermen, fish processors, wholesalers around Lake Chad were not organized in association. Wholesalers of Lagdo and Maga dams were well organized into association.

Critical factors affecting efficiency of trade and proposed actions

The following issues were identified as critical factors affecting the performance of the Cameroonian domestic and cross-border fish trade;

- Poor post-harvest technology. Most fish processors use traditional methods of processing such as smoking, packaging and storage. Since these techniques are passed down from generation to generation, or through non-formal training, product quality differs from batch to batch or from one locality to another. In addition, the fish transporters lack appropriate packaging materials that can preserve the quality of the product during transportation.
- Non-official costs to informal trade: Informal cross-border traders incur many non-official costs, which lead to increase in the price of products. These on- tariff barriers include: road blocks and corruptions along trade corridors; administrative delays and taxes at transit borders. On the roads the traders encounter gendarmeries and all forms of barriers and harassment which can contribute to delays in the movement of products and persons, notwithstanding amounts of unregistered fees.

- Pricing structure: Fish prices are set by traders (mainly wholesalers), therefore, fishers are price-takers. In exceptional cases, prices are set through auctioning of the fish, and this mainly happens with fish from imports and industrial landings. The pricing process can sometimes last for several hours because of the "bargaining process", a situation which often leads to long delays in the sale of fish, leading to deterioration of the quality (Tall, 2016).
- Seasonal price cycle. Fishermen catch fish all year round but prices tend to differ from season to season; with best prices between December and January. This leads to seasonal variation in the incomes of all actors in value chain.
- Poor group organization. The study revealed that the majority of the actors are not organized into associations and therefore, do not have collective power. As a result, they are not able to access services that require numbers as a condition, such as credit.
- Poor extension services. Most of the fishing villages are in remote areas and not easily accessible by extension workers, therefore, the actors do not benefit from any extension service.
- Limited investment financing. The value chain actors do not have access to formal sources of investment financing, therefore, they rely on their own savings, or for the case of fishers, getting an advance financing from traders in return for a guaranteed market.

Table 12: Fishermen associations by site

	Association	No association	Std-dev
Mape	0	2618	1851.2
Sangha	17	30	8.9
Limbe	554	640	61.2
Mouanko	33	36	1.8
Lagdo	920	793	89.7
Maga	1432	976	322.1
Lake Chad	269	0	190.2
Together	3225	5093	1321.0
Std-dev	546.3	925.8	268.3

Table 13: Association of fish processors by site

	Association	No association	Std-dev
Lake Chad	210	0	148.5
Maga	303	0	214.3
Lagdo	1495	472	723.3
Mouanko	72	23	34.5
Limbe	425	1049	441.6
Sangha	0	28	19.8
Mape	0	1526	1079.0
Together	2505	3098	420.0
Std-dev	526.0	616.8	

Table 14: Whole salers associations by site

	Association	No association	Std-dev
Ambam	66	0	46.7
Lagdo	772	103	473.1
Maga	322	54	189.9
Limbe	25	110	60.7
Mouanko	3	49	32.3
Lake Chad	0	230	162.6
together	1188	546	454.0
Std dev	306.5	79.1	

Ph: Transportation of fish without ice in a canoe.

Ph: Traditionnel oven

Ph: Traditional fish drier

Ph: Wholesaler of smoked fish at Kofia

Ph: Whole saler of dry fish at Kofia

Ph: Packing of smoked fish

Ph: Storage for transport at Blangoua

Ph: Transport of dried fish on the lake Chad

Ph: Transport by truck

Ph: Transport by minibus

Suggested Solutions

Improve post-harvest technology. As a result of the mode of the traditional technology transfer, there is lack of standardization in the way the products are processed. Therefore, there is a need for the extension services to work in standard producing technology and train the fish processors accordingly. The standardization of processing techniques might also be reinforced with the development of national fish quality standards. As it has been reported by Bjorndal *et al*. (2014), standards must be set for value-added products other than sun-dried, such as salted, spiced or fried, in order to support. There is a need to assist fish processors to understand the consumer demands (both domestically and regionally) in order to produce products that meet consumer needs. As De Silva (2011) noted, a wide range of factors drives consumer demand for fish and fishery products, and these factors should be taken into consideration when creating a new value-added or value-created product.

Eradicate non-official costs to informal trade. The main cause of non-official costs trade is corruption, but it is not easy to address corruption, especially where it affects cross-border trade. Johnston (2004) reported that cross-border corruption can also weaken their home countries' legitimate export markets. This is so because, cross-border abuses, aided by local officials with a share in the corrupt deals, will impede the growth of sound market institutions and of reliable basic economic rights (Knack and Keefer, 1995). Johnston (2004) recommends a number of strategies, including proper training and realistic salaries for civil servants and the active involvement of the citizenry.

Setting a realistic pricing structure for the fish and smoothing seasonal variations in prices. The difficulty faced by fishers and processors in price setting in Cameroon is similar to the one described by Blume *et al*. (2007), where the participants do not all have uniform access to one another. This is the case in the trade of agricultural goods in developing countries; where given inadequate transportation

networks, and poor farmers' limited access to capital, many farmers have no alternative to trading with middlemen in inefficient local markets (Blume, 2007). This could be the reason why fishers in Cameroon were price-takers and at the mercy of traders, mainly wholesalers. Therefore, it will be important for government to improve marketing infrastructure for the major landing sites, especially cold-storage; support value chain actors with processing technology that improves the shelf-life of the products and improve transportation system to ensure that the products reach the end market in good form. In addition, efforts should be directed at strengthening the cooperation between fishers and processors in order to cut out the influence of wholesalers. All this will help stabilize prices because fishers will not be in a hurry to sell of their products. As was reported by Badaracco (1991), direct communication among value chain actors supports both better marketing knowledge by the producers and better knowledge and understanding by the marketing sector on the needs and aims of the producers.

Strengthen groups/associations of value chain actors; improve technology transfer and access to investment finance. Support to the actors to organize in associations will help them better coordinate their businesses and jointly access services that not easily accessible by individual actors. The difficulties women face were to do with management since women have poor access to raw materials (fish), investment finance and business management capacity. They are not supervised correctly and are not trained either. In addition, the scarcity of means of conveyance increases the cost of transportation which absorbs the bulk of the budget or cost of doing business. Furthermore, women suffer proportionally more from numerous non-official taxes, such as inopportune police controls and corrupt customs officials. Therefore, it will be important to support women to improve their capacity to access funding for business, using the existing popular indigenous savings system (locally called tontine); and set up a special extension unit, preferably led by women, to be in-charge of training the women groups and support them technical issues of processing and marketing. Support to group formation or cooperatives is in line with recommendations by Collier and Dercon (2014), who identified three key areas of potential economies of scale necessary to encourage vertical integration in processing and marketing; and these include (i) skills and technology, (ii) finance and access to capital, and (iii) the organization and logistics of trading. This is supported by the literature about learning and the importance of knowledge transfer in networks (Badaracco, 1991).

Conclusion and Recommendations

This study conducted the value chain analysis in the central African corridor. Results of the study showed that there is a flow of fish in and out of the corridor performed by four main actors of the fish chain: the fishermen, fish processors (71 % represented by women), wholesalers and retailers. The age of fishermen lies between 25 and 35 years while the other groups are above 35 years old with a level of education moving from the primary and Coranic School up to the higher education. The study confirms that the wholesalers achieve the highest surpluses. The level of taxes levied also indicates the informal character of fishing activities and thus the need to look into the sector if the government is to invest. Due to the poor level of statistics and data available, to better analyse the value chain of fish products, there is a need to establish a survey on a whole year basis.

Acknowledgement

Special thanks to World Fish Centre, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under the *Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa"*, following the Malabo Declaration at the 2014 Summit African Heads of States and Governments in Equatorial Guinea. The funding was made possible through the assistance from

the European Union. Special thanks go to the University of Douala and the Ministry of Livestock, Fisheries and Animal Industries, the Legon University of Ghana for all the support and facilities to allow a smooth conduct of this study.

References

Abdel-Fattah M. El-Sayed, A-F.M., Dickson, M.W., G. O. El-Naggar. 2015. Value chain analysis of the aquaculture feed sector in Egypt. Aquaculture 437 (2015) 92–101

Badaracco, J. (1991). The Knowledge Link: How Firms Compete Through Strategic Alliances, Harvard Business School Press, Boston. Pp.129-146

Bjorndal, T., Child, A. & Lem, A. eds. 2014. Value chain dynamics and the small-scale sector: policy recommendations for small-scale fisheries and aquaculture trade. FAO Fisheries and Aquaculture Technical Paper No. 581. Rome, FAO. 112 pp.

Chagomoka, T., Afari-Sefa, V., and R. Pitoro. 2014. Value Chain Analysis of Traditional Vegetables from Malawi and Mozambique. International Food and Agribusiness Management Review Volume 17 Issue 4, 2014

Collier, P. and S. Dercon. 2014. African agriculture in 50 years: smallholder in a rapidly changing world? World development Vol. 63, pp. 92-101.

Department of Fisheries. 2011. Annual Report. Ministry of Livestock and Fisheries Development.

De Silva, D. 2011. Value chain of fish and fishery products: origin, functions and application in developed and developing country markets. FAO Value Chain Project Reports. Rome, FAO. 63 pp. (also available at www.fao.org/valuechaininsmallscalefisheries/Project reports/en/).

FAO, 2016. The State of World Fisheries and Aquaculture 2016. FAO Fisheries and Aquaculture Department. Food and Agricultural Organization of the United Nations, Rome.

GTZ. 2007. ValueLinks Manual: The Methodology of Value Chain Promotion, First Edition. http://www.value-links.de/manual.html [accessed on August 10, 2016]

Johnston, M. 1998. Cross-Border Corruption: Points of Vulnerability and Challenges For Reform. In United Nations Development Programme (UNDP). Corruption, Integrity, Improvement Initiatives In Developing Countries (pp 13-23). New York: United Nations. http://www2.law.columbia.edu/course_00S_L9436_001/2004/Chapter01.pdf [Accessed on 6th September 2016]

Kaplinsky, R. and M. Morris. 2001. A Handbook for Value Chain Research. Brighton, United

Kingdom, Institute of Development Studies, University of Sussex.

Larry Blume, L., Easley, D. and J. Kleinberg. 2007. Trading Networks with Price-Setting Agents. http://www.cs.cornell.edu/~eva/traders.pdf [Accessed on 9th September 2016]

Macfadyen, G., Nasr-Alla, A.M., Kenawy, D.A., Fathi, M., Hebicha, H., Diab, A.M., Hussein, S.M., Abouzied, R.M., El Naggar, G.O., 2012. Value-chain analysis – An assessment methodology to estimate Egyptian aquaculture sector performance. Aquaculture 362–363, 18–27.

Nasr-Allah A.M, Habib OA, Dickson M and Dickson C. 2016. Value chain analysis of Lake Nasser fisheries in Aswan, Upper Egypt. Penang, Malaysia: WorldFish. Program Report: 2016-11.

Tall, A. 2016. Cross-border fish trade in Cameroon. FishTrade Case Study

PROMOTING INTER-REGIONAL FISH TRADE IN THE HORN OF AFRICA: UNDERSTANDING BARRIERS FOR TRADE

Eshete Dejen[1] and Ana Menezes[2]
[1]Inter-governmental Authority on Development, Djibouti. Email: Eshete.Dejen@igad.int
[2]FAO Fisheries and Aquaculture Department, Rome-Italy. Email: Ana.Menezes@fao.org

Abstract

Field survey was carried out by interviewing a total of 2237 respondents from seven Inter-Governmental Authority on Development (IGAD) member countries (Djibouti, Ethiopia, Kenya, Somalia, South Sudan, Sudan and Uganda) representing the whole spectrum of each stakeholder, namely producer/fishermen, traders including middlemen and retailers, processors (traditional and industrial processors), restaurateurs, private and government institutions and also school kids. The study was conducted between 2011 to 2013 commissioned by FAO- Subregional Office for Eastern Africa (SFE), and IGAD through a Technical Cooperation Project (TCP). Trading practices, access to fish market information, mapping of fish trade flows, value chain analysis for major species, consumer preferences and capacity need assessment were core areas addressed in the study. The major issue faced by the fisheries sector is lack of infrastructure for post-harvest facilities, resulting in inefficiencies of the fish distribution circuit, high cost of transportation and preservation of the fish, high post-harvest losses and poor quality of fish sold which at the end affects the consumer. Domestic markets in IGAD countries are dominated by freshwater species with strong preference towards tilapia, catfish, Nile perch and also small pelagic freshwater fish called mukene or omena. Somalia and Djibouti are exceptions as consumers, in general, have a strong preference for marine species. In the study performed by IGAD and SFE, it recommended the harmonization of the trade policy and standards as well as technical regulations and assessment procedures. This recommendation largely informed AU-IBAR activities on harmonization of regional fish trade policies in the Eastern Africa regions based on the collaboration between SFE and AU-IBAR in the implementation of the TCP project. The outcomes of these activities should serve as inputs for the establishment of IGAD guideline and standards, for trading fishery products in the region. The study furthermore, recommends the improvement of security and infrastructure along the borders, particularly in strategic entry and exit points, for facilitating smooth movement of products.

Key words: Fish, illegal trade, export, quality assurance and post-harvest loss.

Introduction

With total production of more than 787,000 metric tons (MT) in 2010, the fisheries sector in 1Inter-governmental Authority on Development (IGAD) member countries has been recognized as one of the important sectors contributing to food security, livelihoods and foreign exchange earnings. The fisheries sector, is dominated by inland fisheries, where the Nile Rivers and Great lakes are located, contributes more than 94% (capture and aquaculture) of the total fisheries production of IGAD countries and contribution from marine fisheries is only 5.7%, produced by Somalia, Djibouti, Kenya and Sudan. Despite its relatively insignificant contribution, aquaculture grew rapidly for the past ten years with production increased from 4,384 MT in 2001 to about 110, 000 MT in 2010, an increase of up to 2395% over the period; also representing an annual of increase of 240%. Freshwater fish like tilapia (Oreocromis niloticus), Nile perch (Lates niloticus), carps (Cyrinus carpio) and catfish (Clarias gariepinus) are the main species harvested, contributing more than 72% of total harvest. Tilapias contributed 26.7% followed by Nile perch (20.5%), carps or cyprinids (15.6%) and catfish (9.8%). The three species are popular in the domestic and regional markets while Nile perch is mainly for export to developed markets.

Rising demand for fish and fishery products has placed excessive pressure on inland capture fisheries which has led to over fishing from Illegal, unreported and unregulated (IUU) fishing and illegal trade practices (e.g. selling undersize fish, illegal cross border trade). The other major issue faced by the fisheries sector is lack of infrastructure and post-harvest facilities, resulting to inefficiency in fish distribution, high cost on transportation and preservation of the fish, high post-harvest losses and poor quality of fish sold. Domestic markets in IGAD countries are dominated by freshwater species with strong preference towards tilapia, catfish, Nile perch and also small pelagic freshwater fish called mukene or omena. However, the exception is in Somalia and Djibouti which have access and strong preference for marine species. The total fish supply (live weight) in IGAD countries was about 697,000 MT in 2010 which was mainly supplied by local harvests. Uganda, consuming around 63% of total food fish supply, is the largest market for fishery products in the region.

In the global fishery trade only Uganda and Kenya, among the IGAD member countries, are actively engaged in fishery product exports. Total exports of fishery products from Uganda and Kenya alone accounted for 97.5%, valued at US$ 176.2 million in 2009. Fish exports from the region, dominated by Nile perch in general have been on a declining trend over the past few years, mainly due to the diminishing fish resources, quality related problems, and strong competition from cheaper products, particularly from other freshwater fish like Pangasius and Tilapia in the international markets. Uganda is the largest fish exporter among IGAD countries, followed by Kenya and Somalia. The main products exported from Uganda and Kenya is Nile Perch (Lates niloticus) caught in Lake Victoria. Fishery exports from other IGAD member countries are minor and mainly engaged in cross border trade for their traditional fishery products.

Regional trade is mainly conducted informally by small scale and traditional traders across the borders and bulk of this trade is unrecorded, thus many consider it is as illegal trade; the products traded mainly are dried, salted and smoked products with limited amount of fresh fish and second grade frozen fish. Uganda is the main fish supplier to the regional markets. Official data indicate that regional fish trade generate an average of US $ 35 million per year for Uganda. Illegal trade is carried out to avoid government regulations such as taxes and tariffs, selling undersized fish, trans-shipment on the sea or lake etc. The governments in IGAD countries acknowledge the importance of cross border trade and efforts have been made to legalise and assist the stakeholders of this trade.

In order to address the above mentioned challenges and assist the IGAD

countries to develop their fisheries in sustainable way, the Food and Agriculture Organization (FAO) Sub-Regional Office for Eastern Africa (SFE), in partnership with the IGAD Secretariat, launched a project under the FAO Technical Cooperation Programme (TCP) entitled "Support to capacity building to promote formal marketing and trade of fish and fish products from and within the Horn of Africa (TCP/RAF/3308), in October 2011.

This report is a compilation of national studies carried out in seven IGAD member countries, in an attempt to get a clearer representation of the fisheries sector in the region, particularly on fish trade, marketing and quality assurance related aspects. The study identified areas for intervention, in order to strengthen the technical and managerial capacities of the actors along the supply chain and to complement national and regional development initiatives. Furthermore, the study provides baseline survey and the capacity need assessments for both the marketing and quality assurance components in the region.

Materials and Methods

This report largely draws on information, data and analysis provided by the national consultants, who carried out the study, based on the following methodologies:

a. *Desk Study:* Desk study has been undertaken by reviewing secondary data sources, statistics and published information. The review also involved cross referencing data sources with other relevant institutions.
b. *Field Survey:* The survey was to gather primary data and information mainly conducted using structured questionnaires developed by FAO. Field visits were also conducted to assess the status of fish trade, right from sources of raw materials up to the exit points/ border points. Direct interviews were carried out with key informants in relevant public institutions as well as private sector and actors along the value chain. The surveys in each country covered major regional fish trade corridors, both on land and across water bodies. The study also took into consideration the four main commercial fish species in the region. Capacity need assessment was also carried out to identify areas that require training. The field survey was carried out by interviewing a total of 2237 respondents from seven IGAD member countries representing the whole spectrum of each stakeholder.
c. *Reporting:* The national consultants were provided guidelines to carry out the study in their respective countries, compile data and information collected and to write the country's report based on standard outline and the national consultants finalised their reports based on inputs given by the international consultants.

Results and Discussion

Regional Trade Flows

The regional trade flow generally maintains the following pattern: In the case of freshwater fish, Uganda and Kenya are the main exporting countries to the region, while, Sudan, South Sudan, Ethiopia, Democratic Republic of Congo (DRC), Burundi and Rwanda are the main importing countries. Somalia is the main player exporting its marine products to Kenya, Djibouti and Yemen. As mentioned in the previous sections, regional trade within IGAD countries for fishery products are dominated by traditional products like dried, salted and smoked fishery products. However, small portion of live, fresh and frozen products are also traded among IGAD member countries. Dried, salted and smoked tilapia products are exported from Uganda and Ethiopia (Northern Lake Tana) to South Sudan, Kenya and DR Congo. Kenya also exports dried tilapia to Sudan and DR Congo. Dried/salted and smoked by-products of Nile perch such as frame, skin and head are exported from Uganda to DR Congo and the Western part of Kenya. Similar products from Kenya are also exported to DR Congo and Sudan. Interestingly fish maws from Kenya are also sent to Uganda, most probably for re-export to Far East markets. Dried, salted and deep fried Mukene from Uganda is

exported to Kenya, DR Congo, Rwanda and Burundi and dried Omena is sent to Sudan from Kenya. There is one commercial processor in Uganda who exports salted sun-dried Mukene to SADC market. In addition to this, Mukene Traders Exporters and Processors Association (MUTEPA) is also generally promoting marketing and trade of Mukene products in both domestic and regional markets.

Fresh tilapia is also exported from Uganda to South Sudan and Kenya, Rwanda and Burundi while fresh Nile perch is shipped from Ethiopia (Lake Rudolf) and Uganda (Lake Victoria) to Kenya. In Kenya, the traders prefer to import fish as there is ready market available. The districts receiving most of the imported fish are Busia, Amagoro, Kisumu and Kuria, although regional fish imports are also destined for the major urban centres of Nakuru and Nairobi. Kenya is also actively exporting fresh, chilled and frozen fishery products to neighbouring Ethiopia, Somalia, Sudan and Uganda.

There are also second grade frozen fish that is sold from Uganda to regional markets especially Rwanda, Burundi and South Sudan. Imported frozen fish from Djibouti is also re-exported to Ethiopia to cater to hotels, restaurants and modern retail outlets.

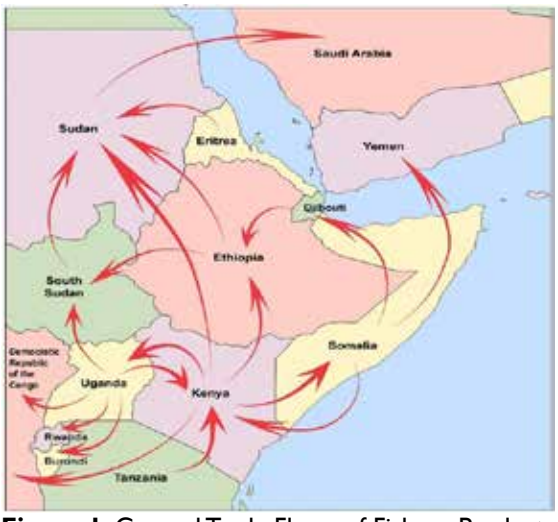


Figure 1: General Trade Flows of Fishery Products in the Horn of Africa

Figure 2: Regional Trade Flow of Tilapia in the Horn of Africa

Figure 3: Regional Trade Flows of Dried/Salted/ Smoked Products from IGAD Countries

As mentioned earlier live lobster from Somalia's Bajuni Islands, sent by chartered flight to Kenya while fresh fish from Zeila is transported to Djibouti. Fresh, smoked and dried products from South Sudan are also reportedly "exported" to Sudan and Ethiopia. Regional trade is carried out by both men and women and the main means of transportation are boats and trucks.

International Trade Flows

Trade flows of fishery products from IGAD countries to the international markets are dominated by Nile perch products from Uganda and Kenya such as chilled and frozen fillet, steaks and portions as well as Nile perch maws. There are also, however, significant amount of marine fishery products exported from Kenya, Sudan and Somalia.

From Uganda, chilled products are mainly shipped through Entebbe International airport, while frozen products go by road and shipped via Mombasa sea port in Kenya. The main international market is the European Union, which takes almost 72% of the fillet and the rest is sold to Non EU Countries. Meanwhile dried fish maws from Nile perch are exported to premium Asian markets like China and Hong Kong. Currently there is no export of fishery products from Ethiopia and South Sudan to the international markets. Certain products, such as Crocodile skin, from these countries are finding their way to international markets via third country.

As indicated earlier, Kenya's main fish product export is also Nile perch products. However, the country also exports significant amount of various marine products to the international markets. The main export destinations during 2010 were Israel accounting for around 38.5% or 3,962 MT, followed by the Netherlands 1,860 MT (18.1%), Portugal 763 MT (7.4%), Spain 598 MT (5.8%), United Arab Emirates (UAE) 499 MT (4.8%) and Germany 459 MT (4.5%) in that order. New and emerging regional and international markets continue to spring up every year. Lately this has been driven by the Euro crisis, leading to a drastic drop in the export prices by 50%. As a result, most of the processing factories have started exploring diverse markets like Japan and China.

Somalia exports its marine fish to international markets in Asia, notably to Thailand (mainly tuna) and Middle East (Saudi Arabia and UAE) for lobster and also for other marine fin fish. Meanwhile Sudan exports marine fishes mainly to Middle East and dried sea cucumber to Far East markets.

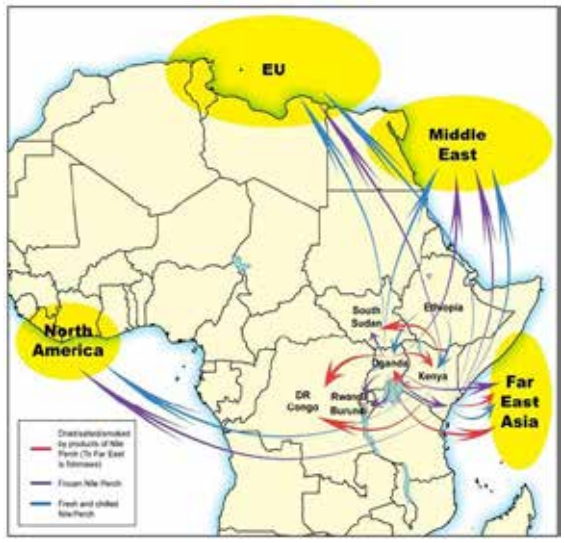


Figure 4: International and Regional Trade Flows of Nile Perch and it's By-products from Uganda and Kenya

Cross border (illegal) trade

As mentioned above most of regional trade mainly consists of cross border trade, whether it is legal or illegal. From various national reports, illegal trade usually refers to informal trade, which is traditionally done by small traders from both sides of the border and illicit trade which is done by traders who try to escape from government regulations such as tax and tariff, illegal products (e.g. undersize fish), trans-shipment on the sea or lake etc. The governments in IGAD countries acknowledge the importance of cross border trade and efforts have been made to legalise and help the players of this trade. Illegal trade, particularly involving IUU fishing and undersized fish, has significant impacts to the management of fish resources.

The survey within IGAD member countries, revealed the main reason for illegal trade practices or cross border trade is that there is better demand and/or better price offered by the neighbouring markets. Most of the respondents interviewed, whether producers, middlemen, traders and retailers, said that cross border markets offer better opportunities in terms of demand and price. The other reason for illegal cross border trade

is to avoid government tax and red tapism such as quality certification, license requirement etc. Only small percentage of the respondents gave reasons like no demand in local market for particular fish and products. It is interesting to note that, generally traders have limited tie-up arrangement with their cross border buyers.

Illegal trade in fish and fish products in Somalia mainly happens on high seas. For example, in the areas where the Yemeni boats operate, fishermen who catch sharks as by-catch, during fishing for large pelagic fish, sell them whole, complete with fins to the Yemeni boats for the sake of convenience. However, it is not possible to estimate the total production of this fishery and the amount of revenue it generates.

It was reported that before and even right after the independence of South Sudan from the Sudan, fish trade route from the south northwards was continuing until recently, when border disputes between the two states erupted and destabilized marketing of fish and other fisheries resources from South Sudan to Sudan. In Sudan illegal trading practices are insignificant in freshwater fish, due to the nature of the inland resources, which depend on the Nile system and its tributaries. As per geographical position, Sudan is neighboured by Egypt in the North, and South Sudan in the south. There is a limited amount of wet salted fish traded across the border with Egypt. Some sporadic trials of illegal trading were known across the Red Sea to Saudi Arabia (shrimp, high value fin fish and shell fish) prompted by higher prices and good demand.

There are some reports on illegal cross border trade between fish traders in lake areas, along the borders of Ethiopia and neighbouring countries. Nile perch and other fish caught from the Ethiopian part of Lake Turkana (formerly Rudolf) are "exported" to Kenya and Uganda; while fish harvested from Gambela and Benshangul Gumuz cross over to South Sudan.

According to Uganda Bureau of Statistics (UBOS) and National Export Strategy (2008-2012), Uganda's informal trade with neighbouring Democratic Republic of Congo, Kenya, Rwanda, Sudan and Tanzania has been estimated around US$ 1.6 billion.

As in Uganda and Ethiopia, traditionally, products from Kenya sold across the borders are mainly split open dried tilapia and dried Nile perch fillets from Lake Turkana.

Fisheries Trade Regulation

Countries with active participation in international trade in fisheries are usually well equipped with trade regulation, particularly with regard to export regulation and quality related certification. This pattern also applies in IGAD countries where Uganda and Kenya have more advanced and have complete trade regulation in fishery, compared with other member countries. It is understandable as they have to comply with requirements from importing countries, particularly with the EU requirements.

In Uganda, Fish and Aquaculture Products (Quality assurance) Rules, 9th schedule provides for sanitary certification fees of fishery and aquaculture products (quality issues related to storage, handling, display, packing, transportation, processing) and export permit from Ministry of trade. Fish Amendment Rules, 2010 gives provision for licenses and permits to anyone involved in fisheries activities (fishermen, fishing vessels, fish traders, fish mongers, fish trucks, fish processors both artisanal & industrial, fish transport boats & vessels). Beach Management Unit Statute 2003 provides for issuance of fish movement permits at the rate of 10 shs/kg for fresh fish and 20 shs/kg cured fishery products.

In Ethiopia, with limited participation in international trade, regulation on fish trade is almost non-existent. The main regulation related to fisheries in Federal Democratic Ethiopia fisheries proclamation (2003). The Act is divided into six Parts and 24 sections and intends to set up the basic principles for the development, management, exploitation, utilization and conservation of fisheries and for connected purposes.

Kenya also has Fisheries (Safety of Fish, Fishery Products and Fish Feed) Regulations

2007, which provides provision with respect to the official control of the safety of fish, fishery products and fish feed and specify health requirements for the production and marketing of (particular) fish products. It is the main fish exporting country in the region. The Ministry responsible for fisheries shall be the Competent Authority for purposes of these Regulations. As mentioned earlier there is also Fisheries (Prohibitions) Regulations 2003, which grants the power to the Director of Fisheries to prohibit fishing, processing and selling of selected fish. The Director may also prohibit the use of scuba-diving gear or spear guns to fish for lobsters and Beche-de-mer within the territorial waters of Kenya, as described under the Maritime Zones Act, unless this is done for experimental purposes.

In Somalia, there are only few fish exporters, thus fish marketing regulation is almost non-existent. The fish exporters are the most sophisticated in the supply chain and they implement basic principles of the Hazard Analysis and Critical Control Point (HACCP). Rest of the chain is completely unaware of export-import regulations and safety issues. The exporter is the price setter: the prices move downwards from the exporter to the supplier, to the agent and then to the fisherman on a daily basis. The level of transparency is very low between each of these groups. Even traders are unaware of the selling price of exporters. Nevertheless, exporters receive prices from their buyers in the importing countries.

The Fisheries Code established in 2001 by Djibouti Government, is the main regulation related to fisheries, including in fish trade. It also includes the Customs Department's Tax Code. In the fisheries sector, all inputs other than fuel (fishing gear, engines and spare parts, etc.) are taxed at 5%. Fuel used by fishermen, is made available at zero tax basis and industrial fishing is prohibited in Djibouti.

In Sudan regulations related to fish import and export, are lying with different ministries and governed by the standards and rules, specified and adopted with the different institutions. The concerned agencies related to fishery trade are Departments of Fisheries, Customs Department, Health and Commerce Ministries.

Preferential Tariffs Received by IGAD Member Countries

IGAD member countries receive preferential tariffs for their fishery products from major markets such as the EU, US and Japan, through bilateral arrangements, as well as from their neighbours through regional agreements. Under the famous Lomé and, later, Cotonou Preferential Trade Arrangements, ACP countries received preferential tariffs for the products, including fishery products entered into the EU up to 31st December 2007. The replacement of the agreement, called Economic Partnership Agreement (EPA) has been negotiated with the ACP countries. Due to various unresolved issues, the progress on EPA negotiations has been slow and so far only South Africa has full EPAs with the EU. Then the EU has embarked on negotiating Interim EPAs (IEPA) which is less comprehensive in scope and time which focuses more narrowly on trade aspects. So far IEPA has been signed only with Seychelles and Mauritius and none from IGAD countries.

Nevertheless, IGAD countries still receive duty free access to the EU market for their fishery products, through the Everything But Arms (EBA) introduced in 2001 for Least Developed Countries (LDCs). Under the Generalized System of Preference (GSP), other developed markets like the US and Japan also give duty free access for some IGAD member countries for their export products, including fishery products. Uganda and Kenya, for example, are given duty free access to the US and also Japan for their fishery exports. Other individual countries like Norway, Russia and China also give preferential treatment for products from selected IGAD countries.

IGAD member countries are also members of Common Market for Eastern and Southern Africa (COMESA) and few (Kenya and Uganda) are members of East African Community (EAC).

Trade Policies

Some members of IGAD countries are already member of WTO (Djibouti, Kenya and Uganda) and Ethiopia and Sudan are in the accession process. As WTO members, any trade policies have to be compatible with WTO rules and regulation and abide to commitments made under that agreed trading system. Similarly, for the countries who have already applied (in the process of accession) they will also have to abide by the WTO rules, in order to be accepted as members. Thus, in general, their trade policies related to fishery products are in compliance with WTO rules in particular, with Non Tariff Barriers (NTB) to trade, such as hygiene and sanitary conditions of the Sanitary and Phyto-sanitary (SPS) and Technical Barriers to Trade (TBT) agreements etc.

In addition to active involvement in multi-lateral trade arrangement, some countries in the region are also joining the global trend in pursuing bilateral and regional free trade agreements to liberalize their economies and speed up regional trade development. This is reflected in regional effort by COMESA, EAC and SADC which has embarked upon a tripartite negotiation since 2005, to establish a comprehensive FTA in the region. The partners to the tripartite negotiations aim for strengthening and deepening economic integration of the southern and eastern Africa region. The strategy to achieve this goal can be summarised as the implementation of various initiatives aimed at harmonising policies and programmes of the three participating RECs in the areas of trade, customs and infrastructure development, and implementing these in a coordinated manner, jointly wherever possible.

Access to Marketing Information

In general stakeholders in IGAD countries, from fishermen to retailers have a common complaint; there is limited access to fish marketing information. Fortunately, with the wide spread usage of mobile phone, fishermen and small scale traders and processors nowadays can get access to market information from their contacts such as buyers, traders and other sources. Though it is an encouraging development, this type of information dissemination (through buyers or traders) is not very transparent and can lead to biased or inaccurate information that will benefit only certain players in the value chain. Industrial processors and exporters have better access via internet or other means to get up to date market information. Nevertheless, the fact remains that mobile phone is the most common method of getting market information for all stakeholders, particularly fishermen and small traders.

Government in IGAD countries have established different types of market information systems, but mainly focusing on agriculture products while limited attention is given for fish and fishery products. In Ethiopia, for example, there is a regular broadcast on price information on crops and coffee, aired through national radio channel, but no fish price information is covered in the programme. In Uganda, however, FIT Uganda Limited in partnership with Agricultural Sector Program Support [ASPS/DANIDA] to set up and manage a self-sustainable agricultural market information system establishes Info-trade which covers also price information on Nile perch and tilapia, accessible on subscription basis, which is too expensive for small scale fishermen and fish traders.

In Kenya information on the fish quantities landed per beach and value per kilogram for the key fish species is easily provided through Electronics Fish Marketing Information System (EFMIS) now. The system disseminates key fish market information from about 150 fish landing sites and markets. The database of market information is updated on a daily basis, with information on quantities and prices of fish around the country. EFMIS releases market information principally on demand by SMS sent to a special code 5565 and also disseminates synthesised market information through various media, including radio and internet. EFMIS monthly Market Bulletin is the summarised price information of Lake Victoria

fisheries, distributed free by e-mail to over 1,000 stakeholders across the world. Survey results show that 29% of the fishermen and 60% of the traders' access market information. Unfortunately, market information for most of fishermen does not come from the EFMIS system but from agents, who set the prices.

Challenges of EFMIS are:

- Meeting information needs of different stakeholders (Fishers, fish traders, farmers)
- Non-cooperation of some key players
- Lack of clear standards on quality & pricing
- Dealing with highly diverse products
- Maintaining contribution of fishers (BMUs)
- Sustaining the system
- Low embrace of the system among middlemen, largescale fish processors (processing factories).

Conclusions

The regional trade in fishery products is not yet developed, which is dominated by traditional cross border trade and in many cases it is illegal, involving mainly undersized fish in the form of dried, salted and smoked products. In addition to this, transportation network and infrastructure facilities connecting IGAD member countries are generally poorly developed. Fishery products from IGAD member countries, except Kenya and Uganda, are unable to access major developed markets, like the EU, USA and Japan because of food safety standards importing requirements. This is due to non-existence of national regulatory framework and implementation of quality assurance programme, to meet required standards of importing countries. Nile perch, the main export item from the region, has been facing strong competition from other freshwater fish products, particularly Pangasius fish from Vietnam. In IGAD countries, apart from the fish products meant for export, there is no quality assurance system in place. The study showed that operators in the sector are aware of quality control measures and it is necessary to improve their capacity for enhanced fish quality control compliance.

In trade and marketing aspects, all the stakeholders in IGAD countries feel that they need to improve their knowledge and skill in business and marketing, simple book keeping, product development, market information and how to use such information, access to loan and financial assistance. For officials from government institutions, they require training on international trade aspects, imports and quality standard requirements in importing countries, development of marketing information system and training on products and market diversification.

In the study performed by IGAD and SFE, it is recommended the harmonization of the trade policy and standards as well as technical regulations and assessment procedures. This recommendation largely informed AU-IBAR activities on harmonization of regional fish trade policies in the Eastern Africa regions based on the collaboration between SFE and AU-IBAR in the implementation of the TCP project. Those should serve as inputs for the establishment of IGAD guideline and standards, for trading fishery products in the region. The study furthermore, recommends the improvement of security and infrastructure along the borders, particularly in strategic entry and exit points, for facilitating smooth movement of products.

Some discussion on the trade routes, products, etc why the chosen routes for particular products? Especially trading in and outside the continent (e.g. Asia) This might be interesting for policy direction.

Acknowledgements:

We would like to thank the Food and Agriculture Organization (FAO) Sub-Regional Office for Eastern Africa (SFE) and Intergovernmental Authority on Development (IGAD) for financial and technical support to implement the project. Thanks are also due to all national consultants for their time and valuable reports which were largely used in preparing this regional report. Without their contribution, we would not be able to finish this task and produce this publication.

References

FAO, Sub-regional Office for Eastern Africa 2012. National Reports of Djibouti, Ethiopia, Kenya, Somalia, Sudan, South Sudan and Uganda on Support to capacity building to promote formal marketing and trade of fish and fish products from the Horn of Africa(TCP/RAF/3308), Addis Ababa, Ethiopia.

FAO Sub regional Office for Eastern Africa 2013. Regional report on Support to Capacity building to promote formal marketing and trade of fish and fish products from and within the Horn of Africa (TCP/RAF/3308), Addis Ababa, Ethiopia. 127 pp.

NATURE AND IMPACTS OF WOMEN PARTICIPATION IN FISH VALUE CHAINS ON HOUSEHOLD AND LOCAL ECONOMIES: THE CASE OF KACHULU AND MSAKA, MALAWI

Chikondi Manyungwa[1], Mafaniso Hara[1] and Sloans K Chimatiro[2]
[1] PLAAS, University of the Western Cape, South Africa,
[2]Word Fish Lusaka, Zambia

Abstract

Economic activities are gaining prominence in most developing countries in the world. Socioeconomic development can never be achieved without women's effort and contribution. In addition to their participation in economic activities within the fish value chains, women also engage in domestic chores such as home management and also community activities. They play an active role in fish trade transactions at the various nodes of the fish value chain. The socio economic contribution and role of women in every community is an indicator of the modernization of the national economy. The study therefore aims to identify the patterns and trends in socio economic activities of women dependent on fisheries and secondly to examine the contributions they make to household and local economies through their participation in the various activities in the fish value chains. This study employs qualitative approach, hence the discussion is more on qualitative with a total of 10 women respondents selected for the focus group discussions and 11 male key informants. The findings indicate that women from communities' dependent on fisheries contribute to household and local economies by providing work opportunities to members of the community; they also help to create avenues for skills acquisition by members of the community. The persistent gender division of labour at the different nodes of the fish value chains has been found to be associated with both economic factors access to production factors like cash/fishing gear and socio-cultural factors - norms and customs regarding women and gender roles in production and reproduction. From the analysis, it shows that women participation in fish value chains is an important source of income which provides a stimulus for income generating activities contributing to livelihood improvements; however, such activities have been found to have weak impact on empowerment. In addition, value chain participants have gained access to networks requiring financial contributions. A policy implication emerging from this study relates to investment in infrastructure that can facilitate value addition for the fish products but also provision Early Child Development Centres that can reduce the burden of domestic work especially child care among women working in fish value chains within the fishing communities.

Key words: Household and local economies, fish value chains, women.

Corresponding author email: cpasani@gmail.com

Introduction

In the present world of sustainable developmental goals, socioeconomic community development can never be achieved without rural women's effort. There is a growing need for focused research on rural women. This is tandem with the United Nations CEDAW recommendation 34 which recognizes the unique situation of rural women. While rural women have much in common with their urban counterparts, the spatial features of distance, low population densities and limited offer of public services that characterize rural areas, together with the mentality of rural societies, contribute to differences between rural and urban citizens. Research on women´s work has mainly focused on four major areas namely documentation of women´s work; evaluating the work in monetary terms; explaining the factors behind gender division of labour; and its impact on the status of women in the family.

Invisibility of women´s productive work is a problem, particularly in developing countries because women usually work within the household, and productive work is often overlapped with the so-called non-productive work. Credible documentation of women's participation in economic activities is problematic particularly for women in fisheries dependent communities. With regards to evaluation of work, neoclassical economic tradition emphasizes the activities undertaken to meet the demand of the markets. To that effect, women's work outside labour market has often been overlooked and excluded from economic analyses.

The neoclassical household economics is criticized for ignoring the influence of cultural and social institutions in determining tastes and preferences and gender division of labour, and for the assumption of unitary household with joint utility function based on altruism among household members (Folbre, 1986a; Elson, 1995). The United Nations conferences during the Decade for Women (1976-1985) popularized the concept of social reproduction. This discourse and debate contributed to the recognition of women's work in the productive and social sectors.

In recent years, empirical research has tried to document the extent of women's involvement in specific tasks, and their contribution to national income, but the controversy regarding the complexity of women's work and the interconnectedness between different types of functions remains.

This papers deals with the case of Malawi. The objectives of the study therefore aim to identify the patterns and trends in socio economic activities in fish value chains of women dependent on fisheries and secondly to examine the contributions they make to household and local economies through their participation in the various activities in the fish value chains.

Background to the study

There is a growing need for focused research on rural women in fishing communities specifically because rural living conditions impinge on them in ways different from men, associated with features such as their lesser access to transport, more disadvantaged economic status, difficulties in access to the labour force, much greater family and caring responsibilities, lack of property rights, patriarchal family relations, relative invisibility in much agricultural and rural development programs and their under-representation in decision-making. Hughes (1997) stated that there is need for the inclusion of women's subjective experiences as a legitimate tool of research in understanding the rural way of life. Ajani *et al*., (2013), in a research pointed out that rural women's economic activities can be promoted in several ways because their potentialities as agents of change to community development through their participation in economic and income generating activities are untapped, but, their theoretical and practical knowledge to the environment and resource is not given due consideration.

Bashir *et al*. (2014) examines the microfinance as a strategy for poverty reduction and a prime to achieve sustainable community development. It gives an opportunity for poor

rural women to starts from small scale business to plan for the future, through investing in their children's education and health. The concept of village savings and Loans (VSL) provides low-income family as well as women with small loans to help them engage in productive activities or expand their businesses. Despite the fact that domestic chores are virtually associated with women in all societies, they are involved in non-domestic and wage earning activities for the well- being of their family and community development in general. The researcher further emphasizes that the role of women in economic activities is necessarily important in low-income families whereby the husband alone cannot afford all the responsibilities of the family.

Participation of women in economic and development activities is significant, today women play major roles in the economic development of a country. Their participation in economic activities differs in each socio-cultural setting. Under a dominant patriarchal planning, managing and socio-economic condition, women, have become second citizens in the country. Although women actively participate in economic and developmental activities all over the globe, each nation experience women's subordination, for this reason.

Methodology

The study is conducted in Kachulu beach on Lake Chilwa and Msaka beach on Lake Malawi in Zomba and Mangochi districts respectively.

Problem statement

Gender issues in the fisheries sector are seldom examined, and women's important role is often not adequately considered. According to Kaplinsky and Morris, (2000), there are mainly three sets of reasons why value chain analysis is important these are: i) with the growing division of labour and the global dispersion of the production of components, systematic competitiveness has become increasingly important, ii) efficiency in production is only a necessary condition for successfully penetrating global markets, and iii) entry into global markets which allows for sustained income growth - that is, making the best of globalilsation- requires an understanding of dynamic factors within the whole value chain.

In fisheries sector, the actual contributions that women make in fish value chains l *et al*one at household and community levels is often not properly assessed and verified. Data for the fisheries sector is mainly documented through statistics on capture and aquaculture, and the quality of sex-disaggregated data has been low with varied reporting frequency. It is against this background that this study was conducted to identify the patterns and trends in socio economic activities of women dependent on fisheries and secondly to examine the contributions they make to household and local economies through their participation in the various activities in the fish value chains.

Research questions

The present study aspires to contribute to the increase of body of the knowledge on the roots of social exclusions of rural women in order to help define requirements for effective implementation of policies and actions that can contribute to greater social inclusion of rural women.

The paper seeks to provide answers to the following research questions:

a. What roles do women in fisheries dependent communities play in the fish value chains?
b. What is the contribution of women participating in fish value chains in household and community development?

Conceptual framework

The study adopted a case study approach focusing on analysing the contributions and impacts of women's involvement in fish value chains at household and community. The study is conducted in Kachulu on Lake Chilwa and Msaka on Lake Malawi in Zomba and Mangochi districts respectively.

Conceptually, the study adopted the Gender Household Approach (GHA). GHA

seems to work as a suitable intervention in the development of livelihood strategies. It focuses on joint planning and decision-making regarding the distribution of workload and resources at household level. The GHA promotes better relation between husband and wife, making her and the children partners of the "head of the family".

The research drew on two methods of data collection namely Key Informant Interviews (KII) and Focus Group Discussions (FGD) using Appreciative Inquiry. Appreciative inquiry has its roots in the positive psychology movement that began in the 1980's and is grounded in "hope theory" which posits that people are most likely to change when they have: (1) an elevating purpose, (2) a sense of collective confidence to accomplish it, and (3) a set of practical steps for moving forward (Ludema, *et al*., 2003).

Data collection and analysis

The research drew on two methods of data collection namely Key Informant Interviews (KII) and Focus Group Discussions (FGD).

A total of 9 KIIs and 2 FGDs were completed at Kachulu and 10 KIIs and 3 FGDs at Msaka respectively to gain perspectives on the social relations outcomes on women participating in the fish value chains. Participants consent for both KII and FGDs was sought before commencement of interviews. The key informants were purposively selected to capture a range of actors involved in the fish value chains.

Maximum variation sampling technique (Palinkas *et al*., 2015) was used involving, fishers, processors/traders, fish collectors, local leaders and extension staff. According to Palinkas *et al*. (2015) the basic principle behind maximum variation sampling technique is to gain greater insights into a phenomenon.

This technique enabled the understanding of the social relations within the value chains from different angles. Interview notes were transcribed in line with the interview and were thematically analysed using inductive process of coding (Berg, 2004). Focus Group Discussions were undertaken to gain insights about how social relations outcomes and obstacles affecting women are perceived in the fish value chain. The FGD involved selected actors representing actors at each node of the value chain. There were some overlaps between KII and FGDs as some participants who participated in KII were also involved in the FGDs.

The FGDs were interactive and took approximately one hour and thirty minutes. We used the dimension of social relations and critical institutionalism as a conceptual lens for approaching the data collection exercise while remaining attentive too other emerging themes from the data as acknowledged by (Fereday, 2006). It was imperative to undertake an analysis of the social relations outcomes within the value chains to establish the experiences of men and women.

Conceptual issues regarding women participation in economic activities

Economic activities in this paper are defined as those that generate income for the households or saves household expenditure for the acquisition of the goods from the market. This includes employment in the agricultural and non-agricultural labour market, but also unpaid work for the household in crop cultivation, homestead gardening, livestock and poultry raising, fishing, cottage industry, transport operation, construction, business, and personal services. Whereas domestic activities done mostly by women that are quasi-economic in nature which are not valued in national income accounting.

Examples are food-processing and preparation of meals for the family members; care of the child, old and sick members of the household; and tutoring of children. If the household had hired workers for doing these jobs, it would involve some expenditure.

Findings

What roles do women in fisheries dependent communities play in the fish value chains?

This question sought to provide pattern and trend in participation in economic activities along the value chains of Engraulycypiris and Barbus species. The FGDs and KII interviews with value chain participants showed that men and women often fulfill different roles in the value chain and have differential access to assets and have separate levels of influence in decision-making processes.

Seven major nodes and actors could be identified in the value chains for Engraulycypiris and Barbus species namely fishers, local brokers (fish collectors) local processors/ traders, transporters, market intermediaries, retailers and foreign export buyers. The production node (gear/boat owners and actual fishing) is dominated by men. Over 95% of gear owners both at Kachulu and Msaka were men with almost all the fishing out on the lake being undertaken by men (crewmember). In both case study communities, men tended to dominate fishing while women dominate the post-harvest fishing activities.

At Msaka, the fishers' wives are given priority to access fish for processing and trading. At times, however, especially when catches are low, traders are allowed to buy the fish. In such cases, the wives play an intermediary role (Jolova) by brokering the deal between fisher (husband) and processor/ trader. At Msaka, widowed and or divorced women were less privileged to access the catch for further processing and trading even though some operated as brokers. Table 1 presents the proportions of women in fish value chains in the two beaches.

Time allocation

A time budget approach was adopted to get a full accounting of labour allocation. The respondents were asked to report the time allocation to different activities (including rest, recreation and personal care) for 12 hours from six in the morning to six in the evening for value chain participants. We also distinguished the activities by paid and non-paid work.

It was learnt that fishers spent more than 9 hours per day on fishing activities including fishing and net mending whereas men and women processors/traders spent equal amount of time approximately 8 hours per day on fish processing and trading activities. However, responsibility for household duties and child care often resulted in much longer workdays for women. As a result, women require support in order to find time to fulfil their reproductive responsibilities in addition to fish processing and trading and hence hire casual labourers and or sometimes used their children to provide extra hands.

Apart from fish processing and trading, 56 % of the women and 22 % of the men at both were engaged in other economic activities such as selling firewood, food/agriculture commodities and other small groceries to make ends meet. The findings on time allocation by broad activities are presented in Table 2. The distribution of work time in different activities indicates a clear gender division of labour.

What is the contribution of women participating in fish value chains in household and community development?

This question sought to demonstrate the impacts of women participation in fish value chains. The study findings provide an overview of participation in economic, and the non□economic gains that have occurred in the households and community levels as a result of women participating in fish value chains. The reported impacts are presented schematically in the figure 1.

Table 1: proportion of women at each node of the value chains of Barbus and Engraulyccypiris species

Value chain actor	Msaka Beach				Kachulu Beach			
	Total	Men	Women	%women	Total	Men	Women	%women
Fishers	167	158	9	5	42	39	3	7
BVC	10	5	5	50	11	8	3	27
Local brokers	60	20	40	67	24	8	16	67
Processors/ Traders	54	26	28	51	48	9	39	81
Transporters	4	3	1	25	4	4	0	0
Exporters	4	0	4	100	6	1	5	83

Table 2: Average labour time allocation for men and women

Type of activity	Men	Women
Fishing related activities	8.57	6.89
Non fishing activities	2.28	2.49
Farming	0.98	4.32
Domestic activity	0.76	7.02

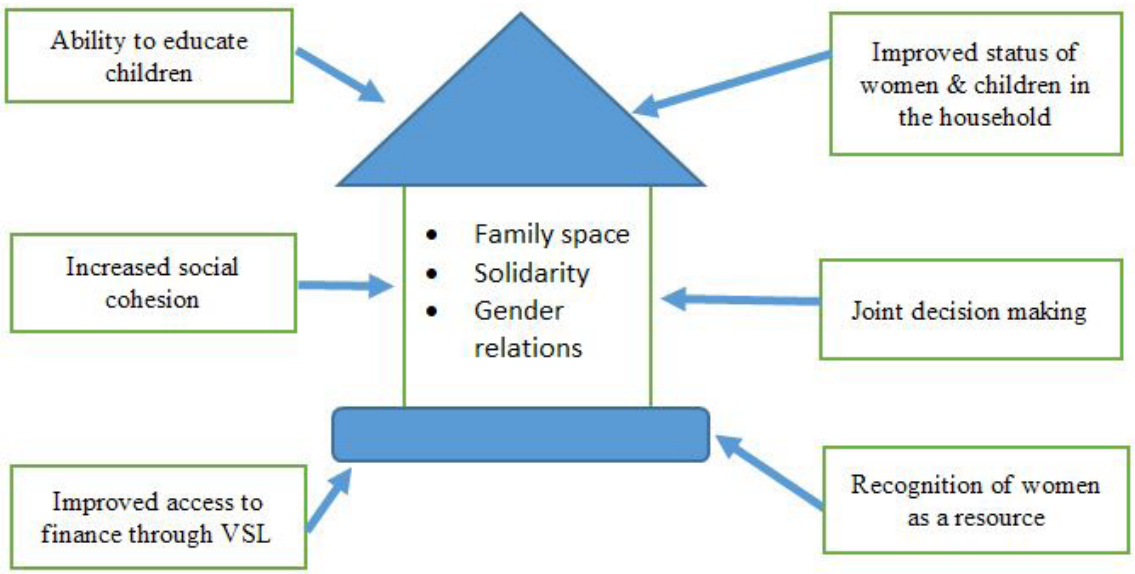


Figure 1: Scehmatic presentation of impacts of women participation in fish value chains at household level

Joint decision making

In the FGD with women only in both fishing communities, a remarkable topic was brought up. The joint planning of the use of the income is a big step forward for the partnership between spouses, the position of women in the family and family life as a whole. But this does not necessarily mean that men and women are at the same level. Transparency in money matters has overall increased with consequences for men and women alike. Although now they generally have a say in how the money is used and appreciate this change, a few women in Msaka stated that their husbands were still dominating the decision about how they spent their own money. Therefore, they

would like to have some money that belongs exclusively to them and that they can spend as they like for instance for helping their parents or family members.

Household poverty, economic and social impacts

From the study generally, the findings indicate that the participation of women in fish value chain activities has reduced the need to engage in rural labour among the women value chain participants. In addition, it has lightened the burden of households' poverty especially women's poverty. It was reported by the respondents in both fishing communities, that as a result of participating in value chain activities most households have attained an improved economic situation. Most of them have acquired and own important household items such as Iron sheets (for roofing their houses), plates, pots, mattresses, they are able to provide school supplies (such as exercise books, pens, pencils and uniforms) and in some cases fishing gear.

Some have even acquired livestock such as chickens and goats and some have improved their houses. Despite these improvements respondents from Kachulu beach also alluded to the fact that climatic variability which affects the Lake Chilwa sometimes jeopardises the ability of the households to sustain their household economy.The study tried to establish the views that the women and men have regarding the contributions that women make at household level as a result of participating in the fish value chains. Binary opposites were used to distinguish gendered perceptions about women participation and contributions that they are making at household refer to table 3. It also tried to establish perceptions on the

Table 3: Household management patterns between men and women

Variable	Male	Females
Spending patterns	60% of the male respondents said men tend to spend money on luxurious things like beer while they acknowledge that women are very good managers of cash and use it for the family.	80% of the respondents said women would normally spend on household necessities and basics.
Understanding household needs	70% of the male respondent said men do not prioritise and think of household needs	100% of the women respondents said women have the existing needs of the household at heart in order to sustain the family.
Management of the money	70% of the men said usually men would manage the money for personal gains	100% of women said women manage cash for the benefit of the family
Decision making	All the male respondents agreed that men have final decision making authority for the whole household no matter where the money is coming from. One man said, "whether it is a woman who has worked to source the money we need to be part to the use of the money"	All women said women have decision making authority on family needs such as food, firewood, soap and other things which are critical at the household.
Savings	70% of the men said often times men would save for personal use. Even if they hand over the money to the wives they demand it after some time to use it for personal gains such as beer and other things.	100% of the women said since women are the ones who face the challenges of caring for the family members' women save to buy useful things for the family.

expenditures between male and female value chain participants. It was acknowledged by the male respondents that female beneficiaries spend on items that would benefit the whole family.

Nutrition and health

The study found that value chain participation by women has contributed to improving households' nutrition. It has established that women participation in fish value chain activities has enabled households to become more self-reliant and better meet their food requirements. As regards nutrition, women's use of cash from value chain activities shows that they spend large fractions of the money to improve household nutrition an average of 90 percent respondents in both case study communities said "we use most of the money on food expenditures".

The study collected data on how households spend the money they acquire from participating in value chain activities. Bearing in mind the recognition that most people today live in a cash economy, participation of women in fish value chain activities provides an injection of cash which is used as a coping strategy. It was reported in both KII and FGD interviews that much of the money from value chain activities is spent within the community as such, the impact is felt beyond the immediate value chain participants. Those value chain participants that started businesses are able to contribute to the broader local economy by offering goods and services on the local markets. Figure 2 shows the proportions of how money from fish value chain participation is spent on various categories at household level.

Impacts on education

60 percent of the study participants at Msaka hinted that the money they get as a result of participating in value chain activities has played a beneficial role for the education of their children. 30% of women in Kachulu reported that they have managed to send their children up to university level from participating in value chain activities. The assessment has established participating in value chain activities has enabled the women to meet the educational needs of their children without the need to sell assets.

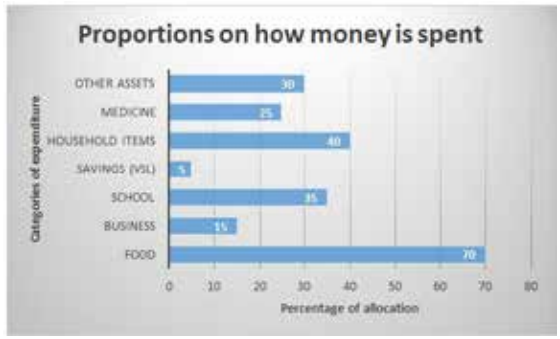


Figure 2: Average proportions of expenditure or incomes from the value chain activities

Personal empowerment

The assessment established that cash transfers have contributed to women's empowerment. In an FGD interview with women in Msaka respondents reported that: "Here in Msaka, women who participate in value chain activities have acquired greater optimism, and self-esteem in addressing problems. At Kachulu beach women said, "Some women have also gained leverage in household bargaining and are able to save, obtain credit, and invest". A case in mention is a lady who own fishing gear at Kachulu beach on lake Chilwa see table 4 which gives a case of a female gear owner who has been empowered as a result of her engagement in fish value chain activities.

Table 4: Impacts on women personal empowerment

In Kachulu one female gear owner has made tremendous progress. It was reported that she has become more proactive in addressing personal problems, helping out her children as she is a single mother and improving her house. The money she gets from participating in fish chains has given her a greater latitude on purchase of food, clothing and ability to pay for school fees for her children. She has acquired a new public identity since she sometimes goes fishing joining her crew men.

It should however be acknowledged that empowerment is a complex and not a nonlinear process, hence with the present the study there is little evidence of changes in household dynamics especially in male headed households. The cash from value chain participation aid women within the framework of traditional gender relations but do little to transform these relations or motivate women to do so. The study established that decisions on how to use the resources rest with both a man and woman in male headed households.

Local economic impacts

The study found that most of the money realized from participating in value chain activities is spent within the communities in both case study communities. Hence the impact is felt beyond the value chain participants and it has positive impacts on the local markets. It was also established that no new markets are created but it was reported that there is a tendency of a boost on the local businesses once fish sales are done despite surges in fish supplies. It was also evident that participation of women in fish exports has led to diversification of goods offered on the local markets. Some respondents who take the fish to South Africa said, "Once I finish selling the fish in South Africa, I order soap, cooking oil, body lotions which I bring back home and sell to my community members" (FGD participant Fish Trader Msaka).

On the other hand, the study established that increased creditworthiness was prevalent in both case study communities. They are able to get credit from colleagues without much of a hassle unlike those who do not participate in the value chain activities. Respondents also highlighted improved access to economic collaboration with others as a result of participating in value chain activities. It was reported that women are able to join contribution based networks and informal financial networks such as Village Savings and Loans. In addition, as a result of participating in value chain activities has helped to promote social cohesion both within the community and at household levels. Participation in VSLs is more than just an issue of money women put their scarce money together to make it circulate for the benefit of their peers this kind of solidarity strengthens social cohesion contributing to and profiting from a common pot of money makes individual dreams come true.

The study also established that value chain participation stimulates business activities. Some value chain participants were engaged in petty trade activities including vegetable trading, and other small businesses such as doughnuts trading on makeshift stands. It was also established that these businesses were also more of survivalist in nature, when asked about the income from these businesses respondents did not have a clear picture of profits because the money generated from sales is immediately used to purchase household needs especially food items. Some respondents justified engaging in petty trading by saying that they could buy more food for their households with the little income realized from trading.

Even though the value chain participants' businesses do not grow, they reported that that the money they acquire at least contribute to constant supply of an income for households. It is important to note that though they have minimal returns these petty trading activities reduce livelihoods vulnerability as they safeguard households against slipping deeper into poverty. As a way of trying to validate the information from the communities an interview with the fisheries extension officer revealed that: The reports have shown that approximately 70% of the money that accrues from the fish value chains activities go towards consumption; about 20% set towards investments in business and 10% in assets. In terms of livelihoods we have seen that some beneficiaries are using the little money to buy farm inputs like fertilizer and are engaging in agriculture.

Some of them have even opened small hawkers/benches, within the community where they are selling items such as repacked sugar, cooking oil and vegetables. Some are even operating restaurants and tea rooms at the beach. We have also seen beneficiaries acquiring

assets such as fishing gear, livestock such as goats and chickens that eventually multiply. The confidence and self-esteem levels have increased especially among female value chain participants (Key Informant Interview with Fisheries Extension officer, Kachulu October 2016).

Gains in social status

The study established that the money realised from participating in value chain activities has created some empowering situations which contributed to transforming men's and women's relationships. In addition, it has contributed to improved households' status by enhancing economic power of women. It was however noted that the gains revolve around the existing gender identities. Table 5 give an overview of the gains in social status for women participating in fish value chains depicted from the findings of the study.

Table 5: Gains in social status for women

Increased social status for both men and women	Women felt more included in social functions. However this does not alter the predetermined social domains.
Social gains for distinct beneficiary groups	Most of the women value chain participants are either widowed, divorced especially those who play the intermediary role of "macheucheu" Since they are not under hegemonic power structure they have earned a livelihood through participating in fish value chain activities. They have the ability to use the money to meet their needs and for the whole family.
Enhancement of peace and harmony	Participation in the value chains has contributed to promoting social cohesion both within the community and household levels. It helped in easing the pressures of daily life.

Discussion

The present study therefore, identify the major value chain activities that women in fishing communities of Msaka and Kachullu engage in include fish production as gear owners, fish processing and trade transaction, but also petty trading. This is in line with the view of Osuala (1991), and Ijere (1999), in a research work which observed that women earn income through a range of economic activities. The current study has also found out that in hegemonic households there is greater joint cooperation in decision making on use of finances accrued by the women. This is tandem with a study conducted in Somalia (Wasilkowska, 2012) which established that women economise the money they acquire as a result of participating in fish value chains while men spend on personal needs which implies that women have a control on household spending decision making ability.

With regards to the aspect of ability to educate children as a result of accessing finances from value chain participation the study is in tandem with Kadzamira (2003) who argues that "while spending on educating children is not an immediate survival strategy, sacrifices made for education in the short term can be considered as investment in future wellbeing of the household". With regards to time allocation to different activities, the study established that men and women processors/traders spent equal amount of time approximately 8 hours per day on fish processing and trading activities. However, responsibility for household duties and child care often resulted in much longer workdays for women.

While facilitating women's roles as mothers and family care providers, participation of women in fish value chain activities also reaffirm social expectations that these are women's sole or primary engagements (Molyneux, 2008). In this study women were seen to engage in diverse activities to sustain their wellbeing. The participation of women in fish value chain activities cushioned constraints for diversification by increasing livelihood security. Flann and Oldhan (2007), emphasised this point by observing that women perform a lot of economic activities for the purpose of generating income for their family upkeep such activities include production, distribution, trading and food processing.

This finding is also in line with the view of Adeferison (1987), who pointed out that the major economic activities that directly add to the income of women include fish production, processing and marketing. The researcher argues that in most cases, the women use this income to supplement household upkeep, pay rent, school fees and training children. These activities undertaken by the women provide an avenue for them to contribute to family and community maintenance and development. It also shows that women in fisheries dependent communities make contribution to their community from their small petty business by employing labourers to work for them and pay them wages at the end of the day, hence the women provide job opportunity for people living in the community.

This is the most significant contribution women dependent on fisheries made to the community members. Even Rauch and Scheuer (2007) noted that money is the lifeblood of an economy, the circulation of money will create a ballooning effect and the total impact of this on the local economy will be several times the amount of money injected into circulation. The study established that there is increased creditworthiness among women fish value chain participants as they are able to get credit from colleagues without much of a hassle unlike those who do not participate in the value chain activities. This finding is in tandem with Edmeads and Hayes (2014) who noted that that employment is not only working in the formal and informal sectors of the economy but also includes access to financial loans and credits to run personal business businesses. Even Farrington and Slater (2006) further contend that poor households rely on social networks.

Conclusions

Based on FGD and KII data collected this paper displays the patterns and trends in women´s work within the fish value chains of Barbus and Engraulycypiris species and secondly, analyses the impacts of their participation on household and community levels. The analysis and findings reveal that the contribution of participation of women in fish value chains to household and local economies is significant. The study also established that value chain participation stimulates business activities and a boost on the local businesses once fish sales are done despite surges in fish supplies. It was also evident that participation of women in fish exports has led to diversification of goods offered on the local markets.

The persistent gender division of labour within the fish value chains has been found to be associated with both economic factors (access to production factors like land and fishing gear, micro credit, fish processing infrastructure and child care centres) and socio-cultural factors (norms and customs regarding women´s mobility and gender role in production and reproduction). One of the main reasons behind low empowerment of women is the gender division of labour that keeps them segregated to home. Economic activities within the household have been found to have a weak impact on empowerment. It can be concluded that the complexity of a shift in gender relations at household and community levels requires many inputs and considerable time. Hence, there in need to undertake an in-depth gender research to establish the household dynamics from a gender perspective.

A policy implication emerging from this study relates to investment in infrastructure that can facilitate value addition for the fish products but also provision of Early Child

Development Centres that can reduce the burden of domestic work especially child care among women working in fish value chains within the fishing communities.

Acknowledgements

Special thanks to WorldFish Center, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under the Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa", following the Malabo Declaration at the 2014 Summit African Heads of States and Governments in Equatorial Guinea. The funding was made possible through the assistance from the European Union. The opinions of the participating value women value chain participants of the key interviews conducted in Kachulu and Msaka have been highly valuable and the authors thank them for their input.

References

Adefarison H. (1987). 'Mobilizing Nigerian Women for Participation in National Development' in Report of the National Seminar on Social Development Policy of Nigeria, Bauchi, 2, p.14-25.

Ajani, E.N., Onwubuya, E.A. and. Mgbenka R.N (2013). 'Approaches to economic Empowerment of Rural Women for Climate Change Mitigation and Adaptation: Implications for Policy'. International Journal of Advance Agricultural Research

Bashir M. S., Samah, A.A., Redzuan, M. Ahmad, N (2014). 'Relationship between Socio-Economic Factors and Participation in Decision Making in Microfinance Scheme among Rural Farmers in Kano, Nigeria'. Life Science Journal, Vol. 11 (4).

Berg B. 2004. Qualitative Research Methods for Social Sciences (5th ed.). Boston: Pearson Education.

Dyson-Hudson, V.R. (1972) Pastoralism: Self-Image and Behavioural Reality. Journal of Asian and African Studies, Volume 7, pp. 30-47.

Edmeades J. and Hayes, R. (2014) Improving the Lives of Married Adolescent Girls in Amhara, Ethiopia. International Centre for Research on Women.

Ellis Frank (1998) 'Household Strategies and Rural Livelihood Diversification', Journal of Development Studies, 35 (1): 1-38.

Elson, D. Male Bias in the Development Process, Manchester University Press, 1995; Press, 1995

Fanworth, C. (n.d) Gender integration in value chains: Good practices from analysis to action {online accessd on 29th August 2017 retrieved from wwww. https://www.g-fras.org/en/knowledge/gender-equality-in-ras-3.html?download=193:gender-integration-in-v

Farrington, J., Harvey, P. & Slater, R. 2005. Cash transfers in the context of pro-poor growth, Hot topic paper for OECD/DAC Povnet Risk and Vulnerability Task Group, London: Overseas Development Institute

Fereday J. 2006. Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. International Journal of Qualitative Methods 5(1):80–92 http://ejournal.library.ualberta.ca/index.php/IJQM/article/view4411

Flann DK, Oldham L. (2007). 'Women's Economic Activities in Jordan; Research Finding on Women's Participation in Micro Enterprise Agriculture and Formal Sector'. A Project Report Submitted to the Office of Women in Development, Bureau for Global Programs, Field Support and Research, U.A. Agency for International Development.

Food and Agriculture Organization of the United Nations (2016) Promoting gender equality and women's empowerment in fisheries and aquaculture

Folbre, N. (1986a) "Hearts and Spades: Paradigms of Household Economics", World Development, Vol. 14, No. 2

Gupta, S. (2009). "Women in India's National Rural Employment Guarantee Programme." in Razavi, Shahra, editor, The Gendered Impacts of Liberalism: Toward "Embedded Liberalism"? New York: Routledge/UNRISD Research in Gender and Development

Hammond S.A. (1998). An Introduction to Appreciative Inquiry: 2nd ed. (Vol. 63). Plano, TX: Thin Book Publishing

Ijere, MO. (1999). Women in Co-operation. J. Centre Rural Dev. Cooperatives, University of Nigeria, Nsukka, P. 16.

Kadzamira, E. (2003) 'Can Free Primary Education Meet the Needs of the Poor? Evidence from Malawi', International Journal of Educational Development, 23: 501–516

Kaplinsky R and Morris. 2001. A handbook for value chain research. Prepared for IRDC Retrieved from. http:www.globalvaluechains.org/tool/html

Kristjanson, P., Waters-Bayer, A., Johnson, N., Tipilda, A., Njuki, J., Baltenweck, I., Grace, D. and MacMillan, S. (2010). Livestock and women's livelihoods: A review of the recent evidence. Discussion paper No. 20, ILRI.

Lee, S. (2011) Positive problem solving: How Appreciative Inquiry works. In Focus strategies and solutions for Local Government Managers (online) accessed from www.dev.southcentral.edu/commoncourse/researchandplanning/strategic_planning/7AppreciativeInquiry/Articles/positive problem solving

Ludema J. D, Whitney D, Mohr BJ, (2003). The Appreciative Inquiry Summit: A Practitioner's Guide for Leading Large Group Change: 1st ed. San Francisco, CA: Berrett Koehler Publishers, Inc.

Maarse, L., Dhamankar, M., Krishnagopal, G.V., Pica-Ciamarra, U., and Dhawan, M. (2008) Concise Guidelines for Drafting a 'Good Practice Note' in the context of Pro-Poor Livestock Development: Version one. South Asia Pro-Poor Livestock Policy Programme. A joint initiative of NDDB and FAO

Maarse, L., Patil, B.R., Saleque, A., and TashiSamdup (2007). Guidelines for Identifying and Documenting Good Practices for Pro-Poor Livestock Development: Version one. SOUTH. ASIA Pro Poor Livestock Policy Programme. A joint initiative of NDDB and FAO.

Molyneux, M. (2008). Conditional Cash Transfers: A Pathway to Women's Empowerment? Institute of Development Studies. Working Paper No. 5. Brighton. Viewed at: http://www.pathwaysofempowerment.org/ PathwaysWP5-website.pdf

Nalule, W. 2015. Livelihood of female-headed-households in Namuwongo Slam, Kampala, Uganda. Master of Philosophy in Gender and Development, SPRING 2015, Faculty of Psychology, Department of Health Promotion and Development. University of Bergen.

Palinkas, L.A, Horwitz, M. Green, C.A, Wisdom, J.P. Duan, N. and Hoagwood, K (2015). Purposeful Sampling for qualitative data collection and Analysis in Mixed Methods Implementation Research. Admin. Policy Mental Health 2015 Sept; 42(5):533-44

Rauch, E. & Scheuer, H. 2007. SDC Cash Workbook: A practical user's guide for the preparation and implementation of Cash Projects. Bern: Swiss Agency for Development & Cooperation

Sen, A.K. (1990) Gender and Cooperative Conflicts. In Tinker, I. (ed.) Persistent Inequalities. Oxford University Press, Oxford

UN Committee on the Elimination of Racial Discrimination (CERD), General recommendation No. 34 adopted by the Committee: Racial discrimination against people of African descent, 3 October 2011, CERD/C/GC/34, available at: http://www.refworld.org/docid/4ef19d592.html [accessed 19 November 2017]

Wasilkowska, K. (2012) Gender Impact Analysis: Unconditional Cash Transfers in South Central Somalia. The Somalia Cash Consortium

ASSESSMENT OF ARTISANAL FISHERIES ACTIVITIES OF DOMA DAM TOWARDS SUSTAINABLE FOOD FISH SUPPLY

Sotolu A O[1]*, Abdullateef M M[1] and Yakubu S O[2]
[1]Department of Aquaculture and Fisheries Management, Faculty of Agriculture, Shabu-Lafia Campus, Nasarawa State University, Keffi.
[2]Department of Aquaculture and Fisheries Management, Faculty of Agriculture, Federal University Gashua, Yobe State, Nigeria.

Abstract

Artisanal fisheries activities on Doma dam was assessed for fisheries management and sustainable fish supply. Three Fishing communities (Kwararrafa, water treatment plant and Yelwa) along the dam were selected as sampling stations. Thirty (30) fishermen were randomly selected from each community giving a total of ninety (90) respondents for the study. Primary data were collected through the use of structured questionnaire and personal interview of the respondents. Data were analysed and subjected to simple descriptive statistics. Results of the study revealed that 80% of the fishermen are married, 36.67% have their personal fishing gears and crafts while all of the fishermen belong to one cooperative society or the other. Results further showed that all of the respondents (100%) do not adopt any fisheries management practices such as gear selection, gear size limitation, seasonal fishing and mesh size limitation. All fishermen carryout their fishing activities throughout the year with the highest catch during the months of March-October. Majority (44.4%) used gill net while 40% use cast net for fishing. The study also revealed that nine fish species belonging to eight families were mostly exploited by the fishermen in the dam which include Tilapia spp, Clarias spp, Heterotis niloticus, Mormyrus spp and Bagrus spp were mostly exploited by the fishermen in the dam. However, in terms of sizes, 80% Clarias spp and 90% Heterobranchus spp are mostly exploited at fingerling stages, while 66% Tilapia spp are exploited at juvenile stages. Other fish species Mormyrus spp, Protopterus annectens, Heterotis niloticus and Bargus spp were mostly exploited at adult stages because they are of less commercial value. Fisheries of Doma dam is exposed to overfishing which can lead to decline in supply of food fish of high commercial value and adequate action should be taken towards sustainable management of the Dam.

Keywords: Artisanal, Fisheries Management, Sustainable, Doma dam

*Corresponding author email: sotoluola@yahoo.com

Introduction

Fishing is an ancient human tradition, it is a traditional activity involving the hunting and gathering of aquatic products for food. Fish represent a major food source, which is valuable for the protein they provide and the industrial products they produce. Economically fish provides an important source of food and income for both men and women and fishing has an important social and cultural position in riverine communities. Artisanal fishing is the term used to describe small scale, less technology, commercial or subsistence fishing practice. It is also described as capturing fish from the natural water using traditional fishing gears such as rod and tackles, arrows and harpoons, cast and drag nets, traps, barrier and traditional fishing canoes and boats (Wikipedia, 2012).

Artisanal fishing usually occurs around the world particularly in developing nations and is vital to livelihoods and food security of the local community. They supply income, employment and also supply the local people with protein at reasonable prices (Shetimma *et al*., 2014). However, the tradition of artisanal fisheries has been transformed over several decades of human civilization to become a resource extraction industry spanning the entire globe. These fishing activities were limited at first to the lakes and rivers, but as men improved on the boats and fishing technologies, they ventured into sheltered coastal areas, river mouths and eventually farther out on to the continental shelves, relatively shallow ocean plains between the land and the deeper ocean areas with little or no consideration on its impact on the aquatic ecosystem (Williams, 1987; Olubanjo *et al*., 2007). Fishing settlements in Nigeria represent one of the oldest forms of community living known to mankind. In these settlements, fisher-folks including children, men and women have evolved over time, different crafts, skills and technologies for fishing and for day to day survival. This is, in addition, to those associated with the preservation and processing of fish catch. In typical fishing settlements (or landing sites), men are predominantly the harvester of wild fish species (Williams, 1987; Olubanjo *et al*., 2007). The extent and nature of the involvement in the capture fisheries in Nigeria however varies by locality, religion, level of education and form of fish sales, among other factors. Doma dam, which host a fishing community in Doma Nasarawa State supplies a high percentage of the artisanal fisheries consumed in the state. The dam supplies fish both in fresh and processed (dried) form to the state and neighbouring states and also serves as a means of livelihood through fishing to the inhabitants living within and around the dam. However, there is paucity of information on the activities of artisanal fishermen and level of exploitation of the fisheries resources of the dam for sustainable fisheries management, sustainable fish supply and ecosystem conservation, hence the basis for this study.

Methodology

The study was carried out in Doma dam. Doma dam is located south of Doma Local Government Area of Nasarawa State, Nigeria. It is about 30 kilometres away from Lafia the State capital. The Dam lies in the northern Guinea Savanna zone of Nigeria between latitude 8□18□0□ and 8□21□20□N and longitude 8□17□24□ and 8□21□54□E. The dam was constructed in 1985 by Lower Benue River Basin Development Authority (LBRBDA) with the aim of providing water for irrigation farming and to supply Doma town and its environment with portable drinking water. The dam is situated 6km away from Doma town, the headquarters of Doma local government area. The dam has its source behind Kwarafin (Agatu) community where the stream was dammed downstream. The dam is surrounded by few hills and riparian vegetation. Three (3) fishing communities settled along the dam, namely Kwararrafa, Water treatment plant, and Yelwa whose primary occupation is fishing. The three fishing villages were chosen for the study, and were designated as station I, II and III respectively as shown in Fig. 1.

Figure 1: Map of Doma Dam showing the fishing communities

Sampling Procedure

The sampling frame for this study comprised of artisanal fishermen in Doma dam. The three fishing communities namely Kwararrafa, Water treatment plant and Yelwa were purposively sampled for the study. Thirty (30) respondents were randomly selected from each fishing community giving a total of ninety (90) respondents for the study.

Data Collection

Primary data was used for the study. This was collected through the use of a set of questionnaires that will be administered to the fishers. Data were collected on the socio-economic characteristics of artisanal fishers in the dam, major artisanal fishing practices for fisheries management and sustainable fish supply, fish species commonly exploited and their sizes.

Data Analysis

Data was analysed with the aid of descriptive statistical tools such as; tables, frequencies, percentages and bar chart.

Table 1: Socio-Economic Characteristic of the Respondents

Variables	Frequency	Percentages	Mean	Standard deviation
Marital status				
Married	72	80.00		
Single	18	20.00		
Educational level				
Primary	26	28.89		
Secondary	14	15.56		
Non- formal education	50	55.56		
Age			30.80	6.29
Household size			4.50	1.29
Years of fishing experience			21.50	6.34
Other occupation				
Farming	41	45.56		
Vocational	1	1.10		
Trading	48	53.34		
Membership of Cooperative Society				
Yes	90	100.00		
No	--			
Fishing gear and craft Ownership status				
Personal	33	36.67		
Rented	39	43.33		
Communal	18	20.00		

Results and Discussion

Socio-Economic Characteristic of the Respondents

Socio-economic characteristics of the artisanal fishermen in Doma Dam are presented in Table 1. Results showed that age is an important socioeconomic characteristic because it affects productivity, output and adoption of innovation. It was observed that majority average age of the fisherfolks was 19 and 48 years, with means value of 30.80 which is regarded as productive age. This shows that majority of the fishermen were in the age range of active labour force and thus, this is very important with respect to fish farming decision for participation in several commercial activities associated with it. The findings were in agreement with those of Olaoye (2012) who substantiated high commercial activities of fisherfolks in Ogun State as a result of high catches by fishermen. Marital status showed that majority of the respondents (80%) in the study area are married while unmarried (single) respondents are fewer in number (20%). This might corroborate the stand that the marriage institution is still cherished and an indication of economic responsibilities of the respondents in caring for their dependents (Adeyemi, 2011). Education level of the fishermen showed that (55.56%) of respondents had no formal education, (28.89%) of them attained primary education, while (15.56%) of the respondents attained secondary education. The trend of the findings is similar to that of Lawal and Idega (2004). Results further revealed that the average family sizes of fisherfolks as shown in Table 2 ranged from 2-8 while the majority of households have 4-6 persons. The finding supports the preponderance of large family sizes among the poor in rural areas as reported by Kumolu-Johnson and Ndimele (2011). Majority (53%) of the respondents were traders while (46%) of the respondents were farmers, (1%) of the respondents engaged in vocational activities. This is clear evidence from the study that trading in fish and other items that have direct bearing with fishing activities booms when fishermen are able to increase on their supplies. Fishing gear and craft were owned personally by 36.67% of the fishermen, while 43.33% were rented and 20% belong to the community. The fisherfolks have an average fishing experience of 10 years, with mean value of 21.50 and standard deviation of 6.34. They are also members of cooperative societies in the fishing community. This shows that the fisherfolks must have gained some level of expertise over the years, which further gave them a better understanding of socio-economic factors that affect their fishing activities. Abdulsalam (2004) stated that people gain more expertise and mastery with experience in their profession/trading.

Major artisanal fishing practices for fisheries management and sustainable fish supply is presented in table 2. The result showed that fishermen in the dam have no any fisheries management practices for sustainable fish supply. They engage in fishing at their own will throughout the year without gear selection, catch quota, gear size limitation and others. However majority 44.4% of the fishermen use gill net for fishing followed by cast net (40.0%), hook and line (11.1%) in that order and the least gear used was Malian trap (4.5%). The result also revealed that all of the respondents said that March-October is their period of highest catch which is during the rainy season when that water volume is high.

The percentage number of fish species exploited by artisanal fishermen of Doma dam was presented in Fig. 2. A total of 9 fish species belong to 8 families were commonly exploited by artisanal fishermen in Doma dam. It further revealed that T. spp is the most exploited of the fish species by the local fishermen in Doma dam, followed by Clarias spp, Heterotis niloticus, Mormyrus spp, Protopterus annectens, Bargus spp, Heterobranchus spp, Gymnarchus niloticus in that order and least percentage number was recorded by Lates niloticus.

Sizes of fish species commonly exploited by artisanal fishermen in Doma dam is presented in fig. 3. Results showed that majority (80%) Clarias spp, (90%) Heterobranchus spp, (80%) other species are exploited at fingerlings stages whereas 72% of Heterotis niloticus, 66% Mormyrus spp, 57% Protopterus annectens,

Table 2: Major artisanal fishing practices for fisheries management and sustainable fish supply

Variables	Frequency	Percentage (%)
Do you carry out gear selection when fishing		
Yes	00	00
No	90	100
Do you select sizes of gears for fishing		
Yes	00	00
No	90	100
Do you engage in seasonal fishing		
Yes	00	00
No	90	100
Do you have catch quota per fishing activities		
Yes	00	00
No	90	100
Do you have specific fish species to be caught when fishing		
Yes	00	00
No	90	100
Do you engage in mesh size limitation as a sustainable fishing practice		
Yes	00	00
No	90	100
Type of fishing gears used for fishing		
Gill net	40	44.4
Cast net	36	40.0
Hook and line	10	11.1
Malian trap	04	4.5
Periods of fishing activities in a year		
Once in a week	00	00
Once in a month	00	00
Once in a while	00	00
Throughout the year	90	100
Period of highest fish catch		
March-October	90	100
November-February	-	-

Source: Field Survey (2017)

28% Gymnarchus niloticus and 55% Bagrus spp of the Dam were exploited at adult stage. In this result, multiple responses were allowed. The result further showed that Lates niloticus were exploited at juvenile and adult stages. The nine fish species identified in Doma dam have also been observed by several fisheries □workers and researchers (Ita *et al*., 1985; Allison *et al*., 2007; Oguntade *et al*., 2014) including species in other families, and found to constitute the major fisheries of inland waters in Nigeria, due to their ability to adapt to the physico-chemical

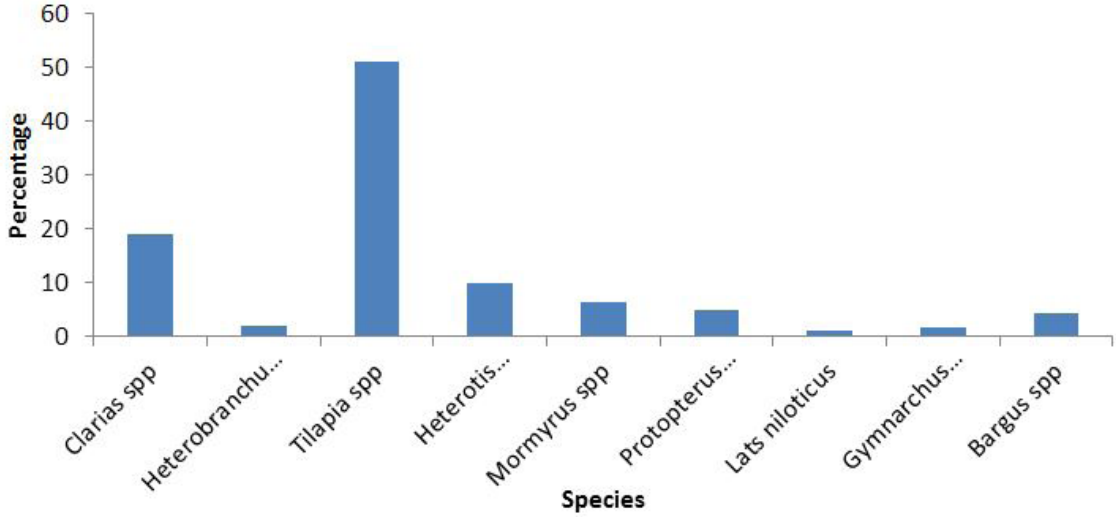


Figure 2: Fish species commonly exploited at Doma dam

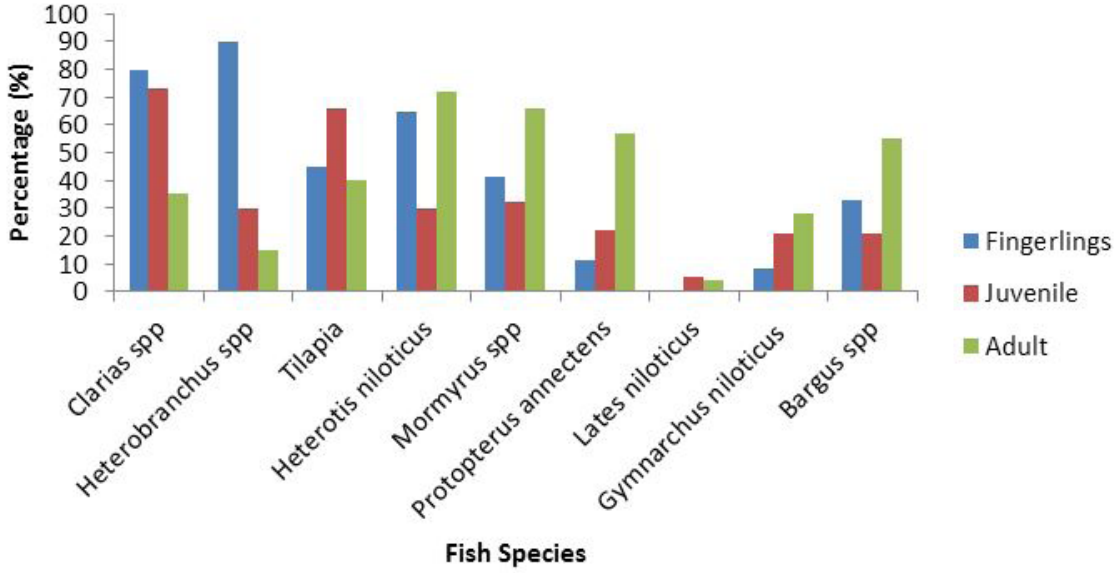


Figure 3: Sizes of fish species commonly exploited by artisanal fishermen in Doma dam.

parameters of the water bodies. However the sizes of the fish harvested revealed that most of the commercially important fish species (Clarias spp, Heterobranchus spp and Tilapia spp) were exploited at fingerlings and juvenile stages without allowing the fish to reach adult stages. This could be as a result of lack of sustainable fisheries management practices adopted by the artisanal fishermen in the water body which makes adult fishes depleted.

Large carnivorous fish species such as Lates niloticus and Gymnarchus niloticus were conspicuously lower in the level of exploitation in Doma dam; this is likely due to the relatively small size of the water body compared with a big one, such as River Benue. The result of this study is in line with Fagade (1992) who stated that large fish species such as Lates niloticus and Gymnarchus niloticus were not commonly found in small water bodies (>2 - <10 ha). Higher number of fish species caught

in the rainy season confirms with the findings of earlier workers Iorchor *et al*. (2007) who recorded higher fish abundance in the wet season than dry season in the main channel of the Lower Benue River, Higher abundance of Paraillia pelucida during rainy season than dry season in the fresh water reaches of Num River, Niger Delta was reported by Allison *et al*. (2007), Yakubu (2012), reported higher fish total abundance, species number and diversity level in rainy than the dry season. On the other hand higher fish abundance was recorded in dry season than rainy season in Lower Bonny Estuary by Chindah and Osuamkpe (1994), Mangrove habitat of Lagos lagoon by Nwadukwe (1995) and Urie creek, Niger Delta by Meye and Ikomi (2008). However, results of this study revealed that most of the fish species were exploited during the rainy season at fingerlings and juvenile stages. The higher occurrence of fingerlings and juveniles during the rainy season could be as a result of increased reproduction activities of fish which usually take place during the rainy season when the water level is high.

Conclusion

The present study showed that fishermen in Doma dam do not adopt any fisheries management practices such as mesh size limitation, closed and open season, catch quota and the resultant effect of it that trade and marketing activities of fish and fish products and input materials such as tools and equipment for carrying out fishing activities will be directly affected as volume of catches continue to decline. Capturing of all sizes of fish including fingerlings throughout the year without serious consideration for the water body to restock itself for sustainable management purposes is imminent. This is a serious threat to the fisheries of Doma dam which can lead to extinction of valuable commercial fisheries resources with time and disruption of the ecosystem due to overfishing of the dam if proper and adequate measures are not put in place to check the activities of the artisanal fishermen in the dam. There is need for the fisheries regulatory bodies in the state and the country at large to set up and enforce measures that will check the activities of artisanal fishermen in our local water bodies for effective fisheries management, sustainable fish supply and preservation of the aquatic ecosystem.

References

Adeyemi, S. O. (2011): Fish catch, composition, abundance and seasonality of an oxbow lake in Central Nigeria. Scienta Africana, 10(2) pp: 24-33

Abdulsalam, Z. (2004). Economic Analysis of Cross-Border Food GrainMarketing between Nigeria and Niger republic. A Published Ph.D. Thesis Ahmadu Bello University Zaria, Nigeria.

Allison, M. E., Sikoki, F. D., Hart, A. I., Abowei, J. F. N. and Ansa E. J. (2007). Distribution of

Prailia pellucid (Boulenger 1910) in the fresh water of the Lower Num River, Niger Delta, Nigeria. International Journal of Agriculture and Food System 1(1): 30-36

Chindah, A. H. and Osumakpe, O. (1994). The fish assemblage of Lower Bonny River, Niger Delta, Nigeria. African Journal of Ecology, 32. 58-65

Fagade, S. O. (1992). Production, Utilization and Marketing of Fisheries: Status and Opportunities. 20th Annual Conference of FISON, Abeokuta, Nigeria.

Ita, E.O., Sado, E.K., Balogun, J.K., Pandogari, A. and Ibitoye, B., (1985). Inventory survey of

Nigeria Inland waters and their fisheries resources I. A Preliminary checklist of inland water bodies in Nigeria with special reference to ponds, lakes, reservoirs and major rivers. Kainji Lake Research Institute Technical Report Series. No. 14. KLRI, New Bussa. pp: 51.

Kumolu-Johnson, C.A. and Ndimele, P.E. (2011). A Review on Post-Harvest Losses in Artisanal

Fisheries of Some African Countries. Journal of Fisheries and Aquatic Science, 6: 365-378.

Lawal, W. L. and Idega, E. O. (2004). Analysis of fish marketing in Benue State. A paper presented at 2004 Annual Conference of the Association of Agricultural Economists (NAAE) Held at A.B.U Zaria, November, 3-5, 2004.

Meye, J.A. and Ikomi, R.B. (2008). A study on the fish fauna of Urie Creek at Igbedi, Niger Delta, Nigeria. The Zoologist, 6: 69-80.

Nwadukwe, F.O. (1995). Species abundance and seasonal variation in fish catch from the mangrove habitats in the Lagos Lagoon. Environment and Ecology, 13(1): 121-128.

Olaoye, O.J., Idowu, A.A., Omoyinmi, G.A.K., Akintayo, I.A., Odebiyi, O.C. and Fashina, A.O. (2012). Social-Economic Analysis of artisanal fisherfolks in Ogun water-side Local Government Areas of Ogun State, Nigeria. Global Journal of Science Frontier Research Agriculture and Biology, 12(4): 8-22.

Olubanjo, O.O., Akinleye, S.O. and Balogun, M.A. (2007). Occupational characteristics, technology use and output determinants among fisher-folks in Ogun waterside area, Ogun State. Farm Management Association of Nigeria Journal, 8(2): 21-32.

Shetimma, B.G., Mohammed, S.T., Ghide, A.A. and Zindam, P.L. (2014). Analysis of socio-economic factors affecting artisanal fishermen around lake Alau, Jere Local Government Area of Borno State, Nigeria. Nigerian Journal of Fisheries and Aquaculture, 2 (1): 48-53.

Wikipedia. (2012), Area covered by Jere Local Government Area, http://en.wikipedia.org/wiki/. Retrieved 15/7/2012.

Williams, S. B. (1987). Economic status of artisanal fishermen in Ondo and Ogun States. Ife J. Agric. 9 (1&2): 101-112.

Yakub, A. S. (2012). A survey of fish fauna of Lower Ogun River at Ishasi, Ogun State, Western Nigeria. Continental Journal of Fisheries and Aquatic Science 6 (2): 1-7.

THE NUTRITION, MICROBIAL AND SENSORY QUALITY OF SOLAR TENT DRIED AND OPEN SUN DRIED DIPLOTAXODON SPECIES (NDUNDUMA) PISCES; CICHLIDAE

James Banda[1]*, Petros Chigwechokha[1], Wales Singini[1], John Kamanula[2], Orton Vundo Msiska[3], Jupiter Simbeye[4]

[1]Fisheries Science Department, Mzuzu University, Private Bag 201, Mzuzu 2. Malawi.

[2]Chemistry Department, Mzuzu University, Private Bay 201, Mzuzu 2. Malawi.

[3]Fisheries Consultant, P.O. Box 833. Mzuzu, Malawi.

[4]Mathematics Department, Chancellor College, P.O. Box 280, Zomba, Malawi.

Abstract

The effects of solar tent drying and open sun drying on Diplotaxodon species were evaluated for nutritional, microbial and sensory quality attributes on fish samples from Malembo landing site in South West Arm of Lake Malawi. Solar tent dried and open sun dried Diplotaxodon species contained statistically similar crude protein (63.3±0.15% and 63.3±0.34%), crude fat (19.6±0.09% and 19.9±0.25%) and crude fibre (0.35±0.21% and ash 0.36±0.20%) contents. On the other hand, moisture (8.3±0.12% and 17.0±0.01%) and ash (15.6±0.61% and 21.9±0.91%) contents for solar and open dried fish were significantly different (P<0.05). Open sun dried fish had significantly higher numbers of viable bacteria counts (5.2×106 CFU/g) than solar tent dried (3.9×102 CFU/g) Diplotaxodon species (P<0.05). Most isolated bacteria from solar tent dried and open sun-dried Diplotaxodon species were Total coliform 1.0×101 and Escherishia coli 7.2×103, 0 and 4.5×103, Salmonella 0 and 7.5×103, 0 and Shigella 5.7×102, Staphylococcus 4.0×101 and 6.1×103, Bacillus 0 and 2.2×103 Vibrio 1.0×101 and 7.0×102. Sensory characteristics were significantly different (p< 0.05) with higher scores with respect to smell 4.17±0.14 and 3.72±0.22, texture 4.17±0.12 and 3.5±0.21, colour 4.22±0.14 and 3.52±0.23, overall quality 4.25±0.15 and 3.55±0.25 for solar tent dried and open sun dried Diplotaxodon species, respectively. These results suggest that solar tent dried products are of superior quality than open sun dried ones. The low microbial counts in solar tent dried fish could be attributed to low moisture content, which might have inhibited growth of microbes responsive for spoilage and pathogens. The need to promote solar tent drying for processing small fish species including Diplotaxodon species to increase quality of dried fish products in the value chain of Malawi cannot be over-emphasized as nutrition security and quality assurance of fish products are of utmost concern with potentially greater public health implications in Malawi.

Keywords: Fish processing, Diplotaxodon, nutrition, microbial, sensory, Lake Malawi

Les effets du séchage des tentes solaires et du séchage au soleil sur les espèces de Diplotaxodon ont été évalués pour les attributs nutritionnels, microbiens et sensoriels des échantillons de poissons du site d'atterrissage de Malembo dans le bras sud-ouest du lac Malawi. Tente solaire séchée et ouverte au soleil Les espèces Diplotaxodon contenaient des protéines brutes statistiquement similaires (63.3 ± 0.15% et 63.3 ± 0.34%), des matières grasses brutes (19.6 ± 0.09% et 19.9 ± 025%) et des fibres brutes (0.35 ± 0.21% et 0.36 cendres ± 0.20%) contenu. En revanche, les teneurs en humidité (8.3 ± 0.12% et 17.0 ± 0.01%) et en cendres (15.6 ± 0.61% et 21.9 ± 0.91%) du poisson séché solaire et ouvert étaient significativement différentes (P <0.05). Le poisson séché au soleil avait un nombre significativement plus élevé de bactéries viables (5,2 × 106 UFC / g) que les espèces de Diplotaxodon séchées sous tente solaire (3.9 × 102 CFU / g) (P <0.05). Les bactéries isolées les plus isolées des espèces de Diplotaxodon séchées au soleil et ouvertes au soleil étaient les coliformes totaux 1.0 × 101 et Escherichia coli 7.2 × 103, 0 et 4.5 × 103, Salmonella 0 et 7.5 × 103, 0 et Shigella 5.7 × 102, Staphylococcus 4.0 × 101 et 6.1 x 103, Bacillus 0 et 2.2 x 103 Vibrio 1.0 x 101 et 7.0 x 102. Les caractéristiques sensorielles étaient significativement différentes

*Corresponding author email: jamesbanda11@gmail.com

(p <0.05) avec des notes plus élevées par rapport à l'odeur 4.17 ± 0.14 et 3.72 ± 0.22, texture 4.17 ± 0.12 et 3.5 ± 0.21, couleur 4.22 ± 0.14 et 3.52 ± 0.23, qualité globale 4.25 ± 0.15 et 3.55 ± 0.25 pour la tente solaire séchée et les espèces de Diplotaxodon séchées au soleil, respectivement. Ces résultats suggèrent que les produits séchés sous tente solaire sont de qualité supérieure à ceux séchés au soleil ouvert. La faible numération microbienne chez les poissons séchés sous tente solaire pourrait être attribuée à une faible teneur en eau, ce qui pourrait avoir inhibé la croissance des microbes sensibles à la détérioration et aux agents pathogènes. On ne saurait trop insister sur la nécessité de promouvoir le séchage des tentes solaires pour le traitement des petites espèces de poissons, y compris les espèces Diplotaxodon, afin d'améliorer la qualité des produits de poisson séchés dans la chaîne de valeur du Malawi. implications pour la santé au Malawi.

Mots-clés: Transformation du poisson, Diplotaxodon, nutrition, microbienne, sensorielle, Lac Malawi

Introduction

High post-harvest losses reaching as high as 40% are threatening the contribution of fish to food and income security in sub-Saharan Africa (FAO, 2012). These losses are high due to poor handling as a result of poor infrastructure such as roads and lack of ice plants and together result in an annual economic loss of $2-5 billion (Béné, 2011). In Malawi 35% of fisheries production from Lake Chilwa valued at $16 million annually, is estimated to be lost through poor post-harvest handling (Chiwaula *et al*., 2011). These losses are manifested in physical damage, quality deterioration and finally market value. Losses incurred in small-scale fisheries accounts for more than half of total fish production in the world and translate into even big losses in food and nutrition security to millions of people, especially in developing countries like Malawi (Singini *et al*., 2017). The available fish processing methods practiced in Malawi are undeveloped and include sun drying and smoking. These methods do not offer immediate solutions especially to quality of products of small pelagic fish species. For instance, drying in the open air exposes the fish products to contamination and the drying process becomes a chall enge during rainy season due to high relative humidity and cloud cover (Jumbe *et al*., 2010). Smoking is linked to uncontrolled contamination by polycyclic aromatic hydrocarbons (Earle, 2013). Studies have shown that individuals exposed to polycyclic hydrocarbons can develop certain cancers (FAO, 2010). Fish products remain the primary mode of contamination for non-smokers. Furthermore, the smoking process is done on open fire that demands more firewood which contributes to deforestation which is counterproductive to the fight against climate change and the smoked products are easily re-contaminated (Ruxton *et al*., 2004; Singini *et al*., 2017). It is therefore imperative to note that the most obvious means of increasing supply of quality fish products, even without increased landings, is by using appropriate processing methods (FAO, 2010).

In view of these challenges, solar tent dryer that uses renewable energy of the sun and friendly to climate change adaptation was designed and tested as a drying technology for processing small pelagic fish species of Lake Malawi. Previous studies in Lake Chilwa on Barbus paludinosus (Matemba) under Lake Chilwa Basin Climate Change Adaptation Programme has demonstrated that the solar tent dryer is more effective in removing the moisture from the fish and reduces spoilage (Luhanga and Jamu, 2012). Although a good number of works on biochemical composition of fishes in Malawi has been done (Taulo *et al*., 2008; Kapute *et al*., 2012; Mpeketula, 2013). The fact that the solar tent drying studies has never been done on small species of Lake Malawi such as Diplotaxodon species underscores the need for determining the quality of the processed fish for its nutrient content, level of microbes and sensory quality. Such information is greatly required by informed consumers.

Materials and Methods

Solar tent dryer construction

The Solar tent dryer was made up of a UV treated polythene 200 µm sheet worn over a wooden frame. The dimensions of the solar tent dryer were 12m x 5m x 5.5m (length x width x height at the center; height at the side was 2.5m). The solar tent dryer consisted of inlet air vent on the bottom with a dimension of 30cm × 30cm and outlet vents on both sides of the vertex with a dimension of 40cm x 40cm to speed up the convection current process. Both vents well sealed with galvanized fine meshed gauze wire to prevent entry of flies. The dimensions of the drying racks were 11m x 1 m (length x width). The air temperature and relative humidity inside the solar tent dryer and outside were monitored using Davis Vantage VUE data logger.

The solar tent dryer theory

The Solar tent dryer works through evaporative drying using the greenhouse principle (Doe *et al*., 2002). When set up in the sun, solar energy passes through the transparent polythene but gets trapped within it thereby raising the internal temperature (Logesh *et al*., 2012). Cool air flowing in through inlet vents gets heated up and moves out moisture from fish laid on racks in the dryer through the outlet vents on the vertex.

Sample preparation

Fresh Diplotaxodon species fish species were collected from Malembo landing sites of the southern part of Lake Malawi. The fish were thoroughly washed and arranged on the racks within the solar tent dryer and open sun drying racks in sub samples of 400g.

Figure 1: Processing of D. limnothrissa samples (A) Solar Tent Drying and (B) Open Sun Dying

Analytical Procedures

After drying, samples were packed and randomly selected for proximate, microbial analyses and sensory evaluation.

Proximate Analysis

Proximate analysis of the fish samples was done at Department of Aquaculture and Fisheries Science Laboratory Lilongwe University of Agriculture and Natural Resources, Bunda Campus. The milled fish samples were analysed for crude protein, crude fat, ash, moisture content, following the procedure outlined by the Association of Official Analytical Chemists (AOAC, 2003).

Crude protein

Protein determination was performed using modified method of Kjeldahl as described by AOAC (2003). For this analysis, 1g fish sample selected from the two processing methods were separately digested in a flask by heating it in the presence of sulphuric acid an oxidizing agent which digested the fish and anhydrous sodium sulphate to speed up the reaction by raising the boiling point. The digestion converted nitrogen in the fresh fish into ammonia, and other organic matter to CO2 and H2O (Equation 1). Ammonia gas was not liberated in an acid solution because the ammonia is in the form of the ammonium ion (NH4+) which bonded to the sulphate ion (SO42-) and thus remained in the solution.

$$N\ (fish) \rightarrow (NH_4)_2SO_4 + CO_2 + H_2O\ (1)$$

After the digestion was completed the digestion flask was connected to a receiving flask by a tube. The solution in the digestion flask was made alkaline (neutralization) by addition of sodium hydroxide, which converted the ammonium sulphate into ammonia gas (Equation 2):

$$(NH_4)_2SO_4 + 2\ NaOH \rightarrow 2NH_3 + 2H_2O + Na_2SO_4 \quad (2)$$

The ammonia gas was liberated from the solution and moved out of the digestion flask and into the receiving flask which contains an excess of boric acid (Equation 3). The low pH of the solution in the receiving flask converted the ammonia gas into the ammonium ion, and simultaneously converted the boric acid to the borate ion:

$$NH_3 + H_3BO_3 \text{ (boric acid)} \rightarrow NH_4^+ + H_2BO_3^- \quad (3)$$

The nitrogen content was then estimated by titration of the ammonium borate formed with hydrochloric acid, using phenopthelene as an indicator to determine the end-point of the reaction.

$$H_2BO_3^- + H^+ \rightarrow H_3BO_3 \quad (4)$$

Since the concentration of hydrogen ions (in moles) required to reach the end-point was equivalent to the concentration of nitrogen that was in the original fish sample (Equation 3). The following equation was used to determine the nitrogen concentration of a sample that weighed m grams using xM HCl acid solution for the titration:

$$\text{Nitrogen (\%)} = \frac{\text{x moles}}{1000\text{cm}^3} \times \frac{\text{Vs} - \text{Vb cm}^3}{\text{mg}} \times \frac{14\text{g}}{\text{moles}} \times 100$$

Where;
Vs = the titration volume of the sample
Vb = the titration volume of blank sample and
14g = the molecular weight of nitrogen N.

A blank sample was raned at the same time with the material being analysed to take into account of any residual nitrogen which might have been in the reagents used to carry out the analysis. The percentage of gross proteinous nitrogen was then calculated out by the following formula:

$$\text{Nitrogen (\%)} = \frac{\text{HCL (L)} \times \text{normality HCL} \times 0.014 \times 100}{\text{Weight of sample (gm)}}$$

% of protein = % of nitrogen × 6.25 (conversion factor)

Crude fat

The lipid content was determined by Soxhlet Method. Ether extracts were analyzed using a sample size of 2 g digested in a Soxhlet extractor with petroleum ether (boiling point 40–60oC). Crude fat (CF) was determined by boiling 1 g of sample in a standard solution of 3.13 % H2SO4 for 10 minutes. The remaining sample was rinsed with hot water followed by boiling in 3.13 % NaOH for another 10 minutes. Thereafter, the remaining sample was rinsed repeatedly with hot water followed by acetone. The residue was oven dried at 60oC for 4 hours, cooled in desiccators and weighed. The fat content was determined by the following formula:

$$\text{Crude fat (\%)} = \frac{m_2 - m_1}{E} \times 100$$

Where: M_2 = weight (g) of dry empty vessel including boiling chips.
M_1 = weight of the vessel including boiling chips and fats residue after evaporation of the solvent
E = weight (g) of the sample.

Moisture content

Moisture content was determined by the standard method where samples were dried at 105oC for about six hours. The difference between the initial weight of the sample and that of the final weight of the sample constituted the moisture content while the final weight was the dry matter. The following equation was used to determine the moisture content of the dry fish sample:

$$\text{Moisture (\%)} = \frac{\text{Weight of sample} - \text{Weight of dried sample} \times 100}{\text{Weight of sample}}$$

Ash content

Ash is the inorganic material that remains after a sample is burnt at 550oC. The ash was determined by heating the sample in the muffle furnace at 550oC for 5 hours. The temperature was used to prevent loss of certain volatile minerals. Ash (%) was calculated by dividing weight of ash (g) of the sample and of dry matter (g) of the sample multiplied by 100. The following equation was used to determine the ash content of the dry fish samples.

$$\text{Ash (\%)} = \frac{W2 \times 100}{W1}$$

Where:
W_2= weight of ash
W_1= weight of sample

Microbial analyses

Fish sample (1 g) were randomly selected from the two processing methods were blended and mixed properly in a sterile mortar then ascetically transferred to a sample vial containing 9 mls of 0.1% sterile peptone water. The vial was closed and shaken thoroughly for 10 minutes then allowed to stand for 20 minutes, after which a 6-fold serial dilution was carried out in triplicates (Figure 2). Total viable bacterial counts were enumerated in standard plate count agar after incubation at 37 °C for 48 hours and results were reported in colony forming units per gram (CFU/g).

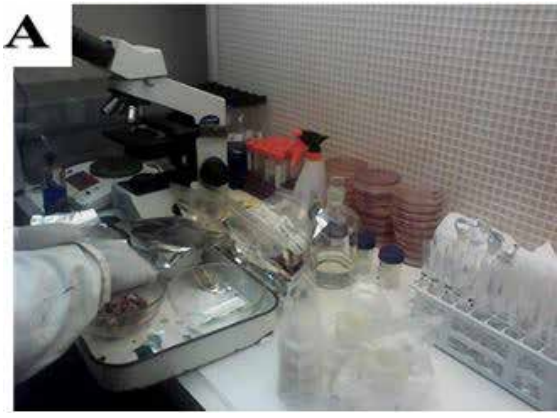


Figure 2: Sample preparation for serial dilution (A). Petri dish sanitization prior to plate pouring with diluents (B)

Identification and enumeration of bacteria

Morphological characteristics of the various bacterial isolates in vitro were noted in the agar plates, and microscopy. After staining reactions and several biochemical tests, individual microbial species were identified (Figure 3). Representative isolates were re-plated on various selective media to observe their habits and specific colony attributes.

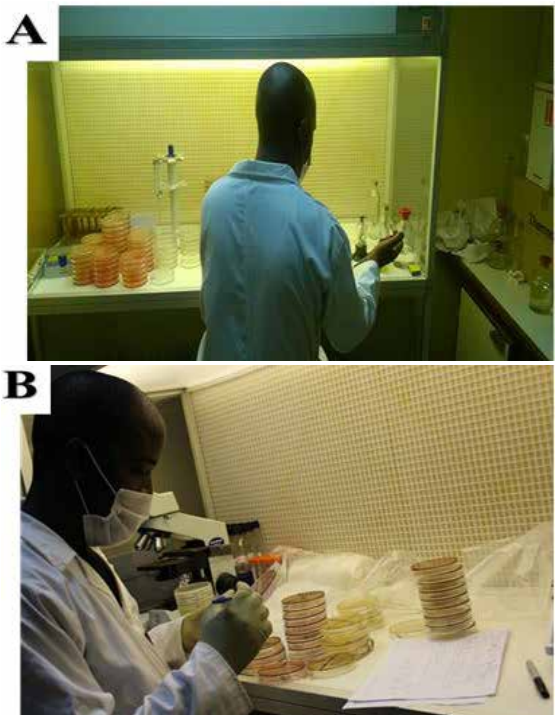


Figure 3: *Microbial isolation (A). Identification of microbes in petri dishes after culturing (B)*

Sensory evaluation

The participants were trained on the sensory evaluation procedure to prevent subjectivity and they signed a consent form for voluntary participation. A 5-point hedonic scale of liking in ascending order for each sensory attribute was used by all participants to indicate their liking for each product with respect to a specific attribute (smell, texture, color and overall quality) of each product prepared. (5= very good) to the least preferred (1= very poor), on a questionnaire.

Data analysis

Data on proximate contents (crude protein, crude fat, moisture, ash), microbial analysis and sensory evaluation was recorded in excel. One way analysis of variance (ANOVA) was used to analyse data in SPSS for windows version 16.0 at P<0.05.

Results

The results obtained in this study are shown in Tables 1 to 4:

The proximate composition for solar tent dried and open sun dried fish were 63.3% and 63.3% for protein, 19.6% and 19.9% for fats, 8.3% and 17.0% for moisture, and 15.6% and 21.9% for ash, respectively (Table 2). Crude protein and crude fat showed non-significant differences (p = 0.05), however, moisture and ash content were significantly different (p = 0.001).

Microbial analysis showed that open sun dried had significantly higher numbers of viable bacteria counts after total plate count (5.2×106 CFU/g) compared to fish from solar tent dryer (3.9×102 CFU/g) and the results were significantly different (p = 0.002). The isolated bacteria from solar tent dried and open sun dried fish were 1.0×101 and 7.2×103 for Total coliform, 0 and 4.5 × 103 for E. coli, 0 and 7.5 × 103 for Salmonella, 0 and 5.7×102 for Shigella, 4.0×101 and 6.1×103 for Staphylococcus, 1.0×101 and 7.0×102 for Vibrio (Table 3).

The qualitative evaluation of sensory attributes such as smell, texture, colour and overall quality of the dried samples showed that solar tent dried Diplotaxodon species had significantly (P<0.05) higher sensory quality scores than open sun dried fish samples (Table 3.0). This suggests that consumer acceptance of the dried fish products was a function of the processing method which affects the quality of the fish.

Higher temperatures and low humidity were associated with solar tent drying than open sun drying which had low temperatures and higher relative humidity (Table 4). High relative humidity for open sun-drying suggest a minimal influence in drying of fish on the racks due to limited amount of water the air could absorb from fish laid on racks.

Table 1: Nutrition composition of Diplotaxodon products

Parameter (%)	Fresh	Solar dried	Open Sun dried
Crude protein	62.0±2.3b	63.3±0.15a	63.3±0.34a
Fat	17.7±0.53b	19.6±0.09a	19.9±0.25a
Moisture	90.4±0.40a	8.3 ±0.12b	17.0±0.01c
Ash	13.8± 0.41c	15.6 ±0.61b	21.9±0.91a

Data presented as Mean ±SD

Means with the same superscript along a column are not significantly different (p>0.05).

Table 2: Bacteria isolates

Bacteria	Fresh	Solar tent dried	Open sun dried
TVC	$4.2\times10^{3}_{c}$	$3.9\times10^{2}_{b}$	$5.2\times10^{6}_{a}$
Total coliform	$4.8\times10^{2}_{b}$	$1.0\times10^{1}_{b}$	$7.2\times10^{3}_{a}$
Escherishia coli	$1.3\times10^{3}_{c}$	0_{b}	$4.5\times10^{3}_{a}$
Salmonella	$8.0\times10^{1}_{c}$	0_{b}	$7.5\times10^{3}_{a}$
Shigella	$1.5\times10^{1}_{c}$	0_{b}	$5.7\times10^{2}_{a}$
Staphylococcus	$7.0\times10^{1}_{b}$	$4.0\times10^{1}_{b}$	$6.1\times10^{3}_{a}$
Bacillus	$4.0\times10^{1}_{b}$	$2.0\times10^{1}_{b}$	$2.2\times10^{3}_{a}$
Vibrio	$1.4\times10^{2}_{a}$	$1.0\times10^{1}_{a}$	$7.0\times10^{2}_{a}$

Table 3: Sensory characteristics of dried Diplotaxodon species

Parameter	Solar tent dried	Open sun dried
Appearance	4.17 ± 0.14^{a}	3.72 ± 0.21^{b}
Colour	4.17 ± 0.12^{a}	3.5 ± 0.21^{b}
Odour	4.22 ± 0.14^{a}	3.52 ± 0.23^{b}
Overall quality	4.25 ± 0.15^{a}	3.55 ± 0.25^{b}

** sensory scores in same row followed by different letters are significantly different at p<0.05, p<0.01.*

Table 4: Meteorological data

Environmental factor	Solar dried	Open Sun dried
Temperature (oC)	30.2	20.7
Relative Humidity (%)	59.5	76.1
Wind speed (m/s)	1.3	1.3
Rainfall (mm)	0	0

** sensory scores in same row followed by different letters are significantly different at p<0.05, p<0.01.*

Discussion

Fish quality aspects which were investigated include the nutrient content, microbial analyses and sensory evaluation. These parameters serve as important landmarks in evaluating quality of fish products under investigation (Costell *et al*., 2010). The average physicochemical composition of analyzed fresh fish, solar dried and open sun dried Diplotaxodon species fish species showed that moisture content of fresh fish was relatively high (table 2). Moisture content is one of the factors which leads to increased muscle spoilage as it favours multiplication of microorganisms (Jay, 1996; Salaudeen *et al*., 2010). Processing through solar tent drying and open sun-drying reduced moisture contents to values less than 18%. This is essential since microorganisms need water to grow and dried fish products experience microbial stability after processing and storage is dependent upon their final moisture contents (Sugathapala *et al*., 2012). Fish products that are well dried with moisture content reduced to 25% are not affected by microbes and if further dried to 15%, the growth of mould ceases, hence increasing its quality and storage life (Oparaku and Mgbenka, 2012). In the study, low levels of moisture were achieved on Diplotaxodon species from solar tent dryer to 8.3 % than 17.1 % that was achieved in the open sun dried. This was due to the high temperature in solar tent drying which facilitated high dehydration (Table

4). Increase in protein was due to dehydration of water molecule present between the proteins that caused aggregation of protein and this resulted in the increase in protein content of dried fish (Ogbonnaya *et al*., 2009). A strong inverse relationship was observed between the moisture and crude protein contents. All dried fish showed crude protein above 50% with equal amount for solar tent dried and open sun dried fish. Ninawe and Rathnakumar (2008) reported that protein nitrogen was not lost during drying, so that the protein content increased with the reduced moisture content in catfish (Clarias gariepinus). The fat content was lower in dried samples than the fresh fish and this could be the result of evaporation of moisture content while retaining fats. Ash content was higher for open sun drying, higher than solar tent drying. This is because open sun drying is done in open space which allows settling of wind borne dust, due to fly infestation. This explains the increase in inorganic content in the fish and is the cause for higher ash content in open dried fish products. However, solar tent drying was done in a closed environment hence the samples were dried hygienically and had low inorganic content leading to lower ash content. The low ash content in solar tent dried fish is in accordance with the earlier findings of Ojitiku *et al*. (2009).

Microbial analysis indicated high total viable counts in open sun dried than solar tent dried fish samples (Table 3). This is a clear indication of cross contamination due to poor sanitary standards of the processing method (Mhango *et al*., 2010). Furthermore, this might also be as a consequence of high moisture content present on the dried fish products that facilitated the growth exponential phase of the microbes hence their increase. Total Coliform is a group of bacteria which are not dangerous to human health. However, these bacteria are not naturally present in such food products as fish and are an indication that more harmful organisms might be present. E. coli is a subgroup within the Total Coliform group which primarily comes from the faeces of warm blooded animals (Saritha *et al*., 2012). The substantial number of E. coli in open sun dried Diplotaxodon species indicates that the fish products have been exposed to faecal material and an immediate risk to consumer health exists. Bearing in mind that the main source of diffusion in the environment always consists of waste from livestock and humans, it is likely that fish products were contaminated with E. coli through contact with faecal material through flies that acted as a vehicle for such during processing (Fig 1B). E. coli causes diarrhoea and kidney damage as well as urinary tract infections (Adelaja *et al*., 2013). Furthermore, E. coli facilitates the production of histamine (Longesh *et al*., 2012). High numbers of Staphylococcus were isolated in open sun dried samples. This bacterium causes Staphylococcal food poisoning due to the heat stable Staphylococcus enterotoxin which is resistant to gastrointestinal enzymes (Okareh and Erhahon, 2015; Neelima *et al*., 2010). The open sun drying method has demonstrated potential for the dried product to become contaminated with microorganisms, including human pathogens due to poor processing methods. Furthermore, most of the bacterial contaminations have been observed to be members of the Enterobacteriaceae and are of particularly concern as they cause gastroenteritis and typhoid fever. Their occurrence in open sun dried Diplotaxodon fish samples may be due to external contamination (Huang *et al*., 2010). These microorganisms causes food borne sickness such as scombroid poisoning which is observed in dried fish products as a result of the chemical agent (Neelima *et al*., 2010). Control of microbe in processed fish products depends upon good manufacturing practices and one of the most effective way to ensure this is being achieved is by application of proper post-harvest processing methods (Jumbe *et al*., 2010). Therefore, for fish processors in Malawi solar tent drying must be promoted to destroy both the pathogens as well as spoilage agents.

The sensory attributes are the strongest determinants of fish products by consumers and the degree of preference is crucial (Sveinsdóttir *et al*., 2009). It provides unique information about a food product to the consumers as it give direct measurement

of the perceived attributes and provide information assisting in better understanding of the consumer responses towards a particular food product (Doe, 2002; Hyldig *et al*., 2007). The qualitative evaluation of sensory properties of the dried fish samples assessed by means of sense organs of the volunteers showed that solar tent dried fish samples had highest sensory scores. Solar tent drying improved the sensory quality of dried fish products tremendously. The open sun dried fish products might have lost the sensory qualities such as smell, texture, colour and overall quality hence the least preferred by consumers. Onyia and Adebayo (2008) reported that methods employed for fish processing, must be such that there is minimum loss of flavour, taste and color. Therefore, the need to promote solar tent drying to increase consumer preference of dried fish products in Malawi is essential. This will help to keep the quality of fish products at a high level until it reaches the consumer.

Trondsen *et al*. (2003) reported that perceptions of fish quality by consumers are based on sensory parameters including overall quality, smell, texture, tenderness and taste. In this study, sensory quality of solar tent dried Diplotaxodon species has been found to be essential driver to consumer preference. This suggest critical to attitude formation due to the fact that eating of food such as dried fish products is a matter of pleasure and consequently few consumers eat products they do not like the taste, regardless of the claimed health benefits (Duff *et al*., 2007). This clearly indicates that solar tent drying improves sensory characteristics of fish products and eventually leads to more consumer acceptability in terms of sensory properties than open-sun drying, hence it must be promoted as an approach of processing and maintaining quality fish products with good sensory characteristics along the value chain from processing to consumer.

Conclusion

The present study has shown that nutrient content in terms of protein and fat content were not different but moisture and ash content were significantly different for open sun dried and solar tent dried Diplotaxodon species. Significant higher populations of total viable counts, foodborne pathogens and spoilage bacteria present in open sun dried fish, indicates that open sun dried D. limnothrissa had poor quality due to unhygienic conditions than solar tent drying and further increased the sensory characteristics of the product; this confirms that sensory quality for dried fish products is a function of processing method. Therefore, means of popularizing solar tent drying technologies must be promoted to improve fish product quality.

Acknolegdgements

This work was carried out with the aid of a grant from Canadas International Development Research Centre (IDRC), www.idrc.ca, and the Australian Centre for International Agricultural Research (ACIAR), www.aciar.gov.au. We also thank members of staff in the Department of Biology at Chancellor College and Aquaculture and Fisheries Science at Bunda College of Agriculture, Malawi for accommodating this study at their laboratories. Special thanks are expressed to Levison Stanley Chiwaula, Joseph Nagoli, Geoffrey Kanyerere and Essau Chisale for the conceptualization of the whole project idea.

References

Akinola O.A, Akinyemi A.A and Bolaji B.O. 2006. Evaluation of traditional and solar fish drying systems towards enhancing fish storage and preservation in Nigeria; Journal of Fisheries International. Pakistan, 1(3-4): 44 -49.

Adelaja O.A, Olaoye O.J, Ikenweiwe N.B and Ashley-Dejo S.S. 2013. Comparison of microbial load associated with smoked fish (Chrysichthys nigrodigitatus) from Oyan Lake and Ogun Waterside in Ogun State, Nigeria. Global Journal of Sciences Frontier Resources. Agriculture and Veterinary. 13 (8): 34-39.

Costell, E., Amparo, T. and Sara, B. 2010. Food acceptance: The role of consumer perception and

attitudes Chemosensory Perception, 3(1): 42-50.

Chiwaula, L, Jamu, D, Chaweza, R & Nagoli, J. 2012. The Structure and Margins of the Lake Chilwa Fisheries in Malawi: A Value Chain Analysis. Project Report 2012-12. WorldFish, Penang.

Ruxton C.H, Reed S.C, Simpson M.J and Millington K.J. 2004. The health benefits of omega-3polyunsaturated fatty acids. A review of the evidence. Journal of Human Nutrition Diet. 2004; 17: 449–459.

Food and Agriculture Organization of the United Nations. 2010. Food Security and Fisheries. Topic Facts sheet Text by Peter Manning. FAO Fisheries and Aquaculture Dept. Rome.

Jumbe, J., Kibas, P., Kakongoro, D. and Tumwebaze, R., 2010. Current state of handling, processing and quality of Omena (Rastrionebola argentea) in Mfangano and Rusinga Islands, Kenya. In Fisheries and Aquaculture Cluster Proceedings. Proceedings of the Cluster Workshop, Mwanza, Tanzania, 12-14 December 2010. Kenya: Inter-University Council for East Africa Lake Victoria Research Initiative.

Jay, M., 1996. The dialectical imagination: A history of the Frankfurt School and the Institute of Social Research. Los Angeles: University of California Press.

Kaputе F, Likongwe J, Kangombe J, Kiiyukia C, and Mpeketula P. 2012. Quality Assessment of Fresh Lake Malawi Tilapia (Chambo) Collected from Selected Local and Super Markets in Malawi. Internet Journal of Food Safety; 14: 112-120.

Doe PE, Ahmed M, and KA Muslemuddin Sachithanathan. 2002. Polyethylene Tent Dryer for improved Sun drying of fish, Food technology in Australia, 29: 437- 441.

Logesh AR, Pravinkumar M, Raffi SM and M Kalaiselvam. 2012. An Investigation on Microbial Screening on Salt Dried Marine Fishes. Journal of Food Resource Science. 1: 15 - 21.

Association of Official Analytical Chemists. 2003. 17th Edition. Association of Official Analytical Chemists 2003. Washington, D.C. USA.

Olokor J.O, Eyo A.A, Mdaihli M, Okomoda J.K and Ayanda J.O. 2009. Promotion of fish drying using solar energy in villages around Kainji Lake. In: S.A. Garba Biotechnology and Sustainable Development in Nigeria. Proceeding of 10th Annual Conference of Biological Technology Society of Nigeria. Minna. 212 – 220.

Eyo A.A. 2001. Fish processing technology in the tropics. National Institute for Freshwater Fisheries Research, New Bussa, Nigeria. 10–170.

Earle, R.L., 2013. Unit operations in food processing. Oxford, England: Pergamon Press.

Ochei J and Kolhatkar A. 2000. Medical Mycology in Medical Laboratory Science Theory and Practice, Ochei, J. and A. Kolhatkar (Eds.). Tata-McGraw Hill, New Delhi, India; 2: 1047-1050.

Huss H.H. 1995. Quality and quality changes in fresh fish. Food Agriculture Organisation Fisheries Technical Paper No.348. Food and Agriculture Organization, Rome.

Kawarazuka N. 2010. The contribution of fish intake, aquaculture, and small-scale fisheries to improving nutrition: A literature review. The WorldFish Center Working Paper No.2106. The WorldFish Center, Penang, Malaysia.

Ogbonnaya C, M.S and Ibrahim M. 2009. Effects of drying methods on proximate composition of cat fish (Clarius gariepinus), World Journal of Agricultural Sciences; 5 (1): 114 - 116.

Ninawe AS and Rathnakumar K. 2006. 1st Edition. Fish processing technology and Product development, Impact of curing; (5): 142.

Ojitiku R.O, Kolo R.J and M.L. 2008. Mohammed Comparative study of sun drying and solar tent drying of Hyperopisus bebe occidentalis. Pakistan journal of Nutrition. 8 (7): 955 – 957.

Mhango M, Mpuchane S.F. Gashe BA. 2010. Incidence of indicator organisms, opportunistic and pathogenic bacteria in fish. African J. Food Agric. Nutr. Dev. 10: 4202-4218. .

Mpeketula M. 2013. Evaluation of the antimicrobial and Sensory effects of dried vinegar and gutting on shelf life extension of fresh Malawian Tilapia (Oreochromis species) under ice storage in coolers. MSc Thesis University of Florida. United Kingdom.

Singini W, Msiska O.V, Mattson N, Kaunda E, Banda J. Food and Agriculture Organization of the United Nations. 2017. Lake Malombe Fisheries Value Chain Analysis FAO- TCP project (TCP/MLW/3504).

Saritha K.I, Immaculate J, Aiyamperumal K.V and Patterson J. 2012. Microbial and Biochemical Qualities of Salted and Sun Dried Sea Foods of Cuddalore, Southeast Coast of India. International Journal of Microbiological Research. 3 (2): 138.

Salaudeen, M, Akande, G, Oguntade, O, Afolabi, O., Olusola, A. and Ezekiel, M. 2010. Effect of preservatives on microbial safety and quality of smoked catfish (Clarias gariepinus) during ambient storage. Journal of Chemical, Biological and Physical Sciences, 3(2): 81-86.

Logesh A.R, Pravinkumar M, Raffi S.M, and Kalaiselvam M. 2012. An Investigation on Microbial Screening on Salt Dried Marine Fishes. Journal of Food Resource Science. 1: 15 - 21.

Luhanga, D. and Jamu, D, 2012. A review of fuel saving technologies and alternative energy sources in Lake Chilwa Basin. MA thesis, Chancellor College, Malawi.

Okareh O.T, and Erhahon O.O 2015. Microbiological Assessment of Food and Hand-Swabs Samples of School Food Vendors in Benin City, Nigeria, Food and Public Health. 1 (5): 23-28.

Huang Y.R, Liu K.J, Hsieh H.S, Hsieh C.H, Hwang D.F and Tsai Y.H. 2010. Histamine level and histamine forming bacteria in dried fish products sold in Penghu Island of Taiwan. Food Control. 2010; 21: 1234 -1239.

Oramadike C.E, Ibrahim A.O and Kolade O.Y. 2010. Biochemical and microbiological quality of frozen fishes available in some supermarkets in Lagos State, Nigeria. SATECH. 3 (2): 48-51.

Oparaku, N.F. and Mgbenka, B.O., 2012. Effects of electric oven and solar dryer on a proximate and water activity of Clarias gariepinus fish. European Journal of Scientific Research, 81: 139-144.

Taulo S, Wetslen A, Abrahamsen R, Kululanga G, Mkakosya R, and Grimason A. 2008. Microbiological hazard identification and exposure assessment of food prepared and served in the rural households of Lungwenya, Malawi. International Journal of Food Microbiology. 125:111-116.

Vaidya S.Y, Vala A.K and Dube C. 2001. Bacterial indicators of faecal pollution at Bhavanagar coast. Indian journal of microbiology. 41: 37 - 39.

Venugopal V. 2002. Biosensors in fish production and quality control. Biosensors and Bioelectronics. 17: 147-157.

INFORMAL FISH TRADE IN MOZAMBIQUE - MAJOR FISHING CENTRES, TRADE ROUTES AND CROSS BORDER TRADE

António Mubango Hoguane[1]*, Joana Alberto José[1], Rodrigues Pita Francisco[1], Rosa Lourenço Simbine[1], Isabel Mário Mucavele[1] and Sloans Kalumba Chimatiro[2]
[1]School of Marine and Coastal Sciences, Eduardo Mondlane University
[2]WorldFish Zambia Office

Abstract

Mozambique, with considerable marine and inland waters' fisheries resources, has a vigorous informal domestic and cross-border trade of fish and of fish products, thought to contribute significantly to food security and livelihood of many people involved. The lack of awareness on its importance prevents the development of supporting policies, and so, continued with low volumes of low quality informal, fish products traded. The present paper aims at providing and strengthening the basis of scientific evidences and raising awareness about the potential of informal trade of fish and fish products have to improve food and nutritional security and reduce poverty. Structured interviews, involving 974 artisanal fisherman and informal fish traders, were conducted in 24 artisanal fishing centres, markets and cross border gates during September 2016 to March 2017. In addition, data on domestic fish products transit permit, obtained from the Instituto Nacional de Inspecção de Pescado (INIP) and from District Administration Offices, were analysed. Major fishing centres, trade routes, cross border fish trade hubs and destinations were identified; and the amounts of fish products traded were estimated. There are over 800 and 100 artisanal landing sites along the coast and in inland waters, respectively. The overall annual fish production is estimated at 289.507 tons (year 2015) from which about 89% are from artisanal fisheries. The result obtained indicated that fishing activities and informal fish trade are mostly carried by men and women, respectively. About 14,500 – 20,000 tons and 1,250-1,500 tons are traded informally per annum in the domestic and across border markets, respectively. The main fish species captured and traded informally are tilapia (Oreochromis mossambicus, Tilapia rendalli, and Oreochromis niloticus), cat fish (Clarias gariepinus, Clarias ngamensis); sardine (Hilsa kelee, Sardinella albella and Pellona ditchela) and anchovy (Thryssa setirostris and Thryssa vitrirostris); sold mostly sundried, salt-sundried (sun-sundried) and smoking. The major cross border informal fish trade are Manguzi, Manica, Magoe, Milange bordering South Africa, Zimbabwe, Zambia and Malawi, respectively and Cobue and Wiikihi bordering Malawi and Tanzania, respectively. The study concluded that the informal domestic and cross border fish trade has a potential to contribute significantly to food insecurity and to the reduction of poverty through the creation of wealth. The fish traders claimed support in means for conservation and transportation of their products to the markets and in accessing bank credits. It is recommended that the Government should seek ways to legalize the activities.

Keywords: fish products, trade, poverty, malnutrition, food security, livelihood, development.

COMMERCE INFORMEL DU POISSON AU MOZAMBIQUE - PRINCIPAUX CENTRES DE PÊCHE, ROUTES COMMERCIALES ET COMMERCE TRANSFRONTALIER

Resumé

Le Mozambique, qui dispose d'importantes ressources halieutiques marines et intérieures, dispose d'un commerce national et transfrontalier vigoureux de poisson et de produits de la pêche, censé contribuer de manière significative à la sécurité alimentaire et aux moyens de subsistance de nombreuses personnes concernées. Le manque de sensibilisation sur son importance empêche le développement de politiques de soutien, et donc, continué avec de faibles volumes de produits de poisson informels de faible qualité échangés. Le présent document vise à fournir et à renforcer la base de preuves scientifiques et à sensibiliser le public au potentiel du commerce informel du poisson et des produits de la pêche afin d'améliorer la

sécurité alimentaire et nutritionnelle et de réduire la pauvreté. Entre septembre 2016 et Mars 2017, des entrevues structurées ont été menées auprès de 974 pêcheurs artisanaux et pêcheurs informels dans 24 centres de pêche artisanale, marchés et portails transfrontaliers. De plus, des données sur le permis de transit de produits halieutiques nationaux ont été obtenues auprès de l'Instituto Nacional de Inspecção de Pescado (INIP) et des bureaux d'administration de district, ont été analysés. Les principaux centres de pêche, les routes commerciales, les carrefours de commerce de poisson transfrontaliers et les destinations ont été identifiés; et les quantités de produits de la pêche commercialisées ont été estimées. Il y a plus de 800 et 100 sites de débarquement artisanal le long de la côte et dans les eaux intérieures, respectivement. La production annuelle totale de poisson est estimée à 289 507 tonnes (année 2015), dont environ 89% proviennent de la pêche artisanale. Le résultat obtenu indique que les activités de pêche et le commerce informel du poisson sont principalement réalisés par des hommes et des femmes, respectivement. Environ 14 500 à 20 000 tonnes et 1 250 à 1 500 tonnes sont échangées de manière informelle par an sur les marchés nationaux et transfrontaliers, respectivement. Les principales espèces de poisson capturées et commercialisées de manière informelle sont le tilapia (Oreochromis mossambicus, Tilapia rendalli et Oreochromis niloticus), le poisson-chat (Clarias gariepinus, Clarias ngamensis); la sardine (Hilsa kelee, Sardinella albella et Pellona ditchela) et l'anchois (Thryssa setirostris et Thryssa vitrirostris); vendu la plupart du temps séchées au soleil, séchées au soleil (soleil-séchées au soleil) et de fumer. Les principaux échanges informels transfrontaliers de poisson sont Manguzi, Manica, Magoe, Milange à la frontière avec l'Afrique du Sud, le Zimbabwe, la Zambie et le Malawi respectivement, et Cobue et Wiikihi à la frontière du Malawi et de la Tanzanie respectivement. L'étude a conclu que le commerce de poisson domestique et transfrontalier informel pourrait contribuer de manière significative à l'insécurité alimentaire et à la réduction de la pauvreté grâce à la création de richesses. Les commerçants de poisson ont réclamé un soutien dans les moyens de conservation et de transport de leurs produits vers les marchés et dans l'accès aux crédits bancaires. Il est recommandé que le gouvernement cherche des moyens de légaliser les activités.

Mots-clés: produits de la pêche, commerce, pauvreté, malnutrition, sécurité alimentaire, moyens de subsistance, développement.

Introduction

Mozambique, located in the Southern Africa, at the East African coast, it has a surface area of about 799,380 km2, a total population estimated at 28,450.19 Million, from which 67.2% were rural, and a GDP per capita estimated at USD1,128 in 2016, according to Environment Statistics Country Snapshot of the United Nations Statistics Division-United Nations Statistics Division (UN, 2016). The country as 13,000 km2 of inland waters and an extension of the coastline of about 2,470 km, the third longest coast in Western Indian Ocean; the Exclusive Economic Zone (EEZ) of 571,955 km2; from which the continental shelf area is 79,451 km2 and the Inshore Fishing Area (IFA) is 73,307 km2 (CIA World Factbook, 2017); it is one of the major producers of marine and freshwater fisheries in the region. The estimated overall annual fish catch was 258,760 tonnes in 2014, according to Environment Statistics Country Snapshot of the United Nations Statistics Division (United Nations Statistics Division, 2016); and according to Jacquet and Zeller (2007), 87% of the total fish catch comes from artisanal fisheries, and targeted primarily to domestic markets.

Despite Mozambique being a fish producing country, the demand for fish products in the country surpass the domestic supply, and so, the country imports on average 25-30,000 tons of scad and mackerel annually to suppress the deficit (FAO, 2015). On the other hand, according to the United Nations fisheries country profile report, published by FAO, non-specified amount of the artisanal processed fish, mostly salt-sundried and smoked, is informally exported to neighbouring countries, namely, Tanzania, Malawi, Zimbabwe, DRC and Zambia (FAO, 2007). Further, FAO assessments of the fish contribution in the food security and in the economy of the country indicated that the annual consumption of fish in Mozambique was estimated at 94,559 tonnes in 2006 (FAO, 2015), a figure considered

highly underestimated due to the challenges in obtaining data in the rural area. According to the same source, the Mozambique's average fish consumption per capita was estimated at 5.0 kg/year and 10 – 12 kg/year among coastal communities, and that 3.5% of the animal protein intake of the population is derived from fish and fish products. The demand for fish products is expected to grow as the population grows at the rate of 2.6% annually (FAO, 2015). According to FAO (2015) the fishing sector in Mozambique employs more than 90,000 people, from which 70,000 and 20,000 in the marine and freshwater fisheries, respectively, where they are involved in fishing and in fish gathering, processing and marketing. Further, it is estimated that about 500,000 people depend directly on fishing activities for their livelihood; most of them engaged fish trade business. Souto (2014) estimated that approximately 850,000 families, equivalent to about 20% of the population in Mozambique, depend on fishing for part of their income and a higher proportion depends on fishing for subsistence and food security.

Furthermore, informal trade sector involves and contributes significantly to the livelihood of the majority poor people and to the economy in African countries. Mclachlan (2005) stated that informal trade is the main source of job creation in sub-Saharan Africa, excluding South Africa, where it provides between 20% and 75% of the total employment, he further stated that in West Africa the informal sector contributes between 20% and 90% of the national economy. According to the national statistics projection (INE, 2010a and INE 2010b) about 75% of the economically active population in Mozambique was involved in informal employment, which includes informal trade. Pinheiro *et al*., (2009) pointed out that most of the people, due to their low income, cannot afford formal markets and so, buy their food in the informal markets, thoughtfully cheaper. Further, Issufo (2017) pointed out that the informal activity in the country accounted for 41% of grosses domestic product (GDP) in 2003 and 40% in 2004.

Despite generally recognized that fish and informal fish trade contribute significantly to the food security and to the economy of the country, the lack of data and information to aid scientific base support to policy development and decision making hinders the government efforts to support this sector, and consequently, the informal fish trade has remained informal, with low volumes of low quality traded, and its contribution in the food security and economy of the country seriously underestimated (Mussa *et al*., 2017). Hence, the present study aimed at examining the domestic and cross-border informal fish trade in Mozambique, and also to disclose the apparent paradox of the domestic fish product deficit against legal import and informal export of fish products. The study maps the main fish production and fish trade hubs and corridors in Mozambique, provides a coarse estimate of the amount of fish traded informally in the domestic as well as in the cross-border markets; in addition, it examined the demography of people involved and discuss the factors driving to informal fish trade.

Methodology

The assessment of the importance of the informal fish trade in the food security and in the family income generation in Mozambique was carried out through semi-structured survey questionnaires in the main fishing centres, fish trade centres and cross-border gates; targeted preliminary to fishermen, fish traders and fish consumers. A total of 24 locations were surveyed, and a total of 1064 households interviewed (Table 1). The sites surveyed were selected based in their relative importance in terms of the amount of fish captured or traded. The households for interview were selected randomly. Sub-samples for southern, central and northern regions were selected randomly for in-depth analysis. Both quantitative and qualitative data regarding demography of the households (age, gender), source and type of fish captured or traded, means of conservation and transportation, prices, income, and other relevant information. In addition data referring

to fish catches and catch species composition were obtained from IIP annual reports and fish transit permit to map the fish trade routes and gauge the amount transported were obtained from the Instituto Nacional de Inspecção de Pescado (INIP).

The sampling unit was households, and the sampling size was estimated according to the following formula:

$$n \geq= \frac{N}{1 + Ne^2} \quad [1]$$

Where n = sample size, N= total number of households whose livelihood depends direct on fishing for their livelihood, here considered 850,000, based on the estimate by Souto (2014), and = 0.05 is the design margin of error (5 percent error assigned). Thus, for the result to be statistically significant the sample size was supposed to be n ≥ 400.

Microsoft Excel Microsoft was used for descriptive statistics, such as percentages, frequencies and means and for presenting data in graphics. The annual trade volumes and values were estimated by the following equations, suggested by Ackello-Ogutu (1996), and also applied by Mussa (2017) in a similar study:

$$ATV = M \bullet N\left[\sum_{i=1}^{n} (Q_d)_i\right] \quad [2]$$

$$ADTV = ATV / J \quad [3]$$

$$AV = ATV \bullet P \quad [4]$$

Where, N is the number of days in a month a trader bought or sold, or, imported or exported fish, from or to the market; M is the number of months in a year during which a trader bought or sold, or, imported or exported fish; Qd is de quantity of fish bought or sold, or, imported or exported per day or trip; J is the total number of days data were collected; P is the weighted average price of fish per unit; ADTV is the average volume traded per day or per trip; ATV is the annual trade volume; AV is the annual traded value; and □ is the trader index.

Result and discussion

Fish production centres and fish trade hubs and corridors

According to the IIP report (IIP, 2015), in Mozambique there about 800 marine artisanal fishing centres, distributed in about 49 coastal districts and about 500 freshwater artisanal fishing centres, distributed in 11 inland districts. The major fishing centres, the main species captured and the annual catches for the year 2015, as stated in the IIP annual report (IIP, 2016) are presented in Table 1. The major fishing centres for marine species are located in Maputo Bay in the south, Sofala Bank in the centre and Quirimbas Archipelago in the north; and the main fishing centres for freshwater species are located in Cabora Bassa reservoirs and in Lake Niassa/ Malawi. The estimated catch of the artisanal fisheries in 2015 was about 225,121tonnes. The southern Mozambique, excluding Maputo Bay and the northern Mozambique captures mainly the line fish species such as of the family LUTJANIDAE, SCOMBRIDAE, TUNIDAE, CORYPHAENIDAE, CENTROPOMIDAE, genera Pristipomoides and species Epinephelus sp., Pagrus pagrus; in Maputo bay and in the central Mozambique, in the Sofala Bank, the mai species catured include shrimp of the family PENAEIDAE, crab of the specie Scylla serrata, Hilsa kelee, sardine (Sardinella albella and Pellona ditchela), anchovy (Thryssa setirostris and Thryssa vitrirostris); in the freshwater bodies, in Massingir reservoir, Cabora Bassa Reservoir, Lake Niassa (Lake Malawi) the main species captured are tilapias (Oreochromis mossambicus, Tilapia rendalli,Oreochromis niloticus), Hipophtalmithys molitrix,Cat fish (Clarias gariepinus, Clarias ngamensis), ussipa (Engraulicypris sardella), utaka (Copadichromis sp) ncheni (Ramphachromis sp. and Labeos sp.), and Oreochromis sp.

Table 1: Sites surveyed and number of fisherman, informal fish traders and fish consumers interviewed.

No	Location	Position		No of people interviewed
		Latitude S	Longitude E	
1	Manguzi (Catuane) border gate	26° 51' 54.0"	32° 21' 54.0"	63
2	Koomatiport (Lebombo) border gate	25° 26' 28.0"	31° 59' 06.0"	31
3	Maputo	25° 57' 18.0"	32° 33' 18.0"	51
4	Chibuto	24° 30' 36.0"	33° 24' 36.0"	28
5	Massingir	23° 55' 45.1"	32° 00' 54.0"	58
6	Inhassoro	21° 33' 18.0"	35° 11' 06.0"	44
7	Mambone (Guvuro)	20° 59' 12.0"	35° 01' 27.0"	93
8	Beira	19° 50' 06.0"	34° 51' 06.0"	50
9	Chimoio	19° 06' 06.0"	33° 28' 15.0"	107
10	Tete (cidade)	16° 08' 06.0"	33° 36' 18.0"	9
11	Zumbo	14°23´13.24´´	32°22´23.66´´	42
12	Magoe border gate	15°48'39.69"	31°45'03.37"	46
13	Cahora Bassa	15°39'54.59"	31°45'59.74"	42
14	Chinde	18° 35' 06.0"	36° 27' 54.0"	26
15	Quelimane	17° 52' 12.0"	36° 53' 06.0"	50
16	Pebane	17° 16' 12.0"	38° 09' 36.0"	30
17	Milange border gate	16° 05' 42.0"	35° 46' 30.0"	49
18	Angoche	16° 12' 24.0"	39° 54' 54.0"	38
19	Nampula	15° 07' 48.0"	39° 16' 12.0"	49
20	Ibo	12° 20' 06.0"	40° 35' 42.0"	42
21	Palma	10° 46' 30.0"	40° 28' 30.0"	50
22	Palma border gate	10° 31' 48.0"	40° 23' 24.0"	24
23	Coube - Niassa	12° 08'26.0"	34° 45' 28.8"	25
24	Wikihi - Niassa	11° 34'49.0"	34° 58' 12.0"	17
	Total			**1064**

Table 2: Annual catches and main species captured in the main fishing centres in the year 2015 (source: IIP annual report, 20016).

Fishing centre	Main species	Annual Catch (tons)
Maputo Bay	*Otolithes ruber, Pellona ditchela, Cynoglossus lida, Gazza minuta, Sillago sihama, Hilsa kelee*	4,836.4
Massingir	*Oreochromis mossambicus, Tilapia rendalli, Hipophtalmithys molitrix, Clarias gariepinus, Clarias ngamensis and Oreochromis niloticus*	4,059.1
Vilankulo	LUTJANIDAE, SCOMBRIDAE, TUNIDAE, *Epinephelus*	4,760.9
Inhassoro	*sp.*, CORYPHAENIDAE, CENTROPOMIDAE, *Epinephelus sp., Pagrus pagrus, Pristipomoides*	2,720.0

Fishing centre	Main species	Annual Catch (tons)
Guvuro (Mambone)	SCIAENIDAE, PENAEIDAE, HAEMULIDAE, DASYATIDAE and DREPANIDAE, SYNANCEIIDAE, CARANGIDAE and SCOMBRIDAE and *Hilsa kelee, sardine* (*Sardinella albella and Pellona ditchela*), *anchovy* (*Thryssa setirostris* and *Thryssa vitrirostris*), *Scylla serrata*	4,127.0
Beira		29,744.0
Marávia	*Oreochromis mossambicus, Tilapia rendalli, Hipophtalmithys molitrix, Clarias gariepinus, Clarias ngamensis* e *Oreochromis niloticus, kapenta, Distichodus schenga, Hydrocynus Vittatus*.	7,486.6
Zumbo		3,181.9
Magoe		4,175.5
Cabora Bassa		3,492.5
Chinde	SCIAENIDAE, PENAEIDAE, HAEMULIDAE, DASYATIDAE and DREPANIDAE, SYNANCEIIDAE, CARANGIDAE and SCOMBRIDAE and *Hilsa kelee, sardine* (*Sardinella albella* and *Pellona ditchela*), *anchovy* (*Thryssa setirostris* and *Thryssa vitrirostris*), *Scylla serrata*	1,006.2
Quelimane		1,513.6
Pebane		9,555.9
Angoche, Moma and Larde	PENAEIDAE, SERGESTIDAE, SCIAENIDAE, TRICHIURIDAE, ACANTHURIDAE, CAESIONIDAE, KYPHOSIDAE, CARANGIDAE, SCOMBRIDAE, LETHRINIDAE, SPHYRAENIDAE, DASYATIDAE, PORTUNIDAE, SILLAGINIDAE	17,454.4
Pemba	CARANGIDAE, CLUPEIDAE, LETHRINIDAE, SIGANIDAE, ENGRAULIDAE, SCOMBRIDAE, SACARIDAE, CAESIONIDAE, PENAEIDAE, HAEMULIDAE, GERREIDAE	3,219.6
Mocimbua da Praia		3,820.3
Quisanga		3,245.1
Macomia		4,139.6
Ibo		1,330.0
Palma		3,319.8
Coube	CYPRINIDAE, CICHLIDAE, ussipa (*Engraulicypris sardella*), utaka (*Copadichromis sp*) ncheni (*Ramphachromis sp.* and *Labeos sp.*), *Oreochromis sp*	3,319.8
Wikihi		6,968.9

Demography of the informal fish traders

Table 3 presents the summary of demographic characteristics of the fish traders by region. The gender distribution of the fish traders shifted from almost gender balance, with slight tendency to female dominance, in the southern to a male and absolute male dominance in the central and northern Mozambique, respectively. Further, the age shifted from youth dominance, in the south to increasing proportion of old people, in the central and northern part of the country. The south-northward differences in the gender proportion involved in the fish trade could be explained by the fact that the central and northern coastal areas are highly dominated by Muslim religion whereas the south is mostly Christian. The In addition, in the main city centres, such as Maputo, woman are more emancipated, and able to undertake business in the equally situation as man compared to the woman from rural areas. The predominance of youth in the fish trade business in the southern part of the country which is balanced by predominance of old people in the central and northern part of the country may be explained by the migration of youth from the rural areas to cities and preferably to the capital which is located in the southern part of the country. One of the immediate implications of the regional differences in the age group of the fish traders is that the fish trade in southern part, which

is driven mostly by youth, is more developed, involving high valued products such as frozen shrimp and fresh fish products and targeted to costumers with high paying capacity, whereas in the northern part it is mostly traded sundried of low valued fish species such as sardine and anchovy (Hoguane *et al*., 2017).

Most of the people involved in fishing and fish trade are married with large proportion of single, throughout the country. However, in the southern and northern part of the country there are minor proportions of polygamy. This is explained by the fact that the southern culture is patrilinear which tolerates polygamy; similar to the Muslim culture in the north. The central part of the country, though, is mostly matrilineal. Regarding education, in the south most of the people involved in informal fish trade are illiterate or with less than 7th grade, whereas as moving north there are more proportion of people with secondary school engaged in informal fish trade and even fishing activities. This could be explained by the fact that in the south there are more opportunities for formal employments for people with education compared to the central and northern part of the country. Mosca (2009) attributed to unemployment or lack of formal employment as the main reason for people to engage in informal activities.

Table 3: Demography characteristics of the fish traders – weighted average on the representative sample by region.

Category		**Southern (Maputo, Massingir, Mambone) (n=202) (%)**	**Central (Beira, Chinde, Quelimane, Pebane, Milange, Tete) (n=246) (%)**	**Northern (Angoche, Nampula, Palma, Ibo) (n=179) (%)**
Gender	Male	44	75	100
	Female	56	25	0
Age group	15-29	41	35	39
	30-39	45	44	21
	40-49	11	19	29
	>50	3	2	11
Marital status	Single	31	49	26
	Married	54	47	61
	Polygamy	8	0	11
	Divorced	0	2	0
	Widow	8	2	2
Education	Illiterate	21	29	35
	7th Grade	17	48	35
	10th Grade	8	12	17
	12th Grade	0	12	13
	>12th Grade	0	0	0

Fish products traded and trade corridors

Figure 1 presents the overall fish trade routes and Table 4 shows the amount of fish traded informally and number of fish traders involved in some of the fishing trade centres in Mozambique. The major source of fish are the coastal area, which is a source of marine fish species, and the inland water, which is the source of freshwater fish species, the Massingir dam reservoir and the lakes of Bambene in Chibuto,

in the southern part, the Cabora Bassa dam reservoir, in the western central Mozambique and the Lake Niassa, in the west-northern part of the country. The main domestic markets are major cities such as Maputo, Beira, Nampula and Tete, consuming mostly fresh fish products; the small cities and villages distributed all over the countries, consume mainly sundried and smoked fish products. Chimoio in the Mercado 38 and Nampula in the Mercado Belenenses were the major fish trade hubs. The overall fish trade route is linking the coastal sources of marine fish products to inland markets and across the border to the neighbouring countries and linking the inland freshwater fish products from the west sources to coastal areas and across the border to neighbouring countries. The cross border fish trade is specifically dealt with in the next chapter.

From Massingir it was estimated that an annual amount of 67.3 tonnes of fresh and sundried tilapia and smoked catfish were traded mainly to markets in Chokwe and Maputo. It was estimated about 39 people involved in fish trade from Massingir, mostly women, in the age group between 30 and 39 years old, most of them illiterate, and less than 40% have education up to 7th grade. About 30 tonnes of sundried tilapia and smoked cat fish annually were estimated to be traded from Chibuto to as far as Nampula and Niassa. From Inhassoro the main fish products traded were line fish of the species LUTJANIDAE, SCOMBRIDAE, TUNIDAE, Epinephelus sp., CORYPHAENIDAE, sold mostly fresh to markets in Maputo, and small line fish, a mixture of species of CENTROPOMIDAE, Epinephelus sp., Pagrus pagrus, Pristipomoides sold mostly dry to markets in central and northern Mozambique. It was estimated that about 465.0 tonnes were traded annually, involving about 77 fish traders, dominated by men. From Guvuro about 270 tonnes mainly of sundried marine sardines, sundried marine anchovy were estimated to be traded annually to central Mozambique (Chimoio) and Maputo. To Maputo were traded mainly fresh fish products of shrimp and crabs. About 53 people, mainly men, were estimated to trade from Guvuro. From Beira about 1,610.0 tonnes, comprising mainly sundried marine sardines and anchovy, alive crabs and clams and frozen shrimp, was estimated to be traded annually to Chimoio, where mainly go sundried products and to Maputo, where mainly go alive, fresh and frozen products. It was estimated that over 250 people were involved in informal fish trade from Beira, dominated by men within the age group 15-29 (>50%) and 30-49 (~30%), and most of them with secondary school, as follows: 7th Grade accomplished (~35%) and 12th Grade accomplished (~50%). Fish from Tete are basically freshwater fish species of tilapias and Kapenta from Cabora Bassa reservoir. These fish products are sold fresh, smoked and sundried. There are four main fishing centres along the reservoir, in the Mozambique site, namely: Magoe and Zumbo, at the border with Zambia, Chitima, at the East end of the reservoir, near Tete City and Maravia at the middle northern margin of the reservoir, facing Zambia and Malawi. It was estimated about 1,511.0 tonnes of sundried kapenta, stilapia, fresh tilapia and smoked tilapia traded from Tete to Tete city, Cassacatiza, Manica, Chidzolomondo, Cuchamano, Zobue, and Malowere; involving about 230 people dominated by women (~55%), with age in the rage 15-39 years (over 70%), about 40% of them were illiterate and about 50% had accomplished 7th grade.

There were some university students (6%) engaged in informal fish trade. 87.5 tonnes of sundried marine sardines and anchovy, fresh and dried shrimp and alive crabs were estimated to be traded annually from Chinde to markest in Sofala, Zambezia and Maputo; over 100 people were estimated to be involved in informal fish trade from Chinde, mostly men (80%) and youth, most of them had accomplished high secondary school (~55%) and over 40% accomplished 7th Grade. Over 40 tonnes of marine fish was estimated to be traded from Pebane to Molocue, Mocuba. Milange. Nampula and Quelimane. Major fish products were fresh shrimp, anchovy and fresh sardine and sundried. Fresh products were sold to major cities such as Mocuba, Quelimane and Nampula, whereas sundried fish products were sold in remote

villages including the border village of Milange, which is bordering Malawi. Over 150 people, mostly men with age between 30 and 39, the majority were illiterate or with standard 7th or below, were estimated to trade fish from Pebane. It was estimated that about 3,000 tonnes of marine fish products were traded annually from Angoche mainly to Nampula, from where it is distributed to other parts of the country. The major fish products were sardines, anchovy, curvine, grouper, spanish mackerel, small tuna and shrimp, most of them were traded as fresh fish products to Angoche and Nampula. About 2,000 tonnes and 1,500 tonnes and 2,000 tonnes of fresh sardine and fresh line fish were estimated to be traded from Ibo and Palma, respectively. Most of the fish products from Ibo are sold mainly in Pemba, whereas the fish products from Palma are most of it sold in Tanzania. From Lake Niassa (Lake Malawi) in Niassa Province, about 150 tonnes of freshwater fish products, composed mainly by Ussipa (Engraulicypris sardella), Chambo (Oreochromis sp.) and Utaka (Copadichromis sp), were estimated to be traded annually to the markets in the neighbouring provinces of Cabo Delgado, Nampula and Zambézia, and to Malawi and Tanzania.

The fish traders used a variety of means of transportation of their products. For short distances and for most of the door-to-door they walked or used bicycles. For medium distances they used bicycle and motorbikes. For large distances they used motorbikes, minibuses, buses, trucks and aeroplanes. Motorbikes are commonly used in the cross border trade to Tanzania in Palma. Boast are used along the coast, between and from islands, in the estuaries and in the lakes.

Table 4: Amount of fish traded informally and number of fish traders involved.

Source	No of people involved	Destination	Fish products	Annual Quantity (Tonnes)
Massingir	39	Chokwe, Maputo	Fresh Tilapia, Sundried tilapia, Smoked cat fish	67.3
Chibuto	-	Maputo, Nampula, Niassa	Fresh Tilapia, Sundried tilapia, Smoked cat fish	30.0
Inhassoro	77	Maputo, Chimoio	Fresh line fish (LUTJANIDAE, SCOMBRIDAE, TUNIDAE), Sundried small line fish (CENTROPOMIDAE, Epinephelus sp., Pagrus pagrus, Pristipomoides)	465.0
Guvuro - Mambone	53	Chimoio, Mulocue	Sundried marine sardines, Sundried marine anchovy	270.0
Beira	250	Manica, Chimoio Nampula, Niassa, Maputo	Sundried marine sardines and anchovy Alive crabs, alive clams, frozen shrimp	1,610.0

Source	No of people involved	Destination	Fish products	Annual Quantity (Tonnes)
Tete (Zumbo, Magoe, Chitima, Maravia)	230	Tete City, Cassacatiza, Manica, Chidzolomondo, Cuchamano, Zobue, Malowere	Sundried kapenta, Sundried tilapia Fresh tilapia, smoked tilapia	1,511.0
Chinde	100	Maputo, Zambezia, Sofala, Nampula	Alive crabs, sundried marine sardines and anchovy, fresh and dried shrimp	87.5
Pebane	150	Molocue, Mocuba, Milange Nampula,	Sundried marine sardines, sundried marine anchovy, fresh shrimp (Penaeus indicus), Sundried Tilapia, Acetes erythraeus	41.8
Angoche		Nampula	Fresh shrimp (Penaeus indicus), fresh sardine, fresh line fish (Allothunnus fallai, Otolithes ruber, Scomberomorus commerson, Lacturizes lactarus), Scylla serrata	1,008.0
Ibo, Palma		Pemba, Tanzania	Fresh sardine, Fresh line fish	3,512.5
Coube and Wikihi		Niassa, Malawi	Sundried Ussipa (Engraulicypris sardella), Chambo (Oreochromis sp.), sundried Utaka (Copadichromis sp),	200.0

Cross border informal fish trade

Table 5 presents the amount and type of fish product traded through the major gate border, as well as the number of fish traders involved. The following 9 border gates were surveyed: Manguzi and Komatiport, bordering South Africa; Cuchamano and Cassacatiza bordering Zambia; Calomue, Zobue and Milange bordering Malawi; Palma bordering Tanzania and Cobue and Wikihi bordering Malawi through Lake Niassa. Result from Milange is not presented because during the survey only import of fish was observed, and so considered the sample not representative.

The study estimated that about 2,579 tonnes of fish is exported informally through the border gates, involving about 600 fish traders. Through Manguzi border gate it was estimated that about 288 tonnes of sundried tilapia and catfish were exported annually to South Africa, involving about 25 fish traders. About 342 tonnes were estimated to be traded

through the Komatiport border gate, also to South Africa, involving about 13 fish traders. The fish traded through the two border gates are caught in Massingir, Chibuto and Catuane. It was observed that through Cassacatiza, Cuchamano, Calomue and Zobue the fish products traded were caught in Cabora Basa Reservoir, consisting mainly of tilapia and kapenta. Through Cassakatiza border gate there was estimated about 580 tonnes of sundried

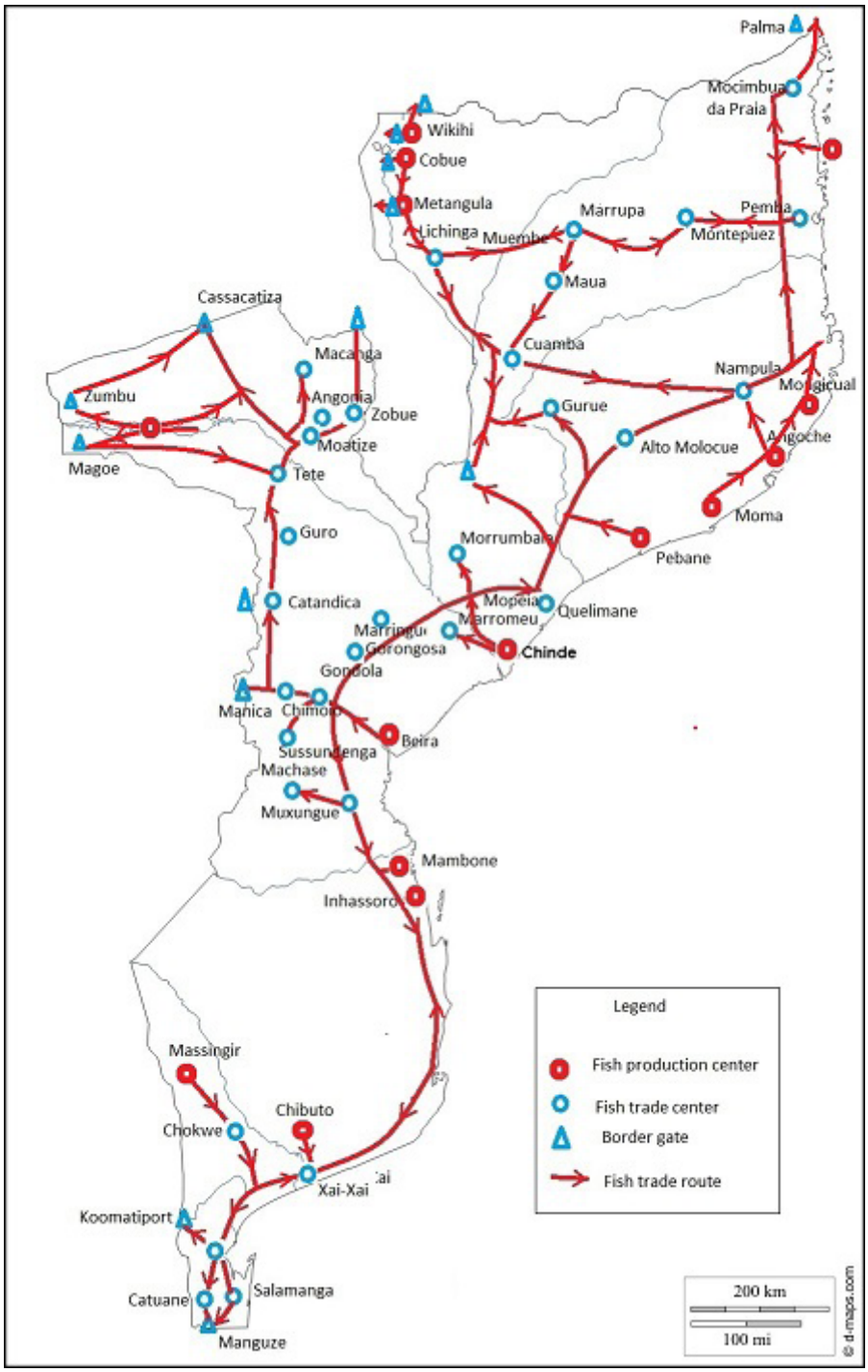


Figure 1: Major fish trade corridors.

and smoked tilapia and about 100 tonnes of sundried kapenta traded to Zambia, involving about 150 traders; Through Cachumano, about 150 tonnes of tilapia and equally amount of sundried kapenta were traded annually to Zimbabwe; through Calomue and Zobue it was estimated that about 130 tonnes of tilapia and about 100 tonnes of sundried tilapia and 130 tonnes of sundried kapenta were traded to Malawi annually, involving 210 and 80 fish traders, respectively. Through Palma to Tanzania, the study estimated an annual trade of about 60 tonnes of fresh and sundried line fish and sardine, involving 30 fish traders. Through Coube and Wikihi about 90 tonnes and 70 tonnes of sundried Ussipa- Engraulicypris sardella and Utaka- Copadichromis sp were estimated to be traded to Malawi, involving 15 and 12 fish traders, respectively.

Table 5: Amount of fish traded informally and number of fish traders involved

Source	No of people involved	Border gate	Fish products	Annual Quantity (Tonnes)
Massingir Chibuto Catuane	25	Manguzi	Sundried tilapia	149.3
			Smoked cat fish	139.0
	13	Komatiport	Sundried tilapia	243.0
			Smoked cat fish	139.0
Cabora Bassa reservoir	150	Cassakatiza	Sundried tilapia	477.6
			Smoked tilapia	105.6
			Sundried kapenta	157.3
	210	Cuchamano	Fresh tilapia	76.3
			Sundried tilapia	73.5
			Sundried kapenta	381.6
	63	Calomue	Sundried tilapia	130.2
	80	Zobue	Sundried tilapia	58.0
			Smoked tilapia	49.8
			Sundried kapenta	180.0
Palma	30	Tanzania	Fresh and sundried line fish and sardine	59.2
Lake Niassa (Malawi)	15	Wikihi	Ussipa- Engraulicypris sardella	54.0
			Utaka- Copadichromis sp	36.0
	12	Coube	Ussipa- Engraulicypris sardella	32.0
			Utaka- Copadichromis sp	35.0

Contribution of the informal fish trade in the food security

The result indicated that fish is the most preferable source of animal protein in most of the country, particularly near the main fish landing sites, along the marine coast and along the Cabora Bassa reservoir and Lake Niassa (Lake Malawi) as indicated in Figures 2 - 4. Fish is consumed on a daily basis in most of the places surveyed. In Zumbo and Mogoe more than 75% of the households interviewed said to consume fish on a daily basis; in Quelimane and Chinde fish is consumed daily by 96% of the households and in Palma and Ibo all the households interviewed stated that fish is part of their daily diet.

Fish is the primarily source of animal protein for the poor people in the rural areas

(Figure 5). In Zumbo, Magoe, Cabora Bassa and Chinde about 90%, 86%, 77% and 95% of the households interviewed said to prefer fish as the primary source of animal protein. The preferable fish products are frozen scad and mackerel, sundried sardines, sundried anchovy, sundried kapenta, sundried tilapia and smoked cat fish available fish products.

In the major cities, though, where there are some people with medium to high purchasing power, beef and chicken became important source of animal protein (Figure 6-7). In Maputo, Beira and Nampula 78%, 76% and 49% of the households said to prefer beef or chicken as the primary source of animal protein. The fish products demanded in the main cities were those of high value such as shrimp, grouper, grunt, tuna and red and silver sea bream, and preferred fresh or frozen. The availability, accessibility and affordability of fish make it a viable choice for poor people. However, people with medium and high purchasing power are few compared to a majority poor people that depends on fish and fish products, which then leads to a conclusion that fish is the overall the main source of animal protein in Mozambique.

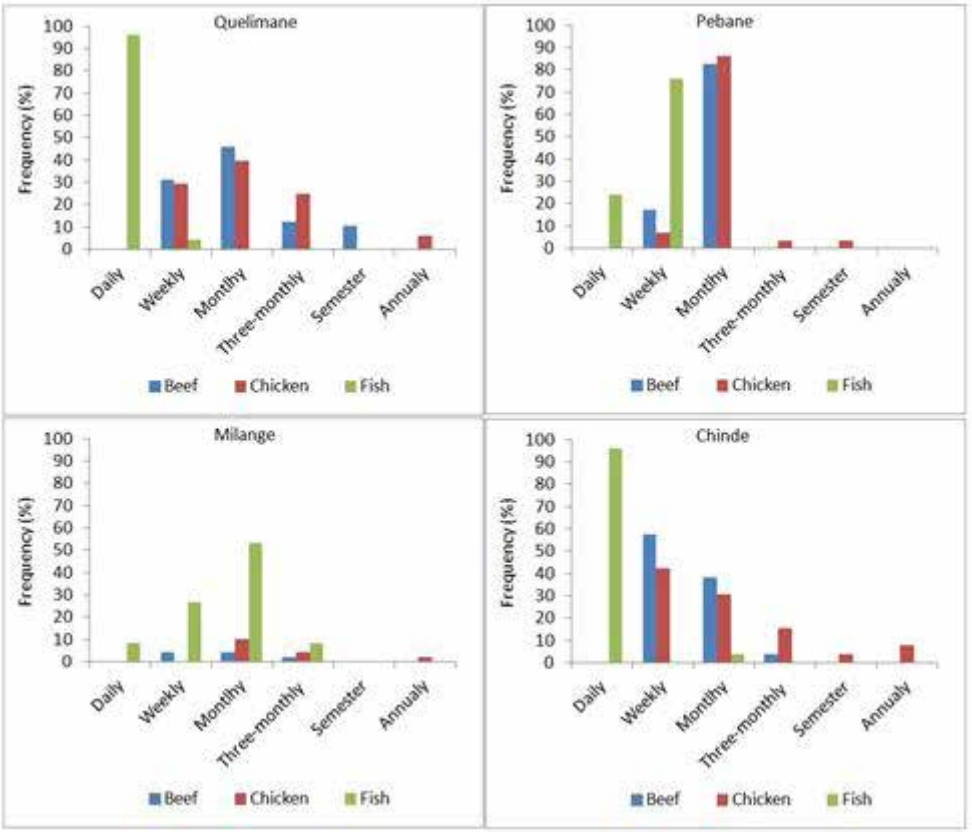


Figure 2: Frequency of consumption of fish and of other animal protein sources in Quelimane, Pebane, Milange and Chinde, December 2016 - February 2017

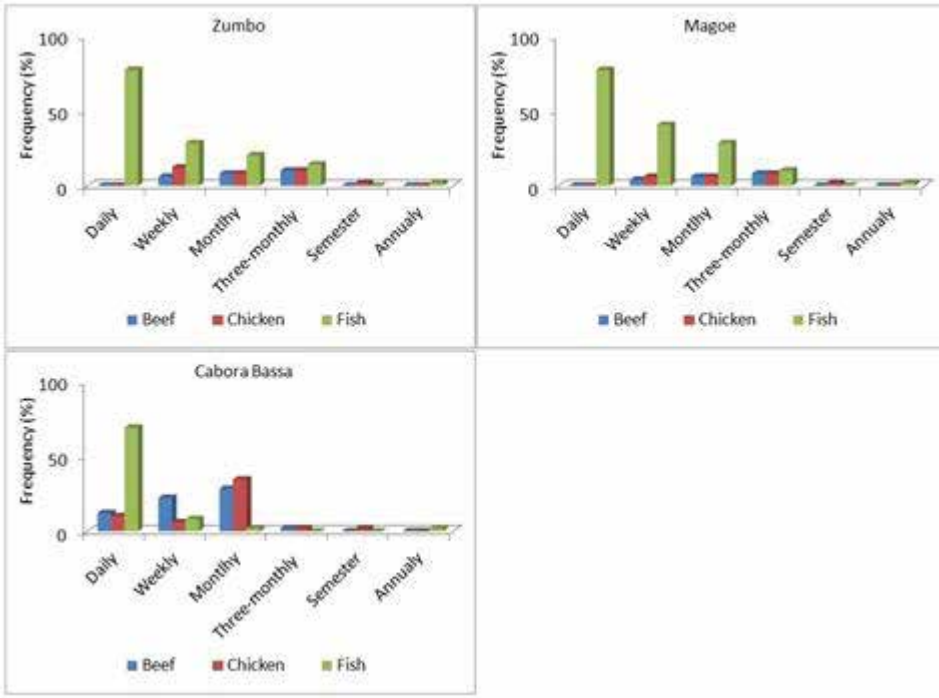


Figure 3: Frequency of consumption of fish and of other animal protein sources in along the Cabora Bassa reservoir, in Tete Province, January-February 2017

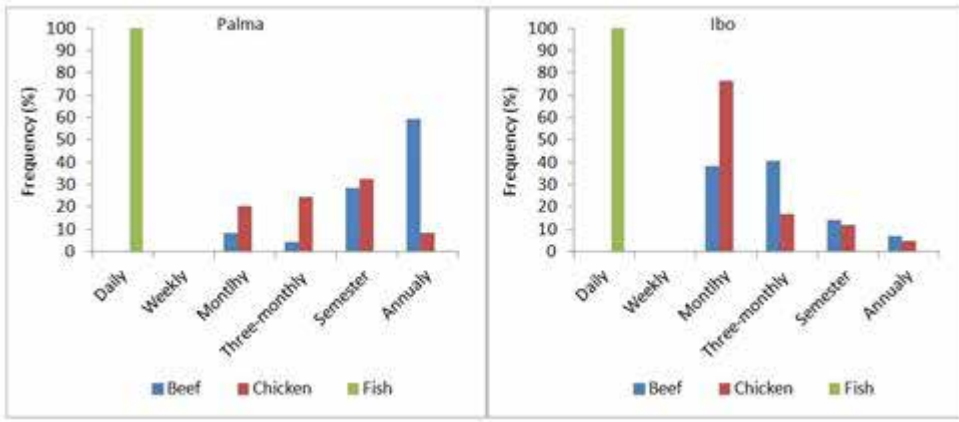


Figure 4. Frequency of consumption of fish and of other animal protein sources in Palma and Ibo, Cabo Delgado Province, December 2016 - February 2017

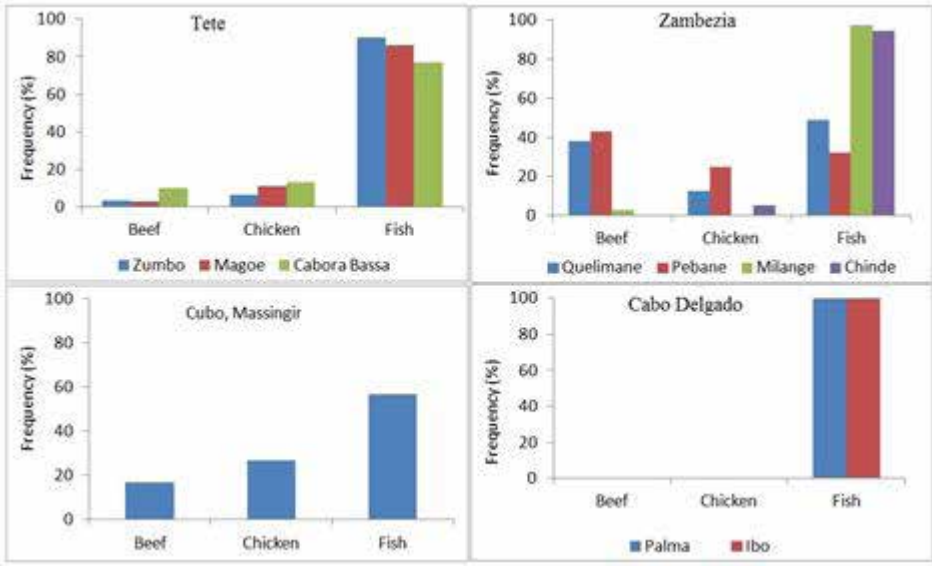


Figure 5. Consumer's preferred source of the animal protein in the major fishing and fish trade centres, December 2016 - February 2017

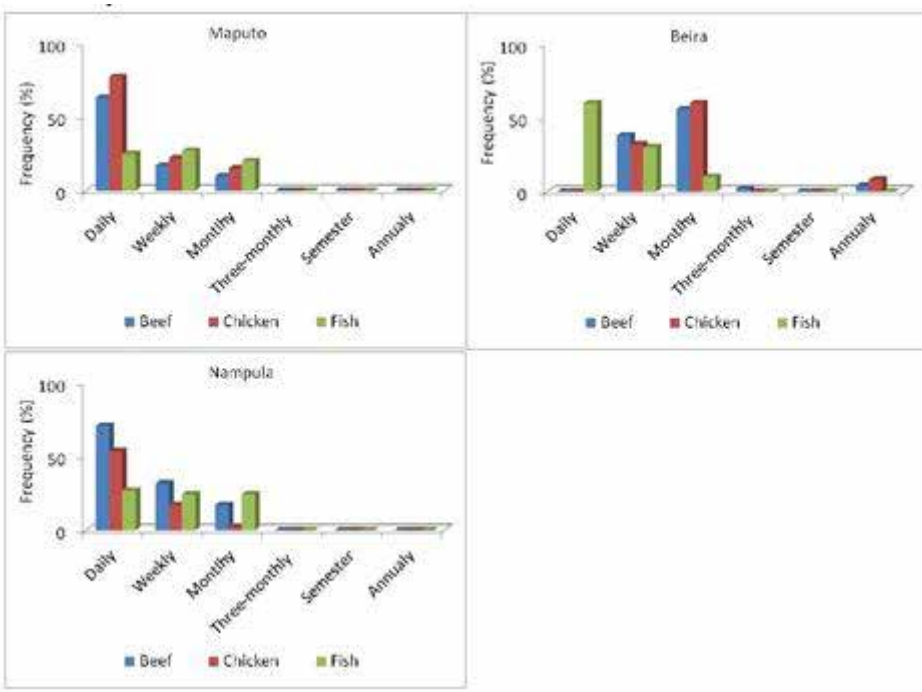


Figure 6: Frequency of consumption of fish and of other animal protein sources in the major cities, December 2016 - February 2017

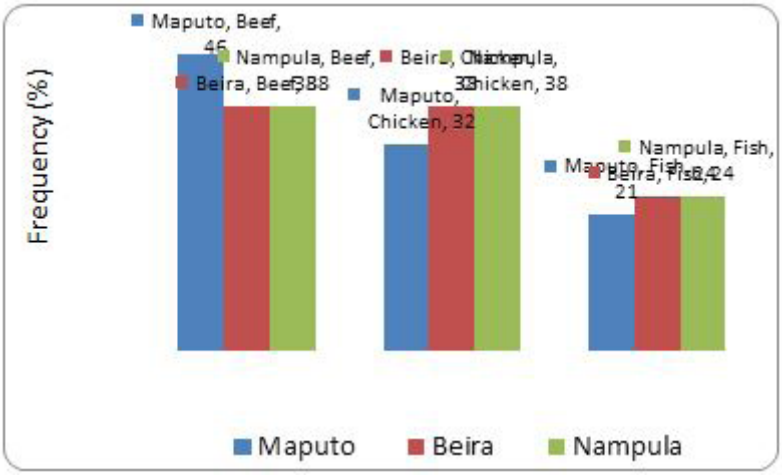


Figure 7: Consumer's preferred source of the animal protein in the major cities, December 2016 - February 2017

Contribution of the informal fish trade in the family income

Regarding the contribution of fish in the family income, surveys along the main fishing centres, along the coast and in the vicinities of the main freshwater bodies, indicated that fish trade is the main source of income (Figure 8). Most of the family incomes are in the range 1,000-3,000MZn and 3,000-6,000MZn. Considerable proportion of households with monthly income higher than 15,000MZn was recorded in Magoe (32%), Cabora Bassa (24%), Ibo (23%) and Chinde (19%). In Ibo two households said their monthly family income was 30,000MZn, equivalent to USD500.

Fish trade dominates the family income (Figure 9). The contribution of the fish trade is over 70% in most of the households. In Zumbo and Cabora Bassa fish trade contributed 78% and 71% of the family income, respectively; higher contribution of the fish trade in the family income was observed in Pebane (95%), Chinde (91%) and Palma and Ibo where all the households interviewed had fish trade as the only source of income. Quelimane registered high diversity of means of livelihood, with 25% of the income from other sources apart from fish trade. In the main cities people have more options for income generation, and fish trade contributes partially (Figures 10-11). In Maputo and Nampula the contribution of fish trade to the family income was 15% and 25%, respectively. In Beira, despite being a large city, fish trade contributed about 69% of the family income. This could be explained by the fact that Beira is a major fish landing site, located in Sofala bank, the major fishing area in Mozambique. Further, the interviews included fish consumers as well as the fish traders. The contribution of fish trade in the family income of the fish traders is expected to be higher.

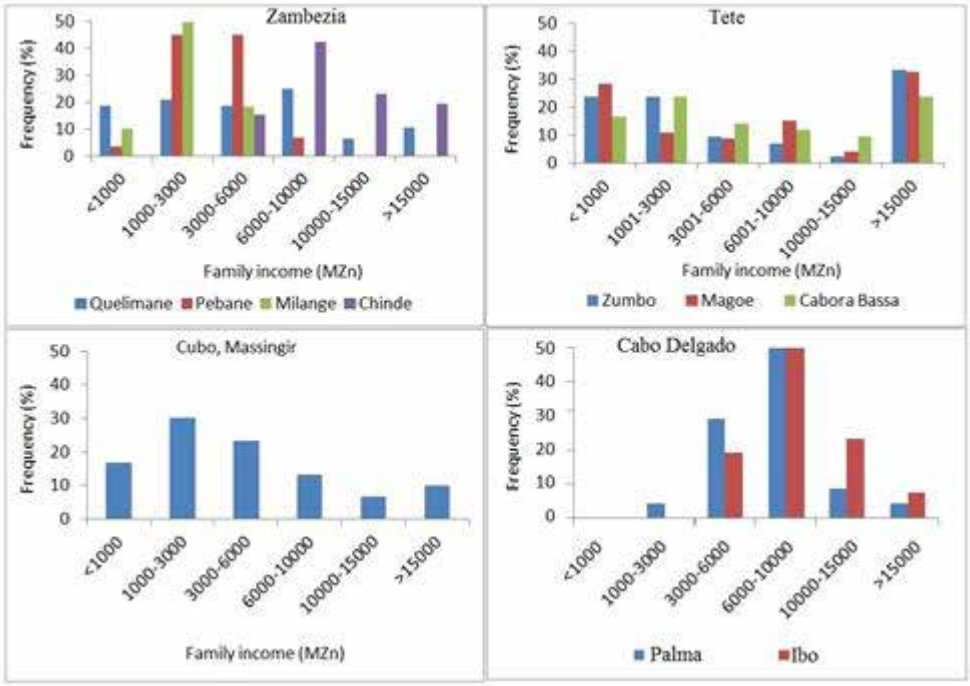


Figure 8: Monthly family income in the main fishing and fish trade centres December 2016 - February 2017

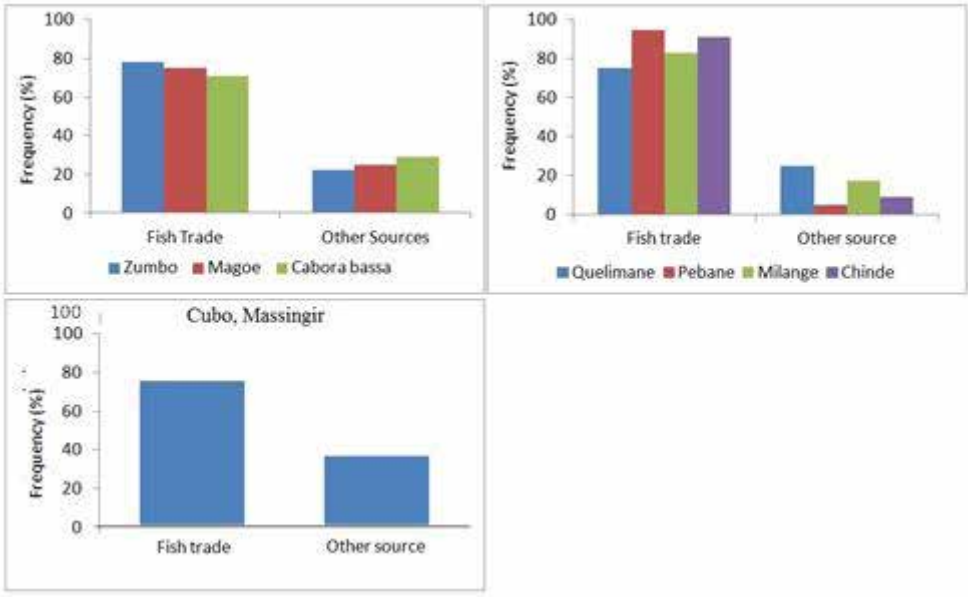


Figure 9: Sources of the family income in the main fishing and fish trade centres December 2016 - February 2017

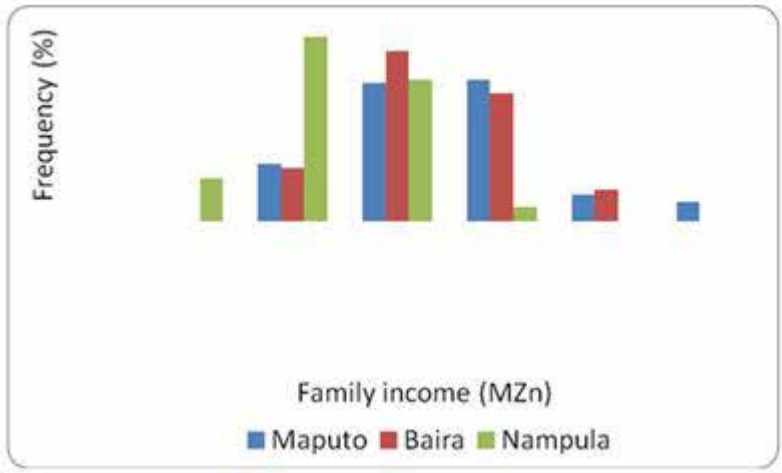


Figure 10: Monthly family income in the major cities, December 2016-February 2017

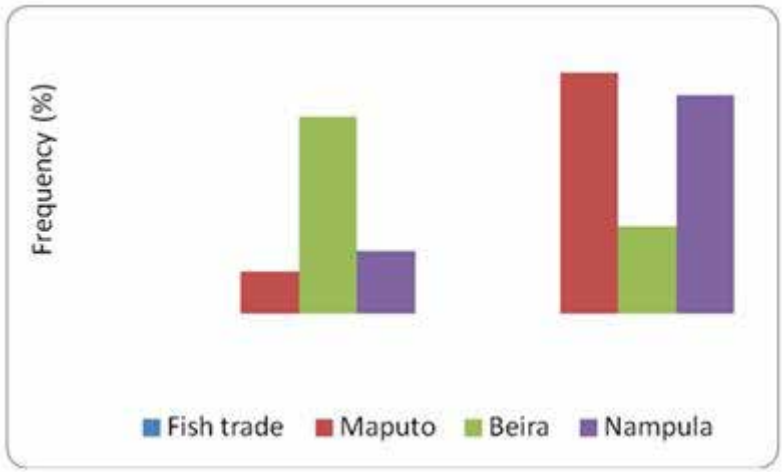


Figure 11: Sources of the family income in the major cities, December 2016-February 2017

Acknowledgement

We would like to thank the all District Government Officials who supported the research teams and kindly provided the information required for the accomplishment of this study. We are greatly thankful to the Instituto de Inspecção de Pescado delegations of Tete and Sofala for the kind provision of data on domestic fish trade. Special thanks to WorldFish Center, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under the Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa", following the Malabo Declaration at the 2014 Summit African Heads of States and Governments in Equatorial Guinea. The funding was made possible through the assistance from the European Union.

References

Ackello-Ogutu C, 1996. Methodologies for EstimatingInformal Cross-Border Trade in Eastern and Southern Africa: Kenya/Uganda Border, Tanzania and Its Neighbors, Malawi and Its Neighbors, Mozambique and its Neighbors. Technical Paper No. 29. USAID/Bureau for Africa. Office of Sustainable Development.

African Union, 2010. The role of African fisheries and aquaculture in the CAADP. A paper prepared

for the Conference of African Ministers of Fisheries & Aquaculture (CAMFA). held in Banjul. the Gambia. from 20th to 23rd September 2010. African Union Technical Report. CAMFA/4/2010. website: www.africa-union.org

Brás VMLL, 2017. Estudo sobre Comercio Informal do Pescado Comercializado na Praia Nova, Cidade da Beira, Província de Sofala. Dissertação de BSc em Biologia Marinha. Escola Superior de Ciências Marinhas e Costeiras, Universidade Eduardo Mondlane, p48. Universidade Eduardo Mondlane.

Carrilho J, Abras M, Junior A, Chidassicua J, Mosca J, 2016. Desafios para a segurança alimentar e nutrição em Moçambique . Maputo.

CIA, 2017. World Factbook – https://www.cia.gov/library/publications/the-world-factbook/fields/2060.html

Duarte CJ, 2015. Avaliação das percepções dos comerciantes informais do município de tete adesão a formalização. Chimoio.

FAO, 2017. Food and Agriculture Organization of the United Nations Database. Available at: http://www.fao.org/countryprofiles/index/en/?iso3=MOZ

FAO, 2015. FAO Yearbool of Fishery and Aquaculture Statistics - Summary tables of Fishery Statistics. FAO Fisheries and Aquaculture Department. Available at: http://www.fao.org/fishery/statistics/yearbook/en.

FAO, 2014. The State of World Fisheries and Aquaculture Opportunities and Challenges. FAO Fisheries Department, Rome. Fisheries Department, Rome.

FAO, 2012. The State of the world Fisheries and Aquaculture, Food and Agriculture Organization, Rome, FAO Fisheries and Aquaculture Department.

FAO (2007) Fisheries country profile. Food and Agriculture Organization of the United Nations. FID/CP/MOZ Report, September 2007. Available at:http://www.fao.org/fishery/docs/DOCUMENT/fcp/en/FI_CP_MZ.pdf

Fernandes GO, 2008. Sector informal da economia e a dinâmica dos territórios nas praias da cidade Natal/RN. Natal/RN.

Gove LB, 2017. Caracterização do comércio informal do pescado no centro de desembarque de Cubo, no distrito de Massingir, na província de Gaza, Sul de Moçambique. Dissertação de BSc em Biologia Marinha. Escola Superior de Ciências Marinhas e Costeiras, Universidade Eduardo Mondlane, p45. Universidade Eduardo Mondlane.

Hoguane AM, José J, Francisco RP, Simbine RL, Mucavele IM, 2017. Contribution of the fish products (traded illegally/informally) in the livelihood, food security and overall development of the country in Mozambique. Technical report on WordlFish project on Illegal Fish Trade in Mozambique. School of Marine and Coastal Sciences, Eduardo Mondlane University, Quelimane, Mozambique.

IIP, 2016. Relatório Anual do Instituto Nacional de Investigação Pesqueira para o ano 2015. IIP Technical report. IIP, Maputo.

IIP, 2015. Relatório Anual do Instituto Nacional de Investigação Pesqueira para o ano 2016. IIP Technical report. IIP, Maputo.

INE, 2010a Projecções anuais da população total, urbana e rural, [name of province] : 2007-2040. Instituto Nacional de Estatística, Direcção de Estatísticas Demográficas, Vitais e Sociais, [2010], 11 volumes; 30 cm

INE, 2010b. Projecções anuais dos agregados familiares, 1997-2010 : Moçambique. Maputo, Mozambique : Instituto Nacional de Estatística, 2000. Série Estudos (Instituto Nacional de Estatística (Mozambique)) ; no. 8, 28 p. : ill. ; 30 cm. HB3663 .A3 P77 2000 F

Issuf A, 2017. Avaliação da contribuição do comércio informal do pescado na segurança alimentar, no distrito de Angoche, Província de Nampula. Dissertação de BSc em Biologia Marinha. Escola Superior de Ciências Marinhas e Costeiras, Universidade Eduardo Mondlane, p41. Universidade Eduardo Mondlane.

Mangadi AN, 2014. characterization of informal cross-border traders across selected botswana borders. international journal of management and marketing research, 102.

Maposse AH, 2011. "O papel do comércio informal na ocupação da força de Trabalho em Moçambique".

Maputo.

Mclachlan G, 2005. Wire craft and urban space: a case study of the informal wire art trade in South Africa. Paper presented at 41st ISoCaRP Congress, p9. Available at: http://www.isocarp.net/Data/case_studies/583.pdf

Mosca J, 2009. Pobreza, Economia "Informal", Informalidades e Desenvolvimento. Conferência do Instituto de Estudos Sociais e Económicos (pp. 83-98). Maputo: Paper n° 34.

Mussa H, Kaunda K, Chimatiro S, Banda L, Nankwenya B, Nyengere J, 2017. Assessment of Informal Cross-Border Fish Trade in the Southern Africa Region: A Case of Malawi and Zambia. Journal of Agricultural Science and Technology B 7 (2017) 358-366, doi: 10.17265/2161-6264/2017.05.009. Available at: http://www.davidpublisher.org/Public/uploads/Contribute/5a82a722ad8db.pdf

Neiland AE, 2006. Contribution of fish trade to development, livelihoods and food security in west africa: Key issues for future policy debate. Sustainable Fisheries Livelihoods Programme technical report. Available at: http://www.fao.org/fishery/docs/DOCUMENT/sflp/SFLP_publications/English/fish_trade.pdf

Pinheiro RH, 2009. Comércio de pescado em mercado de bairro de belém: Aspectos higiênico-sanitários. IV Congresso de Pesquisa e Inovação da Rede Norte e Nordeste de Educação Tecnológica. Belém-PA.

Siana S, 2017. Estudo do Impacto Socioeconómico do Comércio Informal do Pescado na renda familiar dos pescadores da Albufeira de Cahora Bassa na província de Tete. Dissertação de BSc em Biologia Marinha. Escola Superior de Ciências Marinhas e Costeiras, Universidade Eduardo Mondlane, p46. Universidade Eduardo Mondlane.

Saunyama TC, 2013. On The contribution of informal sector trade to poverty reduction in Rusape, Zimbabwe. MSW Dissertation at the University of Pretoria, Department of Social Work and Criminology, Faculty of Humanities, P101. University of Pretoria. Available at: https://repository.up.ac.za/bitstream/handle/2263/41511/Saunyama_Contribution_2014.pdf?sequence=1

Souto M, 2014. Governação e Crescimento Partilhado das Pescas no Sudoeste do Oceano Índico em Moçambique (SWIOFish).

UN, 2016. Environment Statistics Country Snapshot. United Nations Statistics Division Available at: https://unstats.un.org/unsd/environment/envpdf/Country_Snapshots_Dec_2016/Mozambique.pdf

STATUS AND OPPORTUNITIES OF FISH TRADE: FISH IMPORTATION VERSUS LOCAL FISH IN KISUMU COUNTY, KENYA

Lucky Cinny Tubman
University of Nairobi. P.O BOX 30197, GPO Nairobi, Kenya

Abstract

A crisis looms over the fish production of Lake Victoria along the Kenyan shores as the capture fisheries that was once abundant is rapidly declining. The decline of the fish stocks can be attributed to overfishing, pollution and poor management of the resource. This trend therefore prompted the importation of fish into the region in order to meet the growing demand of the commodity and in turn ensure food security. Fish trade has a big impact on a region's socio-economic growth and development hence this study aimed to examine the status and opportunities of the current fish trade with imported and local fish as its main commodity. Data was collected within Kisumu's central business district, from the seven selected units- fish markets and road side vendors. Both descriptive and inferential data was performed using the SPSS version 20.0. The results indicated that the imported fish dominated the region's supply hence increasing the commodity's availability and affordability. Nevertheless a stiff competition has resulted in the trade of local and imported fish. This implies that the consumers are the main beneficiaries of this situation with different options at reasonable prices. The local fish traders however have been negatively impacted due to the decreasing profits and difficult nature of doing business. It reduces their purchasing power hence lowering their food security. The study also suggested that opportunities for improving fish trade in the region are yet to be fully utilized. Varied value addition techniques, rapid uptake of aquaculture, better storage facilities, increased dissemination of information and stronger credit facilities should be encouraged to generate further income from the resource.
Key Words: Fish trade, food security, fish importation and local fish industry

Abstract

Une crise plane sur la production de poissons du lac Victoria le long des rives du Kenya comme les pêches de capture qui était autrefois abondante est en déclin rapide. Le déclin des stocks de poissons peut être attribuée à la surpêche, la pollution et la mauvaise gestion de la ressource. Cette tendance invite donc l'importation de poisson dans la région afin de répondre à la demande croissante de la marchandise et assurer leur sécurité alimentaire. Le commerce du poisson a un grand impact sur l'ensemble de la croissance socio-économique et le développement d'où cette étude visait à examiner l'état et les possibilités de l'actuel commerce du poisson avec des poissons locaux et importés comme son principal produit. Les données ont été recueillies dans le quartier central des affaires de Kisumu, sur les sept unités sélectionnées- marchés aux poissons et les vendeurs de bord de route. À la fois descriptive et inférentielle données ont été effectués en utilisant le SPSS version 20.0. Les résultats ont indiqué que le poisson importé dominait la région d'augmenter ainsi la disponibilité des marchandises et de l'abordabilité. Néanmoins, une vive concurrence s'est traduite dans le commerce des poissons locaux et importés. Ceci implique que le consommateur sont les principaux bénéficiaires de cette situation avec différentes options à des prix raisonnables. Les commerçants de poissons locaux mais ont souffert en raison de la baisse des bénéfices et de la nature difficile de faire des affaires. Elle réduit leur pouvoir d'achat d'où l'abaissement de leur sécurité alimentaire. L'étude suggère également que les possibilités d'améliorer le commerce du poisson de la région n'est pas encore pleinement utilisé. La valeur des techniques plus variées, une absorption rapide de l'aquaculture, de meilleures installations de stockage, l'augmentation de la diffusion de l'information et des facilités de crédit devraient être encouragés à générer des revenus supplémentaires à partir de la ressource.
Mots clé: commerce du poisson, la sécurité alimentaire, l'importation de poissons et de l'industrie du poisson local

Corressponding author email: cinnylucky@gmail.com

Introduction

Continued population growth and urbanization along the shorelines of Lake Victoria in Kenya has led to an increase in the demand of the fisheries resource. The fish production from the lake has not been sufficient to meet this demand as it mainly relies on capture fisheries. Finegold (2000) stated that fish demand is unlikely to be met particularly in sub-Saharan Africa where many capture fisheries have reached their limit and aquaculture development is not at per with the population growth. The declining or stagnating trend of capture fisheries has over the years been evident and it can be attributed to the degraded environment and poor management of the water and fisheries resources. The current status is worrying as fisheries make a critical contribution to food security, employment and trade.

Fisheries play a significant role in food security, both directly and indirectly. It supplies nutritious and healthy animal protein. The fishery from Lake Victoria is dominated by Nile perch (Lates nilotics), Tilapia (Oreochromis niloticus) and Omena (Rastrineobola argenta). Fish is and has always been, for the lake population an integral part of the culturally conditioned diet. Fisheries indirectly support food security by providing avenues for livelihoods, employment and income. LVFO (2014) stated that the lake's fisheries support approximately two million people with household incomes. It furthers meet the annual fish consumption needs of almost 22 million people. Provision of employment from the sector cannot be ignored, since more than 50,000 people are working directly in it, mainly as fishermen, traders, processors and employees (Muigua *et al*., 2015). In developing countries, millions of women are employed in fisheries at all stages but mainly in fish processing and marketing (Finegold 2000). Fish processing and trading especially for women provides an important livelihood support. Béné and Heck (2005) attributes this to the relatively few investments needed for small scale processing and trading, low operational costs, ability to be undertaken by unskilled labour with little strength requirements. This has attracted large number of women to engage in the fish processing and trading activities.

Despite of the huge impact of fisheries on the socioeconomic development of the region, the production continues to decline as mentioned earlier. Béné and Heck (2005) stated that the Africa's fish supply is in crisis and as a result the per capita consumption is low especially in Sub Saharan Africa. This dire situation led the Government of Kenya to import fish from China so as to increase fish supply and meet the demands of the population (Ogutu, 2016). This was back in mid-2016. Importation from China can be attributed to its established aquaculture systems that have enormous gains (FAO, 2006). Other traders have also resorted to importing fish from neighbouring countries. These actions were made to ensure a food secure region and country at large. Importation of fish was however foreign as the region had previously been exporting the high valued species- Nile perch after its boom production before the ban by European Union in early 1999 (Abila, 2003). FAO (2014) stated that Africa in the period of 1985-2010 was an exporter but since 2011 it became a net importer in terms of value reflecting the progressive decline of fish product exports and the lower unit value. Importation of fish has the capacity to increase the fish supply, creation of more employment opportunities and further income generation. However the products of local fish workers are at risk of being displaced with the importation of fish in the area hence threatening their livelihoods and food security. The likelihood of being negatively affected can be lowered if they are involved in the decision making process related to the introduction of export oriented operations (FAO, 2006). The objective of this study was to assess the status of fish trade of local and imported fish in terms of production, supply and demand as well as establish the opportunities to improve the fish industry.

The Sustainable Development Goals number 2 advocates for no hunger. Fisheries resources have the ability to ensure a food

secure nation due to its high nutritional value that can be easily afforded. Fish importation in Kisumu region has been able to meet the demands of the people due to the decreasing fish production. However a long lasting solution needs to be implemented to ensure food security and economic development for all with little or no dependence on imports. In 2013, fish became the highest food trade commodity globally with 130 United States dollars however Africa contributed to only 5 United States dollars revealing that Africa's participation in fish trade globally is still insignificant (ARSO, 2014). This presents an opportunity for Africa, Kenya in specific to increase its capacity for production that can adequately feed its population and participate in the international fish trade. Aquaculture, value addition of fish products, credit facilities and sustainable fishing are potential domains for the increase in fish production. The hypothesis of the study: H0 - Imported fish has not met the fish demand of the region; H1 Imported fish has met the fish demand of the region.

Materials and methods

Study area, research design and sample size

The study was conducted in Kisumu County in January 2018, approximately two years after the introduction of imported fish in the area. It was done at various markets and roadside fish vendors. A stratified random sampling was adopted to select the units-markets and roadside vendors to be surveyed as well as the participants. The first step was to select the units that were within the boundary of a 3km radius from the Central business district. This was due to the limited resources at hand. A total of eight units were selected based on this criterion. The units were then divided into two strata- those that traded both imported and local fish and units that traded local fish only. This was possible from the reconnaissance visit to the units. The units with both imported and local fish, five in number were settled on and the participants were randomly chosen. Thomas (2013) stated that it is critical for the sample to be large enough in order to increase the chances of obtaining a significant effect. Thus 35 respondents were selected, seven from each of the five units.

Data collection and analysis

Primary data was obtained through questionnaires and semi structured interviews. The questionnaires targeted the fish processors and traders while the semi structured interviews targeted the fisheries officer, knowledgeable fish trader and BMU chairman. The questionnaires were presented at markets and roadside vendors. Secondary data was gathered through reviewing relevant published and unpublished studies from journal articles, consultant reports and government documents. Primary data was entered, coded and analysed using the SPSS version 20.0 and Microsoft excel sheet. The generated data was summarized into frequencies and percentages and presented in charts and tabular forms. Variable relationships were analysed mainly by cross tabulation. Content analysis method was used to analyse the information generated from semi structured interviews which were broken down to significant themes.

Results

Source of fish

Among the interviewed fish traders, a majority of 68.6% sourced their fish from the local industry while 31.4% opted for the imported fish. The majority stated that their customer base preferred the local fish as it was tastier compared to the imports. They further added that they were sure of the origin of the local fish. Traders that sourced from fishermen had an agreement – once the fish was sold they would send the money to the traders The fisheries officer noted that some of the traders opted for imported fish due to the affordable prize but claimed it was local fish. (Table 1)

A cross tabulation of the traders' duration in the business and where they sourced their fish was done. It indicated that traders who had been in the fish industry for five years and below opted for imported fish (8 out of 10) while those with 5 years and above

Table 1: Source of fish

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid fisherman imports	24	66.7	68.6	68.6
	11	30.6	31.4	100.0
Total	**35**	**97.2**	**100.0**	
Missing System	1	2.8		
Total	**36**	**100.0**		

Table 2 : Cross tabulation of duration of fishing with source of fish

Duration	Source		Total
	Fisherman	Imports	
less than 1 year	0	1	1
1-3 yrs.	0	4	4
3-5 yrs.	2	3	5
5-10 yrs.	5	3	8
over 10 yrs.	17	0	17
Total	**24**	**11**	**35**

experience opted for the local fish source (22 out of 25). (Table 2)

51.4% of the traders reported that there was constant supply of fish while 48.6% reported it was not constant. Traders that had constant supply of fish were those that sourced them from imports 11 out of 18, while those without constant supply were 17 and sourced the commodity from the local industry. (Table 3).

Table 3: Cross tabulation between constant supply of fish with its source.

Constant Supply	Source		Total
	Fisherman	Imports	
Yes	7	11	18
No	17	0	17
Total	24	11	35

Fish supply

17.1 reported that the fish supply from the lake was increasing, 60.0% said it was decreasing while 22.9% of the respondents said it varied with seasons (Table 4). According to those who reported the increase of fish attributed it to the opening of a closed boundary in Mbita enabling fishermen to have more catches. The decreasing trend was due to the increased number of fishers in the lake, illegal ways of fishing as well as presence of water hyacinth hence depletion of fish stock. Fish varied with seasons- hot and dry less fish was caught as they were in the deep column of the lake, cold and wet seasons more catches as result of fish coming to the surface.

The fisheries officer stated that the imported fish contributed a larger proportion of the regions supply compared to the local fish. Approximately 3 to 4 tons of local fish is supplied into the area. The local fish industry gets its fisheries from Lake Victoria, aquaculture and other neighbouring regions like Busia, Mihuru bay and Homabay. Omena otherwise

known as R. argenta has become the most prevalent species caught from the lake in Kenya; it however has a lower commercial value. Nile perch and tilapia production trail behind respectively. Imported fish only comprise of the tilapia species, from the Alpha and Migingo supplies companies. The flow of local fish supply is monitored by the Ministry of Livestock, Agriculture and fisheries at landing sites and the Fish municipal market while imported fish is not monitored. The overall local fish supply has decreased to nearly half of what used to be produced from the lake from 200,000 tons in the 1990s to 120,000 tons last year.

I mpact of importing fish

72.2% of the respondents stated that the imported fish had a positive impact as it increased the fish supply in the area. They stated that the fish production from the lake could not meet the rising demand of the region with the declining fish stocks in the lake and the slow uptake of aquaculture. 16.7% of those interviewed said it had a negative impact while 2.8% took a neutral stand. About 63.6% of the respondents reported that there was stiff competition as result of importing fish hence negatively impacting the local fish industry. The stiff competition was caused by the lowered prize of the imported fish. Fish traders who agreed that importing fish had a positive and varied impact in terms of competition was the same with 18.2% each. The onset of importing fish brought about a reduction of fish prices, 63.6% stated that this trend was negative while 21.2% said it was positive and 15.2% had a neutral stand (Table 5 and 6).

Table 4: Fish supply

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
increasing	6	16.7	17.1	17.1
decreasing	21	58.3	60.0	77.1
varies	8	22.2	22.9	100.0
Total	35	97.2	100.0	
Missing System	1	2.8		
Total	**36**	**100.0**		

Table 5: Increased Supply

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
increasing	6	16.7	18.2	18.2
decreasing	26	72.2	78.8	97.0
varies	1	2.8	3.0	100.0
Total	33	91.7	100.0	
Missing System	3	8.3		
Total	**36**	**100.0**		

Table 5: Increased Supply

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
increasing	21	58.3	63.6	63.6
decreasing	6	16.7	18.2	81.8
varies	6	16.7	18.2	100.0
Total	33	91.7	100.0	
Missing System	3	8.3		
Total	**36**	**100.0**		

Ease of doing business

Majority of the respondents, 54.3% in this study indicated that the ease of doing business had become hard followed by 37.1% of those who said it varied and 8.6% reported it was easy. The respondents attributed difficulties in the operation of business to the stiff competition from the cheap imported fish, low economic times, limited fish supply from the lake and acquisition of ice for storage. The profit margins were decreasing according to 40 % of the respondents, 37.1% stated they varied and 22.9% said they were increasing. The decreasing and varying profit margins were almost at the same rate and most of the respondents that had this feedback were trading local fish. Few indicated that the profits were increasing, most of whom were involved in the trading of imported fish. This is due to the low price and desirable size of the imported fish. A box that contains frozen fish of the sizes 300g- 400g goes for Ksh. 1,650, containing 35-40 pieces of fish compared to the local fish where one piece of fish is sold according to its size at Ksh. 150- 800. (Table 7 and 8)

Table 7: Ease of Business

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
increasing	3	8.3	8.6	8.6
decreasing	19	52.8	54.3	62.9
varies	13	36.1	37.1	100.0
Total	35	97.2	100.0	
Missing System	1	2.8		
Total	**36**	**100.0**		

Table 7: Profit Margins

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
increasing	8	22.2	22.9	22.9
decreasing	14	38.9	40.0	62.9
varies	13	36.1	37.1	100.0
Total	35	97.2	100.0	
Missing System	1	2.8		
Total	**36**	**100.0**		

The analysis of a cross tabulation done for ease of business and profits margins revealed that majority who reported that the ease of business was hard had decreasing profit margins. 25.7% had alternative sources of income while 74.3% solely relied on fish trade for their income. Traders that had alternative sources of income said that the profit margins were low and had to be augmented by other economic activities (Table 9).

Opportunities for fish trade

The respondents that were interviewed stated that they added value to the fish before selling it by frying, smoking and sun drying. This constituted of 68.6% while those that didn't add value were approximately 31.4%. Most traders that opted not to add value sold the fresh fish in bulk, this was the case in Fish municipal market. Another occurrence was a trader who sold imported fish to retailers in boxes. Traders who were located along the regions of carwash, nyalenda, kondele, jubilee market and the beach added value to increase the commodity's shell life and profit margins. 85.7% were aware of aquaculture while 14.3% were not aware of the practice. Those who were aware identified it as fish ponds and cages. They however didn't

Table 9: Cross tabulation of ease of business with profit margins

Ease of Business	Profit Margins			Total
	Increasing	decreasing	varies	
Easy	1	0	2	3
Hard	1	13	5	19
Varies	6	1	6	13
Total	**8**	**14**	**13**	**35**

know how to do it. The fisheries officer stated that there were approximately 788 fish ponds located within the Nyanza region; Nyakach, Muhoroni, Kisumu east, Kisumu west and Seme. The farmed species are tilapia and catfish. 82.9% of the respondents belonged to a credit facility- mostly chamas with their colleagues, a few in Sacco's. They stated that it was helpful to be part of one during hard situations as they acted as cushion for stressful times. 17.1% did not belong to a credit facility. (Table 10, 11 and 12)

Storage facilities

51.4% of the respondents indicated that they stored fish in ice coolers, 2.9% in the cold room and 45.7% kept them in a cool place. Traders at the Fish Municipal market mostly relied on ice coolers and the cold room which offers its services 24 hours a day at charge that's dependent on the quantity of fish. These are often used with fresh fish as they are easily prone to get spoilt. Respondents who kept them in a cool place did this after frying, smoking and sun drying the fish. Fried fish that was stored in a cool place and if it lasted two days before being sold, they were boiled and later fried to ensure it's safe for consumption and reduce losses.

Majority of the traders, 57.1% took 2 days to finish their stock, while those who took 3 days and more were 22.9% and those who took 1 day were 20%. Ice coolers are mostly used to store fish 51.4% followed by being kept in a cool and dry place 45.7% and cold room 2.9% (Table 13 and 14).

Table 10: Value addition

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	24	66.7	68.6	68.6
No	11	30.6	31.4	100.0
Total	35	97.2	100.0	
Missing System	1	2.8		
Total	**36**	**100.0**		

Table 11: awareness of aquaculture

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	30	83.3	85.7	85.7
No	5	13.9	14.3	100.0
Total	35	97.2	100.0	
Missing System	1	2.8		
Total	**36**	**100.0**		

Table 12: Credit facility

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	29	80.6	82.9	82.9
No	6	16.7	17.1	100.0
Total	35	97.2	100.0	
Missing System	1	2.8		
Total	**36**	**100.0**		

Table 13: Storage facilities

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
ice coolers	18	50.0	51.4	51.4
cold room	1	2.8	2.9	54.3
kept in a cool place	16	44.4	45.7	100.0
Total	35	97.2	100.0	
Missing System	**1**	**2.8**		
Total	**36**	**100.0**		

Table 14: Cross tabulation of storage facilities with sale of fish stock

Storage	Fish Stock			Total
	1 day	2 days	3 days and more	
ice coolers	6	11	1	18
cold room	1	0	0	1
kept in a cool place	0	9	7	16
Total	**7**	**20**	**8**	**35**

Figure 1: Women in front of the fish market where both local and imported fish are traded.

Discussion

Food Supply

The community around Lake Victoria has been dependent on its fisheries since time immemorial. Its supply could meet the nutritional demand of the region and offer a source of livelihood to the inhabitants of the lake shorelines. However, this is not the case in present day as the fish stocks are near to depletion. Overfishing, illegal use of gears, pollution, eutrophication and poor management of the resource has stressed the lake's ecosystem and it has been unable replenish its resource that is relied on. The high value species such as Nile perch and Tilapia that were introduced to increase production now constitute a small percentage of the capture fisheries. The livelihoods of fishermen and traders who deal in local fish are threatened as their purchasing power has reduced hence resulting to food insecurity. Fish importation was therefore a step to increase the fish supply in the region that was to meet the high demand caused by rapid population growth and urbanization. Importation of fish commenced in 2016 and has taken over the fish industry, particularly the fish supply of the region as it is cheaper than the local fish. The production cost of the imported fish is said to be low as aquaculture is done on large scale, feeds are readily available and inexpensive source of energy. This has further affected the traders as most of the local fish is not sold as fast as before and at better prices. This has had a down ward effect to the fishermen who have intensified their fishing activities to gather more fish to the extent of opening the Mbita causeway. The fisheries resources therefore continue to be unsustainably used hence threatening its existence. Gordon (2009) stated that it is unlikely in future for the growth of fisheries to come from capture fisheries in Africa. He further stated that the continent will experience a surge in imports, more interest in aquaculture and actions geared towards the reduction of post-harvest losses.

Source of fish - the source of fisheries for the study area has always been the lakes capture fisheries. The production for the fish was adequate and it even allowed for the export of the Nile perch species in the 1990s. However due to the lake's declining fish stock in the recent years, a few individuals decided to venture into aquaculture to augment the supply of capture fisheries. These two sources of fish are reported by the respondents to form the local fish production where majority get their produce from. The study found out that traders who opted for local fish had been in the fish trade for more than five years while those who preferred imported fish had been in the trade for less than five years. The experienced traders did not embrace the importation of fish and this suggests that the traders were protecting their niche in the trade. Their adamant nature to change resulted from their realization and experience of the benefits of fish trading which was very valuable due to its potential, that to date hasn't been fully tapped. This was back when the fish had not yet started to be imported. The hope to control the fish trade and market for the traders (who deal with local fish) is alive but grows dim with continued imports of fish. They therefore stick to trading the local fish. The traders that had little experience in fish trading opted for imported fish as it presented better returns and more employment opportunities. In turn this would be reflected on their higher purchasing power and a more food secure region. The study further revealed that fish imports source had a constant supply of fish compared to the local fish source. The consistency of fish supply is a major advantage that imported fish have over local fish. The availability of imported fish in large quantities has caused a shift on the customer base – from local to imported fish. This is expected to improve the social and economic growth and development of the region due to the reliable food source.

Impact of imported fish- the lake's fish stocks has over the years experienced sudden changes or shocks and this has led to decline in production. This meant that the growth in supply was not keeping up with the growth in demand. The demand was outrunning supply hence prices went up. This therefore threatened the

food security of the people. This dire situation prompted the National Government to import fish into the region. Gephrat *et al.* (2017) stated that shocks experienced in food production can limit access of food to the locals however it can as well be promoted through international trade networks. This will affect their prices and availability. The study conducted showed that the importation of fish had a positive impact as it had increased the supply of fish in the region. It also reduced the local fish prices of which, local traders believed was a negative impact. These findings indicate that the region's population is likely to be more food secure due to the commodity's availability and reduction of prices in purchasing it. However the local fish traders and the fisher men at large are likely to be negatively affected as this will reduce their purchasing power hence rendering them to be more vulnerable to food insecurity. In light to the adverse effects the local traders face, efforts should be made to subsidize the of local fish price therefore enabling equal market access for both imported and local fish.

Majority of the respondents stated that there was stiff competition between the imported and local fish. The competition negatively affected the local fish trade as it had declined due to the cheap rates of imported fish. It is evident that there are no rules of equal treatment between the imported and local fish hence resulting to unfair competition. Little or no regulation of the flow of imported fish into the fish industry has been put in place. IOC (2012) argued that fair competition discourages subsidies for local goods and dumping of imports in order to increase market share. This allows for an avenue for fair competition on logistical aspects and product attributes for example product safety, quality among others.

Ease of doing business- the majority of respondents agreed that the ease of doing business had become difficult and this coincided with the decreasing profit margins from the trade. These multiple effects on fish trade suggest that the livelihood of the local fish traders has dramatically changed as they previously had the monopoly of fish market in the area. It has elicited negative opinions about the imported fish with murmurs of the fish being unfit for consumption.

Role of women in fisheries- Women are undoubtedly significant in the fisheries sector. The fish marketing system of Lake Victoria is dominated by women with 58% in processing while men dominate the fish production (de Graaf and Gerabaldi, 2014 and Medard *et al*., 2002). This is evident from the study as 91.4% of respondents were female. The preference of women to this business can be attributed to the availability of fish, little capital in commencing, immediate demand/ market for the resource and immediate profits (Medard *et al*., 2002). These findings suggest that women are important in the distribution of the fish and income derived from trade, as they set the prices of fish. Attention should therefore be shifted to women in order to strengthen the fish trade for food security and reduction of poverty.

Opportunities for fish trade; a) value addition in the region is mostly artisanal with traders opting for sun drying, smoking and frying. Majority of the respondents, added value to the fish products before selling them while others opt to take the fish- Nile perch to the two remaining processing factories for filleting and packaging. Medard *et al.* (2002) argued that processing or value addition of fish was done to improve and preserve the flavor of fish. No value addition technologies has been introduced or transferred in the area despite its ability to generate further employment and earnings (Ababouch 2009). Medard *et al.* (2002) adds that processed fish earns more than fresh fish. Improved livelihoods have been improved where value added technologies were adopted. (b) Aquaculture holds the key to meeting the growing fish demand since capture fisheries are not expected to have any more productivity gains. Finegold (2009) stated that the management of aquaculture is easier to capture fisheries as the property rights are clearly defined and its activities under the jurisdiction of national governance frameworks. The uptake of aquaculture in Sub Saharan Africa has however been slow compared to the rapid expansion in Asia. Asia's aquaculture

production accounted for 80.5% in value while Sub Saharan Africa was 0.36% in the year 2004 (Finegold, 2009). She further added that Africa's aquaculture is done on a small scale range which is not able to meet the demand of the region. The study that was conducted showed that a lot of the respondents were aware of aquaculture production but not of the actual processes of production. Lack of adequate information concerning aquaculture processes hinders its adoption in the area. Acknowledging the critical role of aquaculture to increased fish production, efforts should made to sensitize fishers and traders about aquaculture and incentives be given to ensure rapid adoption in the region. c) Credit facilities-the study reported that majority of the fish traders belonged to a credit facility- Chama. This involves a group of women coming together to contribute money for a good cause and they are helpful for loan acquisition. This could enable the traders to pull and merge their resources and venture into areas that could increase their livelihood for example aquaculture with the proper guidance from the fisheries department. d) Storage of the fisheries resource is critical due to its perishable nature. Effective storage ensures that there are minimal loses during fish trade.

Conclusion

The study findings highlight that the importation of fish has been significant in the region's fish trade. Imported fish has dominated over the supply of fish in terms of its contribution and consistency to meet the growing demand. This has led to fish being more available and affordable to area's population. This implies that the consumers are the main beneficiaries of the situation with wider and different options of the commodity at reasonable prices. The onset of importation has nevertheless brought about stiff competition with the local fish industry. This has hardened the ease of doing business and reduced the profit margins made in the local fish trade. In essence the purchasing power of local fish traders and fishermen has reduced due to low incomes therefore threatening their food security. This situation should be dealt with by regulating the fish supply into the region and ensuring fair competition between the local and imported fish hence increasing the market share. The role of women as revealed from the study is very critical in the fisheries sector particularly on the distribution, processing and marketing of fish.

Although importation of fish was introduced to improve food security and boost fish trade, various opportunities need to be fully explored to achieve these results. The study reported that value addition was majorly artisanal in nature and there within lie a gap to introduce modern technology in order to generate more income from the fisheries resource. The population was aware of aquaculture; however there was a slow uptake of the practice in the locality. Aquaculture is important in the wake of declining capture fisheries therefore information about its practice should be widely disseminated and incentives introduced to ensure its rapid adoption for a food secure county. Credit facilities as highlighted in the study is in existence and could enable traders engage in other income generating activities or intensify in the fisheries sector. This would increase their food security resilience as they would be less vulnerable to shocks in fish production and low economic times. Efficient storage of the resource is critical as well in the full maximization of the fish trade opportunity. The storage facilities and methods used in the study area are less effective especially with heavy reliance of ice for coolers and storage in cool places. Modern storage facilities should be introduced to reduce the losses and increase the shell life of the commodity.

Acknowledgement

I wish to appreciate all respondents for their time and honesty in sharing their opinions and experiences that enabled me to understand the status and opportunity of fish trade in Kisumu County. I acknowledge the Ministry of Agriculture, livestock and fisheries, department of fisheries in Kisumu for their

support in the preparation of the research report. Lastly, I recognize the love and moral support from my family especially my mother for her patience, support and constructive comments throughout the preparation of this report.

References

Ababouch L, 2009. Fish utilization and trade. In Fisheries, Sustainability and Development, Ake Barklund, Royal Swedish Academy of Agriculture and Forestry pp 377-398

Abila R.O, 2003. Food safety in food security and food trade. Case Study: Kenyan Fish Exports. Focus 10, Brief 8 out of 17.International Food Policy Research Institute

ARSO 2014, Fishing and fish products in Africa: the untapped potential for a regional market- visited 30/1/2018 from http://www.arso-oran.org/fishing-and-fish-products-in-africa-the-untapped-potential-for-a-regional-market/

Béné C. and Heck S. 2005. Fish and Food Security in Africa. NAGA, World Fish Center Quarterly Vol. 28 No. 3 & 4

De Graaf, G. & Gerabaldi, L. (2014). The Value of African Fisheries. FAO Fisheries and Aquaculture Circular No. 1093. Rome, FAO, 76 pp.

FAO (2014). The State of World Fisheries and Aquaculture- 2014. Rome, FAO.

FAO 2006. Fish trade, Food security and the human right to adequate food visited 30/1/18 from http://www.fao.org/docrep/006/y4961e/y4961e06.htm

Finegold C, 2009. Importance of fisheries and aquaculture in development. Fish utilization and trade. In Fisheries, Sustainability and Development, Ake Barklund, Royal Swedish Academy of Agriculture and Forestry pp 353-364

Gephrat A. J., Deutsch L., Pace L.M., Troell M. and Seekell D. 2017. Shocks to fish production: identification, trends and consequences. Global Environmental Change 42: 24-32

Gordon A, 2009. Fish trade in Africa - its characteristics, role and importance. In Fisheries, Sustainability and Development, Ake Barklund, Royal Swedish Academy of Agriculture and Forestry pp 435-442

IOC, 2012. Regional Fish Trade in Eastern and Southern Africa. Products and Markets. A Fish Traders Guide. Smart Fish Working Papers, No 013

LVFO (2014) Status of Fish Stocks. Visited 30/1/18 from: http://www.lvfo.org/index.php/lvfo/lvfo-secretariat/6state-of-fish-stocks.

Medard M., Sobo F., Ngatunga T. And Chirwa S. 2002. Women and Gender participation in the Fisheries sector in Lake Victoria. Agris, FAO. Visited on30/1/18 from http://agris.fao.org/agris-search/search.do?recordID=QW2012000237

Muigua K., Wamukoya D. and Kariuki F. 2015. Natural resources and Environmental Justice in Kenya. Glenwood Publishers Limited.

Ogutu K. 2016. Chinese fish floods Kisumu markets. Visited 30/1/18 from https://www.standardmedia.co.ke/article/2000207446/chinese-fish-floods-kisumu-markets

Thomas R. P., (2013) .Sample Size Determination and Power. John Wiley & Sons, Inc. Canada

MISE AU POINT DE TECHNIQUES DE REDUCTION DE LA MORTALITE POST-CAPTURE DU CRABE NAGEUR CALLINECTES AMNICOLA (DE ROCHEBRUNE, 1883) AU SUD-BENIN

Dessouassi Comlan Eugène
Institut National des Recherches Agricoles du Bénin. 04BP626 Cotonou. Tél : (229) 97580352

Résumé

La mise au point de techniques de réduction de la mortalité post-capture du crabe nageur (Callinectes amnicola) réalisée de mars à juin 2009, vise à développer et à tester des techniques améliorées d'emballage du crabe nageur vivant depuis les zones de capture jusqu'à la commercialisation. Après avoir caractérisé le système traditionnel d'emballage pour la commercialisation du crabe nageur vivant et identifié un facteur de forte mortalité post-capture, quatre techniques d'emballages des crabes nageurs vivants ont été expérimentées dans les zones de pêcheries (Bénin) et dans le principal marché d'exportation (Togo) pour réduire la mortalité post-capture du crabe nageur (C. amnicola). Les résultats obtenus prouvent que la mortalité post-capture des crabes est due entre autres à la température élevée dans les emballages. Il existe une différence significative entre les taux de mortalité moyens des quatre techniques d'emballage expérimentés (p=0,000). La technique améliorée : "glace en haut + litière (Typha australis) + crabes + litière (Typha australis) + glace en bas" réduit significativement la mortalité post-capture du crabe nageur C. amnicola par rapport à l'emballage traditionnel (p=0,000) avec un écart de 25,3 % (soixante douze heures après capture). Sa vulgarisation permettra aux acteurs de la chaîne de valeur crabes frais vers le marché togolais, de réduire les pertes post-capture enregistrées sur les maillons de cette chaîne de valeur d'exportation des crabes nageurs vivants.

Mots clés : Callinectes amnicola ; Typha australis ; mortalité post-capture ; emballage ; Bénin ; Togo.

Abstract

The development of technique to reduce post-harvest mortality rates of live crab (Callinectes amnicola) was conducted from March to June 2009 and aimed at developing and testing improved techniques for packing live crab from areas of capture to markets destination. We identified that temperature was a major factor for the cause of high post-harvest mortality rates. Some trials of improved packaging were conducted to reduce crab post-harvest mortality. The results obtained showed that the post-harvest mortality of crabs is mainly due to the temperature in the traditional packaging technique. The study found that the improved technique of packaging of live crabs consisting of:"ice in top + litter (Typha australis) + crabs + litter (Typha australis) + ice in bottom" reduces significantly the post-harvest mortality rate at 25, 3 % compare to the traditional packaging method used by the crab's traders (p=0,000) within seventy hours after capture. This improved technique must be popularized.

Key words: Callinectes amnicola; Typha australis; post-harvest mortality; package; Benin; Togo.

Coreressponding author email: dessouassieugene@hotmail.fr

Introduction

Le crabe Callinectes amnicola, de la famille des Poruntidae est l'un des crabes d'importance économique en Afrique de l'Ouest (Solarin, 1988). L'espèce représente une précieuse source de protéines et de minéraux dans l'alimentation humaine et les aliments pour animaux (Chindah *et al*., 2000 ; Babatunde, 2008). Elle est l'une des principales ressources halieutiques exploitées dans la pêche côtière (marine) et lagunaire en Afrique de l'Ouest (Lawal-Are et Kusemiju, 2000).

Au Bénin, la pêche continentale fournit quatre vingt pour cent de la production halieutique annuelle évaluée à quarante mille Tonnes. Les captures annuelles de crabes sont estimées en moyenne à trois mille trois cents Tonnes sur la période 1991 à 2001, soit dix pour cent des captures de la pêche continentale qui s'élèvent à trente mille deux cents tonnes en 2008 (Direction des Pêches, 2009).

L'analyse des chaînes de valeur de la filière crabe au Bénin réalisée en 2008 a montré que soixante dix pour cent des captures de crabes sont exportés vers l'extérieur du pays (Gnimadi *et al*., 2008). Quarante pour cent des exportations vont vers le Togo, et trente pour cent vers le Ghana. La filière crabe au Bénin constituent environ soixante quatorze pour cent des revenus des trois mille acteurs environ impliqués dans la filière crabe (Gnimadi *et al*., 2008). L'exportation se fait sous forme de crabes vivants. Au nombre des difficultés de la filière, figurent les énormes pertes post capture des crabes nageurs, lors du transport des zones de capture vers les différents marchés de commercialisation. Il s'en suit une dépréciation du prix d'achat des crabes nageurs morts allant jusqu'à la moitié du prix d'achat des crabes vivants voire plus.

La présente étude vise à (i) caractériser les techniques d'emballage du crabe nageur Callinectes amnicola dans la chaîne de valeur crabe frais pour le marché togolais ; (ii) évaluer les mortalités post-capture tout au long de la chaine (iii) développer et tester des techniques améliorées pour réduire la mortalité post capture du crabe nageur Callinectes amnicola, de la capture à la commercialisation.

Matériel et Méthode

Milieu d'étude

L'étude a été conduite de mars à juin 2009, période d'abondance des crabes nageurs dans les zones lagunaires du Sud Bénin. Elle s'est déroulée dans les zones de pêche des crabes nageurs et le principal marché d'exportation (figure 1). Il s'agit de :

- Zones de pêche (Bénin)
  - » deux villages riverains du Lac Ahémé (village de Zinkpannou et Dègbo-Condji) ;
  - » deux autres villages riverains du Lac Nokoué (villages de Kétonou et Gbakpodji).
- Marché de commercialisation (Togo)
  - » le marché de Lomé : principal marché d'exportation du crabe nageur C. amnicola pêché dans les lagunes béninoises.

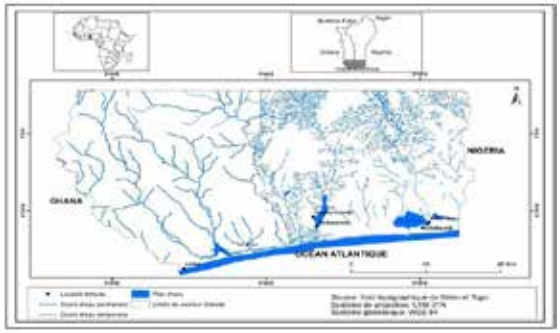


Figure 1 : Localisation du milieu d'étude

Approche Methodologique

L'étude a porté sur le crabe nageur Callinectes amnicola (De Rochebrune, 1883). L'espèce est caractérisé tout comme les autres crabes nageurs par l'aplatissement de la cinquième patte thoracique appelée palette natatoire (figure 2).

Figure 2 : Callinectes amnicola (De Rochebrune, 1883)

Cette étude a été conduite en trois principales étapes :

-1ère étape : *Caractérisation des emballages de crabes et évaluation des mortalités post-capture dans la chaîne de valeur crabe nageur frais pour le marché togolais.*

Cette étape a permis de caractériser les emballages de crabes, d'évaluer les pertes post-capture des crabes dans la chaîne de valeur et d'identifier le facteur sur lequel il faut agir pour réduire cette mortalité post capture. Elle a été réalisée par le suivi de trois emballages de crabes de treize kilogrammes chacun dans une voiture de transport d'emballages de crabes de Zinkpannou (zone de pêche/Bénin) vers le principal marché d'exportation Assiganmè (Lomé/Togo) pour collecter des informations sur les pertes post-capture. Les températures des emballages sont relevées, toutes les trois heures à l'aide d'un thermomètre.A destination, les crabes morts sont retirés de l'emballage, comptés et pesés à l'aide d'une balance pour estimer le taux de mortalité. Les températures de l'eau du Lac Ahémé où les crabes ont été pêchés sont également mesurées au cours de la même période. Cette étape a duré quarante huit heures.

-2ème étape : *Expérimentation de techniques améliorées de réduction des mortalités post capture du crabe nageur dans les zones de pêche (Zinkpannou/Bénin).*

Le dispositif expérimental est composé de :

- Trois emballages dits traditionnels" noté (ET). Ce sont les emballages tels que réalisés par les collecteurs exportateurs : chaque panier contient treize (13) kilogrammes de crabes + 0,5 kilogramme de litière (Typha australis) disposée au fond du panier et au dessus des crabes, le tout recouvert d'un sac de sisal usager suturé au panier). Ce sont les emballages témoins dont le dessin est indiqué à la figure 3.
- Trois emballages améliorés sans glace (Emballage Amélioré 1 noté EA1). Il s'agit des emballages contenant treize (13) kilogrammes de crabes vivants + 0,5 kilogramme de feuilles de Typha australis disposées au fond du panier et au dessus des crabes. Des sachets d'eau (0,5 kilogramme) finement perforés sont déposés sur la litière au dessus pour rafraichir les crabes). Les sachets d'eau sont renouvelés toutes les douze heures (voir la figure 4). Ces emballages constituent la première forme d'amélioration que nous avons expérimentée pour rafraîchir les crabes et réduire la mortalité post-capture.
- Trois emballages améliorés avec glace sans litière (Emballage amélioré 2 noté EA 2). Ces emballages contiennent treize (13) kilogrammes de crabes vivants sur lesquels sont disposés 0,5 kilogramme de glace en sachet dont la fonte rafraichit les crabes. Les sachets de glace sont renouvelés toutes les douze heures (figure 5). C'est la deuxième forme d'emballage amélioré expérimentée.
- Trois emballages améliorés avec litière (Typha australis) et glace. Ils contiennent treize
- (13) kg de crabes nageurs vivants sont recouverts au dessus des feuilles de Typha australis sur lesquelles sont disposées 0,5 kg de sachets de glace dont la fonte rafraichit les crabes). Les sachets de glace sont renouvelés toutes les douze heures (figure 6). Ils représentent la troisième forme d'amélioration des emballages expérimentés.

Le dispositif a été monté sous un hangar à Zinkpannou pour simuler les conditions du marché d'exportation. L'essai a duré soixante douze heurs après la capture des crabes. La température au sein des emballages a été relevée toutes les trois heures. Au renouvellement des sachets d'eau et de glace toutes les douze heures, les crabes morts sont retirés, comptés et pesés.

-3ème étape : *Expérimentation des techniques de réduction des mortalités post-capture du crabe nageur des zones de capture (Bénin) vers le marché d'exportation (Togo)*

Les techniques expérimentées dans les zones de pêche (étape 2) ont été reproduites lors d'un transport des emballages de crabes vers Lomé. Le dispositif décrit plus haut est convoyé dans une voiture transportant les emballages de crabes en direction de Lomé. Il a été réceptionné dans le marché de Lomé (Assiganmè) et installé sous un hangar dans le marché. La température dans les emballages a été mesurée toutes les trois heures. Au renouvellement des sachets d'eau et de glace toutes les douze heures, les crabes morts sont retirés, comptés et pesés. L'essai a duré soixante douze après la capture des crabes.

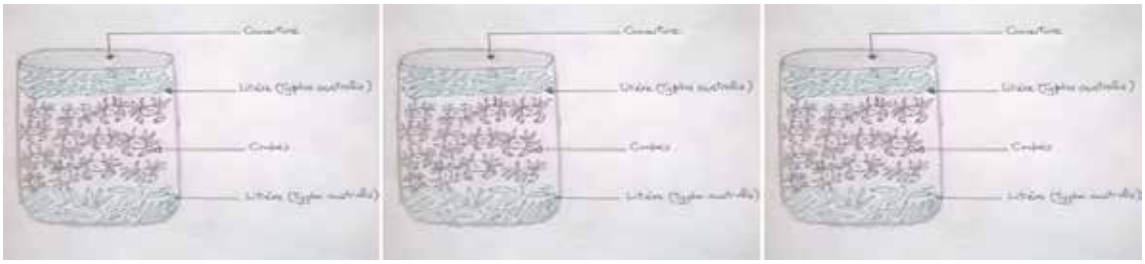


Figure 3 : Emballages traditionnels : témoins (ET)

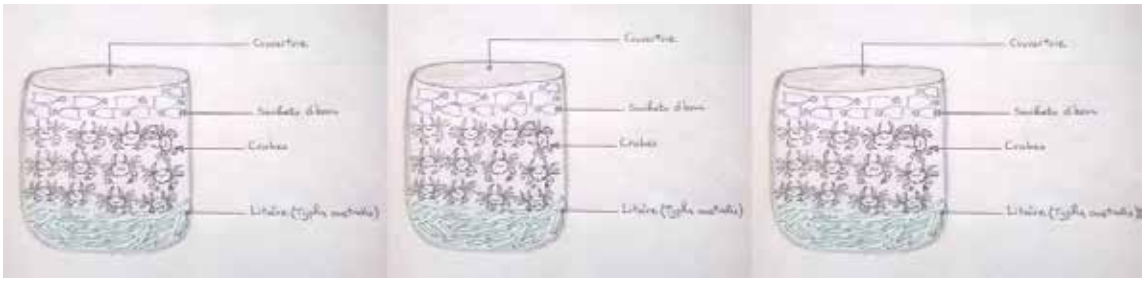


Figure 4 : Emballages améliorés 1 (EA 1)

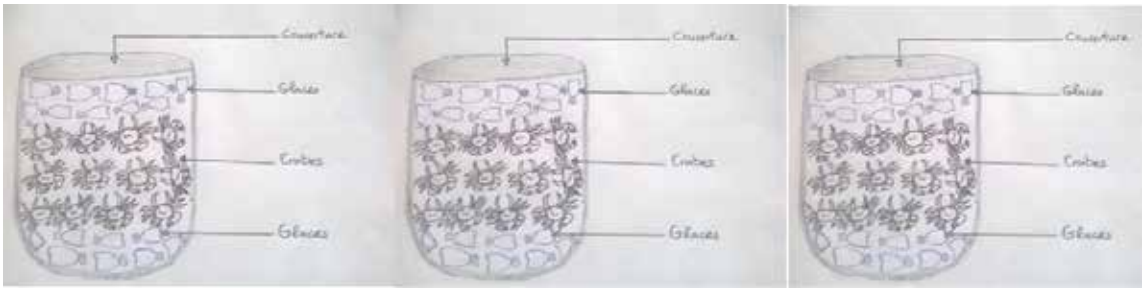
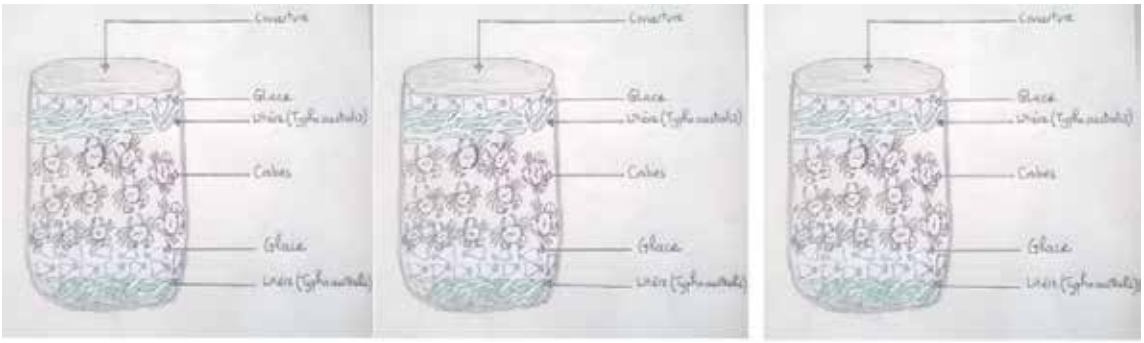


Figure 5 : Emballages améliorés 2 (EA 2)



Figures 3 - 6 : Dispositif expérimental

Figure 6 : Emballages améliorés 3(EA3)

CALCUL DU TAUX DE MORTALITE POST-CAPTURE DES CRABES

Le taux de mortalité post-capture est calculé à partir de la formule :

Taux de mortalité=100 X (Nombre de crabes morts)/(Nombre total des Crabes initial)

Analyses statistiques

Les graphiques (boîtes à moustaches) ont été réalisés à l'aide du logiciel Statistica version 6.

L'analyse de la variance à un critère de classification a permis d'apprécier les différences entre les taux de mortalités des quatre types d'emballages. Le test de Fisher a permis les comparaisons couplées des taux de mortalités des différents emballages. Le niveau de signification retenu est de 5 %. Ces analyses statistiques sont réalisées à l'aide du logiciel Minitab version 14.

Resultats

Caractéristiques des emballages des crabes destinés à l'exportation vers le Togo

L'emballage se fait par empilement des crabes dans des paniers de contenance connue. Les crabes sont recouverts des feuilles de Typha australis. Le panier est fermé à l'aide d'un morceau sac en sisal usager cousu par un fil au panier pour empêcher les crabes de sortir (figure 7).

Figure 7 : Emballages de crabes pour exportation vers le Togo

Mortalités post capture du crabe nageur dans les emballages le long de la chaîne de valeur

Les taux de mortalité post-capture enregistrés dans les emballages traditionnels suivis des zones de capture vers le marché d'exportation sont présentées sur la figure 8. Le taux de mortalité post capture augmente avec le temps de stockage.

En effet, le taux moyen de mortalité post capture des crabes a augmenté de 22,96 % ±2,82 douze heures après capture à 66 ±5,29 % au bout de 48 heures après capture. Le passage des crabes nageurs des fonds vaseux de capture des plans d'eau aux paniers de stockage explique ces mortalités. Les taux de mortalité enregistrés 48 heures après capture chez Callinectes amnicola (66± 5,29 %) sont supérieurs à ceux obtenus dans la filière crabe Scylla serrata (50 %) au Madagascar (FAO, 2014) et au Sénégal pour la filière poisson (25 %) (GRET *et al*., 1993).

Les variations des températures à l'intérieur des emballages de crabes et de l'eau du Lac Ahémé, où les crabes sont capturés sont résumées sur la figure 9.

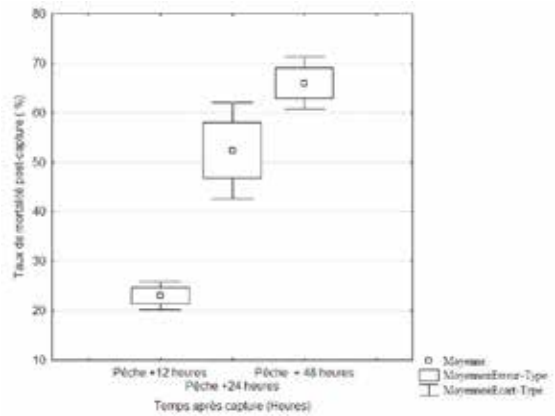


Figure 8 : Evolution du taux de mortalité du crabe nageur "Callinectes amnicola" dans les emballages traditionnels en fonction du temps.

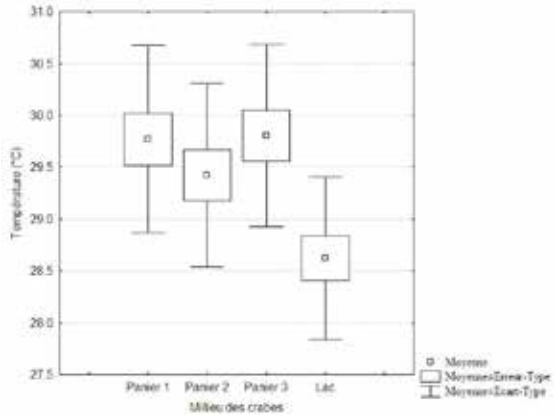


Figure 9 : Température au sein des emballages traditionnels de crabes et de l'eau du lac Ahémé

L'écart thermique moyen entre les emballages traditionnels et l'eau du lac est de 1°C. L'Analyse de Variance à un critère de classification (ANOVA 1) indique qu'il existe une différence significative entre les températures moyennes des emballages traditionnels de crabes et celle du milieu de pêche c'est-à-dire le Lac (p = 0,003). Le test de Fisher indique qu'il n'existe pas de différences significatives entre les températures moyennes des différents emballages de crabes. Cependant, les températures des emballages de crabes sont significativement différentes de celle de l'eau du Lac. Les taux de mortalité sont donc liés au changement de milieu physique des crabes. L'abaissement de la température dans les emballages contribuera à la réduction des mortalités post captures.

Expérimentation des techniques de réduction du taux de mortalité post capture du crabe nageur dans les zones de pêches (Zinkpannou)

Les taux moyens de mortalités enregistrés dans les quatre types d'emballages expérimentés sont indiqués sur la figure N°10.

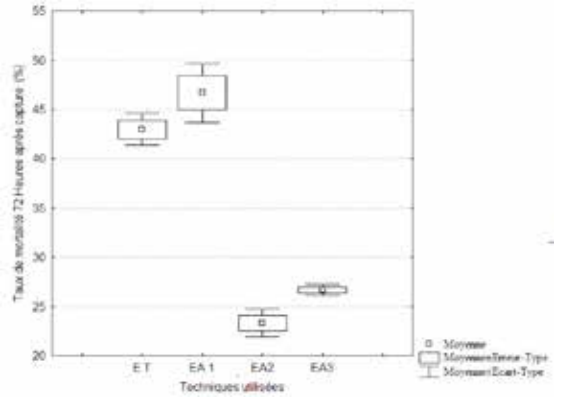


Figure 10 : Taux de mortalité 72 heures post-capture du crabe nageur Callinectes amnicola dans les différents

Types d'emballages expérimentés dans les zones de pêches

Les taux moyens de mortalité des crabes dans les quatre types d'emballages sont significativement différents (p =0,000). Le test de Fisher indique qu'il n'existe pas de différence significatives entre les taux moyens de mortalités des emballages améliorés avec glace en haut + crabes et glace en bas (EA2) et ceux des emballages améliorés avec glace en haut + litière + crabes et litière + glace en bas (EA3). Cependant, il existe une différence significative entre les taux de mortalité moyens des emballages traditionnels (ET) et ceux des emballages Améliorée 1 (EA1).

L'abaissement de la température dans les emballages par l'utilisation de la glace a donc réduit significativement le taux de mortalité post-capture de 16,3 % par rapport aux emballages de type traditionnel. La variation des températures enregistrées au cours de cet essai sont consignées sur la figure 11.

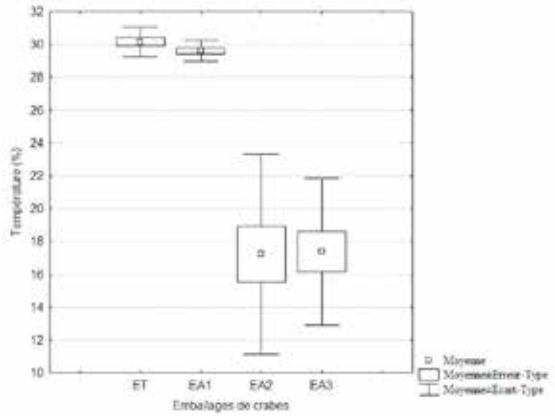


Figure 11 : Température au sein des emballages expérimentaux dans les zones de pêche (Zinkpannou)

Nous pouvons déduire que l'abaissement de la température dans les emballages réduit le taux de mortalité post-capture du crabe nageur. Il existe une différence significative entre les températures moyennes des quatre types d'emballage (p=0,000). Le test de Fisher montre qu'il n'existe pas de différence significative entre les températures moyennes des emballages améliorées utilisant la glace (EA2 et EA3). Il en est de même pour les emballages traditionnels et l'emballage amélioré (EA1) utilisant l'eau comme rafraîchissant.

Expérimentation des techniques de réduction des pertes post capture du crabe nageur des zones de captures (Bénin) vers le marché d'exportation à Lomé (Togo)

L'Analyse de la Variance à un critère de classification révèle une différence significative entre les taux moyens de mortalités post captures des quatre types d'emballage (p=0,000).

De plus, dans la comparaison par paire des taux de mortalité post capture moyens des quatre techniques, le test de Fisher indique qu'ils sont tous statistiquement différents.

La réduction du taux de mortalité post capture avec l'utilisation de la glace s'est confirmée. L'écart moyen du taux de mortalité entre l'emballage traditionnel et l'emballage amélioré glace avec isolant (EA3) est de 25,3 %. On note par ailleurs, que les pertes post capture enregistrées pour l'expérimentation aux marchés sont plus importantes par rapport à celles obtenues en station (Ecart > 20 %). En effet, pour les mêmes quantités de glace utilisées en station et aux marchés, on note des températures plus élevées aux marchés (Ecart thermique = 8°C). Le transport et les diverses manipulations des emballages dans les marchés contribuent aussi à la mortalité post capture (Kabahenda *et al*., 2009).

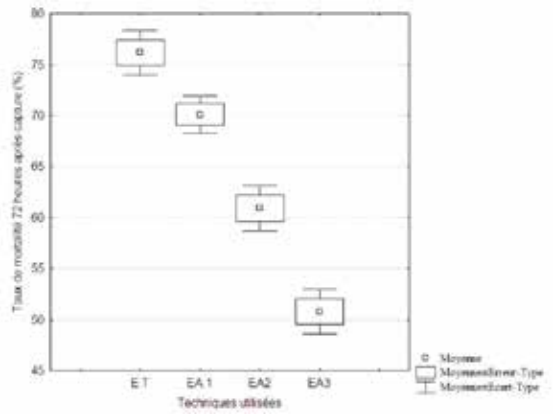


Figure 12 : Taux de mortalité post-capture du crabe nageur Callinectes amnicola dans les différents types d'emballages expérimentés des zones de captures (Bénin) vers le marché d'exportation à Lomé Togo)

La variation de températures enregistrées dans chacun des emballages au cours de l'expérimentation au marché est présentée sur la figure 13.

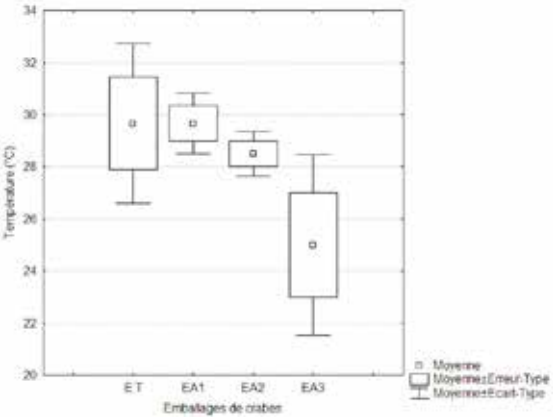


Figure 13 : Température au sein des emballages expérimentaux réalisés des zones de captures (Bénin) vers le marché d'exportation à Lomé (Togo)

Il n'existe pas de différence significative entre les températures moyennes des différents emballages (p = 0, 134). La température moyenne de l'emballage améliorée avec glace et isolant (EA3) est significativement différente des emballages traditionnels et des emballages améliorés avec eau.

Discussion

Les taux moyens de mortalité enregistrés 48 heures après capture chez Callinectes amnicola (66± 5,29 %) au Bénin sont supérieurs à ceux obtenus dans la filière crabe Scylla serrata (50 %) au Madagascar (FAO, 2014) et au Sénégal pour la filière poisson (25 %) (GRET *et al*., 1993). Au cours de la première étape, Il a été révélé une différence significative entre les températures moyenne des emballages traditionnels de crabes et celle de l'eau du Lac. Cela indique que la mortalité des crabes est donc liée au changement de milieu physique (passage de l'eau du lac au milieu ambiant puis dans l'emballage. Cela explique la réduction de la mortalité post-capture par l'abaissement de la température dans les emballages. L'écart moyen du taux de mortalité entre l'emballage traditionnel et l'emballage amélioré glace avec isolant (EA3) est de 25,3 %. On note par ailleurs, que les pertes post capture enregistrées pour l'expérimentation aux marchés sont plus importantes par rapport à celles obtenues en station (écart > 20 %). En effet, pour les mêmes quantités de glace utilisées dans l'étape 2 (dans les pêcheries) et aux marchés (étape 3), on note des températures plus élevées aux marchés (écart thermique = 8°C). Le transport et d'autres conditions du marché telles que densité de commerçants contribuent aussi à la mortalité post capture (Kabahenda *et al* ., 2009). La technique améliorée : ''glace en haut + litière (Typha australis) + crabes + litière (Typha australis) + glace en bas'' peut être vulgarisée pour réduire les pertes post capture enregistrées sur les maillons de cette chaîne de valeur d'exportation des crabes nageurs frais.

Conclusion

Soixante douze heures après la capture du crabe nageur, les mortalités enregistrées au niveau des emballages traditionnels utilisés par les acteurs de la chaîne de valeur crabe nageur frais pour le marché togolais sont avoisinent 70 %. Les taux de mortalités sont liés au changement de milieu physique des crabes intéressant entre autres la température dans les emballages, le transport et d'autres conditions du marché. La présente étude a proposé des techniques réduisant la température au niveau des emballages aux fins de réduire les pertes post captures. Les techniques améliorées : ''glace en haut + crabes + glace en bas'' et ''glace en haut + litière + crabes + litière + glace en bas'' réduisent significativement la mortalité post-capture des crabes. L'écart moyen du taux de mortalité entre l'emballage traditionnel et l'emballage amélioré glace avec isolant (EA3) est de 25,3 %. L'emballage amélioré glace avec isolant peut être vulgarisée.

Remerciements

L'auteur remercie Madame Katrien HOLVOET, Coordonnatrice du Projet Pêche et VIH/SIDA, investir dans des solutions durables pour l'appui financier dans le cadre de cette étude et Dr EYABI EYABI Georges Divine pour son apport technique à la conduite des travaux. Il n'oublie pas Madame ADANMAHO Frida qui a réalisé le dessin du dispositif expérimental.

Références Bibliographiques

Babatunde EE, 2008. The fishery and bionomics of the swimming crab, Callinectes amnicola (DeRocheburne, 1883) from a tropical lagoon and its adjacent creek, South West, Nigeria. Journal of Fisheries and Aquatic Science. 3(2): 114-125.

Chindah AC, Tawari CCB, Ifechukwude KA, 2000. The food and feeding habits of the swimming crab, Callinectes amnicola (Portunidae) of the New Calabar River, Nigeria. Journal of Applied Sciences and Environmental Management, 4: 51-57.

Direction des Pêches (D/Pêches), 2009. Statistiques des pêches. Cotonou, D/Pêches.

FAO Smart Fish Publication, 2014. Meilleure valorisation des crabes de mangroves à travers la réduction des pertes après capture. Manuel technique.

Gnimadi A, Egboou P, Dessouassi CE, Gbaguidi A, 2008. Analyse de la chaîne de valeur sur la filière crabe (Callinectes et Cardiosoma) au Sud du Bénin. Cotonou, D/Pêches, rapport final d'étude.

Groupe de Recherche et d'échanges Technologiques(GRET) & Centre Technique de Coopération Agricole et Rurale (CTA) ,1993. Conserver et transformer le poisson. Paris : le Point Sur.

Kabahenda MK, Omony P, Husken SMC, 2009. Manutention après capture des produits halieutiques de faible valeur et menaces pour la qualité nutritionnelle: une étude des pratiques dans la région du Lac Victoria. Project report 1975. Fisheries and HIV/AIDS in Africa: Investing in sustainable solutions.

Lawal-Are AO, Kusemiju K, 2000. Size composition, growth pattern and feeding habits of the blue crab, Callinectes amnicola (DeRoche burne, 1883) in the Badagry Lagoon, Nigeria. Journal of Scientific Research and Development, 4: 117-126.

Sankaré Y, 2007. Biologie, écologie et exploitation du crabe nageur Callinectes amnicola, De Rochebrune, 1883 (Crustacea-Decapoda-Portunidae) du complexe lagunaire Aby-Tendo-Ehy (Côte d'Ivoire). Thèse de Doctorat, Université de Cococody.

Solarin BB, 1998. The hydrobiology, fishes and fisheries of the Lagos Lagoon, Nigeria. Ph.D. Thesis, University of Lagos.

ANALYSE DE LA CHAÎNE DE VALEUR DES PRODUITS DE PÊCHE AU LAC TCHAD EXTRÊME-NORD CAMEROUN

Ma'a Akono Ludovic[1] et Meke Soung Pierre Nolasque[2]
Institut des Sciences Halieutiques (ISH) de l'Université de Douala, Département de Gestion des Ecosystèmes Aquatiques et des Pêches BP : 7236 Douala- Cameroun

Résume

L'étude sur l'analyse de la chaîne des valeurs des produits de la pêche du lac Tchad effectuée de la période allant du 14 avril au 14 novembre 2015, s'est produite au moment où le WorldFish Center en partenariat avec le NEPAD et l'UA-BIRA avaient lancé le projet "Fish-Trade Corridor analysis" en Afrique. Cette étude, devait de façon générale contribuer à une meilleure connaissance du commerce du poisson du Lac Tchad et permettre de voir plus claire sur sa contribution à l'économie nationale ; plus spécifiquement l'étude devait dans un premier temps analyser la chaîne des valeurs des poissons du Lac Tchad, pour enfin analyser les contraintes qui pèsent sur le secteur pêche de ce Lac. Les données nécessaires à cette étude ont été collectées à l'aide du questionnaire proposé par le WorldFish Center (collecte des données au niveau de chaque maillon de la chaine, et étude de quelques paramètres économiques du commerce). Ces données ont révélé que la chaîne de valeur du poisson du Lac Tchad est composée de quatre maillons: les pêcheurs, les transformateurs, les grossistes et les détaillants. L'analyse socio-économique de ces maillons a montré que quatre espèces (silure, tilapia, machoiron *et al*estes) sont principalement pêchées et commercialisées (frais, fumés, et séchés) dans ce Lac. La pêche au lac Tchad se pratique avec deux permis (tchadien et camerounais). Les maillons pêcheurs et transformateurs fortement représentés par les camerounais sont sous contrat de vente de leurs produits avec les commerçants grossistes (80% nigérians) qui exportent à 75% le poisson vers le Nigéria. La forte présence des grossistes nigérians au Lac Tchad induit directement un grand flux du poisson (silures fumés) de ce Lac vers le Nigéria (50% de la production) soit 63093 kg de poisson vendu par an. En analysant les marges bénéficiaires des acteurs dans la commercialisation du poisson au Lac Tchad, les grossistes réalisent le plus grand bénéfice (17318500 FCFA) et sont les plus grands contributeurs à l'économie nationale, soit 53.35% de valeur ajoutée. L'évolution du poisson le long de la chaîne de valeur fait augmenter son prix en fonction du maillon avec une incidence sur le prix d'achat chez le consommateur final (2500±3300 FFCFA le kg). Plusieurs contraintes (insécurité, manque d'infrastructure et l'insuffisance des sources de financement) ont été établit comme étranglant l'activité de pêche de ce Lac.

Mots clés : Lac Tchad, analyse, chaîne de valeur, entreprise de commercialisation, Ethmalose.

VALUE CHAIN ANALYSIS OF FISH PRODUCTS IN EXTREME-NORTHERN CHAD LAKE CAMEROON

Abstract

The Lake Chad Fishery Value Chain Analysis Study conducted from April 14 to November 14, 2015, is an outcome of the study of by World Fish Center in partnership with NEPAD Agency and AU-IBAR following the launching the Fish Trade Trade Corridor Analysis project in Africa. This study, in general, should contribute to a better knowledge of the fish trade of Lake Chad and its contribution to the national economy. More specifically, firstly the study should analyse the fish value chain of Lake Chad, and finally analyse the constraints on the fishing sector of this lake. The data needed for this study were collected using the questionnaire proposed by the Worldfish Center (data collection at each link of the chain, and study of some economic parameters of the trade). These data revealed that the Lake Chad fish value chain consists of four links: fishermen, processors, wholesalers and retailers. The socio-economic analysis of these links has shown that four species (catfish, tilapia, machoiron and alestes) are mainly fished and marketed

*Corresponding author email: ludovicmaaakono@yahoo.fr

(fresh, smoked, and dried) in this lake. Fishing on Lake Chad is practiced with two licenses (Chadian and Cameroonian). The fishermen and processors who are strongly represented by Cameroonians are under a contract of sale of their products with wholesalers (80% Nigerian) who export 75% of the fish to Nigeria. The strong presence of Nigerian wholesalers in Lake Chad directly induces a large flow of fish (smoked catfish) from this lake to Nigeria (50% of production) or 63093 kg of fish sold per year. By analysing the profit margins of actors in the marketing of fish in Lake Chad, wholesalers make the greatest profit (17318500 FCFA) and are the largest contributors to the national economy, or 53.35% of value added. The evolution of fish along the value chain increases its price according to the link with an impact on the purchase price at the end consumer (2500 ± 3300 FFCFA per kg). Several constraints (insecurity, lack of infrastructure and insufficient sources of funding) have been established as strangling the fishing activity of this lake.

Key words: Lake Chad, analysis, value chain, marketing company, Ethmalose.

Contexte et justificatif de l'étude

Les exportations du poisson et le commerce d'autres produits aquatiques sont une source importante de revenus pour les pays en voie développement. Ces derniers représentent à l'heure actuelle plus de 50 % des exportations mondiales du secteur. Leurs recettes d'exportation nettes sont supérieures à 27 milliards de Dollars américain. Des emplois sont créés dans les secteurs de la production, de la transformation et du commerce. La sécurité alimentaire locale en sort renforcée (Anonyme, 2011). C'est la raison pour laquelle les produits de pêche sont commercialisés sous différentes formes (frais, congelés, fumés, séchés, conserveries, gros, et détails). Cette importance alimentaire et économique mondiale des produits de pêches est aussi bien ressentie dans la sous-région Afrique-Centrale, en particulier dans les pêcheries du Lac Tchad. En effet, Le lac Tchad est un bassin de production des produits de pêches qui irrigue quatre pays (Cameroun, Niger, Nigeria, Tchad) sur une superficie de plus de 2000km2 regroupés au sein la Commission du Bassin du Lac Tchad (CBLT) (Anonyme,2007). En outre ce Lac est la zone d'adjonction entre le corridor A (Afrique central) et le D (Afrique de l'ouest) à N'djamena dans le commerce du poisson du projet « fishtrade corridor analysis » de worldfishcenter (Anonyme, 2015). La production de pêche continentale dans le bassin du lac Tchad est de loin la plus grande de la production de pêche continentale du Cameroun: 26000 tonnes (Anonyme, 2014). Par l'exploitation des pêcheries du Lac Tchad, entre 2000 et 2001, il a été commercialisé environ 57 320 tonnes de poisson pour une valeur estimée à 23,5 millions de dollars américains (Anonyme, 2000). Ce poisson est vendu sous différentes formes (fumée, séchée, et fraiche) soit sur place dans les différents débarcadères des pêcheries concernées ou sur le marché au quotidien. Mais le poisson séché et fumé s'exporte également dans les centres urbains voisins et les pays limitrophes du lac. La transformation des produits halieutiques revêt donc une importance capitale au Lac Tchad car 89% des captures sont transformées avant commercialisation d'une part (FAO, 1993). D'autre part 80% de ces poissons sont exportés, secs ou fumés, vers le Nigeria, le pays le plus peuplé d'Afrique. Les activités de pêche dans le bassin du Lac Tchad sont donc un élément fondamental de la survie sociale et économique de plusieurs millions de personnes vivant dans mais également autour du bassin (Neiland *et al*, 2001).

L'éventail des services rendus par l'exploitation des pêcheries du Lac Tchad montre que le poisson pêché dans ce Lac est destiné à la consommation des populations locales et régionales. Ce poisson permet ainsi à ces populations locales de renforcer leur sécurité alimentaire. En même temps, la commercialisation de ces produits de pêche met à la disposition des familles de revenus relativement suffisants pour lutter contre la vie chère et sortir ainsi de la pauvreté dont font face la plupart des pays en voie de développement et le monde de nos jours. Toutefois, les pêcheries

du Lac Tchad connaissent actuellement de nombreux problèmes dont les plus saillants sont la diminution de la profondeur en eau des grandes cuvettes de ce Lac, la forte demande urbaine en poisson frais, fumé ou séché. L'absence des données récentes (dernières en date de 1968) sur le commerce du poisson provenant de ces pêcheries du Lac Tchad. D'autre part les administrations en charge de la pêche et les acteurs de ce secteur n'ont pas assez d'informations sur la contribution réelle des différentes activités de la pêche au Lac Tchad à l'économie nationale. Le Worldfish Center et UA□BIRA en vue de mieux apprécier les obstacles au commerce des produits de la pêche en Afrique et sa contribution aux économies propose l'analyse de la chaine de valeur qui est aussi préconisée par le FAO et d'autres organisations. L'Université étant le creuset de la science, afin de contribuer au renforcement des capacités, il a été convenu d'y associer les universités. C'est à ce titre que l'Université de Douala (ISH) a conduit l'analyse du commerce du poisson dans le cooridor D (Afrique centrale) via ses étudiants. D'où le thème sur l'analyse du commerce du poisson dans le Lac Tchad site important dans l'analyse du commerce du poisson dans le corridor D proposé.

Matériels et Méthodes

Les travaux se sont déroulés dans les eaux camerounaises en particulier sur une superficie recouvrant les 1/12 de 2500 km2 du total des eaux du Lac Tchad. La période de l'étude est allée 14avril au 14 Novembre 2015. Avec pour objectif d'analyser la chaîne de valeur du poisson du lac Tchad pour voir la contribution du commerce du poisson de ce Lac à l'économie et procéder à un examen des contraintes de cette activité de pêche du Lac Tchad. La méthodologie utilisée à été celle de Worldfish Center via son questionnaire. Cette étude s'est déroulée dans les pêcheries et les marchés de poissons du Lac Tchad (« Blaram, Koffia, Goun, Djimitjilio, Kouloudia, Blangoua, Maidougouri »et Kouseri) en général et plus précisément celle du Lac Tchad partie camerounaise (« Koffia, Darak, Blangoua »et Kouseri)).

Les premières données collectées dans cette étude ont été les données documentaires hors du terrain: internet, et les bibliothèques. Plus précisément les données ont été collectées à travers la recherche documentaire sur internet, et auprès des organismes de pêches grâce aux anciens rapports sur l'activité de pêche dans les bassins du Lac Tchad, des documents du Ministère de l'Industrie et du Commerce, des revues spécialisées, des bulletins d'inscription de professionnels de pêche. La recherche a porté sur les aspects tels que les acteurs de la chaîne de valeurs, l'analyse des prix et leur fixation dans le commerce du poisson du Lac Tchad. Mais aussi sur l'économie de pêche dans le monde, la région Afrique et dans le Lac Tchad. Les Données sur les statistiques d'exportation/ d'importation des poissons du lac Tchad ont été aussi collectées.

Les secondes données ont été collectées à l'aide du questionnaire proposé par le Worldfish Center. Pour mieux collecter ces données de terrains en tenant compte des objectifs fixés, la chaine de valeur des poissons du Lac Tchad a été segmentée en 04 maillons importants (maillon pêcheur, maillon transformateur, maillon grossiste et maillon des détaillants du poisson du Lac Tchad) rassemblant toute la chaîne. Ensuite au niveau de chaque maillon, des informations techniques, sociales et économiques des acteurs de chacun des maillons de cette chaîne de valeur et celles relatives au commerce informel du poisson au Lac Tchad ont été collectées.

Collecte au niveau du maillon pêcheur : 30 pêcheurs sur plus de 900 pêcheurs présents dans la zone ont été enquêtés. A l'aide des trames d'enquêtes proposées par le Worldfish Center, d'une balance de marque Naval pour peser, et d'un GPS pour la prise des coordonnée géographiques nous nous sommes rendu chaque matin dans les débarcadères de « Koffia, de Malam, de Goun, et de Djimitiolio ». En effet très tôt le matin on se rendait dans ces débarcadères pour collecter les informations (sociodémographiques) sur les pêcheurs et surtout prendre les données (espèces, taille,

zone de pêche) sur le poisson pêché, les engins utilisés pour le pêcheur, avant que celui-ci ne soit remis aux transformateurs. Cette phase terminée on a procédé à un système de questions ouvertes pour collecter les données sur les opportunités et contraintes qui influencent la fixation et l'évolution des prix des poissons par le pêcheur suivant le guide proposé par le Worldfish Center.

Collecte au niveau du maillon transformateur : ce maillon était le deuxième à analyser dans lachaîne de valeur. Ici on a travaillé non seulement avec les 30 pêcheurs du premier maillon qui étaient en même temps des transformateurs mais aussi avec 27 autres transformateurs simples de l'espèce Clarias gariepinus. Des informations techniques, sociales et économiques sur le transformateur ont été prises. En effet, en ce qui concerne les informations sur l'économie on devait prendre les unités d'achat, deventes, les prix d'achat et de vente, ainsi que les quantités et les lieux d'achat-ventes, le circuit de distribution des produits de chaque transformateur. Techniquement on a collecté des informations sur le type de transformation (fumé ou séché) effectué par chaque acteur, sa logistique et enfin on a pris des informations sur les contraintes et opportunités qui influencent l'activité à ce niveau de la chaîne.

Collecte des données du maillon grossiste : sur plus de 200 acteurs exerçant cette activité on a pu travailler qu'avec 30 uniquement. Sur lesquels on a d'abord recherché des informations sur le type de grossiste (national ou exportateur), sa sociodémographique, le type de produits achetés (séché et/ou fumé), les lieux d'achats, les lieux de ventes, les destinations des produits, les prix d'achats et de ventes, la formalisation de l'activité. Enfin les contraintes et opportunités qui influencent l'activité des acteurs de ce maillon ont identifiées.

Collecte des données du maillon détaillant : ayant aussi travaillé avec 30 détaillants sur plus de 500 acteurs présents à Kousseri l'on a collecté des données sur la socio-démographie du détaillant, ensuite le type de produits achetés (séchés et/ou fumés, les lieux de ventes, les destinations des produits, les prix d'achats et de ventes, la formalisation de l'activité. En fin on a recherché les contraintes et les opportunités qui influenceraient l'activité des acteurs de ce maillon.

Paramètres étudiés : Les paramètres étudiés pour l'atteindre des objectifs de cette étude ont été : les prix, les quantités, les unités de vente, la valeur ajouté nette et brute, le chiffre d'affaire, l'investissement initial, l'excédent brute et nette. Les différentes formules de ces paramètres sont ainsi définies:

- Consommation intermédiaires (CI)= Cout des différentes charges variables;
- chiffre d'Affaire (C.A) = prix de vente unitaire * nombre d'unité vendue;
- Valeur Ajoutée brute (V.A.B) = C.A - Consommations intermédiaires;
- Valeur Ajoutée nette (V.A.N) = C.A - somme des amortissements;
- Excédent Brute(E.B) = V.A.B –impôts -main d'œuvre;
- Excédent Net (E.N) = V.A.N –impôts – taxes.

Pour l'analyse statistique on a utilisé dans le cadre de cette étude deux types d'analyses : une dite descriptive avec le tableur Excel et l'autre dite inférencielle grâce au logiciel SPSS 20. Certains coefficients comme celui de corrélation de rang de Spearman ont été calculé.Ce coefficient a été utilisé pour évaluer le degré de liaison entre deux variables : prix du poisson et acteurs intervenant dans la fixation de ce prix afin de voir si l'évolution de ce prix le long chaîne des valeurs est fonction des acteurs intervenant dans le processus commercialisation. Afin de pouvoir conclure si oui ou non le prix du poisson au lac Tchad augmente de manière significative du producteur (pêcheur) jusqu'au consommateur final (ménage). Il a été déterminé grâce au logiciel SPSS.20 par la formule :

$$\rho = 1 - 6\frac{\sum_{i=1}^{n} di^2}{n3-n}$$ dans laquelle

di= différence entre les rangs des deux séries de mesures considérées,
n = nombre total d'observations.

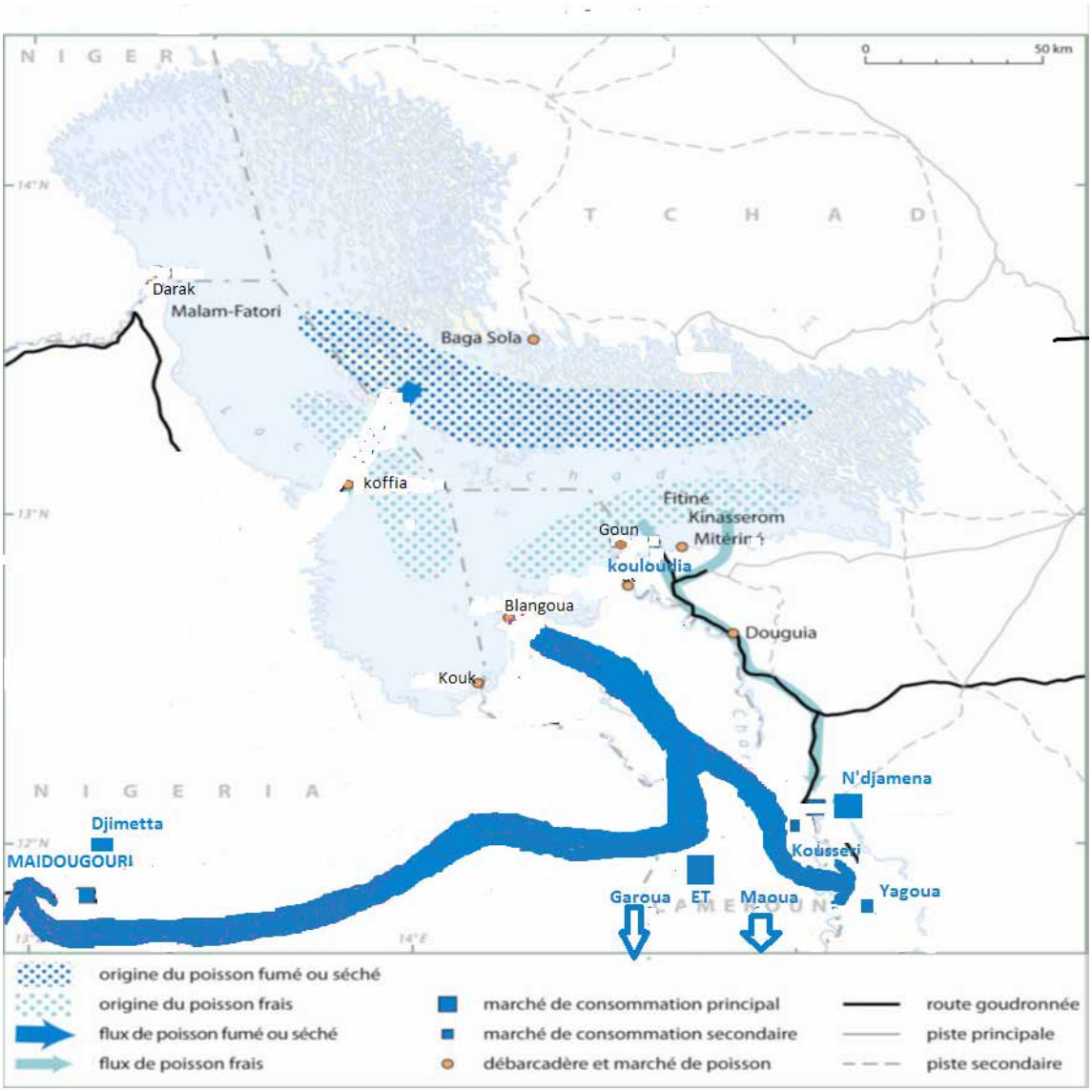


Figure1 : Carte de la zone d'étude et circuit du poisson dans le Lac Tchad (Magrin adaptée par l'auteur, 2015)

Résultats

Présentation des données socio-démographiques des acteurs des différents maillons de la chaînede valeur des poissons du lac Tchad

Il ressort de ce tableau que sur 30 pêcheurs, 27 transformateurs, 30 grossistes et 30 détaillants interrogés que 50% de ces pêcheurs sont musulmans et sont en majorité des hommes qui sont tous sous contrat de vente avec le grossiste, sans toutefoisêtrepropriétaires de leurs embarcations. Les espèces ciblées sont :Oreochromisniloticus (tilapia),Clarias gariepinus(silure),Alestes longidarsalus (alestes), Heterotisniloticus(kanga), et Ch risichtyslongidarsalus(machoiron). Les transformateurs quant à eux sont en majorité des femmes, qui utilisent des fours banda et des nattes en rotins pour transformer le poisson. En outre 70% de ces femmes ont pris du crédit pour exercer leurs activités. La plus part des

grossistes du Lac Tchad sont des ressortissants nigérians qui exportent le produit vers leur pays d'origine, en plus ils vendent les deux types de produits (séchés et fumés), les grossistes du Lac Tchad font presque tous partir de l'association des grossistes et se font aider par des enfants payés à la tâche qui remplissent, conditionnent, chargent et déchargent les produits dans les véhicules. La vente au détail du poisson dans le Lac Tchad est assurée par des femmes camerounaises qui la plus part du temps ne vendent que du poisson séché dans lesmarchéslocaux(tab I).

Tableau I : Données socio-démographiques

Acteurs	Pêcheurs	Transformateurs	Grossistes	Détaillants
Informations sociodémographiques	-50% musulman, 80% sont pêcheurs sédentaires, 80% sont des hommes ; - détention de deux permis (tchadien et camerounais) ; - 65% sont anciens dans l'activité et pêchent avec la pirogue à moteurs et 35% pêchent avec la monoxyle ; -espèces ciblées (salanga, tilapia, silure, kanga, capitaine, machoiron) ; - capture destinée à la vente et vendue dans des cuvettes - très peu sont propriétaires de leurs équipements et pêchent en groupe ; -70% sont sous contrat de vente avec le grossiste ; -80% ne sont pas membres d'une association ; - la saison de forte production va de mars à juillet.	-80% de femmes ; -Poissons séchés (soleil) et fumés -Utilisation des fours traditionnels banda et des nattes en rotins ; -Utilisation du bois local et nigérian ; -manque d'encadrement dans ce sous-secteur -Période de forte activité: saison sèche ; -Payement des taxes ISV et mairie -Inexistence d'association ; -70% ont pris le crédit pour lancer leur activité et 30% utilisent des fonds propres ; - unité de vente : cuvette - ne sont pas propriétaires du poisson transformés.	-90% Nigérians, 75%, exportateurs ; -Manutention (cartons, sacs, paniers) ; -moyens de transports (pirogues, camions et cars) ; -deux types de grossistes : exportateur et local ; -deux types de produits séchés et fumés ; -payent taxe isv/ mairie, la marine marchande ; -tous sont membres d'une association ; - sacs et cartons remplis, conditionnés et transportés par des enfants payés à la tache.	-en majorité camerounais ; -90% représenté par les femmes ; -vente localement, manutention (sacs et cartons) ; - unités de vente : assiettes, et tas ; -payent taxe mairie et isv ; -30% sont membres d'une association.

Présentation du circuit de commercialisation et du schéma de la chaîne de valeur des poissons dans le Lac Tchad

- Présentation du circuit de commercialisation du Poisson du Lac Tchad

De ce circuit on observe que le poisson du lac provient des pêcheries (« kouk, koffia,djimitilio », etc…), ou 80% sont envoyé dans les campements de transformations (Koffia, Kouk, et Goun, etc…) et 20% est vendu frai au Tchad. Après transformation, 70% du poisson est acheté par les grossistes exportateurs nigérians, seulement 20% est vendu dans le marché local (Kousseri, Maroua, Garoua et yagoua),et le reste des 50% est

vendu au Nigéria en majorité le poisson fumé(fig 2), et tout ce poisson fini dans les différents ménages des villes concernées.

- **Etapes de la chaîne de valeur du poisson du lac Tchad**

La chaîne de valeur du poisson du Lac Tchad peut se résumer en trois étapes (fig 3) : pour le poisson fumé qui ne concerne que l'espèce silure 6840 kg de poisson sont pêchés et vendus / an à raison de 625 FCFA le kg, les transformateurs en s'approvisionnant chez d'autres pêcheurs peuvent se retrouver avec 2160kg de poisson / an qu'ils vendent aux grossistes nigérians ou le kg leur revient à 2500 FCFA et eux ils pourront le revendre à 3300 FCFA dans le marché nigérian. Pour ce qui est des espèces tilapia,alestes, et machoiron, ceux-ci sont d'abord transformés avant commercialisation par les pêcheurs eux-mêmes ou le kg moyens des trois espèces est vendu à 1700 FCFA aux grossistes avec une possibilité d'avoir 13500kg de poissons pêchés / an. Les grossistes quant à eux peuvent se retrouver avec 7128kg de poissons vendu/ an à 2200 FCFA le kg, ces 7128kg de poisson sont vendus par le détaillant à raison de 2800 FCFA le kg, il faut préciser que cette étape est la seule source d'approvisionnement des ménages (fig 3).

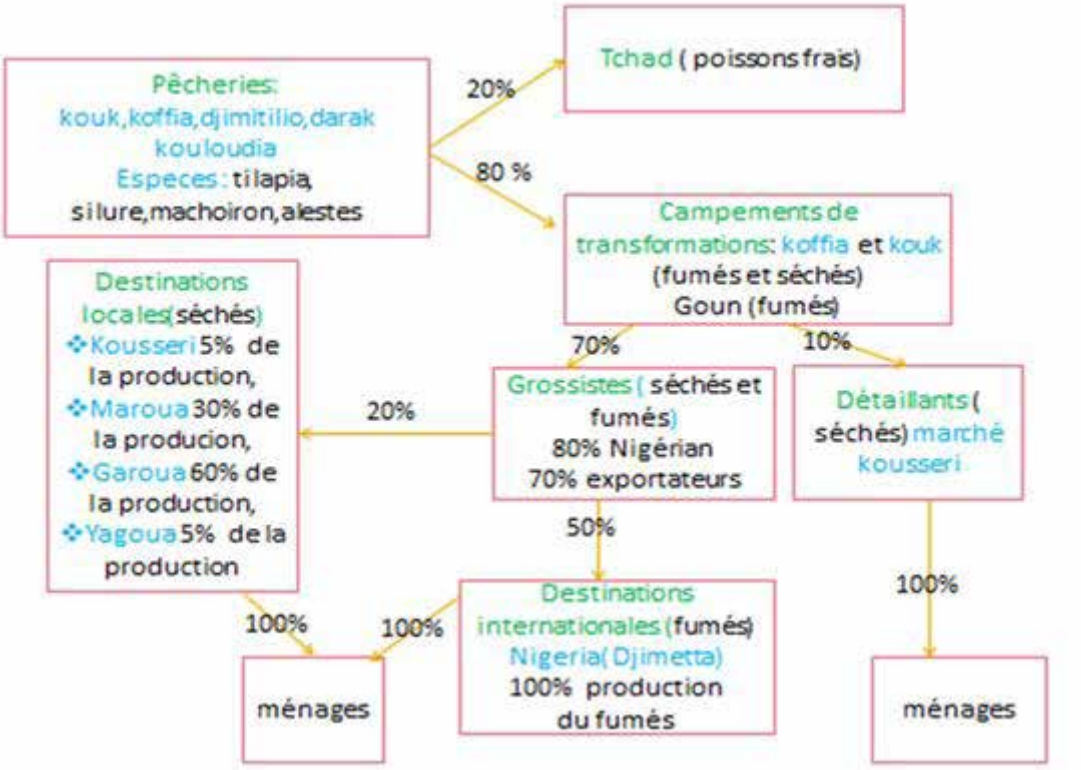


Figure 2 : circuit de commercialisation du poisson du Lac Tchad

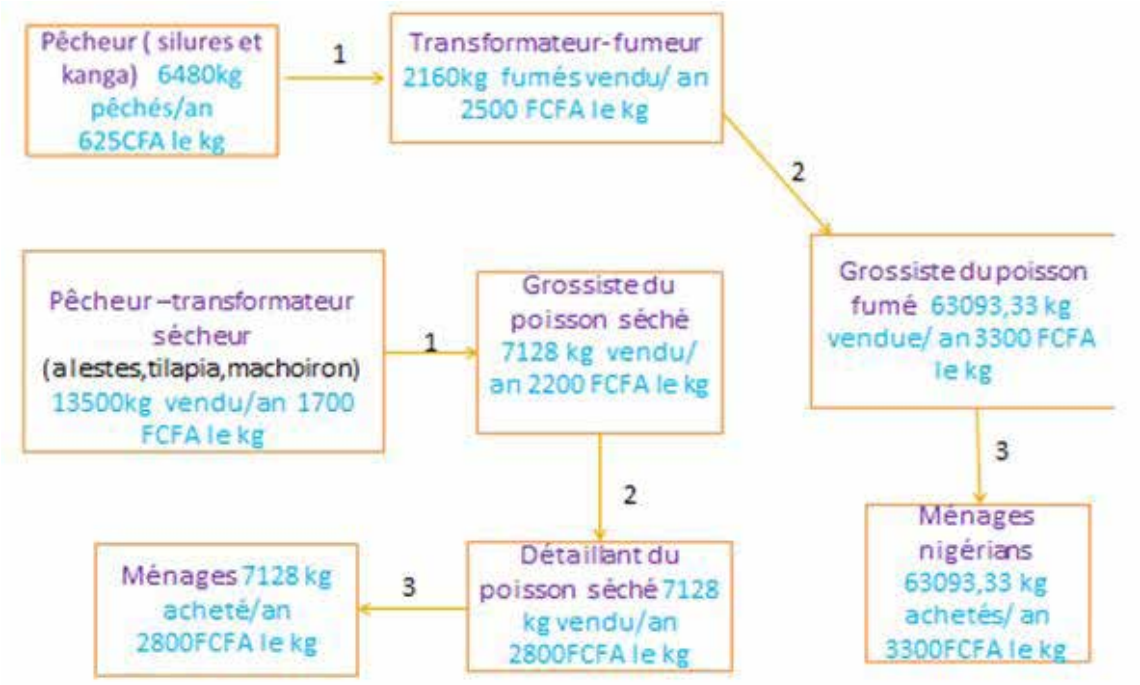


Figure 3 : étapes de la chaîne de valeur du poisson du Lac Tchad

Analyse financière

Tableau II: Contribution économiques des différents maillons

ACTEURS	Pêcheur-transformateurs	Transformateurs poissons fumés	Grossistes du poisson fumés	Grossistes du poisson séchés	Détaillants
Unités de vente	Cuvettes (20l) 15kg	Cuvettes 18kg (20l)	Cartons (75kg)	Sacs (33kg)	Assiettes (0.4kg)
Prix de vente en FCFA	24750	45000	150000	101000	2250
Quantités journalières vendues	5	2	2	3	35
Quantités annuelles	900	144	288	216	1260
Chiffre d'affaire (FCFA)	17325000	6480000	43200000	21816000	2835000
Consommation intermédiaires (FCFA)	15475000	3528000	25321500	12469000	1356000
Valeurs ajoutées brutes (FCFA)	1850000 (5.54%)	2952000 (8,8%)	17878500 (53,35%)	9347000 (27,89%)	1479000 (4,41%)
Excédent net	1745000	2874500	17318500	9045000	1470000

L'application de la statistique descriptive sur Excel dans l'analyse économique des maillons de la chaine de valeur du lac Tchad montre que tous les acteurs de cette chaîne par leur valeur ajoutée contribuent à l'économie nationale et tirent un profit de leurs activités. Mais le constat fait de ce tableau est que les maillons des grossistes (poissons fumés et séchés), contribuent pour une valeur ajoutée de : 1787500(53,35%) et 9347000 (27,89%) FCFA à l'économique nationale que tous les autres mailons (tab II).

Analyse des contraintes et opportunités ou analyse SWOT (Strenghts, Weaknesses, Opportunities, and Threats) de la chaîne de valeur du poison du Lac Tchad.

Tableau III: analyse SWOT de la chaine de valeur du poisson du Lac Tchad.

Forces	Opportunités	Faiblesses	Contraintes
Acteurs à 70% anciens dans le secteur.	Demande croissante en poisson.	Problèmes d'infrastructures.	Longues distances à parcourir et moyens de transport inadaptés.
Abondance de la ressource	La forte production en poisson	Engins de pêche et embarcations amortis et peu adaptés.	Diminution de la profondeur du lac par les grandes sècheresses.
Existence d'une grande clientèle pour écouler les produits.	Existence des grands marchés potentiels dans la sous- région et à proximité des zones frontalières	Faible maitrise de la chaine de valeur et de la structuration des prix.	Insécurité dans la zone.
Bonne maitrise de l'activité.	Température favorable à la transformation	Fours peu adaptés et hygiène des produits douteux	Insuffisance des intrants.
Acteurs autochtones ou encore originaires des zones de pêche ou zones de commercialisations des produits halieutiques.	Existence d'autres activités agropastorales comme complément à la pêche.	Acteurs mal organisés, peu solidaires dans leur métier et originaires des pays divers.	insuffisances de capital ou des sources de financements pour le lancement des activités.
	Pecheries s'étendant sur des grandes superficies.	Existence des conflits pour la ressource entre pêcheurs.	Soumissions à plusieurs administrations et règlementations dans l'exercice du métier.
Pêcheurs aptes à pêcher en toutes saisons.	Lac riche en espèces halieutiques et à forte productivité.	Acteurs mal formés aux nouveaux concepts de la pêche.	Nécessité de transformer les captures avant la commercialisation.

L'analyse SWOT réalisée sur la chaîne de valeur du poisson du Lac Tchad montre que les acteurs de la commercialisation du poisson du Lac Tchad sont soumis à plusieurs contraintes (Longues distances à parcourir et moyens de transport inadaptés ;insécurité dans la zone ; insuffisances de capital et des sources de financement ; nécessité de transformer les produits avant la commercialisation poussant ces dernier à opter pour une commercialisation informelle.

Tous ceci pouvant influencer négativement dans l'exercice de leurs activités et jouer en défaveur sur les prix au niveau du consommateur final des produits de pêche. Toute fois ces acteurs bénéficient aussi de l'existence de certaines opportunités (Demande croissante en poisson; existence des grands marchés potentiels dans la sous- région et à proximité des zones frontalières) (Tab III).

L'application de la corrélation de Spearman aux types d'acteurs et au prix du poisson a été établie pour voir l'évolution des prix des poissons et de signifier ainsi le degré de liaison entre le prix des poissons du Lac Tchad le long de la chaine de valeur. Cette corrélation montre qu'il existe des liaisons positives et hautement significatives entre ces deux données comme par exemple la corrélation positive entre le type d'acteur et le prix du tilapia (r = 1.00 ; p = 0.01) ou encore entre le type d'acteur et le prix du silure (r = 0.989 ; p = 0.01 (tab IV).

Tableau IV : Coefficients de corrélation de rang de Spearman entre les types d'acteurs et le prix du poison

	Prix tilapia	**Prix silure**	**Prix machoiron**	**Prix alestes**
Type d'acteur	1,000**	,989**	,989**	1,000**

** = *corrélation significative à 1%.*

Discussion

Données sociodémographiques des acteurs des différents maillons de la chaîne de valeur des poissons du Lac Tchad

La pêche est subdivisée en deux catégories de pêches : la pêche artisanale et industrielle, de même que les unités de productions associées à chaque type de pêches sont différentes, ainsi que les acteurs intervenant le long du processus des activités qui la constitue (Bjorndal *et al*, 2014). Les 50 % de pêcheur-sédentaires musulmans, tous détenteurs de deux types de permis(tchadien et camerounais) prix respectifs 6000 et 10000 FCFA, de même que les 80% de femmes d'origines diverses ; la présence de 90 % de grossistes nigérians exportateurs des produits halieutiques ; et les 90% de femmes camerounaises impliquées dans le commerce de détail du poisson du Lac(tab I). Toutes ces divergences perçues dans le secteur de la pêche du Lac Tchad seraient peur être dues au caractère transfrontalier des pêcheries du Lac Tchad.

La présence de 65% de pêcheurs utilisant les pirogues motorisées, et de 35% de pêcheurs utilisant les pirogues monoxyles(tab I)même lorsque la pêche dans ce lac est spécifiquement industrielle et ces pêcheurs qui dans la plus part du temps ne sont pas propriétaires de leurs embarcations ; de même le manque d'encadrement des femmes du sous-secteur de la transformation, et leur refus à l'adhésion et à la création des associations seraient peut être la cause du manque destructures d'encadrement de la pêche, et l'absence des structures de financement limitant l'accès au crédit à ces acteurs.

Le paiement des diverses formes de taxe (taxes ISV, mairie, marine marchande) (tab I)par les acteurs de la pêche au lac Tchad montrerait le caractère formel des activités de pêche dans ce Lac. Enfin le fait que les pêcheurs du lac ciblent uniquement certaines espèces (silure, tilapia, salanga et machoiron) au détriment des autres espèces , et que toute leur prise soit destinée à la commercialisation affirmeraient l'importance que les populations accordent à la consommation des produits halieutiques (Anonyme, 2008) de nos jours et dans cette zone en particulier.

Comparer aux caractéristiques du secteur de la pêche et de ses acteurs dans une étude de Bjorndal *et al* sous la supervision de la FAO en 2014 sur la chaîne des valeurs dans plusieurs régions du monde, on peut dire que les données sociodémographiques des acteurs de la pêche dans le Lac Tchad s'approchent des données de cette étude de la FAO sur la chaîne des valeurs.

Circuit de commercialisation et chaîne de valeur du poisson du Lac Tchad

L'étude de DURAN et COUTY en 1961 révélait déjà que le commerce du poisson dans le Lac Tchad concernait uniquement les espèces telles que : le silure, le salanga, le machoiron, et le tilapia vendus frais mais surtout fumés et séchés dans les villes septentrionales et principalement au Nigéria ou la destination est Maiduguri. Ces données qui ne sont pas loin de la précédente étude sur la chaîne de valeur du poisson au Lac Tchad, avec les mêmes espèces commercialisées (silure, alestes et autres) même si la quantité a eu à diminuer dans le temps. Le circuit de commercialisation précisant l'origine (« Blangoa, Baga-kawa, Guitté, Douguia » etc…) et la destination (Makari, N'djamena, Maiduguri, et Kousseri) du poisson du Lac Tchad comme le montre les résultats avaient déjà été signalé lorsd'une étude de MAGRIN (2010) sur le commerce du poisson du Lac Tchad, corroborant ainsi les résultats de la précédente étude . Ce pendant la diminution du nombre de débarcadères et le signale d'une existence d'autres villes de destination(Garoua, Maroua, et Yagoua) des poissons du Lac Tchad(fig 2) et d'un circuit plus complexe ou la plus part des exportateurs de poissons sont obligés de traverser la Bénoué pour évacuer leur produit vers le Nigéria dans cette étude seraient peut être le fait de la période de trouble et d'insécurité causée par la secte Boko Haram que traversait cette partie de la sous- région durant de la période d'étude.

L'analyse des quantités en pourcentage que reçoit chaque ville (fig 2) montre déjà un grand flux (50% de la production totale) des produits vers le Nigéria à Djimetta et Maiduguri et l'existence d'un flux non négligeable (20%) de poisson frais à destination du Tchad. Ces résultats seraient peut être dus au fait que le Nigéria est le pays le plus peuplé d'Afrique (150 millions d'habitants) donc une forte population à nourrir (Neiland *et al*, 2001) et que la ville de N'djaména capitale tchadienne est proche de tous les débarcadères de poisson du lac donc peut recevoir le produit à l'état frai sans que celui-ci ne soit avarié.

De l'analyse des étapes de la chaîne des valeurs du poisson du Lac Tchad(fig 3), il ressort que le produit suit 3 étapes selon son état de transformation : les silures qui sont touchés par 4 intervenants par rapport aux autres espèces(tilapia, alestes, et machoiron) et dont le prix du kg au niveau des ménages est élevés (3300fcfa) comparativement au prix moyen du kg des autres trois espèces(2800 fcfa), ensuite la quantité de poissons fumés (63093.33 kg/ an) diffusée vers le Nigéria par les grossistes du poisson fumés interrogés et uniquement 7128 kg/an de poissons séchés vendu par les grossistes du poisson séchés montre déjà une différence au niveau de l'intérêt porté par les consommateur pour ces différente espèces du Lac Tchad. Cet état des choses serait peut être la cause de la valeur nutritive différentes de ces poissons ou alors de la texture charnue du silure qui serait bonne chaine à consommer et par conséquent préféré au détriment des autres espèces.

Analyse financière des différents maillons de la chaîne des valeurs du poisson au Lac Tchad

L'analyse financière de la filière pêche permet de mettre en exergue les relations de pouvoir entre les acteurs de la filière, les maillons créateurs de richesse et ceux qui au contraire en détruisent, les activités qui optimisent l'utilisation des ressources, les agents les plus démunis de la filière sur le plan de la rémunération de leur activité (Anonyme, 2008). L'activité de commerce au gros du poisson fumé du Lac Tchad est celle qui crée le plus de valeur ajoutée dans la filière (53,35%). Elle est d'autant bénéfique à la collectivité et au grossiste qui est bien rémunéré (17318500) FCFA par an). Les gros commerçants de poisson séchés sont aussi des agents aisés de la filière avec une valeur ajoutée de 27,89% pour un profit individuel et annuel de 9045000 FCFA. Les transformateurs quant à eux sont les troisièmes bénéficières de la filière. Ils contribuent à la création de la valeur ajoutée de la filière de l'ordre de 8,8% et un agent réalise un profit annuel de 2874500 FCFA. Les activités de vente au détail et de pêche sont aussi financièrement rentables et contribuent à la création de la valeur ajoutée (5,54% et

4 ,41%) (tab II). Le constat selon lequel les grossistes sont les plus grands bénéficiaires et créateurs de richesses de l'activité de pêche au lac Tchad s'expliquerait par le fait que ces derniers autofinancent l'achat des embarcations et engins qu'ils mettent à la disposition des pêcheurs et transformateurs résultats qui semblent corroborer ceux d'une étude au Burkina Faso en 2006 sur la filière pêche. Le fait que tous les maillons de la filière pêche du lac Tchad tirent profit de leurs activités se justifierait par la position transfrontalière entre quatre pays de ces pêcheries du Lac Tchad (Anonyme, 2015) qui sont de ce fait stratégiques pour l'économie de la pêche dans le corridor D.

Analyse SWOT de la chaîne des valeurs du poisson au Lac Tchad

La nature internationale du secteur pêche du Lac Tchad (eaux partagées entre quatre pays riverains), la présence des pêcheurs migrants, les impacts à grande échelle des activités humaines, le problème des grandes sècheresses qui frappent le lac Tchad et la limite à la maitrise de la situation actuelle de la compréhension et la connaissance des pêcheries du Lac Tchad rendent complexe la gestion du lac Tchad pour les Etats qui partagent les eaux de ce Lac (Quensière, 1994). A cela s'ajoutent les moyens de transport précaires utilisés par les acteurs de ce secteur, l'insuffisance des intrants et des sources de financements, et le problème d'insécurité due à la secte Boko Haram qui sévit dans la zone comme le montre cette étude(tab III). Le secteur de la pêche au Lac Tchad dans cette étude comme la plus part des pêcheries du monde fait face à plusieurs contraintes infrastructurelles, socio-économiques et techniques le long de la chaîne de valeur comme le confirme AZIZ Lamatai dans l'étude de la chaîne de valeur de la Dorade rose du Maroc en 2010.

Les grandes superficies des pêcheries du Lac Tchad, l'existence des marchés à proximité des zones frontalières et la forte demande en poisson de ce lac (tab IV)se justifieraient par la position transfrontalière du Lac Tchad servant en poissons une forte population de l'Afrique comme l'avait déjà indiqué une étude de MAGRIN en 2010.

Analyse des corrélations

Corrélation entre le type d'acteur et le prix du poisson le long de la chaine de valeur

Les prix de toutes les quatre espèces (tilapia, silure, machoiron *et al*estes) commercialisés au Lac Tchad sont fortement corrélés avec des valeurs positives (□ = 0,98 à 1 ; □ = 0,05) aux différents maillons le long de la chaine de valeur (tab IV).Ce qui signifie que le prix des poissons est élevé au niveau du consommateur final. Ceci pourrait être la conséquence du fait que plusieurs acteurs entrent dans la commercialisation du poisson du lac à chaque étape, ou chacun de ces acteurs fait la pluie et le beau temps sur le prix des poissons en l'absence d'une réglementation forte sur l'activité.

Conclusion

Quelques photos

A) Quelques pirogues monoxyles B) débarquement du poisson àkouk

C) Fumoir traditionnel banda à un trou D) séchoir traditionnel

E) Grossistes du fumés à koffia F) grossistes du séchés à kofia

G) Remplissage dans les cartons et triage du poisson

H) Entrepôts de poissons fumés et séchés à Blangoua avant transport

Au terme de cette étude sur la chaîne de valeur du poisson au Lac Tchad, on peut noter que le commerce du poisson au Lac Tchad est rentable. En effet, l'analyse des données socio-économiques révèle que les principales espèces pêchées et commercialisées sont : Oreochromis niloticus (tilapia),Clarias gariepinus (silure),Alestes longidarsalus (alestes), Heterotis niloticus (kanga), et Chrisichtys longidarsalus (machoiron). Le poisson du Lac Tchad est vendu non seulement dans le marché local (Garoua, Maroua, Kousseri et Yagoua) mais aussi dans le marché régional (N'djaména, Maidougouri,etDjimetta). Les pêcheurs disposent de deux types de permis (tchadiens et camerounais) coutant respectivement 10000 et 6000 FCFA pour exercer leurs activités. La commercialisation du poisson au Lac Tchad est assurée en majorité par des grossistes nigériens (90%) dont les exportations du poisson fumés (50%) vers le Nigeria leur rapportent un bénéfice annuel de 17318500 FCFA pour une contribution de 53.35% la plus importante à l'économie. Ces derniers font subir un cout d'achat du poisson le plus élevé aux ménages, ou ceux-ci achètent le kg moyen de poisson à 2800FCFA vérifiant ainsi l'hypothèse selon laquelle le prix du poisson augmente au niveau du consommateur final. Le bénéfice net perçu par chaque maillon (147000±17318500FCFA) est intéressant et montre que le commerce du poisson du Lac Tchad se porte bien. Même si plusieurs contraintes de tout ordre influencent l'activité de pêche au Lac Tchad vérifiant ainsi l'hypothèse sur la multiplicité des contraintes qui étouffent cette activité de pêche. Ces contraintes peuvent être élucidées en contraintes d'ordre infrastructurel : obsolescence d'engin et embarcation, four peu adaptés et précaires, et le manque d'intrants (bois, sels, huiles et carburants) chez les pêcheurs et transformateurs, organisationnel : manque de structure d'encadrement et insuffisance des sources de financement (banques, coopératives, micro-finances, GIC, et autres) et enfin sécuritaire (attaques de Boko Haram).

Recommandation

Le commerce du poisson dans le Lac Tchad fait ainsi face à plusieurs goulets d'étranglements dont il serait important d'amoindrir pour continuer à promouvoir le bien-être des populations locales qui tirent un grand profit social et économique de la richesse de ces pêcheries. D'où les propositions de recommandations suivantes:

- Au gouvernement : sur le plan organisationnel de créer les coopératives et des GIC prônant la formation adéquate des pêcheurs et transformateurs à la pratique d'une pêche durable et d'une transformation plus concurrentielle du poisson. En plus d'encourager les micro-finances et banques à s'installer dans la région pour faciliter l'accès des pêcheurs et transformateurs au crédit pour autofinancer leurs activités. Ce qui les libèrera de la dépendance vis-à-vis du commerçant grossiste.
- Au gouvernement, institutions et organismes internationaux :de financer des projets qui visent la limitation à l'utilisation des intrants à disponibilité limitée comme le bois par les pêcheur-transformateur. D'encourager plutôt l'utilisation des énergies dites renouvelables comme l'énergie solaire dans la transformation du poisson du Lac Tchad, car cette zone est

favorable à l'utilisation de ce type d'énergie. Enfin d'apporter une assistance logistique (filets, moteurs hors-bord de 8 chevaux fiscal,) aux pêcheurs du Lac Tchad pour qu'ils ne pêchent plus pour le commerçant grossiste qui d'habitude préfinance cette activité, pour après fixer son prix d'achat du poisson.

Remerciements

Ce travail marque la fin de la formation d'ingénieur en sciences Halieutiques. C'est ici l'occasion de remercier toutes les personnes qui ont contribué de manière physique et morale à son effectivité. Je rends d'abord infiniment grâce au Seigneur Dieu Tout Puissant dont la présence a été ressentie durant toute cette longue période d'étude, par la santé, le courage, l'intelligence, la sagesse et les opportunités offerts gracieusement.

- ☐ Je tiens à exprimer de manière particulière les sentiments de gratitude et de remerciement aux personnes suivantes :
- ☐ le PrTOMEDI EYANGO Minette épouse TABI Directrice de l'ISH de l'université de Douala à Yabassi, et superviseur de ce travail pour nous avoir fait confiance en participant à notre formation. Ses observations, ses remarques et encouragements durant la formation ont permis d'améliorer les connaissances ;
- ☐ le DrMEKE SOUNG Pierre Noloasque Directeur Adjoint de l'ISH , Coordonnateur du projet de Worldfish Center sur le commerce du poisson dans le corridor D (Afrique Centrale) et encadreur de ce travail, qui nous a accordé beaucoup de crédit en nous confiant ce thème de recherche, et accompagné dès le début de stage jusqu'à ce jour ;
- aux partenaires du projet « fish trade » en Afrique en particulier le Worldfish Center, UA☐BIRA, le NEPAD, le MINEPIA, et bien d'autres pour leur apport financier et matériel dans la réalisation de ce travail ;
- le Dr NACK Jacques Chef de Département de la filière Gestion des Pêches et Ecosystèmes Aquatiques ;
- les personnes enquêtées dans le Logone et Chari et zone du lac Tchad, les informateurs et interprètes, les administrations locales de toutes les localités visitées dont la disponibilité a permis la collecte des données et la réalisation de ce travail ;
- au PrKENNE dont l'analyse des données sur différents logiciels a été indispensable pour la concrétisation de ce travail ;
- à mes collègues ingénieurs, dont le travail en groupe et l'apport collectif a permis que ce travail évolue au jour le jour jusqu'à sa réalisation complète. Je pense ici à Serge MEDJO, Armel NOKAM, Edgar BIAKOUM, Félicité NDJANTANG, et Marie-Claire ABENA dont la disponibilité, le dévouement et la responsabilité dont ils ont fait montre a permis l'atteinte des objectifs escomptés ;
- à ma mère MENDA BITOMO Marie dont le soutient maternel, financier et moral durant toute ma formation est resté indéfectible ;
- à mon tuteur monsieurAJABE Samuel et son épouse Mme AJABE Edwige dont l'assistance tant morale que matérielle et financière durant toute mon cursus scolaire et surtout à la fin de la formation a été assidue et précieuse ;
- à mes neveux et nièces Rodrigue, Dora, orchèlle, Landry, Joane, Miguel, et Cyrielle dont l'ambiance et les moments de détente offerts m'ont été inestimables ;
- à mes amis Sonia, Ericka, Ulrich et Jaky dont le soutien et le réconfort m'ont été bénéfiques;
- à la grande familles des halieutes de la 2eme promotion de l'ISH dont le soutien moral et les conseils ont permis d'avoir un séjour agréable durant notre formation à Yabassi ;
- -à tous ceux qui de près ou de loin ont participé à la réalisation de ce mémoire.

ANALYSIS OF THE INFLUENCE OF VALUE ADDITION ON THE PROFITABILITY OF MARINE FISH IN CAMEROON

Mkong Cynthia Jeh[1, 2]*, Mvodo M E Stephanie[2], Molua L Ernest[2] and Assoua Eyong Joe[1, 2]
[1]Centre for Independent Development Research (CIDR), Buea, Cameroon
[2]Faculty of Agriculture and Veterinary Medicine, University of Buea, Cameroon

Abstract

Fishing is of great economic, social and nutritional importance to a large population of Africans, carried out for both subsistence and commercial purposes. In Cameroon, fish is the most accessible and most consumed source of protein and fishing contributes about 119.4 billion FCFA to wealth creation, providing about 200,000 jobs due to the multitude of activities that follows fish catch. However, while many Cameroonian natives are involved in harvesting and processing of fish, little profit is realized from it, which is thought to be the cause of the observed fall in fish supply. This study set out to analyse the effect of value addition on the profitability of marine fish in Fako Division of Cameroon. It used data collected from 120 respondents through personal interviews, using a pre-tested questionnaire in Buea, Limbe and Muyuka communities. The study adopted net profit analysis to determine profitability at key nodes on the fish value chain and a Cobb Douglass function to quantify the effects of various factors on net profit. The STATA.14 software was used to obtained Ordinal Least Square (OLS) estimates. Marine fishing was found to be a seasonal activity. Furthermore, each of the fish related activities had specific gender dominance with fishing and trading as male dominated tasks while processing was a female dominated task. Findings further showed that fish processing and trading were profitable businesses, the trader node being the most profitable. Linear regression showed that profitability of marine fishing was influenced by years of experience, cost of labor and the particular node occupied by an actor. The implications of the findings are that profitability can be enhanced by capacity building in cost management to ensure profit maximization. Improvement on local transportation and marketing infrastructure can help in the development of a more effective fish value chain in Cameroon which is urgently needed.

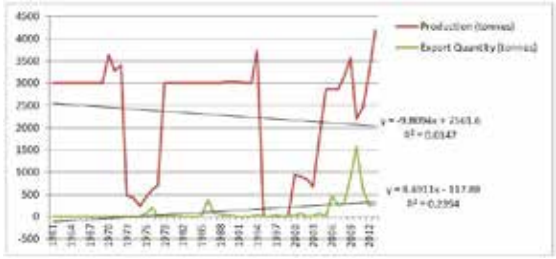
Keywords: Profitability, Marine fishing, Value chain, Value addition, Cameroon.

* *Corresponding author email: mkongcynthiajeh@gmail.com*

Introduction

Cameroon is predominantly an agrarian society with agriculture acting as the driving force for the country's economic development. It employed 61.3% of the active population in 2001 and 76.9% in 1986, contributes 35% of all export earnings and accounts for an average 21.3% of its Gross Domestic Product (GDP) (Molua *et al*., 2009). Fishing is a vital sector in Cameroon's economy. In 2003, its contribution to the creation of wealth was estimated at 119.4 billion FCFA (Ngok *et al*., 2005; Id, 2011). According to these authors, the sector creates about 200000 jobs due to the multitude of activities that follows the catch: commercialization, handling, and transformation. Figure 1 below shows production and export quantities of marine fish in Cameroon between 1961 and 2012. Fish is the most accessible and the most consumed source of protein in Cameroon (Diomandé, 1992). Its consumption is 17 kg per person per year against 13.09 kg for meat and 14 kg for milk (Ngok *et al*., 2005). This represents about 40% of protein intake from animal origin and 9.5% of the total requirement (Kébé *et al*., 1993). Processing remains a major challenge for the entire economy. According to Nout *et al*., (2003), food security cannot be guaranteed by only increasing agricultural production. The efforts made can be annihilated if emphases are not put on post-catch losses. One of the main challenges of the fishing sector is the high rates of post-catch losses which are evaluated at about 15 to 20 % of offloading (Diomandé, 1992; ACPFish II, 2011). The losses are mainly due to the inadequate storage infrastructures which makes processing necessary.

The hydrograph and the marine fisheries are influenced by several rivers e.g. the Wouri, which waters Douala, the Sanaga, the Nyong and the Ntem rivers. The main fisheries are divided into two major sectors: the artisanal fishery operating in the creeks, estuaries and shallow inshore waters within a depth of 25m and above the thermocline; an area dominated by "white fish" (mostly Clupeidae and Carangidae) and the industrial fishery (trawlers /shrimpers) supposedly exploiting the deeper waters beyond the 25m depth contour that is beyond the thermocline, an area dominated by red fish (mostly demersal fish) but where some white fish also extend.



Source: Author's analysis based on FAOSTAT, 2017

Figure 1: Production and export quantities of marine fish in Cameroon between 1961 and 2012

As shown in figure 1 above, production and exports of marine fish have followed both increasing and decreasing trends which more often correspond to both indegenous and exogenous shocks (SAPs, agricultural trade liberalization, climate change and diseases). Official figures show marine fish production to have been constant at 3000 tonnes per annum from 1961 to 1969 but increased to 3640 tonnes in 1970. It again dropped to 3290 tonnes in 1971, 3406 tonnes in 1972 and further dropped drastically to 714 tonnes per annum in 1978. In 1979, Cameroon produced 3000 tonnes of marine fish and maintained this production volume till 1988. Thereafter was a slight increase to 3034 tonnes that was observed in 1989 and 1990, 3033 tonnes in 1999 and 3000 tonnes in 1992 and 1993. Production increased to 3740 tonnes in 1994 and between 1995 and 1999, there was no production. In 2000, production rose to 954 tonnes and progressively reduced to 907 tonnes, 830 tonnes and 674 tonnes in 2001, 2002 and 2003 respectively. It peaked to 4200 tonnes in 2013 following swings from 1800 tonnes to 3300 tonnes between 2004 and 2012. Official figures show that Cameroon was not involved in marine fish exportation between 1961 and 1974. In 1975 however, exports were registerd at 7 tonnes per annum and increased to 78 tonnes and 202 tonnes in 1976 and 1977 respectively. It plummeted to 13 tonnes in

1978 and no exports were registerd in 1979. In 1980, exports again rose to 14 tonnes but stagnated at 0 tonnes between 1981 and 1984. Two years after, exports spiked to 389 tonnes but drastically dropped to 3 tonnes in 1991. The period between 1992 and 2005 was marked by an alternation which was followed by another spike in export to 469 tonnes in 2006. Exports reached its peak at 1572 tonnes in 2010 and again plummeted to 614 tonnes, 244 tonnes and 284 tonnes in 2011, 2012 and 2013 respectively.

Capture fisheries in Africa face a challenge of declining supply against growing demand for fish. A 2% fall in per capita supply is anticipated, aggravating what is already the lowest regional supply in the world (World Bank, 2013). Although so many Cameroonian natives are involved in harvesting and processing marine fish, very little profit is realized at the end of their activities (FAO, 2009). Also true is the fact that of the so much fish harvested from Cameroonian waters,a considerable proportion is lost between the time of harvest at sea and when it reaches its final consumer, (FAO, 2009). The setbacks mean that the government must annually import about 200,000 metric tons of fish to meet domestic demand. Barriers to fish production in the country are scientific and more pertinent to smoked fish producers are the problems of inadequate processing and marketing facilities, limited extension services and inaccessibility to information and decrease in price of substitutes (meat, poultry) amongst others. These problems sums up to low output (supply) and low returns to fish production and marketing in the country. This fall in fish supply in Cameroon is thought to be due to a fall in profitability of both production and marketing. This detected fall in profitability is most likely as a result socioeconomic factors such as high input cost (cost of boat, engine, fuel and transportation), inadequate technical knowledge and limited access to credit facilities (thought to be caused by poor level of infrastructural linkages, low level of education of actors, limited media exposure, limited number of extension workers and limited membership in groups an cooperatives). This fall in profitability force fishermen and other value chain actors to abandon their line of business. Addressing the impact of value addition on the profitability of fish offers an important means to address the problem.

The effects and consequences of such a decrease in profitability of fish production and marketing include but are not limited to: increase in the price of all fish derivatives which leads to a fall in consumption of fish products; an increase in the unemployment rate; a fall in value chain actors' income; a fall in the standard of living; an increase in the poverty level; a fall in life expectancy and an increase in crime rate.

Primarily, this research hypothesizes that:

Ho: Value Addition has no effect on the profitability of fish in the Fako Division of Cameroon.

The specific research hypotheses are as follows:

Ho1: There is no significant relationship between profit earned and the factors hypothesized to influence it.

Ho2: The different value chain actors earn the same amount of profit.

Abiodun (2012) studied women in fish value chain in Nigeria and observed that women's activities in the value chain are characterized by low capital and technology input. Most of their handling operations are without appropriate capacity to meet national and international sanitary and technical standards and hence possess low substantial benefits to fish trade. He recommended that financial status of women be improved, which will in turn lead to the improvement in the fisheries marketing activities of women in fisheries value chain in Nigeria. Abiodun's findings are consistent with those of Gordon *et al*., (2011) in their study of smoked marine fish from Western Region Ghana: a value chain assessment. They found out that the women traders in Ghana (at the beach and retail markets) appear to act in ways that are anti – competitive because of problems of inadequate

infrastructure and financial capital.

Cho (2009) in his study of fish marketing in Cameroon found out that the artisanal fisheries today are under threat of extinction due to many reasons; abandonment of the sector by the state to the local fishing communities, leading to over exploitation and unsustainable management of indigenous species. This therefore implies that research institutions and development organizations – most especially those which have carried or are currently carrying out research on fishes, have to make results available to the local and regional communities as well as sensitize them on the advantage of consuming, producing and preserving indigenous fish species.

Maina (2011) sought to assess the effectiveness of the Omena marketing channels; evaluating the price spreads along the different marketing channels; and to determine whether the spatially separated markets for Omena are integrated. Gross margin and co-integration modeling was used for analysis and results indicated that Omena marketing channels are to a large degree effective as it regards to meeting the consumption needs. However, results also indicated that longer marketing channels resulted not only to high costs and thus high retail prices; but also to lower returns to the fishermen.

Chifuniro (2016) assessed profitability of the fishery enterprise to different actors of the value chain, quantified post-harvest losses affecting different actors along the chain and determined factors affecting profitability and post-harvest losses using gross margin (total revenue less total variable cost) in Barotse Floodplain, Zambia. The Ward and Jeffries approach was used to determine levels of post-harvest losses while Translog profit function was used to quantify effect of various factors on gross margins. Multiple linear regressions were used to assess factors influencing post-harvest loss as cost of loss. The study concluded that fish related activities are profitable. It also concluded that post-harvest losses occur at all nodes along the value chain with trader node experiencing highest levels of percentage physical loss and quality loss. Profitability at trader node was determined by price of capital; price of material; squared price of capital; squared price of labor; squared price of transport; interaction of price of capital and price of materials; interaction of price of labor and price of transport; interaction of price of labor and price of materials; and age. Post-harvest losses at trader node are affected by price of capital, age and form in which fish is sold.

Materials and Methods

Empirical Model

In order to assess profitability, net profit analysis was used. Data was based on the last consignment a chain actor caught, processed or traded fish. Data on the particular quantity and price of fish sold was collected. Fish consumed was valued in order to quantify the gross income. The cost of taking fish from one node of the chain to the next which was also collected is specific to a particular fish enterprise and varies according to quantity handled.

Net returns was calculated per respondent using the formula given as:

$$NR=P_Y\gamma-\Sigma P_i X_i \qquad \text{(Eqn 1)}$$

Where:
NR= Net Returns in FCFA, PY = Price of fish per Kg, Y= Quantity of output in Kgs, P_i = Price for each ith input (both variable and fixed) unit and X_i = Quantity of input (both variable and fixed) used/respondent unit for each ith input.

Factors affecting profitability were assessed using Cobb Douglas Production Function (Biddle, 2012). This function was employed to quantify how different cost related variables and socio-economic factors affect net returns of actors.

In a general form, according to Cobb (1928), the Cobb Douglas function can be written as:

$$Y = \beta_0 X_1^{\beta 1} X_2^{\beta 2} \qquad \text{(Eqn 2)}$$

Where:
Y = Output, X1 and X2 = Input factors, $\beta_1$and β_2 = Output elasticities.

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

$$\prod = \beta_0 PX_1^{\beta 1} PX_2^{\beta 2}) \quad \text{(Eqn 3)}$$

Where:
$\prod$ = Net Returns (in FCFA), PX1 and PX2 = Price of input factors,β_1 and β_2 = Price elasticities.

The function is linearized and specified as follows:

$$\ln \pi = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3 \ln x_3 + \beta_4 N_2 + \beta_5 N_3 + \varepsilon \quad \text{(Eqn 4)}$$

Where;
$\prod$ =Net Returns (in FCFA), x1= years of experience, x2= labor cost (in FCFA), x3= transportation cost (in FCFA), N2=1, if the respondent occupies node 2(processor) and 0, otherwise, N3=1, if the respondent occupies node 3(trader) and 0 otherwise and ε = error term.

Type of data

This study was conducted in Fako Division of Cameroon and made use of both primary and secondary data. The main instrument for collecting the primary data was a self-administered and structured questionnaire. Information was collected on input and output as well as the socio-economic characteristics of chain actors through personal interview, participatory rural appraisal (PRA); use of focus group discussions and a stakeholder interview in the area of study.

Sampling Design

A multistage sampling technique was adopted for this study.After preselecting Limbe, Muyuka, and Buea towns, a stratified sample of fishermen, small-scale processors, domestic wholesalers and retailers, were then selected. Fishermen and small-scale processors were sampled in one only pre-selected area (Down-beach/Dock-Yard Limbe) while wholesalers, retailers and consumers were sampled at 3 municipal markets (Muea, Buea Central and the Mile 16 markets) within Buea municipality and one market in each of the other towns (Tiko, Kumba and Muyuka main markets). Finally, actors from each stratum were randomly selected to meet up to the required sample size. In total, 38 fishermen, 40 small scale processors. 18 wholesalers and 24 retailers were interviewed making a total number of 120 respondents for the study. OLS estimations were obtained using STATA.14 software.

Results

Fishing is seasonal in the Fako Division of Cameroon. Fishing is at its peak from the month of September to December. During this time, flood water recedes and fish are confined in small pools of water. The off season is from the month of March to June. During this season, water levels are high and fish have more area to move hence, an observed difficulty in catching fish. The closed months are also rainy seasons when sea water rises. The seasonality of fishing influenced price fluctuations of fish. At peak seasons, price of fish was relatively low due to abundance of fish on the market and relatively high over low seasons due to scarcity and high demand of fish.

Table I below indicates cost distribution in fishing, processing and trading. It shows that the total cost composition of the three fish related activities are different. Fishermen did not have transport as a cost component. This was because fishermen sold fish by the shore to transitory customers while processors and traders had to travel to local markets to reach better markets. Fishermen's variable costs generally include; cost of setting and pulling nets, cost involved in removing fish from nets and other operational costs. Their fixed cost was mainly the cost of boat and engine. Processors on the other hand had packaging cost, preservation cost, transportation cost, fuel wood cost and storage cost as the main variable cost components. Their fixed cost was

mainly the cost the construction of smoking barns. Traders however do not incur fixed cost. Their variable costs include transportation cost, storage cost, trader association fees and market levies.

We deduce from table 1 above that along the marine value chain, fishermen, processors and traders had significantly different net profits ($p<0.05$¬). The trader enjoys the highest amount of net profit (264300 FCFA), which may be explained by the fact that traders incur zero fixed cost. The next most profitable is processor node with a mean net profit of 102598 FCFA. The fisherman, at node 1, earns a negative net profit of -814085 FCFA. This can be explained by the high fixed input cost (boat and engine) which may only be covered in the long run of business.

Table 2 below presents an analysis of variance summary for the regression model.

The probability values in table 2 permit us to reject the null hypothesis that cost of labour does not affect net profit. Conversely, we can also reject the null hypothesis that the particular node occupied by an actor does not affect net profit. The coefficients, standard error values, t-values and levels of significance obtained from running the regression are presented in table 3 below.

Table 1: Cost distribution, mean cost and net profit estimations of different actors per cycle of four months

Mean Variable Cost item (FCFA)	Fisherman	Processor	Trader
Setting and pulling nets	3335		
Removing Fish from nets	4000		
Operational Cost	60000		
Packaging		23000	
Fire wood		69000	
Preservation		33000	
Transportation		10000	15000
Processing labor		5000	
Storage		3500	8000
Preservation chemicals		0	0
Market levies			1500
Association fees			5000
Total Mean Variable Cost	67335	143500	29500
Mean Fixed Cost			
Boat and Engine	1335750		
Construction of smoking barn and storage		59417	
Total Mean Fixed Cost	1335750	59417	0
Total cost(TC)	1403085	202917	29500
Total revenue(TR)	589000	305515	293800
Net Profit(TR-TC)	-814085	102598	264300

Source: Field survey results, 2017

Table 2: ANOVA summary of the model

Variable	Mean	F-value	(Prob>F)
Model	7.842e+11	37.74	0.0001***
Cost of labor	1.201e+11	5.78	0.0192**
Cost of transportation	2.555e+10	1.23	0.3780
N2	1.098e+12	52.82	0.0003***
N3	4.788e+12	230.42	0.0000***

*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Field survey results, 2017.

Table 3: Regression results

Variable	Parameter	Coefficient	Std. Err	T	P>|t|
Constant	β_0	4844541	573520.3	8.45	0.000***
Experience	β_1	66950.98	70560.2	0.95	0.041**
Cost of labor	β_2	3.039233	7.244382	-0.01	0.029**
Cost of transportation	β_3	5.227537	33.93592	0.15	0.996
N_2	β_4	-1449104	141682.2	-10.23	0.000***
N_3	β_5	1552695	187203.6	8.29	0.000***
R^2		0.8741			
Adjusted R-squared		0.8479			
F(5, 24)		33.32			0.000***
Df		59			
Observations		60			

*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Field survey results, 2017.

The regression results showed that actors on the fisherman node (which is used as the bench mark or reference in this study) had a mean net profit of 4844541 FCFA per cycle of 4 months, which was significant at 1% (p< 0.01). Using this benchmark, processors' mean net profit is 1449104 FCFA less than that of fishermen (p< 0.01). Hence processors have mean net profit of 3395437 FCFA. Conversely, the mean net profit of traders is 1552695 FCFA greater than that of fisher men (p< 0.01). This aligns with a priori, given that traders incur the least cost (especially fixed cost) along the chain. Evidently, the trader node is the most profitable along the marine value chain.

A one year increase in the level of experience (a covariate) will lead to an increase in net profit of marine chain actors by 66950.98 FCFA. A plausible explanation for this lies in the fact that more experienced actors are more risk friendly and can better adapt and mitigate business risk than novices. Besides, they might also be better placed to access credit. In addition, a unit increase in the cost of labour (human capital) will lead to an increase in net profit by 3039233FCFA (p< 0.05). These findings, although unexpected in theory, are in agreement with the results of Okeke-Agulu (2012) which revealed that cost of capital and other costs significantly affect profitability positively except labor which was not significant. Finally, the effect of cost of transportation on net profit was statistically not significant

The adjusted R-squared value indicates that about 85% of variation in the net profit is accounted for by experience, transport cost, labour cost, and dummies for the processor node (N2) trader node (N3).

The significance of the F-value ($p<0.01$) suggests that the sample data provides sufficient evidence to conclude that our model fits the data better than a model with no independent variables. Therefore, years of experience, cost of labour, cost of transportation, N2 and N3 improve the general fit of the model.

Discussion

It emerges from the results obtained from the sample of marine actors that three of the five explanatory variables (experience, N2 and N3) produce the expected outcomes and four of these variables (experience, cost of labour, N2 and N3) have a significant influence on the profitability of marine fish production and marketing. Experience and cost of labour were significant at 5% while N2 and N3 are significant at 1%. We therefore suggest a plausible answer to our first research question (what are the factors affecting profitability along the fish value chain of the Fako Division of Cameroon?) that along the marine fish value chain in Fako, profitability is determined by years of experience of actors, cost of labour, dummy for processor node (N2) and dummy for the trader node (N3). The outcome that a unit increase in the cost of labour (human capital) leads to an increase in net profit, although unexpected in theory is in agreement with Okeke-Agulu (2012), which reveals that cost of capital and other costs significantly affect profitability positively except labour which was not significant effect. Furthermore, the findings that the mean net profit of traders is greater than that of all other chain ($p< 0.01$) aligns with a priori given that traders incur the least cost (especially fixed cost). Based on these findings, we put forward an answer to our second research question (which is the most profitable node on the fish value chain of the Fako Division of Cameroon?) that the trader node is the most profitable along the marine value chain. This result is very similar to those obtained by Chifuniro (2016) who assessed profitability of fishery enterprise to different actors of the value chain, and found that profitability at trader node was determined by price of capital, price of materials, squared price of capital, squared price of labour, squared price of transport, interaction of price of capital and price of materials, interaction of price of labour and price of transport, interaction of price of labour and price of materials and age.

Conclusion

The study concludes that marine fishing, processing and trading are profitable businesses. Levels of profitability are determined by the years of experience, cost of labour and the particular node that the actor occupies along the chain (fisherman, processor or trader). Moreover, the trader node is the most profitable node on the marine fish value chain associated with the Fako Division of Cameroon. The implications of the findings are that profitability can be enhanced by capacity building in cost management to ensure profit maximization. The study therefore recommends that the government should improve on the transport and marketing infrastructure for a more effective and efficient fish value chain in Fako division.

Acknowledgements

We would like to thank Ernest Atangana and Ajap Akamin for their useful and very helpful comments on an earlier version of this manuscript.

Policy Brief

The study findings indicate that marine fishing, processing and trading are profitable businesses. Levels of profitability are determined by the years of experience, cost of labor and the particular node that the actor occupies along the chain. There is therefore need to build capacity of all actors on efficiency. Actors need to know ways to manage both variable and fixed costs to maximize profits. Traders can, for the most part, target high value markets that are less sensitive to price changes. There is also need to build capacity of fishermen, processors and traders on fish

handling to reduce post-harvest losses. In particular, processors and traders need to package and transport the fish in a way that will not expose the fish to breakage. Furthermore, infrastructural development can play an important role in facilitating competition, encouraging investment, and allowing a more efficient allocation of resources and enhancing profitability along the value chain.

References

Abiodun, O. (2012). Establishment of model Fish Market For Women In Ugbodede village of Delta State, Magazine of African Women leadership Training

ACPFish II (2011). Renforcement de la Gestion des Pêches dans les pays ACP. Situation des moyens intra-institutionnels (privés et publics) et des relations inter-institutionnelles aux niveaux national et international dans la filière crevetticole au Cameroun. Projet No CU/PE1/GB/10/005.

Ann, G., Alan, P., & Ellen O. (2011). Smoked marine fish from Western Region, Ghana, a value chain assessment. World fish center. USAID Integrated Coastal and fisheries Governance Initiative for the Western Region, Ghana, 46pp.

Biddle, J. (2012). The Introduction of the Cobb – Douglas Regression. Journal of Economic Perspectives, 26(2), 223–236.

Chifuniro, S. (2016). Profitability and post-harvest loss assessment along fish value chain associated with barotse floodplain, Zambia. Master Thesis. Jomo Kenyatta University Of Agriculture And Technology.

Cho, C. A. (2009). Fish Marketing in Cameroon: A Case Study of Yaoundé Markets. Conference on International Research on Food Security, Natural Resource Management and Rural Development. University of Hamburg, October 6-8, 2009.

Cobb,C.W.,& Paul H. Douglas.(1928).A Theory of Production.The American Economic Review,18(1),139–165

Diomandé,L.(1992).Traitement et commercialisation du poisson au Cameroun. FAO. Extrait de http://www.fao.org. FAO. (2009). The State of World Fisheries and Aquaculture 2008.

FAO (2009) Fisheries and Aquaculture Department, Food and Agriculture Organization of the UN, Rome.

FAO. (2010). The State of World Fisheries and Aquaculture 2010. FAO Fisheries and Aquaculture Department, Food and Agriculture Organization of the UN, Rome.

Kébé, M., Njock J. C., & Gallène, J. (1993). Revue sectorielle de la pêche artisanale été maritime au Cameroun. Programme de Développement Intégré des Pêches Artisanales en Afrique de l'Ouest (DIPA), p. 30. + annexes, DIPA/WP/48.

Maina B. J., (2011). Analysis Of Market Performance: A Case Of Omena Fish In Selected Outlets In Kenya. A Masters Thesis, Egerton University

Molua, E.L. & Cornelius M. Lambi (2009). A Cropwat Experiment on Maize Water Requirements in Diverse Agroecological Zones in Cameroon: Some Implications for Climate Change. Journal of Applied Social Sciences, Vol. 8 (1): 1-24

Ngok E., Ndjamen D., and Dongmo J, V. (2005). Contribution économique et sociale de la pêche artisanale aux moyens d'existences durables et à la réduction de la pauvreté. Rapport Provisoire. p. 45.

Nout R, Hounhouigan JD, Van Boekel T (2003). Les aliments. Transformation, conservation et Qualité. Backhuys Publ., CTA.

Okeke-Agulu, N. A., & Chukwuone, K. (2012). Profitability of Catfish Production in JOS Metropolis of Plateau State, Nigeria: A Profit Function Approach. Agricultural Journal, 7(3), 226–229.

World Bank. (2013). Fish to 2030 Prospects for Fisheries and Aquaculture. Washington DC. doi:83177-GLB Yola, I. A. , Timothy, O. (2012). Proximate Composition and Consumer Acceptability of African Mudfish Clarias Gariepinus Smoked with Two Energy Sources. Bayero Journal of Pure and Applied Sciences, 5(2), 115–118.

ANALYSIS OF THE MARKET STRUCTURE OF SMOKED AND DRIED FISH IN KAINJI-INLAND FISHERIES AND THE STATES ALONG THE NIGERIA-NIGER BORDER

Omitoyin B O[1], Ajani E K[1], Falaye A E[1], Olajide O A[2], Oyesola O B[3], Ihenyen H E[4]. Chimatiro S K[5], and Okeleye I O[1]

[1]Department of Aquaculture and Fisheries Management, University of Ibadan, Ibadan Nigeria
[2]Department of Agricultural Economics, University of Ibadan, Ibadan Nigeria
[3]Department of Agricultural Extension a4nd Rural Development, University of Ibadan, Ibadan Nigeria
[4]Department of Fisheries, University of Benin, Benin City Nigeria
[5]Worldfish Centre, Zambia

Abstract

Improvement of food, nutritional security and poverty reduction in Africa can be addressed through better integration of intra-regional fish trade into the national policy agenda. Data crucial to the development of regional fish trade needs to be obtained. However, there is paucity of information on market structure, products and value of fish trade along regional borders in Africa. This study therefore investigated fish market structure, the market actor's characteristics, distribution channels, market profitability and efficiency along the Nigeria-Niger border and Lake Kainji inland fisheries. A multistage random sampling procedure was used in the selection of respondents for this study. Four states Sokoto, Katsina, Jigawa and Yobe along the Nigeria-Niger border and Niger State were selected. Data was collected from 150 respondents in each of the states comprising 50 producers, 50 processors and 50 marketers each, totalling 750. Data on socio-economic characteristics, marketing channel, market structure, profitability and trade flow were obtained. Data were analyzed using descriptive statistics, budgetary indices, Gini coefficient, stochastic production frontier model and ANOVA at □0.05. There was a predominance of male producers, marketers and processors in Katsina (100.0%, 98.0%, 98.0%), while in Niger state, processing was dominated by women (54.0%). Majority (50%) of the respondents were 35 years of age on average. The minimum and maximum average volume (kg) of fish traded within and across the states were for fried (882.25±339.15, 730.72±283.39) and fresh fish (1702.23±978.32; 1673.20±439.88). An average volume (kg) of 1386.46±760.57 of dried fish was traded across the regional border. Processors had the highest average gross margin per kg (□1157.94±492.26) while wholesalers had the least □387.94±363.87 for smoked fish. The Gini coefficient value for most of the actors showed partial inequality in the revenue distribution of fresh, smoked, dried, fried, spiced and frozen fish, except for wholesalers of smoked fish (0.34), retailers of spiced fish (0.45); wholesalers (0.41) and retailers (0.43) of frozen fish. Direct marketing channels were most efficient for fresh and processed fish. Market structures for most of the producers (capture), marketers and processors were monopolistic in nature and there was barrier into entry for fried and dried fish. The study recommends a review of governance systems, market structures, policies and institutions along the trade route leading to an effective organization of the markets.

Key Words: Marketing Channels, Profitability, Marketing Efficiency, Performance, Market structure

Corresponding author e-mail: bam_omitoyin@yahoo.co.uk

Introduction

Fish is indispensable in the diet, because of its content of high quality protein nutrient essential for good health, growth and maintenance of the body. The quality of fish protein is comparable to that of meat, milk and poultry (Ezihe, 2013). The fishery sector (captured and farm-raised) in Africa generates a variety of benefits including food and nutrition security, employment, livelihoods, exports and foreign currencies, conservation and biodiversity values. Due to its low cost, about 200 million people amounting to 30% of the continent's population eat fish as their main source of animal protein and micro nutrition (NEPAD, 2015) which is particularly important in Africa where one in three children are stunted as a result of poor nutrition (WorldFish, 2015).

Marketing of fish could be regarded as the performance of all business activities involved in the flow of fish from the point of production (Fisherman or fish farmer) to the final consumer (Olukosi *et al*., 2007). Marketing plays an important role in a market economy. Agricultural marketing is central to agricultural development and overall growth and development of the economy (Awoyinka, 2009). Marketing ensures that the right product is available at the right place, at the right price, at the right time in order to fully meet consumer expectations (Okoh *et al*., 2008). The marketing of agricultural commodities in Nigeria involves various markets or exchange points. Currently, people involved in marketing of fish are on the increase; this might be as a result of the profitability of the venture or increase in population (Ali *et al*., 2014).

Market structure refers to a set of market characteristics that determine the economic environment in which a firm operates (Thomas and Maurice, 2011). According to Olukosi *et al*. (2007), market structure tends to consider whether the number of firms producing a product is large or whether the firms are of equal sizes or dominated by a small group. It is also concerned with whether entry for new firms is easy or difficult and whether the purchases for the products are in a competitive state or not. It equally relates to the degree of market knowledge that is available to the participants. Market structure analysis emphasizes the nature of market competition and attempts to relate the variables of market performance to types of market structure and conduct. It is a description of the number and nature of participants in a market while market conduct deals with the behaviour of firms. Firms that are price makers are expected to act differently from those in a price taker type of industry. The term competition always indicates the presence of at least two sellers and two buyers of a definite commodity, in this kind of market situation, each seller acts independently of the other sellers and each buyer also acts independently of the other buyers (Reddy *et al*., 2010).

Several studies have utilized Gini Coefficient as one of the measures of market structure; most of them have found inequality in the distribution of income in fish markets thus resulting in an inefficient market structure. Entry analysis goes beyond asking whether impediments exist and whether entry could conceivably occur. Typically, it also asks whether entry would occur and, if so, whether it is likely to happen quickly enough and to be substantial enough to fix the anticompetitive problem that is central to a case (Organisation for Economic Co-operation and Development, OECD, 2007). Entry and exit conditions are important factors that determine existing firms' possibilities to exert market power. Gona *et al*., (2004) showed that the degree of concentration of marketers is indicated by the value of Gini coefficient. The Gini coefficient value ranges from zero to one. A perfect equality in concentration (low) of sellers is expected if Gini coefficient tends towards zero, while perfect inequality in concentration (high) of sellers is expected if Gini coefficient tends towards one. That is, if Gini coefficient = 1 market is imperfect, and if Gini coefficient = 0 market is perfect and competitive. Knowledge of market structure is important in that it affects market outcomes through its impact on the motivations, opportunities and decisions of economic actors participating in the market. Therefore,

this study analysed the structure of smoked and dried fish markets in the States along the Nigeria-Niger border with the application of the Gini coefficient

Methodology

Study Area

The Nigerian Niger border region comprises of Sokoto, Katsina, Jigawa, and Yobe State Sokoto State was situated in the North Western corner of Nigeria (Figure 1); Sokoto state occupies 25,973 square kilometres. Sokoto shares its borders with Niger republic to the North, Zamfara state to the East, Kebbi state to the South East and Benin Republic to the West (Nigeria Galaria 2015).

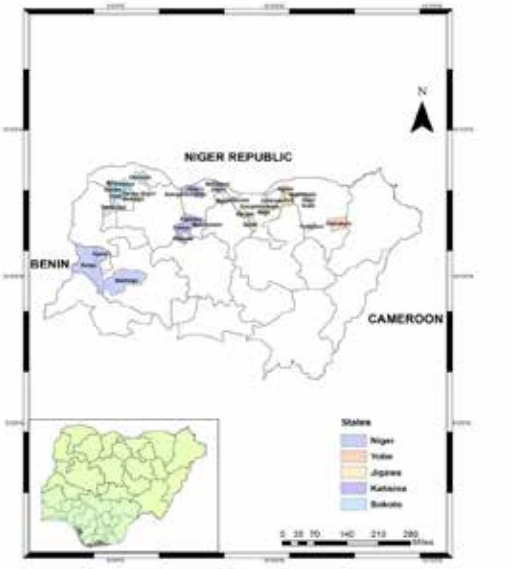


Figure 1: Map showing the Local Governments sampled along the Nigeria-Niger border and Lake Kainji-inland fisheries

Katsina state is one of the seven states in North-west Nigeria. It is located in the Sudan savannah agro-ecological zone. The state lies between longitude 12°59' N and latitude 7°36' E. The state is bounded in the East by Kano and Jigawa States, in the West by Zamfara State, in the South by Kaduna State and in the North by Niger Republic. It has a total land area of 1.64 million ha. Rainfall in Katsina State ranges from 400-800 mm in the Northern and Southern part, respectively (Adekunle *et al*., 2005). The state has a population of about 5,792,579 (National Population Commission., 2006). The population of the study includes all marketers and processors in the Lake Kainji inland fisheries and the States along the Nigeria- Niger border.

Sampling procedure and Data Collection

A multistage sampling procedure was employed in the States along the Nigeria-Niger Border:

Stage 1: States were randomly selected from states from the Nigeria-Niger border.

Stage 2: Purposive selection of Local governments based on the prevalence of fishing activities in the area

Stage 3: Random selection was used to select the respondents from these local government areas. There were Twenty nine local government areas that were sampled within all the states in total, they were: Goronyo, Binji, Kware, Silame, Yabo, Tambuwal, Bodinga, and Dange-shuni in Sokoto state. Jibia, Batagarawa, Kankara, Faskari, Sabuwa, Malumfashi, Mai'Adua, and Daura in Katsina state. Roni, Kazuare, Ringim, Dutse, Kaugama, Auyo, Miga, Kirikasa, and Guri in Jigawa state. Nguru, Bade, Potiskum and Damaturu in Yobe state.

Niger state was selected based on the presence of the Kainji dam. Three (3) Local government areas were selected from around the dam based on the intensity of fishing activities there. They were Borgu, Agwara and Mashagu. The sample size from each state was 100 respondents comprising 50 processors and 50 marketers in each State with a total of 500 respondents in all the states. Quantitative method was used for collection of primary data; this was collected with aid of a structured questionnaire which was administered to the respondents by trained enumerators. A structured questionnaire was used in the collection of data. One type of questionnaire was used for the three levels of operation (Producer, Marketer, and Processor).

Market Structure

Concentration

The Gini coefficients were used to determine the degree of market concentration of sellers in the market. The Gini coefficients were computed by using the following formulae according to Okereke and Anthonio (1988):

$$G=1-\Sigma xy$$

Where:
G = Gini coefficient.
x = Percentage share of each class of seller.
y = Cumulative percentage of the sales.

The Gini coefficient ranges from zero to one. A perfect equality in concentration (low) of sellers is expected if GC tends towards zero, while perfect inequality in concentration (high) of sellers is expected if GC tends towards one, if G = 1 market is imperfect, and if G = 0 market is perfect and competitive.

Ease of/or Barrier to Entry or Exit

In a perfect competitive market, there is ease of entry or exit by sellers. The market becomes imperfect when sellers concentration is not even (imbalance). Scale economies is the measure that was used to determine entry and exit conditions in the market. It is a measure that examines the average cost function associated with the sellers' marketing activities. This was computed using least square regression of the form:

$$b_0 + b_i x_i + e$$

(Pomeroy, 1989)

Where:
y = Total cost of marketing per class of seller per week (N).
xi = Number of dried fish (cartoon) sold per week.
bi = Coefficient of explanatory variables.
bo = Intercept.
e = Error term.

If the coefficient of bi is negative, it means as quantity increases, cost decrease; this increase in cost could form barrier to entry especially by sellers that are not financially sound.

Results and Discussion

Market Structure

Processors (Smoked fish)

Table 1 shows that majority (14.5%) of smoked fish processors in the States along the Nigeria-Niger border and the Lake Kainji Inland fisheries earn between □1,750,000.01 – 2,000,000.00. The value of the Gini coefficient computed was 0.54. Figure 2 shows the Lorenz curve of smoked fish processor in fish markets along Nigeria-Niger border and Kainji Lake Fisheries.

The value of the Gini coefficient computed for smoked fish processors indicates that there is partial inequality in the market earnings of smoked fish processors which tend to imply that the smoked fish market for processors is concentrated but few of them control the market share. Thisalso shows a monopolistic nature indicating inefficiency in the market structure of smoked fish among processors in the States along the Nigeria-Niger border and the Lake Kainji Inland fisheries this corresponds with the findings of Ismail *et al*. (2014) who reported a Gini coefficient value of 0.5478 indicating that the wholesaler of dried fish were concentrated suggesting the possibility of existence of non-competitive behaviour with monopolistic nature.

Wholesaler (Smoked fish)

Table 2 shows the computation of Gini coefficient for wholesalers of smoked fish. About 61.10% of the wholesalers of smoked fish had monthly revenue of less than equal □4000000.01. The Gini coefficient value of 0.34 tends toward zero. Figure 3 shows the Lorenz curve of smoked fish marketed by wholesalers along the Nigeria-Niger border and Lake Kainji inland fisheries. The value of the Gini coefficient computed for wholesalers of smoked fish indicates that there is equality in the market share/earnings of wholesalers

of smoked fish. This result means that most of the wholesalers of smoked fish have revenue within the same range implying that there is high competition in the market and therefore suggesting an efficient market structure. This is further buttressed by the Lorenz curve which is very close to the 45o line therefore indicating equality in market share. This is in line with the findings of Ugwumba *et al.* (2011) who analysed the market structure of fresh fish market in Anambra and reported Gini coefficient index of 0.19 for retailers that demonstrated evidence of a perfectly competitive market.

Table 1: Monthly revenue and sale of smoked fish marketed by the processors

Total Revenue (□)	Frequency	% of Marketers (X)	Cumulative Percent	Total Value of Monthly Sales (□)	% of Total Sales	Cumulative Percent (Y)	XY
750000.01 - 1000000.00	1	0.80	0.80	800000.00	0.23	0.23	0.00
1000000.01 - 1250000.00	2	1.60	2.40	2358000.00	0.68	0.91	0.00
1250000.01 - 1500000.00	11	8.90	11.30	15325996.30	4.40	5.31	0.00
1500000.01 - 1750000.00	16	12.90	24.20	25891344.10	7.43	12.74	0.02
1750000.01 - 2000000.00	18	14.50	38.70	33449436.50	9.60	22.34	0.03
2000000.01 - 2250000.00	13	10.50	49.20	27347651.50	7.85	30.19	0.03
2250000.01 - 2500000.00	10	8.10	57.30	23565842.20	6.76	36.95	0.03
2500000.01 - 2750000.00	6	4.80	62.10	15675977.50	4.50	41.45	0.02
2750000.01 - 3000000.00	2	1.60	63.70	5632546.50	1.62	43.07	0.01
3000000.01 - 3250000.00	1	0.80	64.50	3250000.00	0.93	44.00	0.00
3250000.01 - 3500000.00	0	0.00	64.50	0.00	0.00	44.00	0.00
3500000.01 - 3750000.00	6	4.80	69.40	22185922.00	6.37	50.37	0.02
3750000.01 - 4000000.00	5	4.00	73.40	19233500.00	5.52	55.89	0.02
≥ 4000000.01	33	26.60	100.00	153717031.00	44.11	100.00	0.27
Total	124	100.00		348433248.00	100.00	∑xy	0.46

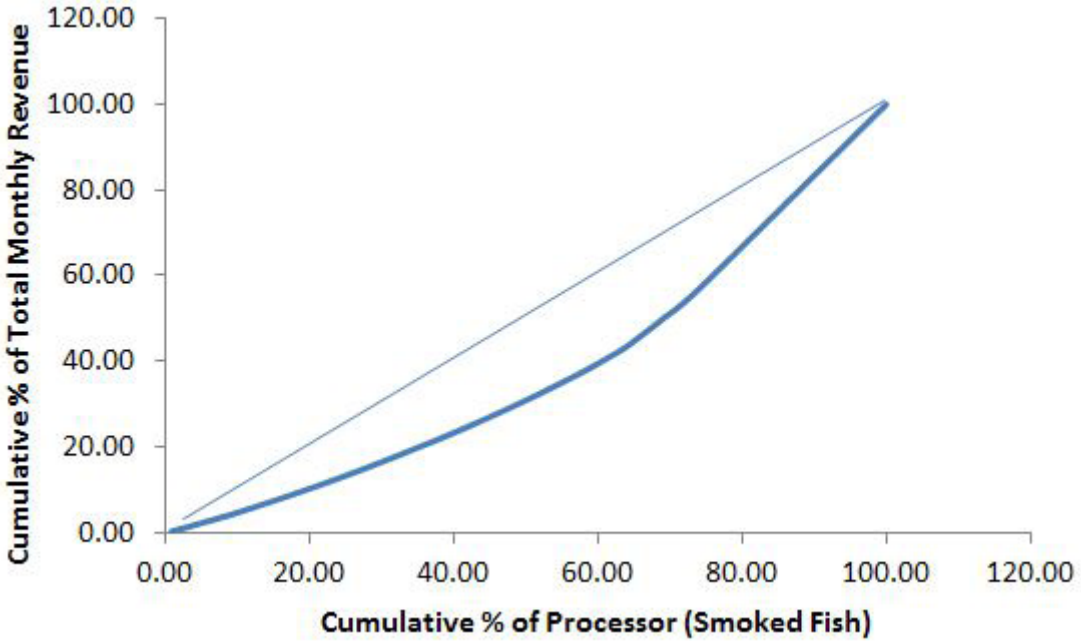


Figure 2: Lorenz-curve of smoked fish processor in fish markets along Nigeria-Niger border and Kainji Lake Fisheries

Table 2: Cumulative percentage of monthly revenue and sale of smoked fish marketed by the wholesalers

Total Revenue (☐)	Frequency	% of Wholesaler (X)	Cumulative Percent	Total Value of Monthly Sales (☐)	% of Total Sales	Cumulative Percent (Y)	∑xy
2000000.01 - 2250000.00	2	5.60	5.60	4313400.00	2.43	2.43	0.0014
2250000.01 - 2500000.00	2	5.60	11.10	4823000.00	2.71	5.14	0.0029
2500000.01 - 2750000.00	2	5.60	16.70	5348400.00	3.01	8.15	0.0046
3000000.01 - 3250000.00	3	8.30	25.00	9525000.00	5.35	13.50	0.0112
3250000.01 - 3500000.00	1	2.80	27.80	3333330.00	1.87	15.37	0.0043
3500000.01 - 3750000.00	3	8.30	36.10	10876111.50	6.11	21.48	0.0178
3750000.01 - 4000000.00	1	2.80	38.90	3840000.00	2.16	23.64	0.0066
≥4000000.01	22	61.10	100.00	135821407.40	76.36	100.00	0.6110

Gini coefficient 0.34
Source: Field survey, 2016

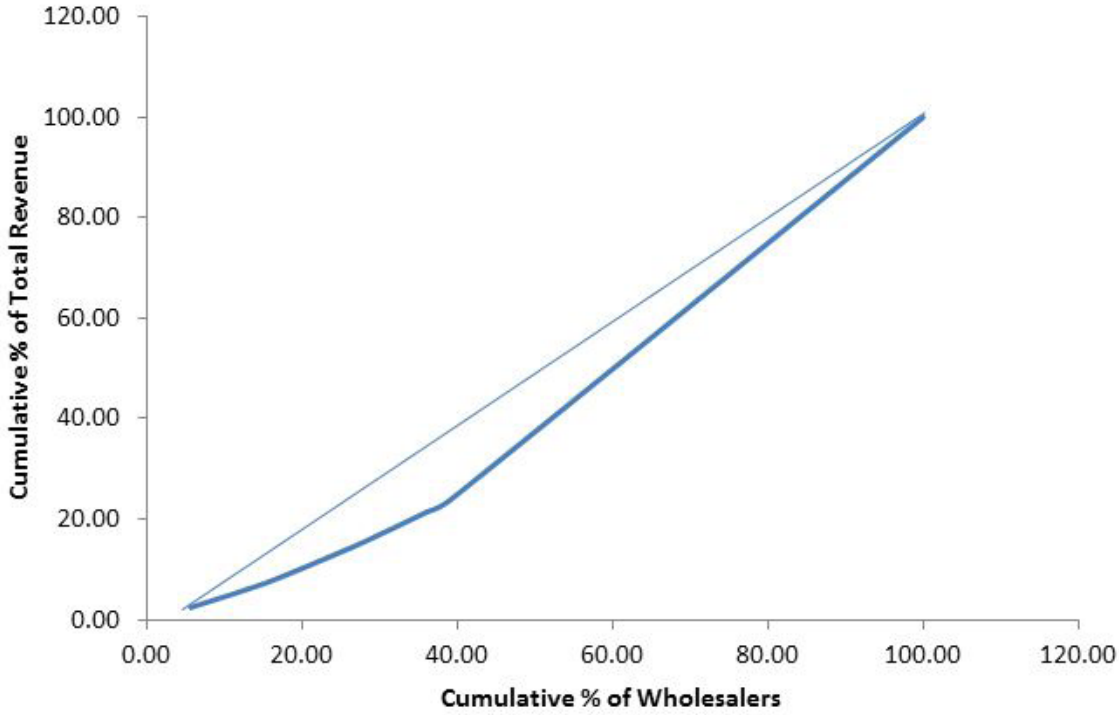


Figure 3: Lorenz-curve of wholesalers marketing smoked fish products along Nigeria-Niger border and Kainji Lake Fisheries

Retailers (Smoked Fish)

Table 3 shows that the majority (20%) of the retailers of smoked fish in the States along the Nigeria-Niger border and Lake Kainji inland fisheries had total monthly revenue of between ☐2,000,000.01 – 2,250,000.00. The value of the Gini coefficient 0.53 tends towards zero. Figure 4 shows the Lorenz curve of smoked fish retailers in the States along the Nigeria-Niger border and Lake Kainji inland fisheries. The value of the Gini coefficient computed for retailers of smoked fish indicates that there is partial inequality in the market share of retailers of smoked fish in the States along the Nigeria-Niger border and Lake Kainji inland fisheries; this implies that most of the retailers of smoked fish do not have revenue within the same range meaning that few retailers of smoked fish dominate the market which indicatesthe possibility of non-competitive behaviour and monopolistic nature and therefore inefficiency in the market structure. The Lorenz curve is farther from the 45o line than that of wholesalers of smoked fish therefore indicating a level of inequality in the market share. This observation is in line with the findings of Ismail *et al.* (2014) who reported a Gini coefficient of 0.5252 for retailers of dried fish in Maiduguri showing high concentration and monopolistic behaviour in the market structures.

Processors (Dried Fish)

Table 4 shows that majority (24.10%) of the processor of dried fish in the States along the Nigeria-Niger border and the Lake Kainji Inland fisheries earn between ☐1,750,000.01 – 2,000,000.00. The value of the Gini coefficient computed was 0.53. Figure 5 shows the Lorenz curve of dried fish processor in fish markets along Nigeria-Niger border and Kainji Lake Fisheries. The value of the Gini coefficient computed for processors of dried fish indicates there is partial inequality in the market earnings of dried fish processors in the States along the Nigeria-Niger border and the Lake Kainji

Inland fisheries. This finding implies that most processors of dried fish do not have revenue within the same range implying the existence of a monopolistic nature in the market and hence an inefficient market structure of dried fish among processors this is in line with the findings of Afolabi (2008) who found obtained a Gini coefficient of 0.5854 showing a high level of concentration and hence high level of inefficiency in the market for smoked fish.

Wholesaler (Dried)

Table 5 shows the computation of the Gini coefficient of wholesalers of dried fish. The table indicates that majority (45.50%) of the wholesalers earn greater than equal to ☐4,000,000.01.The value of the Gini coefficient computed was 0.43. Figure 6 shows the Lorenz curve of dried fish marketed by wholesalers along the Nigeria-Niger border and Lake Kainji inland fisheries.The value of the Gini coefficient computed for wholesalers indicates that there is partial equality in the market share/earnings of wholesalers of dried fish. This implies that there is low concentration of wholesalers and high competition amongst them. It means that no one firm dominates the market of dried fish amongst wholesalers hence high efficiency in the market structure.This is further buttressed by the area between the line of perfect equality and the Lorenz curve which is small, this is in line with the findings of Ugwumba *et al*. (2011) who analysed the market structure of fresh fish market in Anambra and reported Gini coefficient indices of 0.26 for producers/ suppliers, 0.34 for wholesalers and 0.19 for retailers reflecting evidence of a perfectly competitive market.

Retailer (Dried Fish)

Table 6 shows that majority of the dried fish retailers in the States along the Nigeria-Niger border and Lake Kainji inland fisheries have monthly revenue of between ☐2,250,000.01 – 2,500,000.00.The value of the Gini coefficient computed was 0.57. Figure 7 shows the Lorenz curve of dried fish marketed by retailers in the States along the Nigeria-Niger border and Lake Kainji inland fisheries. The value of the Gini coefficient computed for retailers implies that there is inequality in the market share/earnings of retailers of dried fish marketed in the States along the Nigeria-Niger border and Lake Kainji inland fisheries. This means that there few retailers dominate the market of dried fish in the area. This possibly suggests an inefficient market structure for dried fish among retailers in the area. This is supported by the Lorenz curve which shows that the area between the perfect line of equality and the Lorenz curve is wide. This is in line with the findings of Oparinde and Ojo (2014) who reported a Gini coefficient of 0.64 which showed that there was inequality in the share of the artisanal fresh fish market.

Table 3: Monthly revenue and sale of smoked fish marketed by the retailers

Total Revenue (☐)	Frequency	% of Retailers (X)	Cumulative Percent	Total Value of Monthly Sales (☐)	% of Total Sales	Cumulative Percent (Y)	∑xy
1000000.01 - 1250000.00	3	6	6.00	3129000.00	2.39	2.39	0.00
1500000.01 - 1750000.00	1	2	8.00	1630000.00	1.26	3.65	0.00
1750000.01 - 2000000.00	5	10	18.00	9350320.20	7.15	10.80	0.01
2000000.01 - 2250000.00	10	20	38.00	21490600.00	16.43	27.23	0.05
2250000.01 - 2500000.00	7	14	52.00	16771154.00	12.82	40.05	0.06
2500000.01 - 2750000.00	5	10	62.00	13039000.00	9.97	50.02	0.05
2750000.01 - 3000000.00	7	14	76.00	20015991.00	15.31	65.33	0.09
3000000.01 - 3250000.00	2	4	80.00	6139120.00	4.69	70.02	0.03
3250000.01 - 3500000.00	5	10	90.00	17166113.00	13.13	83.15	0.08
3750000.01 - 4000000.00	1	2	92.00	3850000.00	2.94	86.09	0.02
≥ 4000000.01	4	8	100.00	18194000.00	13.91	100.00	0.08
Total	50	100		130775298.2	100		0.47

Gini coefficient 0.34
Source: Field survey, 2016

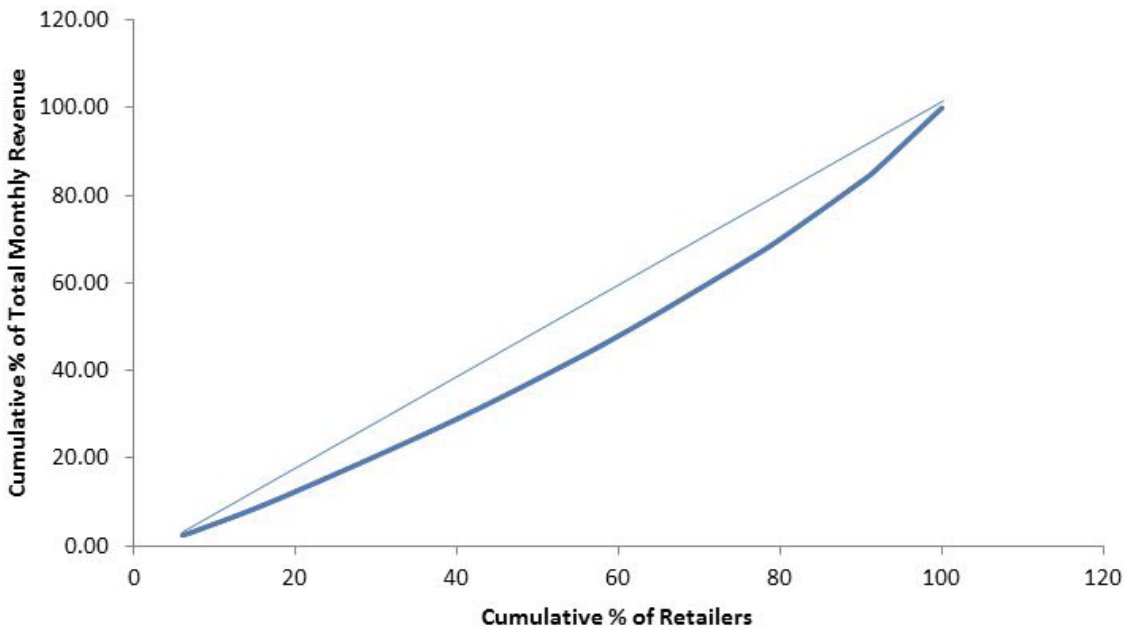


Figure 4: Lorenz-curve of retailers marketing smoked fish products along Nigeria-Niger border and Kainiji Lake Fisheries

Table 4: Monthly revenue and sale of dried fish marketed by the processors

Total Revenue (☐)	Frequency	% of Marketers (X)	Cumulative Percent	Total Value of Monthly Sales (☐)	% of Total Sales	Cumulative Percent (Y)	∑xy
1000000.01 - 1250000.00	1	1.70	1.70	1147575.00	0.88	0.88	0.00
1250000.01 - 1500000.00	4	6.90	8.60	5492125.00	4.22	5.10	0.00
1500000.01 - 1750000.00	12	20.70	29.30	19431833.50	14.93	20.03	0.04
1750000.01 - 2000000.00	14	24.10	53.40	25614557.50	19.68	39.71	0.10
2000000.01 - 2250000.00	8	13.80	67.20	16683772.10	12.82	52.53	0.07
2250000.01 - 2500000.00	7	12.10	79.30	16250158.20	12.49	65.02	0.08
2500000.01 - 2750000.00	3	5.20	84.50	7581000.00	5.83	70.85	0.04
2750000.01 - 3000000.00	2	3.40	87.90	5712000.00	4.39	75.24	0.03
3750000.01 - 4000000.00	2	3.40	91.40	7888000.00	6.06	81.30	0.03
≥4000000.01	5	8.60	100.00	24343524.00	18.70	100.00	0.09
Total	58	100.00		130144545.30	100.00	∑xy	0.47

Gini coefficient 0.34
Source: Field survey, 2016

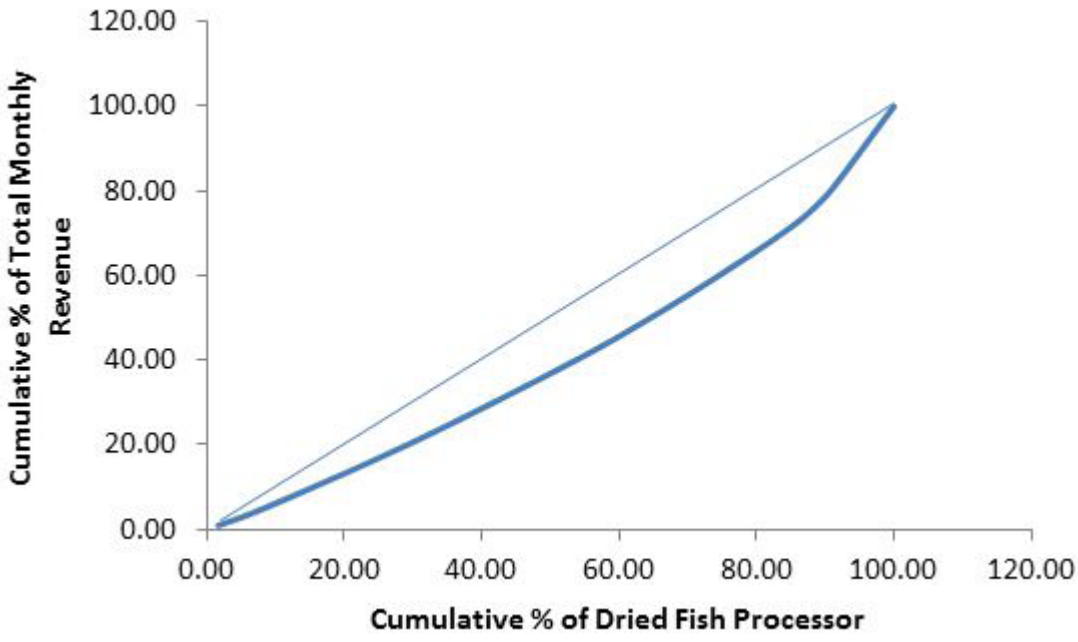


Figure 5: Lorenz-curve of dried fish processor in fish markets along Nigeria-Niger border and Kainji Lake Fisheries

Table 5: Monthly revenue and sale of dried fish marketed by the wholesalers

Total Revenue (☐)	Frequency	% of Wholesaler (X)	Cumulative Percent	Total Value of Monthly Sales (☐)	% of Total Sales	Cumulative Percent (Y)	∑xy
2250000.01 - 2500000.00	2	18.20	18.20	4740000	9.99	9.99	0.02
2500000.01 - 2750000.00	1	9.10	27.30	2520000	5.31	15.30	0.01
3000000.01 - 3250000.00	1	9.10	36.40	3234000	6.81	22.11	0.02
3250000.01 - 3500000.00	2	18.20	54.50	6690000	14.10	36.21	0.07
≥4000000.01	5	45.50	100.00	30271034	63.79	100.00	0.46
Total	11	100.00		47455034	100.00		0.57

Gini coefficient 0.34
Source: Field survey, 2016

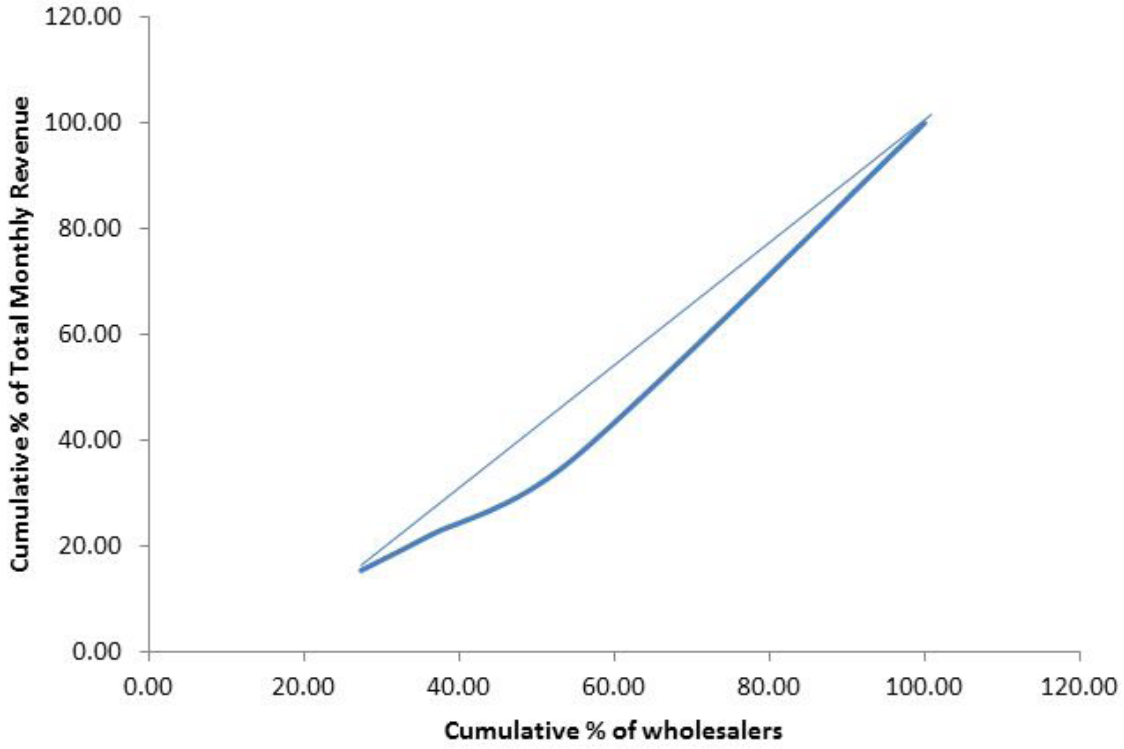


Figure 6: Lorenz-curve of wholesalers marketing dried fish products along Nigeria-Niger border and Kainji Lake Fisheries

Table 6: Cumulative percentage of monthly revenue and sale of dried fish marketed by the retailers

Total Revenue (☐)	Frequency	% of Retailers (X)	Cumulative Percent	Total Value of Monthly Sales (☐)	% of Total Sales	Cumulative Percent (Y)	∑xy
500000.01 - 750000.00	2	5.60	5.60	1271400.00	1.42	1.42	0.00
750000.01 - 1000000.00	6	16.70	22.20	5501000.00	6.15	7.57	0.01
1000000.01 - 1250000.00	2	5.60	27.80	2293000.00	2.56	10.13	0.01
1500000.01 - 1750000.00	1	2.80	30.60	1575000.00	1.76	11.89	0.00
2000000.01 - 2250000.00	4	11.10	41.70	8631266.80	9.64	21.53	0.02
2250000.01 - 2500000.00	8	22.20	63.90	18617523.20	20.80	42.33	0.09
2500000.01 - 2750000.00	2	5.60	69.40	5113000.00	5.71	48.04	0.03
2750000.01 - 3000000.00	1	2.80	72.20	2925000.00	3.27	51.31	0.01
3000000.01 - 3250000.00	3	8.30	80.60	9505280.00	10.62	61.93	0.05
≥4000000.01	7	19.40	100.00	34070400.00	38.07	100.00	0.19
Total	36	100.00		89502870.00	100.00		0.43

Gini coefficient = 0.57
Source: Field survey, 2016

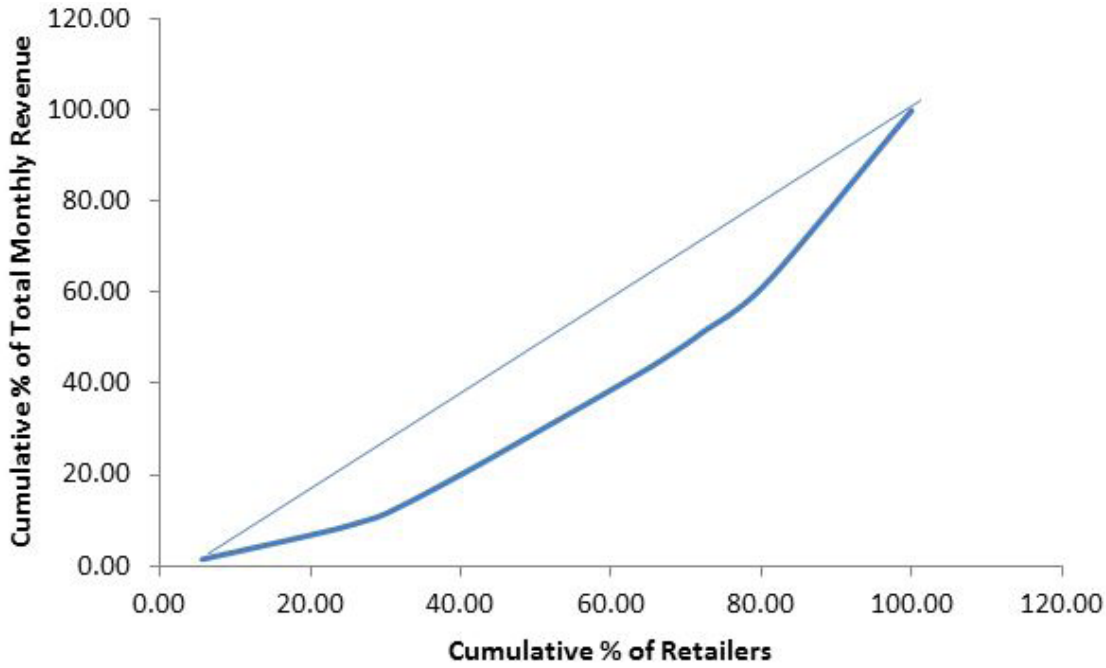


Figure 7: Lorenz-curve of retailer marketing dried fish products along Nigeria-Niger border and Kainji Lake Fisheries

Barrier to Market entry/exit

Smoked Fish

The relationship of total monthly marketing cost and total monthly quantity of smoked fish sold in the states along the Nigeria-Niger border and the Lake Kainji inland fisheries is presented in figure 8. The regression coefficient value is positive, 6.03. The regression model for smoked fish is given as TMC = 25135.77+ 6.03Qs. The positive value of the regression coefficient implies that as the quantity of smoked fish sold increases, the total marketing cost increases. This further implies that there is no scale of economies and therefore no barrier to entry into the smoked fish market in the states along the Nigeria-Niger border and the Lake Kainji inland fisheries.

Dried Fish

Figure 9 shows the relationship of total monthly marketing cost and total monthly quantity of dried fish sold in the states along the Nigeria-Niger border and the Lake Kainji inland fisheries. The regression coefficient value is negative -7.66. The regression model is shown as TMC = 41605.06 – 7.66Qs. The regression coefficient value for dried fish is negative implying that as the quantity of dried fish sold increases, the total marketing cost decrease. This also this implies that there is scale of economies and therefore barrier to entry into the dried fish market in the states along the Nigeria-Niger border and the Lake Kainji inland fisheries. This means that marketers will have to operate on a large scale in order to enjoy reduced marketing cost which is consistent with the findings of Ismail *et al*. (2014) who reported a negative regression coefficient value and asserted that there was barrier to entry into the dried fish market in Maiduguri, Borno State.

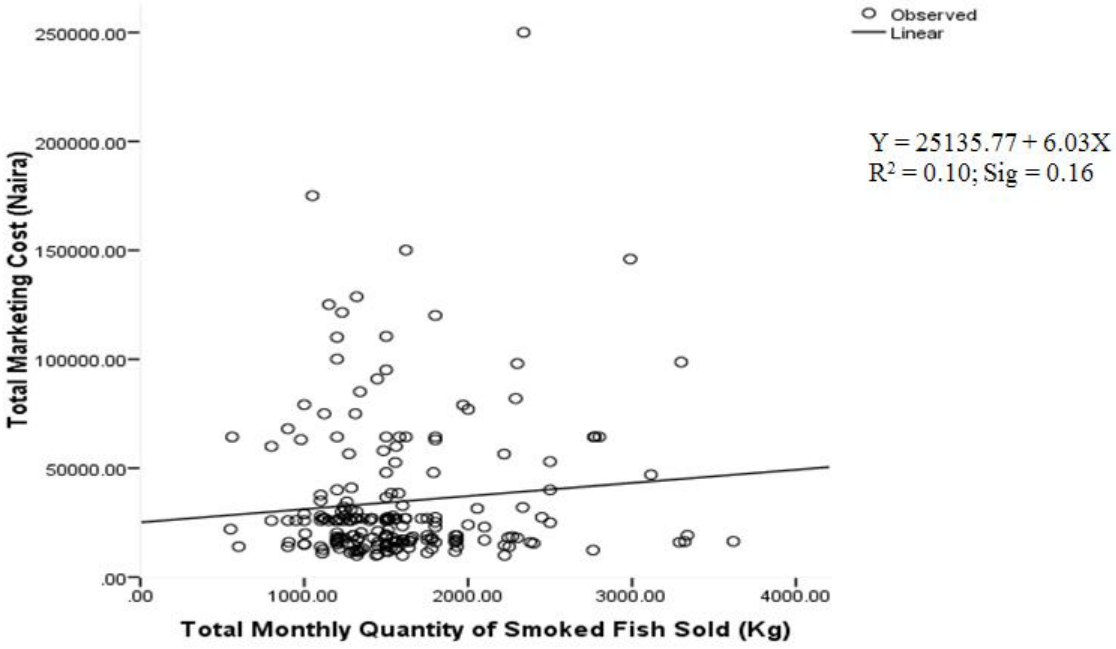


Figure 8: Relationship between total marketing cost and total monthly quantity of smoked fish sold

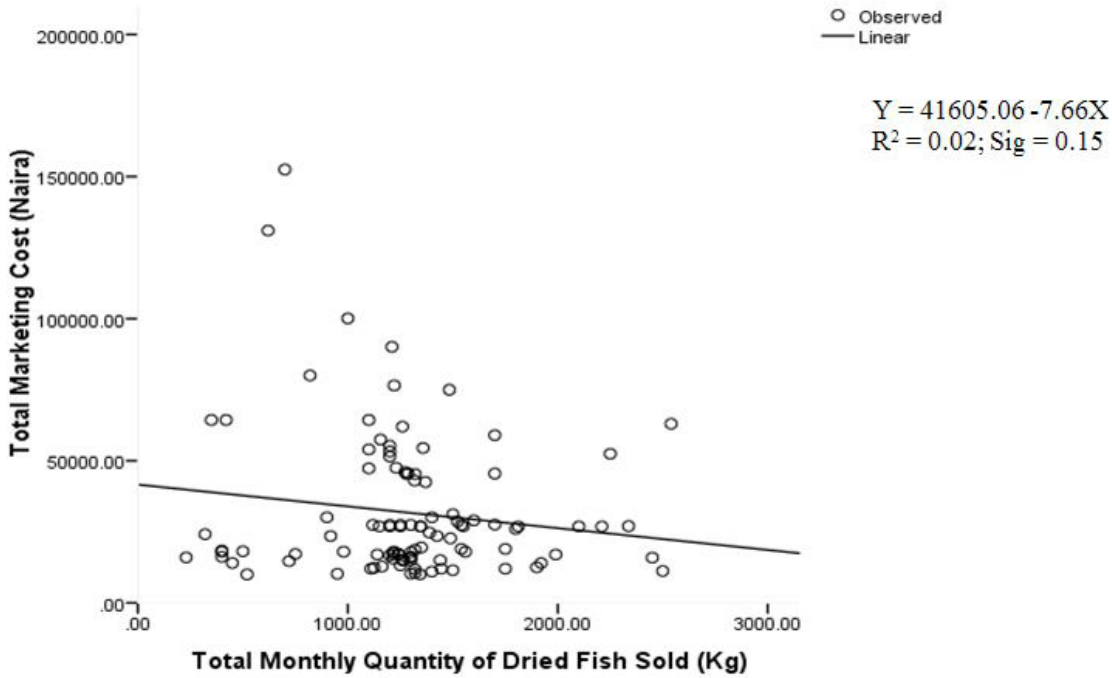


Figure 9: Relationship between total marketing cost and total monthly quantity of dried fish sold

Conclusion and Recommendation

The results of Gini coefficient indicate that the market structures for processors and retailers of smoked and dried fish were concentrated without competition and monopolistic in nature. Among wholesalers of processed fish products, the market structure was competitive in nature. basedon the results from the economies of scle, it can be concluded that there is no barrier of entry into smoked fish markets while there is an existence of barrier into dried fish markets in the States along Nigeria-Niger border.

Acknowledgement

Special thanks to WorldFish Center, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under the Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa", following the Malabo Declaration at the 2014 Summit African Heads of States and Governments in Equatorial Guinea. The funding was made possible through the assistance from the European Union.

References

Afolabi, J. A. 2008. Analysis of Smoked Fish Marketing in Nigeria. Proceedings of the Fourteenth Biennial Conference of the International Institute of Fisheries Economics & Trade, July 22-25, 2008, Nha Trang, Vietnam: Achieving a Sustainable Future: Managing Aquaculture, Fishing, Trade and Development.

Ali, M. M., Rahman, M. M., Hossain, M. Y., Rahman, M. Z., Hossen, M. A., Naser, S.M.A., Islam, R., Subba, B.R., Masood, Z. and Hoque, M.A. 2014. Fish marketing system in southern Bangladesh: Recommendations for efficient marketing. Our Nature 12.1:28-36.

Awoyinka, Y. A. 2009. Cassava Marketing: Option for Sustainable Agricultural Development in Nigeria. Ocean Journal of Applied Science 2.2:175-183.

Ezihe, J. A. C., Agbugba, I. K. and Ogbeba, J. 2014. Marketing channels and margin analysis of fish in Markurdi local government area in Benue state, Nigeria. Pacesetter Journal of Agricultural science 2.6:64-70.

Gona, A., Tanko, L. and Mohammed, I. 2004. Analysis of Market Performance of the Food Service Industry in Sokoto State, Nigeria. Proceedings of the 23rdAnnual National Conference of Farm Management Society of Nigeria, 14th– 17th December, 2009, Pp. 79 – 84. http://www.oecd.org/competition/mergers/37921908.pdf. 6.

Ismail, I., Tijani, B.A., Abdullah, A.M. and Mohammed, B. 2014. Analysis of Marketing Channel and Market structure of Dried Fish Marketing in Maiduguri Metropolis of Borno State Nigeria. European Journal of Business and Management 6.7: 147-155.

NEPAD 2015. The NEPAD Agency Fisheries and Aquaculture Programme. Retrieved on September 20th from www.nepad.org. 6.

Okoh, R.N., Ugwumba, C.O.A. and Elue, H.O. 2008. Gender roles in foodstuff marketing in delta-north agricultural zone: The case of rice. In: J.C. Ume, C.P. Obinne and W. Lawal (eds.), Prospects and Challenges of Adding Value to Agricultural Products: Proceedings of the 22nd Annual National Conference of Farm Managers Association of Nigeria (FAMAN), Markudi, Nigeria, 114–123.

Olukosi, J. O., Isitor, S. U. and Ode, M. O. 2007. Introduction to Agricultural Marketing; Principles and Application. 3rd Edition. G. U. Publisher, Abuja, Nigeria. 47 – 57.

Oparinde, L.O. and Ojo, S.O. 2014. Structural Performance of Artisanal Fish Marketing in Ondo State Nigeria. American Journal of Rural Development 2.1:1-7

Organisation for Economic Co-operation and Development 2007. Competition and barriers to entry. Policy Brief. Retrieved on 28th November, 2016 from

Pomeroy, R. S. 1989. The Economics of Production and Marketing in Small-scale Fishing. In Gregory J. S. Prices, Product and People; Analyzing Agricultural Markets in Developing Countries, Lynne Rienner Publishers, Inc Boulder, Colorado. 277-299.

Reddy, S. S., Ram, P. R., Sastry, T. V. N. and Devi, I. B. 2010. Agricultural Economics. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi 110049, India, 525-532.

Thomas, C.R. and Maurice, S.C. 2011. Managerial Economics: Foundations of Business Analysis and Strategy. 10th ed., John Wiley and Sons, New York. 26 – 47

Ugwumba, C.O.A., Okoh, R.N. and Uzuegbunam, C. O. 2011. Market Structure of Live Catfish in Anambra State, Nigeria. Journal of Agriculture and Social Sciences 7.1: 25-29.

WorldFish March 2015. Pan African Project to Focus on Potential of Fish for Increased Nutrition and Income. Press Release. WorldFish Penang, Malaysia. Retrieved on 26th July, 2016 from http://www.worldfishcenter.org/content/pan-africa-project-focus-potential-fish-trade-increased-nutrition-and-income

VALUE CHAIN ANALYSIS OF FISH TRADE ALONG NIGERIA-BENIN BORDER

Falaye A E[1], Ajani E K[1], Omitoyin B O[1], Oyesola O B[2], Olajide O A[3], Chimatiro S K[4] and Okeleye I O[1]

1Department of Aquaculture and Fisheries Management, University of Ibadan, Ibadan Nigeria
2Department of Agricultural Extension ad Rural Development, University of Ibadan, Ibadan Nigeria
3Department of Agricultural Economics, University of Ibadan, Ibadan Nigeria
4Worldfish Centre, Zambia

Abstract

Fish trade is an important tool in the distribution of fish and fish products from production point to point of demand. However, there have been challenges in developing inter-regional trade in West Africa as a result of limited empirical evidence and data on fish trade in the region. Therefore, this study assessed the socio-economic characteristics, profitability, and technical efficiencies of value-chain actors along Nigeria-Benin border. Six States (Oyo, Kwara, Ogun, Lagos, Niger and Kebbi) were purposively selected for the study because they lie along the borders. Multi-stage random sampling procedure was used to select 132 artisanal fishermen, 132 fish farmers, 264 fish processors, and 264 fish traders from whom data were collected using focus group discussions and structured questionnaires. The analytical tools used include descriptive statistics, budgetary tools and Cobb-Douglas function. Majority of the respondents were males: 92.42% for artisanal fishermen; fish farmer: 87.88%; fish processors: 54.55%; and fish traders and 59.09%. The average range of the respondents was 40 years. The profitability analysis indicated that artisanal fishermen and fish farmers in Lagos had the highest mean monthly revenues of ☐278,092.50±229,206.53 and ☐2,408,461.54±1,249,180.37, respectively those in Kwara State had the least revenues of ☐61,349.47±31,665.94 and ☐461,511.58±336,954.31 respectively. Smoked fish was the highest product (79.35%) produced by processors while spiced fish and fried fish were the least (1.11% and 1.52%). The smoked fish were processed from the fresh fish 'imported' across the Nigeria-Benin border in Ogun State. The Cobb-Douglas function indicated that the fish farmers and fish processors had technical efficiency of 0.88±0.02 and 0.89±0.02, respectively. In conclusion, value-addition is imperative for efficient and effective inter-regional fish trade irrespective of the fish products. Although, inter-regional trade was observed among the fish processors and traders, the percentage of processed fish products (dried and smoked fish) traded and the number of value-chain actors involved was extremely low. This study therefore recommends the need for provision of adequate fish trade facilities to boost inter-regional trade in the study area.

Keyword: Fish, Profitability, technical efficiency, inter-regional trade

Corresponding author email: aefalaye@yahoo.com

Introduction

Fish is one of the most important sources of food and income to many people in developing countries. According to FAO, 2012, the demand of fish globally and particularly in Nigeria has been on the increase not meeting up the demand with a supply gap at staggering 1.8 million tonnes (Oyinbo and Rekwot, 2013). Nwiro, 2012 described the Nigerian fish farming industry as being at the infant stage when compared to the large market potential for its production and market. As one of the important animal protein foods available in Nigeria, fish constitutes 40% of animal protein intake (Atanda, 2009) with a rapidly accelerating increase in its demand owing to the rapid increase in human population. Spore (2012) depicts value chain as actors connected along a chain to produce and deliver goods and services through a sequenced and coordinated set of activities that adds value at all stages (production, processing and distribution). The value chain concept is used to describe approaches aimed at improving market prospects for producers and scaling up profit margins.

In the distribution of fish and fish product, fish trade is key. Although, exports of fishery products are still subject to many trade barriers, tariffs play important roles in strategic business decisions on whether to export unprocessed fish products which normally have zero tariffs in the importing country. To gain control over revenue, exporting firms need to gain command of significant parts of the value chain for their products especially the latter stages where significant proportions of the total value adding occurs. With the world's fish supply trend and in spite of the huge import bills and recent government effort towards boosting fish production through aquaculture and sound fishery policies, the gap between projected fish demand and supply continues to widen (Bassey *et al*., 2015). The fish supply and marketing suffer from setbacks such as supply shortage, price fluctuations due to drying up of source, poor distribution and length of chain, spoilage in transit etc. (Esiobu and Onuobogu, 2014).

With the increase in value chain actors as a result of increase in the population with a corresponding increase in demand and despite the nutritional and commercial values of fish and fish products, its production and marketing remains low in Nigeria when compared to other nations of the world (FAO, 2012). The local fish seller is also faced with the problem of profit maximization due to the cumbersome nature of fish distribution channels (Magudu and Edward, 2011). Irrespective of the great opportunities embedded in Nigerian fisheries, a lot of fish resources are being discarded on a daily basis due to unorganized or uncoordinated distribution channel (Aihonsu and Shittu, 2008). With a job creation potential for over 41 million people, analysing the fisheries value chain will help provide insight into various employment opportunities that remain untapped in the fisheries sector (Kaplinsky and Morris, 2000). Nigeria thus have a great potential of fish resources whose distribution and value chain needs to be strengthened to bridge the gap between demand and supply of fish in Nigeria (Amao *et al*., 2006). Little is known about the quantities traded, the actual number of people involved and the type of trade they engage in, the products traded, or the problems value chain actors face in the sector (ICSF, 2002). There is also limited empirical evidence and data on socio-economic characteristics of value-chain actors, costs and return, profitability, technical efficiency and little information is, however, available about the volumes traded and the routes used in fish trade in Nigeria. Therefore, this study is determined to provide adequate information in this regard to help policy makers in enhancing inter-regional fish trade in the study area by examining the following:

- The socio-economic characteristics of value-chain actors in fish mark *et al*ong Nigeria-Benin border.
- The quantity of fish trade, costs, returns and profitability across the different actors along the value chain.
- Factors influencing the technical efficiency of the respondent value-chain actors in the study area.

- Constraints of actors along the fish market value chain along Nigeria-Benin border.

Methodology

The study focused on value addition and fish products in states along Nigeria-Benin borders. States considered along this border in Nigeria are Oyo, Kwara, Ogun, Lagos, Niger and Kebbi states. A multi-stage sampling technique was employed in this study. The six states were purposely selected based on their link with Nigeria-Benin border, where local governments were selected and respondents (main actors in the fish trade value chain) were randomly sampled from fish markets and farms were also selected randomly. Respondents in the States along Nigeria-Benin border were sampled from the following forty-six (46) local government areas: Ngaski, Argungu, Yauri, Shanga, Bunza, Jega, Augie in Kebbi state ,Borgu, Magama, Anfani in Niger state, Ogbomoso South, Egbeda, Iseyin, Oyo West, Iddo, Ibadan North West, Akinyele, Afijio, Ibarapa, in Oyo state, Ewekoro, Abeokuta, Ogun Waterside, Yewa North, Ado Odo, Ikenne, Sagamu, ijebuode, Ifo, Odeda, in Ogun state Badagry, Ikorodu, Eti Osa, Ibeju, Oshodi, Isolo, Ikotun, Ejigbo, in Lagos state, Asa, Offa, Ifelodun, Patigi, Baruten, Moro, Ilorin south, Ilorin West, Ilorin East in Kwara state. The study used primary data collected through questionnaires and personal interviews where respondents could not read or write. Group discussions with actor:s 22 fish farmers, 22 fishermen, 44 traders and 44 fish processors were also conducted.

The data was analysed using descriptive and inferential statistics, the budgetary technique were used to analyse the profitability, efficiency and structure of fish marketing. The market margin analysis was also used to measure market performance.

According to Omonona and Udoh, 1999 defined the absolute market margin and marketing efficiency as;

Marketing margin= Total marketing revenue - Purchase cost

Marketing efficiency= Total revenue - Total marketing cost.

The model used in estimating the gross margin is;

Gross margin income = Σ Total Revenue - Σ Total Variable Cost

Total Revenue = Unit Price of Output Produced (Naira) * Quantity of output produced (kg)

Net Returns = Total Revenue - Total Cost

where Total Cost = Total Variable Cost + Total Fixed Cost.

Market structure:

The structure of dried fish markets was described based on findings on concentration, product differentiation and ease of/or barrier to entry or exist.

Scale economics was used to determine the entry and exit conditions in the market. It examines the average cost function associated with the sellers marketing activities. This was computed using least square regression of the form

$y = b0 + bixi + e$ (Pomeroy, 1989).

Where:
y = Total cost of marketing per class of seller per week (N).
xi = Number of dried fish (cartoon) sold per week.
bi = Coefficient of explanatory variables.
bo = Intercept
e = Error term.

If the coefficient of bi is negative, it means as quantity increases, cost decrease. This increase in cost could form barrier to entry especially by sellers that are not financially sound.

Technical Efficiency and Production Function

A stochastic production frontier (SPF) function was specified which related the fish production as a function of inputs used according

to Singh *et al.* (2009). Assumption about the functional form is an important consideration in the specification of an econometric model. Past studies on technical efficiency utilizing stochastic frontier approach have used either Cobb-Douglas (CD) or the transcendental logarithmic (translog) functional forms. When the second order and the interaction terms in translog are restricted to zero, then the resulting functional form represents a Cobb-Douglas form. The translog and Cobb-Douglas models are specified as per Equation (1) and (2), respectively:

$$\ln Y_i = \beta o + \sum_{j=1}^{n} \beta_j \ln X_{ij} + \sum_{j=1}^{n} \sum_{j=1}^{n} \beta_j (\ln X_{ij} X \ln X_{ij}) + v_i - \mu_i \quad \ldots\ldots (1)$$

$$\ln Y_i = \beta o + \sum_{j=1}^{n} \beta_j \ln X_{ij} + v_i - i \quad \ldots\ldots (2)$$

where, Y is the fish production, Xjs are the inputs, subscripts 'i', 'j'/'k' denote the ith farm and jth/kth inputs, Vi is independent and identically distributed random errors having normal distribution N(0, □2v and independent of μi., μi is the technical inefficiency effects, and βs are the parameters to be estimated.

v_i is the random component of error term. The variance parameters □2u and □2v are expressed in terms of parameterization: □2μ + □2v = □2 and □ = □2μ/ □2, □ can take values from 0 to 1, where 0 implies that the random component of model is due to noise whereas □ = 1, implies that the random component of model is entirely due to inefficiency. The independent variables (Xjs) included in the model were cost of fish seed, lime, feeding, labour, other operational costs (including cost of water, medication and others) and depreciated fixed cost for the artisanal fish farmers; cost of fresh fish processed, processing, total variable cost, depreciated fixed cost and production cost for fish processors.

Results

Tables 1, 2, 3 and 4 profile the socio-economic characteristics of artisanal fishermen, producers, processors and traders in the study area. Analysis of sex of the respondents revealed that majority of the respondent artisanal fishermen were male. Odebiyi *et al.* (2013) and Jim-Saiki (2016) reported that majority of the respondents are male. The result is consistent with the findings of Inoni and Oyaide (2007), who reported male as the dominant (72.3%) fishermen in Delta.

This study revealed that majority of the respondents' ages in the study area were within the age group of 31-40 years. The implication was that the respondents were within the productive and economic active age, and could be able to increase fish catch and improve livelihood of the families. The finding was in agreement with those of Olaoye (2013), who found that most of the fisher folks are in their economic active ages to undertake strenuous task associated with the fishing enterprise. The results of this study revealed that most people involved in fish traders were married. This indicated that fish marketing was a source of livelihood for the marketers and their families. This is in line with the study of Afolabi (2009), who observed that marketers were dominated by married people. Also, Kainga and Adeyemo (2012) recorded the same result. This also is in agreement with the findings of Nwabunike (2015) who reported majority of the fish traders to be married, though each of the categories were represented. Fish traders were dominated by individuals who had little or no formal education. This agrees with the findings of Kainga and Adeyemo (2012) who reported that most fish marketers in Bayelsa State had no formal education. In south-western Nigeria, most agricultural fish marketers had primary education (Afolabi, 2009). Majority of the fish processor in the study area were within the age bracket of 31-40 years, a highly productive and active age when actors could undertake strenuous task. This corroborates the observation of Odebiyi *et al.* (2013) and George *et al.* (2010) that age had a positive correlation with productivity of fish processors in Nigeria.

Table 1a: Socio-economic characteristics of artisanal fishermen in Sampled States along Nigeria-Benin border

Variable	Category	Kwara		Niger		Oyo	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
Sex	Male	16	72.73	22	100.00	22	100.00
	Female	6	27.27	0	0.00	0	0.00
Age	Less or equal 30	6	27.27	4	18.18	2	9.09
	31 – 40	7	31.82	10	45.45	8	36.36
	41 – 50	8	36.36	6	27.27	7	31.82
	51 – 60	1	4.55	2	9.09	3	13.64
	Above 60	0	0.00	0	0.00	2	9.09
Marital Status	Married	21	95.45	22	100	22	100.00
	Single	1	4.55	0	0.00	0	0.00
	Divorced	0	0.00	0	0.00	0	0.00
	Widowed	0	0.00	0	0.00	0	0.00
	Separated	0	0.00	0	0.00	0	0.00
Religion	Christian	9	40.91	1	4.55	10	45.45
	Islamic	13	59.09	21	95.45	12	54.55
	Others	0	0.00	0	0.00	0	0.00
Level of Education	No Formal Education	6	27.27	0	0.00	6	27.27
	Primary Education	11	50.00	9	40.91	9	40.91
	Tertiary Education	1	4.55	0	0.00	5	22.73
	Quranic Education	3	13.64	13	59.09	2	9.09
	Secondary Education	1	4.55	0	0.00	0	0.00
Household size	Less or equal 5	7	31.82	14	63.64	10	45.45
	6 – 10	15	68.18	6	27.27	10	45.45
	11 – 15	0	0.00	1	4.55	1	4.55
	Above 15	0	0.00	1	4.55	1	4.55
Fish catching experience	Less or equal 10	6	27.27	9	40.91	3	13.64
	11 – 20	10	45.45	9	40.91	9	40.91
	21 – 30	4	18.18	4	18.18	7	31.82
	31 - 40	2	9.09	0	0.00	1	4.55
	Above 40	0	0.00	0	0.00	2	9.09

Table 1b: Socio-economic characteristics of artisanal fishermen in Sampled States along Nigeria-Benin border

Variable	Category	Ogun		Lagos		Kebbi	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
Sex	Male	19	86.36	21	95.45	22	100.00
	Female	3	13.64	1	4.55	0	0.00
Age	Less or equal 30	2	9.09	3	13.64	3	13.64
	31 – 40	2	9.09	12	54.55	4	18.18
	41 – 50	9	40.91	4	18.18	2	9.09
	51 – 60	7	31.82	3	13.64	6	27.27
	Above 60	2	9.09	0	0.00	7	31.82
Marital Status	Married	21	95.45	22	100.00	22	100.00
	Single	1	4.55	0	0.00	0	0.00
	Divorced	0	0.00	0	0.00	0	0.00
	Widowed	0	0.00	0	0.00	0	0.00
	Separated	0	0.00	0	0.00	0	0.00
Religion	Christian	14	63.64	7	31.82	0	0.00
	Islamic	8	36.36	15	68.18	22	100.00
	Others	0	0.00	0	0.00	0	0.00
Level of Education	No Formal Education	4	18.18	7	31.82	8	36.36
	Primary Education	13	59.09	14	63.64	2	9.09
	Tertiary Education	0	0.00	1	4.55	3	13.64
	Quranic Education	0	0.00	0	0.00	9	40.91
	Secondary Education	5	22.73	0	0.00	0	0.00
Household size	Less or equal 5	8	36.36	8	36.36	3	13.64
	6 – 10	11	50.00	12	54.55	7	31.82
	11 – 15	3	13.64	1	4.55	5	22.73
	Above 15	0	0.00	1	4.55	7	31.82
Fish catching experience	Less or equal 10	1	4.55	9	40.91	0	0.00
	11 – 20	6	27.27	8	36.36	8	36.36
	21 – 30	4	18.18	3	13 .64	3	13.64
	31 - 40	9	40.91	1	4.55	9	40.91
	Above 40	2	9.09	1	4.55	2	9.09

Table 2a: Socio-economic characteristics of Aquaculture Producers in Sampled States along Benin-border

	Kwara State		Niger State		Oyo State	
Variable	**Frequency**	**(%)**	**Frequency**	**(%)**	**Frequency**	**(%)**
Male	17	68.18	22	100.00	16	72.73
Female	5	18.18	0	0.00	6	27.27
Less or equal 30	0	0.00	1	4.55	4	18.18
31 – 40	7	31.82	11	50.00	11	50.00
41 – 50	7	31.82	6	27.27	2	9.09
51 – 60	7	31.82	5	22.73	3	13.64
Above 60	1	4.55	0	0.00	2	9.09
Married	18	81.81	20	90.91	19	86.36
Single	3	13.64	2	9.09	3	13.64
Divorced	0	0.00	0	0.00	0	0.00
Widowed	1	4.55	0	0.00	0	0.00
Separated	0	0.00	0	0.00	0	0.00
Less equal 5	16	72.72	14	63.64	15	68.18
6 – 10	5	22.73	6	27.27	5	22.73
11 – 15	1	4.55	2	9.09	2	9.09
Above 15	0	0.00	0	0.00	0	0.00
Less equal 5	19	86.36	19	86.36	9	40.91
6 – 10	0	0.00	3	13.64	0	0.00
11 – 15	0	0.00	0	0.00	0	0.00
Above 15	0	0.00	0	0.00	0	0.00
Christian	9	40.91	5	22.73	16	72.73
Islamic	13	59.09	17	77.27	6	27.27
No formal education	10	27.27	2	9.09	7	31.81
Primary education	0	0.00	4	18.18	1	4.55
Quranic Education	1	4.55	15	68.18	0	0.00
Secondary education	11	50.00	0	0.00	13	59.09
Tertiary	0	0.00	1	4.55	1	4.55
Less equal 3	21	95.45	22	100	22	100
3 – 6	1	4.55	0	0.00	0	0.00
6 – 9	0	0.00	0	0.00	0	0.00
Above 9	0	0.00	0	0.00	0	0.00
Less equal 5	11	50.00	19	86.36	4	18.18
6 – 10	3	13.64	3	13.64	7	31.82
11 – 15	1	4.55	0	0.00	3	13.64
Above 15	2	9.09	0	0.00	3	13.64

Table 2b: Socio-economic characteristics of Aquaculture Producers in Sampled States along Benin-border

	Ogun State		Lagos State		Kebbi State	
Variable	**Frequency**	**(%)**	**Frequency**	**(%)**	**Frequency**	**(%)**
Male	20	90.91	21	95.45	20	90.91
Female	2	9.09	1	4.55	2	9.09
Less or equal 30	1	4.55	0	0.00	0	0.00
31 – 40	4	18.18	1	4.55	4	18.18
41 – 50	6	27.27	13	59.09	5	22.73
51 – 60	8	36.36	5	22.73	10	45.45
Above 60	3	13.64	3	13.64	3	13.64
Married	19	86.36	20	90.91	19	86.36
Single	2	9.09	2	9.09	3	13.64
Divorced	1	4.55	0	0.00	0	0.00
Widowed	0	0.00	0	0.00	0	0.00
Separated	0	0.00	0	0.00	0	0.00
Less equal 5	17	77.27	21	95.45	4	18.18
6 – 10	5	22.73	1	4.55	11	50.00
11 – 15	0	0.00	0	0.00	3	13.64
Above 15	0	0.00	0	0.00	4	18.18
Less equal 5	22	100.00	21	95.45	15	68.18
6 – 10	0	0.00	1	4.55	2	9.09
11 - 15	0	0.00	0	0.00	4	18.18
Above 15	0	0.00	0	0.00	1	4.55
Christian	14	63.64	15	68.18	2	9.09
Islamic	8	36.36	7	31.82	20	90.91
No formal	0	0.00	5	22.73	6	27.27
Primary	8	36.36	3	13.64	0	0.00
Quaranic	2	9.09	0	0.00	8	36.36
Secondary	12	54.55	3	13.64	8	36.36
Tertiary	0	0.00	11	50.00	0	0.00
Less equal 5	7	31.82	9	40.91	12	54.54
6 – 10	10	45.45	4	18.18	3	13.64
11 – 15	3	13.64	6	27.27	3	13.64
Above 15	2	9.09	3	13.64	4	18.18

Table 3: Socio-economic characteristics of Fish processors in Sample State along Nigeria-Benin Border

	Kwara	Niger	Oyo	Ogun	Lagos	Kebbi
Category	**Frequency**	**Frequency**	**Frequency**	**Frequency**	**Frequency**	**Frequency**
Male	24(54.55)	42(95.45)	11(25.00)	10(22.73)	25(56.82)	43(97.73
Female	20(45.45)	2(4.55)	33(75)	34(77.27)	19(43.18)	1(2.27)
Less or equal 30	11(25)	0(0.00)	6(13.64)	0(0.00)	4(9.09)	3(6.82)
31 - 40	15(34.09)	8(18.18)	18(40.91)	12(27.27)	12(27.27)	13(29.54)
41 - 50	13(29.55)	8(18.18)	13(29.55)	17(38.64)	18(40.91)	7(15.91)
51 - 60	5(11.36)	17(38.64)	4(9.09)	10(22.73)	9(20.45)	12(27.27)
Above 60	0(0.00)	1(2.27)	3(6.82	5(11.36))	1(2.27)	9(20.45)
Christian	22(50.00)	2(4.55)	27(61.36)	27(61.36)	29(65.91)	5(11.36)
Islamic	22(50.00)	42(95.45)	17(38.64)	17(38.64)	15(34.09)	39(88.64)
Married	29(65.91)	44(100)	39(88.64)	38(86.36)	36(81.82)	43(97.73)
Single	12(27.27)	0(0.00)	4(9.09)	2(4.55)	2(4.55)	1(2.27)
Divorced	0(0.00)	0(0.00)	0(0.00)	3(6.82	1(2.27)	0(0.00)
Widowed	1(2.27)	0(0.00)	1(2.27)	1(2.27)	5(11.36)	0(0.00)
Separated	1(2.27)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Less or equal 5	19(43.18)	4(9.09)	34(77.27)	37(84.09)	26(59.09)	9(20.45)
6 - 10	12(27.27)	28(63.64)	10(22.73)	7(15.91)	15(34.09)	19(43.18)
11 - 15	13(29.54)	7(15.91)	0(0.00)	0(0.00)	3(6.82)	7(15.91)
Above 15	0(0.00)	5(11.36)	0(0.00)	0(0.00)	0(0.00)	9(20.45)
No Formal Education	8(18.18)	3(6.82)	26(59.09)	8(18.18)	23(52.27)	8(18.18)
Primary Education	0(0.00)	1(2.27)	2(4.55)	18(40.91)	5(11.36)	1(2.27
Tertiary Education	30(68.18)	4(9.09)	10(22.73)	10(22.73)	16(36.36)	8(18.18)
Secondary Education	6(13.64)	6(13.64)	6(13.64)	3(6.82)	0(0.00)	1(2.27)
Quranic Education	0(0.00)	30(68.18)	0(0.00)	5(11.36)	0(0.00)	26(59.09)
Less or equal to 5	31(70.45)	3(6.82)	12(27.27)	14(31.82)	4(9.09)	0(0.00)
6-10	10(22.73)	13(29.54)	20(45.45)	10(22.73)	8(18.18)	11(25.00)
11-15	3(6.82)	2(4.55)	6(13.64)	6(13.64)	11(25.00)	5(11.36)
Above 15	0(0.00)	26(59.09)	6(13.64)	14(31.82)	21(47.73)	28(63.64)

Note: Percentages are in parenthesis

Table 3: Socio-economic characteristics of Fish processors in Sample State along Nigeria-Benin Border

Category	Kwara	Niger	Oyo	Ogun	Lagos	Kebbi
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
Male	32(72.73)	37(84.09)	17(38.64)	26(59.09)	0(0.00)	44(100)
Female	12(27.27)	7(15.91)	27(61.36)	18(40.91)	44(100.00)	0(0.00)
< or equal 30	24(54.55)	3(6.82)	12(27.27)	1(2.27)	5(11.36)	7(15.91)
31 - 40	16(36.36)	4(9.09)	24(54.55)	9(20.45)	26(59.09)	15(34.09)
41 - 50	2(4.55)	9(20.45)	5(11.36)	18(40.91)	10(22.73)	15(34.09)
51 - 60	2(4.55)	17(38.64)	3(6.82)	10(22.73)	3(6.82)	6(13.64)
Above 60	0(0.00)	11(25.00)	0(0.00)	6(13.64)	0(0.00)	2(4.55)
Married	20(45.45)	40(90.91)	33(75.00)	41(93.18)	30(68.18)	39(88.63)
Single	24(54.55)	4(9.09)	8(18.18)	1(2.27)	1(2.27)	5(11.36)
Divorced	0(0.00)	0(0.00)	1(2.27)	1(2.27)	10(22.73)	0(0.00)
Widowed	0(0.00)	0(0.00)	0(0.00)	1(2.27)	3(6.82)	0(0.00)
Separated	0(0.00)	0(0.00)	2(4.55)	0(0.00)	0(0.00)	0(0.00)
Christian	10(22.73)	24(54.55)	20(45.45)	20(45.45)	32(72.73)	7(15.91)
Islamic	34(77.27)	20(45.45)	24(54.55)	24(54.55)	12(27.27)	37(84.09)
others	0	0(0.00)	0(0.00)	0	0	0
No formal education	8(18.18)	32(72.73)	15(34.09)	9(20.45)	15(34.09)	13(29.55)
Primary education	1(2.27)	0(0.00)	7(15.91)	9(20.45)	10(22.73)	1(2.27)
Tertiary education	30(68.18)	0(0.00)	13(29.54)	10(22.73)	5(11.36)	3(6.82)
Quaranic	0(0.00)	12(27.27)	1(2.27)	10(22.73)	8(18.18)	20(45.45)
Secondary education	5(11.36)	0(0.00)	8(18.18)	6(13.64)	6(13.64)	7(15.91)
44.00	0	0	0	0	0	3
Less or above 5	30(68.18)	9(20.45)	23(52.27)	28(63.64)	20(45.45)	13(29.55)
6 - 10	14(31.82)	12(27.27)	13(29.54)	11(25.00)	24(54.55)	12(27.27)
11 - 15	o(0.00	9(20.45)	8(18.18)	3(6.82)	0(0.00)	15(34.09)
Above 15	0(0.00)	14(31.82)	0(0.00)	2(4.55)	0(0.00)	4(9.09)
Less or equal 10	35(79.54)	6(13.64)	34(77.27)	13(29.54)	16(36.36)	6(13.64)
11 - 20	6(13.64)	19(43.18)	7(15.91)	12(27.27)	18(40.91)	17(38.64)
21 - 30	2(4.55)	5(11.36)	2(4.55)	11(25.00)	8(18.18)	15(34.09)
31 - 40	1(2.27)	6(13.64)	1(2.27)	8(18.18)	2(4.55)	4(9.09)
Above 40	0(0.00)	8(18.18)	0(0.00)	0(0.00)	0(0.00)	2(4.55)

Note: Percentages are in parenthesis

Table 5: Average monthly quantities, cost variables and profitability indices associated with fresh fish caught and marketed by artisanal fishermen in Nigerian States along Nigeria-Benin Border during the period of study

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (kg)	279.02^{bcd}	295.17	175.08^{cd}	125.32	502.93^{a}	241.48	293.27^{bc}	179.60	119.63^{d}	64.21	371.82^{ab}	315.29
Average Selling Price (☐)	687.52^{ab}	261.00	574.21^{bc}	143.00	593.33^{bc}	175.00	750.00^{a}	227.00	526.32^{c}	145.00	816.00^{a}	224.00
Operational Cost (☐)	25989.37^{a}	18257.63	3221.05^{c}	206.74	1992.30^{c}	1159.34	16808.85^{b}	12507.01	1100.20^{c}	20.50	14121.08^{b}	14188.22
Maintenance Cost (☐)	12994.68^{a}	9128.82	1610.53^{c}	103.37	933.89^{c}	612.89	8404.42^{b}	6253.51	520.04^{c}	10.06	7060.54^{b}	7094.11
Marketing Cost (☐)	16538.69^{a}	12439.54	2040.00^{c}	498.55	996.15^{c}	887.89	9481.91^{b}	8697.37	575.76^{c}	234.17	9414.05^{b}	9458.81
Total Variable Cost (☐)	38984.05^{a}	27386.45	4831.58^{c}	310.11	2988.44^{c}	1739.01	25213.27^{b}	18760.52	1520.10^{c}	12.10	21181.62^{b}	21282.33
Fixed Cost Depreciated (☐)	3406.56^{a}	691.32	1634.46^{b}	1013.99	2078.85^{b}	2887.94	3868.39^{a}	1315.23	1930.92^{b}	1143.49	3385.49^{a}	2173.25
Total Cost of Value-addition (☐)	42390.61^{a}	27656.50	6466.04^{c}	967.59	5067.29^{c}	4249.18	29081.66^{b}	18642.37	3430.92^{c}	1143.49	24567.11^{b}	22686.06
Total Revenue	172922.14^{ab}	142338.83	106468.42^{bc}	99743.35	273920.00^{a}	119347.20	228809.09^{a}	161626.39	61349.47^{c}	31665.94	278092.50^{a}	229206.53
Gross Margin (☐)	133938.10^{bc}	129393.89	101636.84^{c}	99675.63	270931.56^{a}	119321.51	203595.82^{ab}	159998.58	59849.47^{c}	31665.94	269790.40^{a}	215273.97
Gross Margin/ kg (☐)	500.37^{b}	268.14	529.77^{b}	150.03	584.90^{b}	169.65	639.39^{ab}	280.07	509.10^{b}	146.51	741.35^{a}	208.12
Net Return (☐)	130531.54^{bc}	129199.24	100002.38^{c}	99836.58	268852.71^{a}	119901.26	199727.43^{ab}	160380.71	57918.55^{c}	31436.58	266292.64^{a}	214430.28
Net Return/ kg (☐)	478.43^{b}	269.34	514.50^{b}	155.57	577.51^{ab}	163.62	612.89^{ab}	288.40	487.83^{a}	146.12	726.86^{a}	209.00
Marketing Efficiency	12.58^{c}	8.04	49.05^{bc}	45.31	268.15^{a}	143.92	24.18^{c}	13.06	92.02^{b}	47.50	35.40^{c}	23.88

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Table 6: Mean Monthly Quantities, Cost Variables and Profitability Indices Associated with Fresh Fish Produced and Marketed by Respondent Fish Farmers in sampled Nigeria States along Nigeria-Benin Border

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (kg)	2276.82^{ab}	1509.75	1950.00^{bc}	1860.16	2574.29^{ab}	2543.78	2733.43^{ab}	1428.04	922.97^{c}	907.46	3415.38^{a}	1763.45
Selling Price (☐/kg)	546.72^{c}	42.16	492.62^{d}	79.96	586.43^{b}	81.11	488.64^{d}	45.39	507.37^{d}	56.06	702.31^{a}	23.15
Buying Price (☐/fish seed)	13.41^{b}	4.73	12.84^{b}	5.58	22.07^{a}	8.29	11.82^{b}	4.00	13.11^{b}	5.53	13.15^{b}	2.79
Total Purchase Cost (☐)	39704.55^{bc}	37274.61	37631.58^{bc}	46944.96	91428.57^{c}	56786.66	43295.45^{bc}	45288.14	19455.26^{c}	17386.06	343923.08^{a}	218815.55
Other Operational Cost (☐)	26980.45^{a}	31397.12	17973.68^{ab}	25476.61	20783.14^{ab}	16783.80	23231.82^{ab}	31609.81	7928.95^{c}	5403.43	6571.54^{c}	3690.80
Cost of Feeding (☐)	365022.73^{bc}	392965.79	241300.00^{cd}	188260.23	506107.14^{ab}	473392.43	329563.64^{bcd}	241256.30	123892.11^{d}	81558.24	590807.69^{a}	320999.58
Cost of Labour (☐)	31742.86^{b}	13313.57	20820.00^{c}	5000.64	27650.00^{bc}	16766.61	26333.33^{bc}	8515.16	21133.97^{c}	10081.26	57891.54^{a}	21679.74
Fixed Cost Depreciated (☐)	1818.22^{c}	737.31	2098.33^{c}	1095.99	3609.05^{b}	2696.50	2285.16^{c}	1565.75	1631.43^{c}	1100.34	4698.74^{a}	1453.08
Total Variable Cost (☐)	464018.77^{bc}	447117.02	318341.93^{cd}	236854.99	646781.36^{b}	491586.59	422424.24^{bc}	263260.29	172737.04^{d}	101121.54	999427.82^{a}	461882.67
Total Cost of Value-addition (☐)	465836.99^{bc}	447265.28	320440.26^{cd}	236961.44	650390.41^{b}	492169.37	424709.40^{bc}	263229.86	174368.47^{d}	101413.47	1004126.56^{a}	462629.07
Total Revenue (☐)	1255467.26^{b}	831626.14	972379.39^{bc}	893382.36	1595428.57^{b}	1483752.17	1323950.55^{b}	704723.41	461511.58^{c}	336954.31	2408461.54^{a}	1249180.37
Gross Margin (☐)	791448.49^{bc}	570804.68	654037.46^{bc}	773377.68	948647.21^{ab}	405121.28	901526.30^{ab}	613319.26	288774.54^{c}	447844.20	1409033.72^{a}	828259.73
Gross Margin/ kg (☐)	337.79^{ab}	132.30	275.56^{b}	151.01	251.88^{b}	151.44	316.04^{ab}	97.15	249.09^{a}	106.03	373.21^{a}	128.31
Net Return (☐)	789630.27^{bc}	570783.91	651939.14^{bc}	773347.31	945038.17^{ab}	404649.49	899241.14^{ab}	612762.00	287143.11^{c}	447709.12	1404334.98^{a}	827536.69
Net Return/ kg (☐)	336.61ab	132.70	273.57b	151.78	249.57b	152.33	314.98ab	97.25	246.03b	107.58	371.20^{a}	129.86
Marketing Efficiency	44.49b	14.54	42.19b	14.06	30.49c	14.55	43.52b	10.78	42.31b	13.21	54.55^{a}	11.98

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Table 7: Mean monthly quantities, cost variables and profitability indices of small scale artisanal fishermen in sampled Nigeria States along Nigeria-Benin border

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (kg)	208.39^{bc}	137.90	175.08^{bc}	125.32	323.00^{c}	118.48	231.78^{ab}	129.21	119.63^{c}	64.21	195.46^{bc}	150.52
Average Selling Price (☐)	705.37^{ab}	268.28	574.21^{bc}	143.22	662.50^{bc}	200.23	738.89^{ab}	252.01	526.32^{c}	144.83	855.71^{a}	233.64
Operational Cost (☐)	24549.47^{a}	18492.12	3221.05^{c}	206.74	1526.11^{c}	1074.61	16210.81^{ab}	13873.66	1000.00^{c}	0.00	12116.34^{b}	14180.16
Maintenance Cost (☐)	12274.74^{a}	9246.06	1610.53^{c}	103.37	763.06^{c}	537.31	8105.41^{ab}	6936.83	500.00^{c}	0.00	6058.17^{b}	7090.08
Marketing Cost (☐)	16366.32^{a}	12328.08	2147.37^{c}	137.83	1017.41^{c}	716.41	10807.21^{ab}	9249.11	666.67^{c}	0.00	8077.56^{b}	9453.44
Total Variable Cost (☐)	36824.21^{a}	27738.17	4831.58^{c}	310.11	2289.17^{c}	1611.92	24316.22^{ab}	20810.50	1500.00^{c}	0.00	18174.51^{b}	21270.24
Fixed Cost Depreciated (☐)	3387.08^{a}	724.06	1634.46^{c}	1013.99	1971.21^{bc}	2578.19	3990.69^{ab}	1341.34	1930.92^{bc}	1143.49	3038.85^{ab}	2101.25
Total Cost of Value-addition (☐)	40211.29^{a}	28011.24	6466.04^{c}	967.59	4260.37^{a}	4086.56	28306.91^{ab}	20666.81	3430.92^{c}	1143.49	21213.36^{b}	22489.69
Total Revenue	143208.68^{ab}	100248.66	106468.42^{bc}	99743.35	195600.00^{a}	42433.41	178322.22^{ab}	129376.96	61349.47^{c}	31665.94	158717.86^{ab}	132000.33
Gross Margin (☐)	106384.47^{bc}	84486.49	101636.84^{bc}	99675.63	193310.83^{a}	43828.44	154006.00^{ab}	128858.64	59849.47^{c}	31665.94	150415.91^{ab}	112068.31
Gross Margin/kg (☐)	507.72^{b}	281.41	529.77^{b}	150.03	651.54^{ab}	191.33	615.19^{ab}	307.26	509.10^{b}	146.51	767.37^{a}	227.16
Net Return (☐)	102997.39^{bc}	84192.36	100002.38^{bc}	99836.58	191339.63^{a}	45984.37	150015.31^{ab}	129105.61	57918.55^{c}	31436.58	147239.64^{ab}	111227.35
Net Return/ kg (☐)	484.00^{b}	283.16	514.50^{b}	155.57	640.27^{ab}	182.66	584.12^{ab}	314.36	487.83^{a}	146.12	748.76^{a}	230.14
Marketing Efficiency	11.92^{c}	7.59	49.05^{c}	45.31	264.34^{a}	131.35	21.65^{c}	12.92	92.02^{b}	47.50	26.37^{c}	18.94

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Table 8: Mean Monthly Quantities, Cost Variables and Profitability Indices of Medium Scale Fish Farmers in sampled Nigeria States along Nigeria-Benin Border

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (kg)	991.67^{ab}	289.78	867.50^{b}	248.18	1030.00^{ab}	348.55	1321.67^{a}	371.08	842.79^{b}	231.70	1300.00^{a}	264.58
Selling Price (☐/kg)	533.93^{bc}	39.30	471.86^{c}	29.94	568.75^{b}	65.12	506.67^{bc}	80.66	500.00^{c}	55.90	710.00^{a}	36.06
Buying Price (☐/fish seed)	13.33^{ab}	5.00	15.00^{ab}	7.63	20.50^{a}	9.07	11.67^{b}	4.08	14.11^{ab}	6.86	12.0^{ab}	0.00
Total Purchase Cost (☐)	20944.44^{b}	15363.20	32812.50^{b}	22548.26	86250.00^{b}	74582.17	22916.67^{b}	19153.11	26283.33^{b}	19214.19	185333.33^{a}	186776.16
Other Operational Cost (☐)	22178.89^{a}	15686.28	11787.50^{a}	7830.42	23608.00^{a}	19975.49	7650.00^{a}	5728.44	9183.33^{a}	7127.94	9043.33^{a}	7349.67
Cost of Feeding (☐)	162522.22^{bc}	99816.73	142062.50^{bc}	99600.07	260687.50^{ab}	126432.06	183900.00^{abc}	95926.85	129505.56^{c}	33038.43	285833.33^{a}	113477.24
Cost of Labour (☐)	25723.81^{b}	7211.58	19115.00^{b}	3812.92	22300.00^{b}	3045.84	23722.22^{b}	4611.18	18348.48^{b}	5744.38	44666.67^{a}	26945.93
Fixed Cost Depreciated (☐)	1618.11^{a}	461.27	2534.85^{a}	1319.28	3469.23^{a}	3519.10	2198.61^{a}	1915.89	1723.40^{a}	1218.80	3774.66^{a}	2090.79
Total Variable Cost (☐)	231749.00^{b}	104666.12	206311.87^{b}	126222.71	393366.33^{a}	142526.97	238188.89^{b}	95531.72	184010.52^{b}	44951.93	524876.67^{a}	212537.93
Total Cost of Value-addition (☐)	233367.11^{b}	104740.93	208846.73^{b}	126681.95	396835.56^{a}	143306.32	240387.50^{b}	95702.28	185733.92^{b}	44936.67	528651.32^{a}	214585.44
Total Revenue (☐)	533008.10^{bc}	169061.73	406455.93^{c}	109122.27	586250.00^{bc}	209876.66	653866.67^{b}	142808.78	418950.00^{c}	116055.31	916666.67^{a}	145716.62
Gross Margin (☐)	301259.10^{ab}	153375.78	200144.06^{b}	114687.79	192883.67^{b}	133958.08	415677.78^{a}	159687.44	234939.48^{ab}	121863.75	391790.00^{a}	322980.09
Gross Margin/kg (☐)	292.92^{a}	116.17	239.30^{a}	101.67	175.33^{a}	87.53	310.77^{a}	81.47	270.92^{a}	90.98	277.69^{a}	222.34

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Net Return (☐)	299640.99^{abc}	153521.50	197609.20^{bc}	114571.48	189414.44^{c}	132077.79	413479.17^{a}	160956.06	233216.08^{abc}	121696.23	388015.34^{ab}	324742.68
Net Return/ kg (☐)	291.07^{a}	116.78	236.44^{a}	101.84	172.06^{a}	87.39	308.82^{a}	82.49	268.73^{a}	90.76	274.58^{a}	224.40
Marketing Efficiency	43.74^{ab}	14.56	36.66^{b}	14.88	32.44^{b}	15.34	44.67^{ab}	10.15	39.83^{b}	14.14	58.17^{a}	3.00

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Table 9: Mean Monthly Quantities, Cost Variables and Profitability Indices of Large Scale Fish Farmers in sampled Nigeria States along Nigeria-Benin Border

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (kg)	3166.54^{ab}	1355.20	3596.25ab	1851.86	4633.33^{a}	2784.00	3262.83^{ab}	1308.80	2620.67^{b}	2206.45	4444.44^{ab}	845.74
Selling Price (☐/kg)	555.57^{bc}	43.28	529.68^{cd}	107.74	610.00^{b}	100.00	481.88^{d}	23.16	496.67^{cd}	5.77	705.56^{a}	10.14
Buying Price (☐/fish seed)	13.46^{b}	4.74	11.25^{b}	2.76	24.17^{a}	7.36	11.88^{b}	4.10	13.33^{b}	5.77	13.67^{b}	3.28
Total Purchase Cost (☐)	52692.31^{b}	42748.07	54375.00^{b}	66159.84	98333.33^{b}	22286.02	50937.50^{b}	50206.86	27333.33^{b}	20033.31	428777.78^{a}	187629.14
Other Operational Cost (☐)	30304.62^{a}	39138.36	26787.50^{a}	37370.56	17016.67^{a}	11999.57	29075.00^{a}	35417.20	7966.67^{a}	2542.31	5588.89^{a}	1815.52
Cost of Feeding (☐)	505215.38^{abc}	459945.41	395150.00^{bc}	183868.80	833333.33^{a}	579154.79	384187.50^{bc}	258358.83	244066.67^{c}	140425.12	743000.00^{ab}	254065.44
Cost of Labour (☐)	35909.89^{b}	15150.42	22980.00^{b}	6314.85	34783.33^{b}	24719.72	27312.50^{b}	9522.27	37000.00^{b}	15099.67	64843.33^{a}	18385.82
Fixed Cost Depreciated (☐)	1956.76^{c}	871.02	1861.53^{c}	911.81	3795.48^{b}	1222.37	2317.62^{c}	1484.78	2005.55^{c}	1413.79	5197.44^{a}	1051.74
Total Variable Cost (☐)	624820.92^{bc}	523518.37	500222.71^{c}	247536.31	984668.06^{ab}	600098.39	491512.50^{c}	274440.90	316366.67^{c}	174087.86	1242210.00^{a}	292380.00
Total Cost of Value-addition (☐)	626777.68^{bc}	523617.27	502084.24^{c}	247810.40	988463.53^{ab}	600859.55	493830.12^{c}	274348.23	318372.22^{c}	174523.65	1247407.44^{a}	292187.58
Total Revenue (☐)	1755631.29^{b}	727170.87	1826804.03^{b}	765161.27	2941000.00^{a}	2099704.26	1575232.00^{b}	664480.38	1293666.67^{b}	1076317.95	3137222.22^{a}	600620.05
Gross Margin (☐)	1130810.37^{ab}	499520.57	1326581.32^{ab}	791026.50	1956331.95^{a}	1725059.01	1083719.50^{ab}	623135.51	977300.00^{b}	912226.26	1895012.22^{ab}	361546.02

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gross Margin/kg (☐)	368.86[a]	138.11	359.81[a]	166.95	353.94[a]	164.41	318.01[a]	104.81	346.22[a]	47.77	427.19[a]	25.96
Net Return (☐)	1128853.61[ab]	499698.34	1324719.78[ab]	790624.88	1952536.47[a]	1724491.57	1081401.89[ab]	622295.74	975294.45[b]	912314.38	1889814.78[ab]	361179.80
Net Return/ kg (☐)	368.14[a]	138.17	359.23[a]	167.19	352.91[a]	164.96	317.29[a]	104.64	345.07[a]	48.43	425.98[a]	25.79
Marketing Efficiency	45.01[a]	15.09	48.24[a]	13.66	27.89[b]	14.39	43.09[ab]	11.30	40.50[ab]	14.72	53.50[a]	14.37

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Table 10: Mean quantities, costs, profitability indices and marketing efficiency of fresh fish products marketed by respondent fish traders in Nigeria States along Nigeria-Benin Border.

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (Kg)	852.38b	390.87	1653.32a	1198.00	1425.00a	945.01	597.91b	426.60	1384.20a	1016.11	1536.35a	599.60
Selling Price (☐/kg)	675.24d	41.06	830.00a	110.41	694.55cd	74.05	736.82bc	42.69	782.40ab	51.58	816.88a	122.67
Buying Price (☐/kg)	487.14c	41.49	531.82a	23.43	475.68cd	26.78	518.18ab	19.67	497.60bc	45.94	458.33d	43.80
Cost of Purchase (☐)	415428.57b	195201.32	880578.18a	652602.36	683931.82a	467790.23	309804.55b	218404.45	694092.00a	497893.54	711444.51a	302796.77
Total Fixed Cost Depreciated (☐)	951.27c	485.91	935.72c	410.55	1686.32a	572.30	938.27c	302.79	1326.62b	479.52	1318.61b	397.49
Other Operational Cost (☐)	6819.05c	3126.96	31964.15a	23161.41	19000.00b	12600.08	9167.94c	6541.21	18363.72b	13480.36	21508.86b	8394.46
Total Marketing Cost (☐)	16109.52c	2633.86	39389.46a	22668.68	26922.78b	8446.12	21593.97bc	3538.79	25973.26b	11065.63	35413.91s	7201.95
Marketing Cost/Kg (☐)	23.02b	12.12	25.88b	4.62	27.00b	19.09	52.44a	32.53	28.04b	22.06	24.82b	5.11
Total Variable Cost (☐)	438357.14b	200675.76	951931.80a	696364.34	729854.60a	488112.03	340566.45b	227750.82	738428.98a	521352.34	768367.29a	317220.32
Total Cost of Value-addition (☐)	439308.42b	200840.96	952867.52a	696417.08	731540.92a	488084.20	341504.73b	227681.40	739755.60a	521473.48	769685.90a	317334.33

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Monthly Revenue (☐)	572095.24b	256312.10	1362114.55a	970966.43	1018636.36a	735696.26	438207.73b	304618.79	1080480.00a	790451.12	1262018.15a	539859.80
Gross Margin (☐)	133738.10c	78756.79	410182.75ab	299940.99	288781.76b	270963.44	97641.27c	79305.13	342051.02b	281982.71	493650.86s	291516.42
Gross Margin/kg (☐)	157.07a	67.13	252.97b	99.36	178.53b	83.10	150.86b	53.38	243.50b	49.37	319.72a	126.93
Net Return (☐)	132786.82c	78730.45	409247.03ab	299867.79	287095.44b	271040.13	96703.00c	79330.67	340724.40b	281914.53	492332.25a	291411.09
Net Return/ kg (☐)	155.51c	68.06	252.26b	99.38	176.39c	83.96	148.27c	54.41	241.52b	49.01	318.76a	126.96
Marketing Efficiency	34.18a	11.03	33.12a	7.42	34.02a	15.52	19.13b	10.65	37.33a	15.65	34.39a	8.98

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Table 11: Mean quantities, costs, profitability indices and marketing efficiency of smoked fish products marketed by respondent fish traders in Nigeria States along Nigeria-Benin Border

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (Kg)	490.00[d]	213.43	1002.00b	303.43	1450.00[a]	1252.00	565.00[cd]	307.23	434.64[d]	189.34	914.92[bc]	521.06
Selling Price (☐/kg)	2635.71[d]	108.82	3055.00[c]	127.91	3240.00[b]	181.66	3406.67[a]	119.42	3323.57[ab]	242.73	2765.38[d]	152.57
Buying Price (☐/kg)	1142.86[c]	134.25	1464.00[b]	80.86	1680.00[a]	529.86	1641.67[a]	70.17	1627.86[a]	44.58	1539.15[ab]	164.38
Cost of Purchase (☐)	556035.71[c]	244267.39	1458660.00[b]	425678.30	2697500.00[a]	1971274.98	916500.00[bc]	475669.15	706821.43[bc]	307241.61	1298959.23[bc]	708004.46
Total Fixed Cost Depreciated (☐)	917.94[b]	319.79	2232.20[a]	1516.80	1399.84[b]	472.67	1621.75[ab]	629.64	1180.73[b]	490.74	1050.88[b]	375.72
Other Operational Cost (☐)	6533.33[c]	2845.78	18960.00[b]	11407.94	29566.67[a]	24730.66	13183.33[bc]	7168.72	9562.14[c]	4165.38	9149.23[c]	5210.57
Total Marketing Cost (☐)	19679.52[c]	4796.40	56530.75[a]	29706.09	36942.83[b]	15753.74	28161.67[bc]	5377.03	18992.41[c]	5064.01	36471.15[b]	9827.59
Marketing Cost/Kg (☐)	46.61[ab]	22.03	53.88[ab]	16.80	31.78[b]	10.06	59.90[ab]	22.25	50.26[ab]	20.63	62.75[a]	51.99
Total Variable Cost (☐)	582248.57[c]	249635.06	1534150.75[b]	450261.73	2764009.50[a]	2009886.31	957845.00[bc]	487131.53	735375.98[bc]	313316.90	1344579.62[bc]	718149.64
Total Cost of Value-addition (☐)	583166.51[c]	249758.75	1536382.95[b]	450891.89	2765409.34[a]	2010005.67	959466.75[bc]	487505.03	736556.72[bc]	313344.78	1345630.49[bc]	718091.02
Total Monthly Revenue (☐)	1295142.86[c]	578493.75	3067150.00[b]	939221.93	4730000.00[a]	3151830.92	1939125.00[bc]	1094774.76	1456553.57[c]	666518.91	2555061.54[bc]	1501351.98

Variables	Niger State		Oyo State		Kebbi State		Ogun State		Kwara State		Lagos State	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gross Margin (☐)	712894.29^{c}	337082.57	1532999.25^{ab}	510676.09	1965990.50^{a}	1239730.28	981280.00^{bc}	610357.22	721177.59^{c}	358015.43	1210481.92^{bc}	877075.76
Gross Margin/kg (☐)	1432.91^{b}	127.07	1516.33^{ab}	155.18	1507.55^{ab}	379.30	1681.76^{ab}	158.44	1623.46^{ab}	258.15	1230.41^{c}	270.16
Net Return (☐)	711976.34^{c}	336952.81	1530767.05^{ab}	510017.13	1964590.66^{a}	1239573.86	979658.25^{bc}	609997.53	719996.86^{c}	357971.20	1209431.04^{bc}	877058.10
Net Return/ kg (☐)	1430.79^{b}	126.85	1514.12^{ab}	154.92	1506.20^{ab}	379.13	1678.41^{ab}	159.15	1620.22^{ab}	258.94	1228.30^{c}	270.93
Marketing Efficiency	65.71^{b}	23.87	61.13b	16.47	113.73^{a}	48.86	66.25^{b}	28.99	76.98^{b}	30.79	68.51^{b}	39.27

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Table 12: Mean quantities, costs, profitability indices and marketing efficiency of dried fish products marketed by respondent fish traders in Nigeria States along Nigeria-Benin Border

Variables	Kebbi		Lagos		Ogun		Kwara		Oyo		Niger	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (Kg)	965.71^{ab}	493.35	456.40^{bc}	260.26	335.00^{c}	162.63	477.50bc	301.74	380.00^{bc}	56.57	1190.57^{a}	404.46
Selling Price (☐/kg)	1778.57^{c}	111.27	2886.00^{a}	41.59	2050.00^{c}	212.13	1768.75^{d}	121.59	2300.00^{b}	70.71	1871.43^{d}	48.80
Buying Price (☐/kg)	1207.14^{c}	145.57	1928.00^{a}	54.04	1600.00^{b}	70.71	1316.25^{c}	29.73	1475.00^{b}	106.07	1264.29^{c}	113.85
Cost of Purchase (☐)	1137642.86^{ab}	527169.86	879480.00^{ab}	508848.14	530250.00^{b}	236527.22	626637.50^{b}	390199.32	557500.00^{b}	43133.51	1496104.14^{a}	509631.65
Total Fixed Cost Depreciated (☐)	825.25^{ab}	238.97	729.04^{b}	348.89	1060.66^{ab}	668.10	1037.81^{ab}	371.86	1281.89^{a}	0.00	1084.64^{ab}	200.20
Other Operational Cost (☐)	11588.57^{a}	5920.21	12170.67^{a}	6940.24	7150.00^{a}	3889.09	10505.00^{a}	6638.39	6333.33^{a}	942.81	7937.12^{a}	2696.43
Total Marketing Cost (☐)	23001.43^{b}	7296.68	19995.33^{b}	5432.25	23133.25^{b}	1.06	21647.92^{b}	3683.72	19235.42^{b}	389.50	34368.56^{a}	7636.41
Marketing Cost/Kg (☐)	26.89^{b}	9.94	53.16^{ab}	22.90	78.28^{a}	38.00	52.65^{ab}	15.14	51.26^{ab}	8.66	34.37^{b}	21.50
Total Variable Cost (☐)	1172232.86^{ab}	539473.89	911646.00^{ab}	521098.54	560533.25^{b}	240415.24	658790.42^{b}	400351.31	583068.75^{b}	43686.82	1538409.83^{a}	511899.46
Total Cost of Value-addition (☐)	1173058.10^{ab}	539291.58	912375.04^{ab}	521159.45	561593.91^{b}	241083.34	659828.23^{b}	400572.37	584350.64^{b}	43686.82	1539494.47^{a}	511943.19
Total Monthly Revenue (☐)	1703857.14^{ab}	828888.30	1323112.00^{ab}	768723.36	669500.00^{b}	262336.62	842312.50^{b}	535414.19	872000.00^{b}	103237.59	2229909.00^{a}	759330.10

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Variables	Kebbi		Lagos		Ogun		Kwara		Oyo		Niger	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gross Margin (☐)	531624.29^{ab}	318800.04	411466.00^{abc}	248522.43	108966.75^{c}	21921.37	183522.08^{bc}	139336.10	288931.25^{bc}	59550.77	691499.17^{a}	281927.69
Gross Margin/kg (☐)	532.53^{bc}	97.91	878.17^{a}	81.23	350.72^{d}	104.83	377.85^{cd}	111.28	757.07^{a}	44.01	566.10^{b}	132.31
Net Return (☐)	530799.04^{ab}	318971.12	410736.96^{abc}	248437.07	107906.09^{c}	21253.27	182484.27^{bc}	139140.21	287649.36^{bc}	59550.77	690414.53^{a}	281854.80
Net Return/ kg (☐)	531.35^{bc}	98.32	876.20^{a}	81.55	347.68^{d}	105.35	375.37^{cd}	111.41	753.66^{a}	44.52	565.08^{b}	132.45
Marketing Efficiency	72.10^{a}	19.46	61.54^{abc}	22.28	28.94^{c}	11.34	36.88^{bc}	14.59	45.40a^{bc}	6.29	67.70^{ab}	26.71

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Table 13: Mean quantities, costs, profitability indices and marketing efficiency of frozen fish products marketed by respondent fish traders in Nigeria States along Nigeria-Benin Border

Variables	Kebbi		Oyo		Ogun		Kwara		Lagos	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (Kg)	225.00^{b}	106.07	799.29^{b}	233.46	665.33^{b}	424.08	640.00^{b}	268.70	2900.00^{a}	1969.24
Selling Price (☐/kg)	825.00^{ab}	106.07	885.71^{a}	114.43	728.67^{b}	62.78	775.00^{ab}	35.36	700.00^{b}	50.00
Buying Price (☐/kg)	505.00^{bc}	63.64	667.14^{a}	58.51	487.33^{bc}	57.00	575.00^{b}	35.36	430.00^{c}	26.46
Cost of Purchase (☐)	110250.00^{b}	39244.43	539121.43^{b}	165685.81	326266.67^{b}	213390.48	363250.00^{b}	131875.41	1277833.33^{a}	887346.09
Total Fixed Cost Depreciated (☐)	791.67^{a}	58.93	1339.48^{a}	695.29	1415.71^{a}	693.72	1064.25^{a}	119.15	1381.26^{a}	172.11
Other Operational Cost (☐)	1500.00^{b}	707.11	22073.81^{b}	5733.53	14806.67^{b}	9061.24	12800.00^{b}	5374.01	63800.00^{a}	43323.25
Total Marketing Cost (☐)	12175.00^{c}	714.18	28931.19^{b}	3981.10	23452.67^{bc}	6148.64	21310.00^{bc}	2531.44	49566.67^{a}	26331.79
Marketing Cost/Kg (☐)	61.72^{a}	32.27	39.60^{a}	14.42	52.41^{a}	37.52	35.60^{a}	10.99	20.12^{a}	6.81
Total Variable Cost (☐)	123925.00^{b}	39237.36	590126.43^{b}	173026.60	364526.00^{b}	227839.03	397360.00^{b}	139780.87	1391200.00^{a}	956984.54
Total Cost of Value-addition (☐)	124716.67^{b}	39178.43	591465.91^{b}	173279.04	365941.71^{b}	228151.97	398424.25^{b}	139661.72	1392581.26^{a}	957029.02
Total Monthly Revenue (☐)	180000.00^{b}	63639.61	713107.14^{b}	224671.14	480266.67^{b}	304040.58	491250.00^{b}	185615.53	2093833.33^{a}	1496089.43
Gross Margin (☐)	56075.00^{b}	24402.26	122980.71^{b}	80468.08	115740.67^{b}	82648.89	93890.00^{b}	45834.66	702633.33^{a}	548076.59
Gross Margin/kg (☐)	251.62^{a}	10.16	150.87^{b}	84.63	166.22^{b}	43.65	144.40^{b}	10.99	227.88^{a}	38.97
Net Return (☐)	55283.33^{b}	24461.18	121641.23^{b}	80279.10	114324.96^{b}	82343.15	92825.75^{b}	45953.81	701252.07^{a}	548070.72
Net Return/kg (☐)	247.59^{a}	8.00	149.12^{b}	84.64	162.97^{ab}	44.88	142.53^{b}	11.96	227.04^{ab}	39.55
Marketing Efficiency	14.96^{b}	6.10	24.56^{ab}	7.55	18.83^{b}	8.95	22.70^{ab}	6.01	37.67^{a}	12.91

Note:There is significant difference (P<0.05) in the mean values of with different superscript alphabets on the same row

Tables 5, 6, 7, 8, 9, 10, 11, 12 and 13 shows the profitability of respondents along the value chain

The results of this study also indicated that majority of the respondent artisanal fishermen along Nigeria-Benin border operated in a small-scale level of operation. This was also in consonance with the observation of Olaoye *et al.* (2012). This could be attributed to low cost of investment require in starting-up the fisheries. This study has also revealed that scale of operation does have influence on the quantity of fish catch by the fishermen as medium scale respondent fishermen tends to record higher catch than the small scale artisanal fishermen. This could be as a result of high cost of investment in advance fishing equipment which tends to be more efficient. This could have been responsible for the significant difference in the net return and gross margin per kg of the small and medium scale artisanal fishermen.

Explicit from this study were positive profitability indices of the respondent fish processors in the study area. This was an indication that value-addition through fish processing is a profitable agro-business. Adebo and Toluwase (2014) also observed high returns for processed fish products (smoked fish) when compared to fresh fish marketing. Value addition is known to improve income and reduce challenges of finance in farming (Adebo and Toluwase, 2014). Evident from the results of this study was the fact that fish there was significant different in the level of profit realized from the trade of different fish products marketed by the fish traders/marketers along Nigeria-Benin border. Fish traders involved in marketing of processed fish products had higher profit margin than traders of fresh fish. This result is corroborated by the findings of Adebo and Toluwase (2014). This could be as a result of effect of value-addition through processing to the processed fish products which tend to increase their market value when compare to fresh fish with little or no evident of value-addition. However, irrespective of the fish product marketed by the fish trader the profit margin was high and positive, indicating that fish marketing is a lucrative business in the study area.

Model Estimation and Resource Use Efficiency of Respondent Artisanal Fishermen

The results of the linear regression model estimation of the respondent artisanal fishermen presented in Table 4.50 indicated that total quantity of fish catch sold (x3), selling price (x4) and operational cost (x5) had a significant ($P<0.05$) regression coefficients while age (x1), fishing experience (x2), depreciated fixed cost (x6) and marketing efficiency (x7) were not. It should be noted that only age had a negative influence on the respondent fishermen's revenue (value of output) while other variables were positive. The model relationship had a significant ($P<0.05$) regression determinant (R2) value of 0.922.

Table 14: Model estimation and resource use efficiency of respondent artisanal fishermen along Nigeria-Benin Border

Model	Coefficients	Std. Error	t	Sig.
(Constant)	-134626.695	22943.006	-5.868	0.000
Age (x1)	-265.383	669.323	-0.396	0.693
Fishing Experience (x2)	33.325	651.978	0.051	0.959
Total Quantity Sold (x3)	568.177	22.717	25.011	0.000
Average Selling Price (x4)	222.294	22.662	9.809	0.000
Operational Cost (x5)	1.011	0.413	2.445	0.016
Fixed Cost Depreciated (x6)	1.893	3.048	0.621	0.536
Marketing Efficiency (x7)	75.031	59.613	1.259	0.211

Dependent Variable: Revenue

Constraints Facing Value-Chain Actors along Nigeria-Benin Border

Artisanal Fishermen along Nigeria-Benin Border

Presented in Table 4.53 are the lists of constraints facing respondent artisanal fishermen along Nigeria-Benin border. On the list, inadequate credit accessibility was ranked first with the highest mean score of 2.57, followed by poor transport facilities (2nd) while inadequate man-power ranked last with the lowest mean of 1.38.

Artisanal Fish producer along Nigeria-Benin Border

Mean scores of constraints facing respondent fish farmers along Nigeria-Benin border are presented in Table 4.54. High cost of fish feed had the highest mean score of 3.00 (1st rank) followed by poor supply of electricity with mean score of 2.57 (2nd rank) while corruption/pilfering had the least mean score of 1.31 as the least constraint (10th rank) facing fish farmers along Nigeria-Benin border.

Artisanal Fish processor along Nigeria-Benin Border

The results of the mean scores of constraints faced by fish processors along Nigeria-Benin border indicate that poor transport facilities/road condition had the highest mean score of 4.12 (1st rank), followed by poor electricity supply with mean score of 3.02 (2nd rank) while unskilled man-power had the least mean score of 1.29 (9th rank) as presented in Table 4.55.

Table 15: Ranking of constraints of respondent artisanal fishermen along Nigeria-Benin Border

Constraints	Mean Score	Ranking
Inadequate credit accessibility	2.57	1
Poor transport facilities/road condition	2.38	2
Lack of access to modern fishing facilities	2.23	3
Inadequate access to fishing inputs	2.05	4
Lack of storage facilities	2.00	5
Poor electricity supply	1.88	6
Difficulty access to the fishing ground	1.75	7
Drying up of rivers	1.72	8
Lack of training	1.68	9
Corruption/pilfering	1.45	10
Inadequate man-power	1.38	11

Table 16: Ranking of constraints of respondent fish farmers along Nigeria-Benin Border

Constraints	Mean Score	Ranking
High cost of fish feed	3.00	1
Poor Electricity Supply	2.57	2
Inadequate Credit accessibility	1.92	3
Lack of Training	1.72	4
Unskilled man-power	1.58	5
Poor Transport facilities/Road Condition	1.56	6
Inadequate water Availability/Supply	1.55	7
Lack of Storage facilities	1.35	8
Inadequate Land Accessibility	1.32	9
Corruption/Pilfering	1.31	10

Table 17: Ranking of constraints of respondent fish processors along Nigeria-Benin Border

Constraints	Mean Score	Ranking
Poor Transport facilities/Road Condition	4.12	1
Poor Electricity Supply	3.02	2
Corruption/Pilfering	2.70	3
Inadequate Credit accessibility	2.58	4
Inadequate Land Accessibility	1.91	5
Lack of Storage facilities	1.78	6
Lack of Training	1.71	7
Inadequate water Availability/Supply	1.40	8
Unskilled man-power	1.29	9

Table 18: Ranking of constraints of respondent fish traders along Nigeria-Benin Border

Constraints	Mean Score	Ranking
Inadequate Credit accessibility	2.87	1
Poor Transport facilities/Road Condition	2.84	2
Inadequate water Availability/Supply	2.72	3
Poor Electricity Supply	2.47	4
Lack of Storage facilities	2.19	5
Corruption/Pilfering	2.10	6
Lack of Training	2.09	7
Inadequate Land Accessibility	1.93	8
Unskilled man-power	1.61	9

Conclusions and Recommendation

Value-addition has been found to be essential to sustainable development of aquaculture and fisheries industries. Consequently, several actors namely: artisanal fishermen, fish farmers, fish processors and marketers/traders were observed to be actively involved in value-addition of fish products along Nigeria-Benin border. These actors operated small, medium and large scale operation systems. It was observed that value-addition is a lucrative business irrespective of the fish products produced and the scale of operation of the actors. Furthermore, the technical efficiencies of the value-chain actors were above 80%, indicating that there are still opportunities to improve fish productivity in the area. Government agencies and international organizations should provide transport, storage, packaging facilities and other essential inputs at a subsidized rate for value-chain actors in the study area.

Acknowledgement

Special thanks to WorldFish Center, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under the Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa", following the Malabo Declaration at the 2014 Summit African Heads of States and Governments in Equatorial Guinea. The funding was made possible through the assistance from the European Union.

References

Adebo, G.M. and Toluwase, S.O.W. 2014. Comparative analysis of fresh and smoked catfish marketing in Ekiti and Ondo States of Nigeria. Journal of Biology, Agriculture and Healthcare 4.19: 6-11.

Aihonsu, J. and Shittu, A. 2008. Value- addition: Comparative economic analysis of fish processing technologies in two fishing communities in Lagos State, Nigeria. In: V.M.E, Obinne and A. Lawal eds., Prospects and challenges of adding value to agricultural products. Proceedins of the 22nd Annual National Conference of Farm Managers Association of Nigeria. Pp. 317 – 321.

Amao, J. O., Oluwatayo, I. B. and Osuntope, F. K. 2006. Economics of Fish Demands in Lagos State, Nigeria. Journal of Human Ecology19 1, 25-30.

Atanda AN, 2009. Freshwater fish seed Resources in Nigeria. Fish Network 21: 26 – 57.

Bassey, N. E, Uwemedimo, E. Okon, Uwem, U. I. and Edet, N. E. 2015. Analysis of the Determinants of Fresh Fish Marketing and Profitability among Captured Fish Traders in South-South Nigeria: The Case of Akwa Ibom State. British Journal of Economics, Management and Trade 5.1: 35-45.

Edwards, S., Allen, A.J. and Shaik, S. 2005. Market Structure Conduct Performance (SCP) Hypothesis revisited using Stochastic Frontier Efficiency analysis. Selected paper for presentation at the American Agricultural Economics Association Annual Meeting, Long Beach, California, July 23-26, 2006. 4-5.

Esiobu, N. S., Nwosu, C. S and Onubuogu, G. C. 2014. Economics of Pineapple Marketing in Owerri Municipal Council Area, Imo State, Nigeria. Int. J. Appl. Res. Technol.. 3.5: 3 – 12.

FAO 2013. A value-chain analysis of international fish trade and food security with an impact assessment of the small-scale sector. FAO Fisheries Technical Paper 456 Retrieved http://www.fao.org/valuechaininsmallscalefisheries

George, F. O. A., Olaoye, O. J., Akande, O. P. and Oghobase, R. R. 2010. Determinants of Aquaculture Fish Seed Production and Development in Ogun State, Nigeria. Journal of Sustainable Development in Africa, 12.2: 44-52.

Inoni, O. E. and Oyaide W. J. 2007. Socio-economic analysis of artisanal fishing in the South Agro-ecological Zone of Delta State, Nigeria. Agricultural tropical and subtropical, 40.4:11-17.

International Collective in Support of Fishworkers ICSF. 2002. Report of the Study on Problems and Prospects of Artisanal Fish Trade in West Africa. ICSF, Chennai, India, 92pp.

Jim-Saiki L. 2016. Socio-Economic Analysis of Artisanal Fishing Operation in West and East Axes of Lagos State, Nigeria. Nigerian Journal of Fisheries and Aquaculture 4.1: 43-56.

Lindner, A., Fisher, C., Felix, A., Scherer, V., Warkentin, A. 2010. Investment and valuation of firms. Market efficiency theory. Publication of Universidad de Huelva. Retrieved on 20th September, 2016 from http://uhu.es/45151/temas/Unit%204_1.pdf. 17.

Lo, A. W. 2004. The adaptive markets hypothesis. The Journal of Portfolio Management 30.5: 15–29

Magudu, A. J. and Edward, A. 2011. Marketing and distribution channel of processed fish in Adamawa State, Nigeria. Global Journal of Management and Business Research 11.4: 23-32.

Molyneux, P. and Forbes, W. 1995. Market Structure and Performance in European Banking. Applied Economics 27: 155-159.

Nwiro, E. 2012. Fish Farming a lucrative Business Retrieved on 20 October, 2012 from http://www.thisdaylive.com/articules/fish-farming-alucrative business/11

Odebiyi, O. C, George, F. O. A, Odulate, D. O., Agbonlahor, M. U. and Olaoye O.J. 2013. Value-chain analysis for coastal fisheries development in Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary 13.11: 6 -15.

Olaoye, O.J, 2013. Assessment of socio-economic analysis of fish farming in Oyo state, Nigeria. A Ph.D Thesis of Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta, Ogun State, Nigeria. Pp367

Omiti, J., Otieno, D., Nyanamba, T. and Mc Cullough, E. 2009. Factors influencing the intensity of market participation by smallholder farmers: A case study of rural and peri-urban areas of Kenya. African Journal of Agricultural and Resource Economics 3.1: 57-82.

Onoja, A.O., Usoroh, B.B., Adieme, D.T. and Deedam, N.J. 2012. Determinants of Market Participation in

Nigerian Small-Scale Fishery Sector: Evidence from Niger Delta Region. Consilience: The Journal of Sustainable Development 9.1: 69-84.

Onyango, C.O. 2013. Analysis of Structure, Conduct and Performance of small ruminant stock market participants of Isiolo-Nairobi trading market, Kenya. M.Sc Project. Agricultural andApplied Economics of Egerton University. xiii+93pp.

Oyinbo O, Rekwot GZ, 2013. Fishery production and economic growth in Nigeria: Pathway for sustainable economic development. J Sustain Dev Afr, 15.2:99-109.

Singh, K., Dey, M. M., Rabbani, A. G., Sudhakaran, P. O. and Thapa, G. 2009. Technical Efficiency of Freshwater Aquaculture and its Determinants in Tripura, India. Agricultural Economics Research Review 22: 185-195.

Spore, A. 2012. Making the connection: The rise of agricultural value chains. The magazine for agricultural and rural development in ACP countries. Technical Centre for Agricultural and Rural Cooperation CTA, Waganingen, the Netherlands. 3-7

Williams T.O., Spycher B. and Okike I. 2006. Improving livestock marketing and intra-regional trade in West Africa: Determining appropriate economic incentives and policy framework. ILRI (International Livestock Research Institute), Nairobi, Kenya. 122 pp

FISH TRADE MARKET STRUCTURE ALONG NIGERIA-CAMEROON-CHAD BORDER NODES

Ajani E K[1], Omitoyin B O[1], Falaye A E[1], Oyesola O B[2], Olajide O A[3], Ojo D O[1], Okeleye I O[1] and Chimatiro S K[4]

[1]Department of Aquaculture and Fisheries Management, University of Ibadan, Ibadan Nigeria
[2]Department of Agricultural Extension and Rural Development, University of Ibadan, Ibadan Nigeria
[3]Department of Agricultural Economics, University of Ibadan, Ibadan Nigeria
[4]Worldfish Centre, Zambia

Abstract

Better integration of intra-regional fish trade into national policy agenda is reported as a tool for improving food and nutritional security; and poverty reduction in Africa. However, critical information on market structure of intra-regional fish trade needed to ensure food security in the West African corridor is very limited. This study investigated the market structure for fish trade along Nigeria-Cameroon-Chad border. Akwa Ibom, Cross River, Benue, Taraba, Adamawa and Borno States along the Nigeria-Cameroon-Chad border were purposively selected for this study. Snowball sampling procedure was employed for sample selection. Structured questionnaires were administered to producers (300), processors (300) and marketers (300). Data were analysed using descriptive statistics, budgetary analysis, Herfindahl index, Gini coefficient, and ANOVA at □0.05. The study revealed that the production node was dominated by males 93.3%, while the processing (55.0%) and marketing (56.0%) nodes were dominated by females. Majority of the producers (34.3%), processors (34.0%) and marketers (39.7%) were within the age bracket of 41-50 years and had secondary school education (31.7%, 40.7% and 43.7% respectively). Majority of the respondents had marketing experience averaging 15 years for producers, 13 years for processors and 8 years for marketers. The empirical findings on Gini coefficients for actors in fresh fish production node were (0.63, 0.53) and marketing node (0.43, 0.43); smoked fish processing node (0.68,) and marketing node (0.46, 0.39); dried fish processing node (0.69) and marketing node (0.51, 0.34) and frozen fish marketing node (0.36, 0.25) translating to imperfect competitive market structure. Herfindahl index was highest for fresh (0.72), smoked (0.80) and dried (0.99) fish markets in Borno, Cross River and Adamawa States, respectively and frozen (1.00) fish markets in Akwa Ibom, Cross River and Borno States. Processing node had the highest gross margin (□371,559.91±282965.56) and marketing margin (□405,394.09±392255.64), and marketing node had the highest marketing efficiency of 87.69±84.86. Fresh fish (564.13±552.27kg) was the highest volume of fish sold in intra-State marketing. The bulk of inter-State and intra-regional inflow and outflow trade came from the quantity of fresh (1, 250.64±703.53kg and 1, 719.44±638.63kg, respectively) and dried (2, 098.00±306.88kg and 2, 205.11±987.43kg, respectively) fish products traded. The processing node is the most profitable and the marketing node is the most efficient of the fish marketing nodes identified. Hence, investment in the fish value chain should focus on enhancing the efficiency and the profitability of the weak nodes in the chain.

Key words: Marketing Nodes, Fish Trade, Profitability, Market efficiency.

Corresponding author email: ekajani@yahoo.co.uk

Introduction

Fish is economically, socially and culturally important as a global dietary aspect of sustainable food security (Odebiyi *et al*., 2013). Fish products are highly traded and an estimated 45% of the world catch now traded internationally (The FishSite, 2015). Vibrant markets for fish and fish products exist in Nigeria, Ghana and Ivory Coast, being the three major importers of fish products and hence a huge potential for Intra-regional fish trade in West Africa (Ndiaye, 2013; Torres and Van Seters, 2016). Nigeria has a staggering demand-supply gap of about 1.8 million tonnes of fish, from an annual fish demand of about 2.66 million tonnes and a paltry domestic production of about 780,000 tonnes (Oyinbo and Rekwot, 2013). Africa's participation in the global fish trade has been limited, providing only about 4.9% of the total value traded (Worldfish, 2015a). Nigeria imports between $400 and $600 million worth of fish and fish products each year (FMARD, 2016) and her top suppliers are United States and Chile followed by Europe (18%), and Asia (10%); meanwhile, African suppliers provide only a meagre 7% (FAO, 2016). International trade has not served as an effective tool for the achievement of sustainable economic growth and development for many African countries, however, promotion of intra-regional trade will contribute to enhancing African countries' capacity and getting them ready to compete more effectively on international markets (FAO, 2016).

West African region is among the best-endowed fishing grounds in the world and the region benefits from the nutritional and economic advantages of its fisheries (Ndaiye, 2013). Yet the fisheries sector still faces many challenges ranging from poor exploitation of resources to marketing problems (Ndaiye, 2013). In an effort to resolve the challenge of marketing problems, development practitioners have focused attentions on targeting fisheries value chains in order to improve smallholder participation in markets (Rota and Sperandini, 2010). To promote responsible and equitable fish trade and marketing, European Union funded "Fish Trade for a Better Future" project, which is focused on conducting research to generate data that will inform crucial policy decisions towards improving food security and reduction of poverty through intra-regional fish trade in sub-Saharan Africa (WorldFish, 2015b). Intra-regional fish trade in Africa is constrained by inadequate market information, trade infrastructure, deficient policy and institutional frameworks which have prevented Africa from optimizing the social and economic benefits available from fish trade (Lokuruka, 2016). One of the policy thrust to improving marketing and trade in the recent Agriculture Promotion Policy (APP) in Nigeria is enhancing access to market information (process, opportunities etc.), regulations, price discovery, etc. (FMARD, 2016).The paucity of information on the market structure and value of intra-regional fish trade needed to ensure food security in the West African corridor makes it imperative to study fish marketing system in Nigeria and trade flow of fish products with other countries.

Theoretical Framework

Market structure conduct and performance (S-C-P) framework was derived from the neo-classical analysis of markets (Edwards *et al*., 2005). As a branch of applied price theory, the basic paradigm of Industrial organization (IO) which was popularized by Bain in late 1950s, holds that market structure influence the competitive conduct of firms in the market, which in turn influences market performance. Therefore, structure, conduct and performance (SCP) is the basic framework of analysis in the theory of Industrial organization (Gichangi, 2010). According to APEC (2008), the relationship of the market players affects the conduct (either negatively or positively) and consequently affects the market performance and vice versa. The model in which the three market characteristics (S-C-P) affects one another is an interactive system and therefore discussing the measuring criteria includes a deep understanding of the market participant behaviours as well as the external environment that may contribute to certain peculiar outcomes (Onyango, 2013).

Market structure relates to how market participants are organized in terms of the size and number of individual players in the market. In some cases, it denotes the institutional barriers to new entrants. Characteristics such as the degree of product differentiation, market integration, concentration (number and size of buyers and sellers) influences market structure. Market conduct refers to certain behaviours of firms in the market. Market conduct is more or less influenced by market structure (Onyango, 2013). According to World Food Programme (2011), level of competition in the market is critical: how prices are determined, whether or not actors collude or price discriminate, and how far the prices of goods are above their production costs. Competitiveness of market actors, particularly traders (wholesalers and retailers), can be particularly important in the context of how they would likely respond to changes in market supply (e.g. an increase due to food aid) or household demand (e.g. an increase due to non-food transfers, thus increasing liquidity and purchasing power). Market performance is the ultimate result derived from the market and it encompasses the outcome from various market activities (Onyango, 2013). To measure the market performance, an evaluation of the contribution of marketing to the overall economic welfare in terms of efficiency remains a key focus. The elements traditionally classified under performance are profits, operational efficiency, pricing efficiency and stability and progressiveness, price stabilization of information, cost of sales promotion. The structure-conduct-performance (SCP) approach is often used in the investigation of agricultural subsectors (Suleiman, 2007). Gross Margin is computed as the difference between the total revenue and total variable cost (Oparinde and Ojo, 2014). According to Madugu and Edward (2011) marketing margin depicts the ratio that determines the gap between producer and consumer prices. Marketing efficiency is defined as the maximization of the ratio of output to input in marketing (Olukosi *et al*., 2005). The study seeks to examine the fish value chain with respect to the following:

- The marketing nodes for fish trade and species of fish produced and traded along Nigeria-Cameroon-Chad border
- The socio-economic characteristics of the marketing actors involved in fish trade.
- The structure of fish (fresh, smoked, dried and frozen) marketing along these borders.
- The performance of the actors at each node of the chain.

Based on the aforementioned- research questions, this research was conceptualized to provide a framework for the development of recommendations for stakeholders and to be able to aid policy makers to develop sound and sustainable fishery marketing strategies with realizable objectives that would improve fish marketing system in Nigeria and on the long run enhance regional fish trade in Africa. Hence, this study identified the marketing nodes for fish (frozen, dried, smoked and fresh) trade; determined the socio-economic characteristics of the actors operating along the fish trade routes; described the structure of fish marketing and estimated the profitability and efficiency of the actors involved in fish trade and trade flow.

Hypotheses

i. There is no significant difference in the profitability and efficiency of fish marketing across the marketing nodes for fish trade along Nigeria-Cameroon-Chad border.
ii. There is inequality in the share of monthly income among the actors across the various fish (fresh, smoked, dried and frozen) markets.

Methodology

This study was conducted along the Nigeria-Cameroon-Chad border and data was collected from the States along this border, comprising Akwa-Ibom, Cross-river, Benue, Taraba, Adamawa and Borno states. Snow ball sampling technique was adopted to select 150 respondents from each of the sampled State, comprising 50 producers (both capture and culture), 50 processors and 50 marketers,

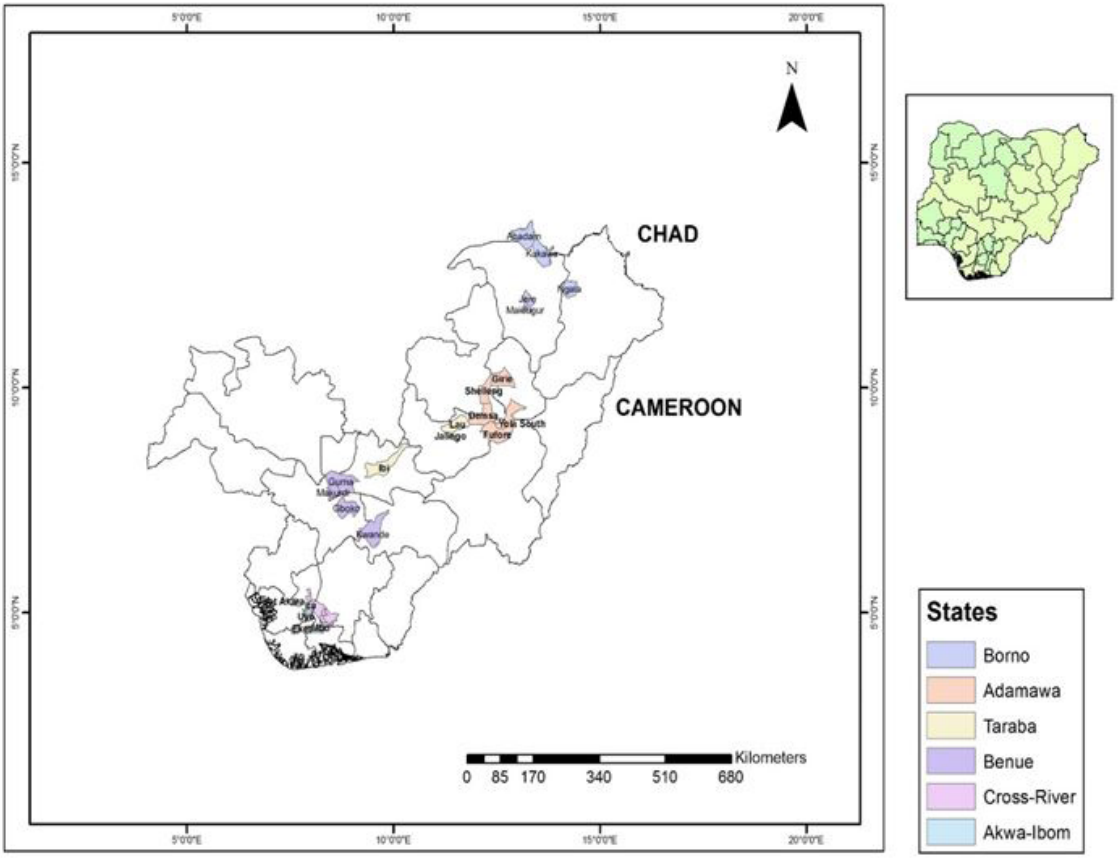


Figure 1: Map of the study area

making a total of 900 respondents from the six States. The selection of the respondents in thirty-three (33) Local Government Areas (LGA) was based on the intensity of fishing and fish marketing and their acceptance of the target respondents to provide data for the research. Field observation was also conducted to supplement the data collected in the questionnaires. Independent Variables collected were the socio-economic characteristics of the actors operating along the fish trade routes, fish marketing nodes and the structure of fish marketing. Dependent variables are the profitability and efficiency indices of the marketing actors.

Marketing Nodes: Each marketing node was identified as a point in the value chain where a product is exchanged or goes through major transformation (Bolwig *et al*., 2010).

Market Structure: This was described based on findings on concentration, product differentiation, market knowledge and ease of/or barrier to entry or exist (Suleiman, 2007). Herfindahl Index (HI) was used to measure the concentration of the market which is one of the variables of the market structure (Agom *et al*., 2012). According to Oparinde and Ojo (2014), the formula for herfindahl index is given thus:

$$\text{Herfindahl index (HI)} = \sum_{i=1}^{n} (S_i)^2$$

Where
i= 1, 2, 3,… , n
n=number of respondents,
S= share of firm in the industry.
In addition, Gini Coefficient (Okereke and Anthonio, 1988) was computed to determine the degree of market inequality or equality and illustrated in Lorenz curve.

$$G = 1-\sum xy$$

Where,
G = Gini coefficient.
x = Percentage share of each class of seller.
y = Cumulative percentage of the sales.

Gona *et al*. (2004) showed that the degree of concentration of marketers is indicated by the value of Gini coefficient. The Gini coefficient value ranges from zero to one. A perfect equality in concentration (low) of sellers is expected if Gini coefficient tends towards zero, while perfect inequality in concentration (high) of sellers is expected if Gini coefficient tends towards one. That is, if Gini coefficient = 1 market is imperfect, and if Gini coefficient = 0 market is perfect and competitive. In graphical terms, the Gini index is the ratio of the area between the Lorenz curve and the line of perfect equality (Garba *et al*., 2015). Descriptive statistics using simple percentages was used to analyse the different forms of fish sold in the markets.

Scale economies is the measure that was used to determine entry and exit conditions in the market. It is a measure that examines the average cost function associated with the sellers' marketing activities. This was computed using least square regression of the form (Pomeroy, 1989):

$$y=b_0+ b_i x_i+e$$

Where,
y = Total cost of marketing per class of seller per month (N)
xi = Number of fish (kg) sold per month
bi = Coefficient of explanatory variables
bo = Intercept
e = Error term

If the coefficient of bi is negative, it means as quantity increases, cost decrease. This increase in cost could form barrier to entry especially by sellers that are not financially sound.

Profitability and Efficiency of the actors in the marketing nodes: Budgetary analytical tools were employed to analyse the profitability and efficiency of the actors involved in fish trade in the study area.

Gross Margin= TR-TVC
(Oparinde and Ojo, 2014)

Where, TR = Total Revenue in naira; TVC = Total Variable Cost in naira

Marketing Margin= TR-PC
(Omonona and Udoh, 1999)

Where, TR = Total Revenue in naira; PC = Purchase Cost in naira

Marketing Efficiency= TR/TC
(Omonona and Udoh, 1999)

Where, TR = Total Revenue in naira; TC = Total Marketing Cost in naira

Results

Marketing Nodes: This research identified three major marketing nodes for fresh and processed fish in the study area- Production, Processing and Marketing nodes as illustrated in figure 2.

Socio-economic characteristics of respondents in the marketing nodes: As presented in table 1, the percentage of female processors and marketers was more than the male. Among the processors, women constituted 55.00% and men were 45.00%. In the category of marketers, women constituted 56.00% and men were 44.00%. The greater percentage of women in processing and marketing nodes could be because of the persuasive nature of women in promoting fish sales. This finding is in line with Esiobu *et al*. (2014a) who asserted that females constitute a greater proportion of those involved in agribusiness activities. However, the percentage of producers that are male (93.33%) were more than female (6.67%). Men are more involved in the production (upstream) activities and invest in fishing vessels, nets, other fishing gear and pond construction (Lem *et al*., 2014). The modal age bracket was 41-50 years and

the percentage of producers, processors and marketers that fall within this age bracket of 41 and 50 years were 34.33%, 34.00% and 39.67% respectively.

Omitoyin and Okeowo (2015) reported majority of catfish producers, processors and marketers in Lagos State to be between 41 and 50 years of age. Esiobu *et al*., (2014b) reported that this age group constitutes the major productive workforce. The mean age of the respondents was 43.31±10.19 years.

The highest percentage of the fish producers (87.67%), fish processors (88.33%) and fish marketers (85.33%) were married. This could be because of the opportunity of getting cheap family labour. Moreover, trade is remunerative to cater for family responsibilities as opined by Kwaghe *et al*. (2008). Christianity was a common religion largely practiced among the producers (61.67%), processors (68.67%) and marketers (63.33%). Majority of the respondents were Christians, similar to the findings of Odebiyi *et al*. (2013). The position of the actors in their respective households reveals that majority of the producers (77.33%) and processors (51.67%) are household heads. This implies the high expectation of responsibility and generation of income from producers and processors. However, majority of the marketers (52.33%) are not the heads of their households. The distribution of the household sizes reveals that majority of the producers (45.67%), processors (52.00%) and marketers (46.67) have a household size of 4-7 persons. The use of hired labour in small-scale agribusiness enterprise is very low (Esiobu and Onugbuogu, 2014). The highest level of education of respondents across the marketing nodes is secondary school education with a percentage of 31.67% among fish producers, 40.67% among fish processors and 43.67% among fish marketers. The number of respondents with Tertiary education was high among the producers (26.33%) compared to the other marketing nodes.

This signifies that the respondents have the ability to read and write, comprehend policy measures as well as to make decisions that will expand their businesses and improve their livelihoods. Respondents have substantial number of years of experience in marketing and possess good skills and ability to make wise decisions that will enhance their business performance. Similar to the findings of Udoh and Nyienakuma (2008), Odebiyi *et al*. (2013) and Babalola *et al*. (2015). The percentage of respondents that belonged to a marketers' association was highest among the producers (51.33%), processors (65.67%) and marketers (67.67%). Similar to the finding of Umoinyang (2014), the rate of membership in marketers' association could be because it afforded the respondents access to credits and vital information that will necessitate the expansion of their businesses.

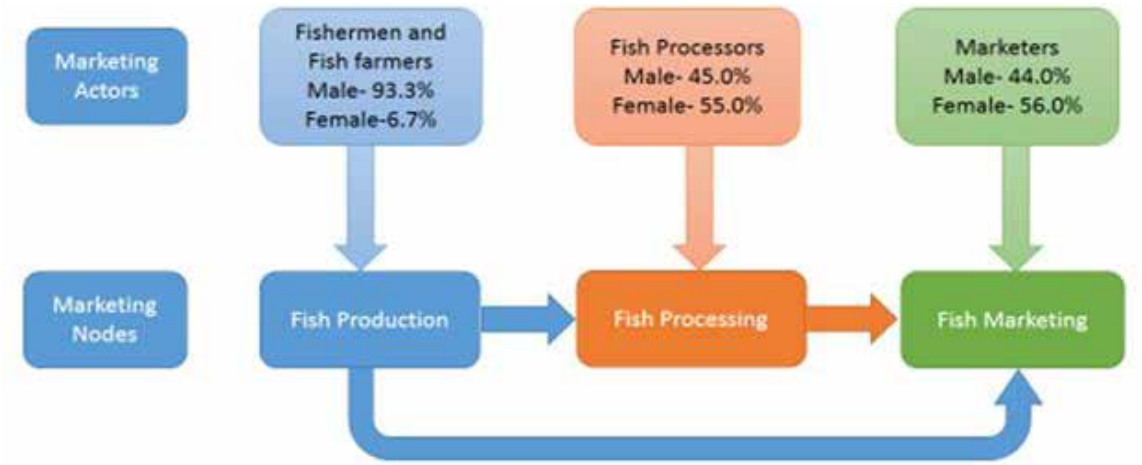


Figure 2: Schematic view of fish marketing chain along Nigeria-Cameroon-Chad border

Table 1: Socio-economic characteristics of respondents in the marketing nodes

Variables	Groups	Main occupation					
		Freq	(%)	Freq	(%)	Freq	(%)
Sex	Male	280	93.33	135	45.00	132	44.00
	Female	20	6.67	165	55.00	168	56.00
Age	≤ 20years	2	0.67	1	0.33	2	0.67
	21-30years	45	15.00	35	11.67	33	11.00
	31-40years	75	25.00	75	25.00	97	32.33
	41-50years	103	34.33	102	34.00	119	39.67
	>50years	75	25.00	87	29.00	49	16.33
Marital Status	Single	34	11.33	11	3.67	19	6.33
	Married	263	87.67	265	88.33	256	85.33
	Divorced	0	0.00	4	1.33	8	2.67
	Widowed	3	1.00	20	6.67	17	5.67
Religion	Christianity	185	61.67	206	68.67	190	63.33
	Muslim	114	38.00	94	31.33	110	36.67
	Traditionalist	1	0.33	0	0.00	0	0.00
	Others	0	0.00	0	0.00	0	0.00
Household Head	No	68	22.67	145	48.33	157	52.33
	Yes	232	77.33	155	51.67	143	47.67
Household size	≤ 3 persons	68	22.67	53	17.67	53	17.67
	4 - 7 persons	137	45.67	156	52.00	140	46.67
	8 - 11 persons	69	23.00	65	21.67	84	28.00
	≥12 persons	26	8.67	26	8.67	23	7.67
Level of Education	Primary	63	21.00	91	30.33	92	30.67
	Secondary	95	31.67	122	40.67	131	43.67
	Tertiary	79	26.33	25	8.33	29	9.67
	Qu'ranic	57	19.00	51	17.00	39	13.00
	Informal	6	2.00	11	3.67	9	3.00
Years of Selling	☐1 year	4	1.33	2	0.67	2	0.67
	1-5 years	65	21.67	31	10.33	45	15.00
	6-10 years	77	25.67	88	29.33	98	32.67
	11-15 years	65	21.67	98	32.67	69	23.00
	☐15 years	89	29.67	81	27.00	86	28.67
Membership of Association	No	146	48.67	103	34.33	97	32.33
	Yes	154	51.33	197	65.67	203	67.67

Source: Field survey, 2016

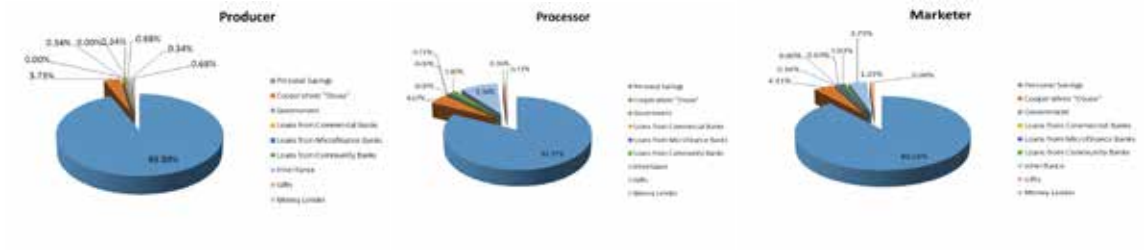


Figure 3-5: Charts showing the primary sources of fund for the respondents

Figures 3-5 above shows that personal savings was the major primary source of funds for all the value chain actors. Across the nodes, producers (92.33%) had the highest percentage of respondents that used their personal savings as their primary source of fund.

Analysis of fish market structure: The forms of fish sold by the market participants (producers, processors, wholesalers and retailers) at the levels of operations in each marketing node were fresh, dried, smoked and frozen fish. Gini coefficient indices for each form of market were computed in tables 2-5 below, and the empirical results revealed Gini coefficients of 0.65, 0.71, 0.70 and 0.59 for fresh, dried, smoked and frozen fish markets, respectively.

The analysis revealed inequality in the market share among the marketing participants in fresh fish markets. This finding corroborates the result of Adeleke and Afolabi (2012) who reported high Gini coefficient for fresh fish markets. Similarly, Irhivben *et al.* (2015) reported a high level of inequality in the share of fresh catfish marketers in Oyo State, Nigeria. Gini coefficient value was very high for dried and smoked fish markets which indicated the non-competitive imperfect market structure and implied the presence of high concentration with monopolistic nature of sellers, hence high inequality in the distribution of market revenue among the marketing actors in dried and smoked fish markets in the States along Nigeria-Cameroon-Chad border. This is similar to the findings of Ismail *et al.* (2014) on dried fish wholesaling and retailing (marketers). There is the possible existence of monopolistic condition in the imperfect structure of frozen fish markets and inequality in market share among the market participants in frozen fish markets in Nigeria-Cameroon-Chad border region. Phiri *et al.* (2013) reported the exact Gini coefficient value for retailers in their study. Therefore the null hypothesis II that stated that there is inequality in the fish market was accepted. The Lorenz curves for these analyses are presented in figures 6-9, respectively.

Herfindahl index (HI) calculated for fresh, dried, smoked and frozen fish markets fish markets comprising of producers, wholesalers and retailers were 0.32, 0.55, 0.46 and 0.72, respectively. HI for fresh fish market revealed some level of concentration of sellers and non-monopolistic nature of fresh fish markets, which suggests that the actors in the fresh fish marketing nodes jointly control the fresh fish market in keen competition. Similar findings by Oparinde and Ojo (2014) reported a much lower index among artisanal fish marketers and some degree of concentration in the market. The HI estimated for dried and smoked fish markets showed a greater degree of concentration of fish sellers in these markets. There existed high degree of concentration and low competition among frozen fish marketers in this study, which suggests that wholesalers had the highest market power as a result of their huge market share in the frozen fish markets in the study area. Contrarily, Agom *et al.* (2012) reported a perfectly competitive frozen fish market with herfindahl index of 0.211 in Cross River State.

Table 2: Gini-coefficient for fresh fish markets in Nigeria-Cameroon-Chad border region

Total Revenue (☐)	Frequency	% of Actors (X)	Cumulative Percent	Total Value of Monthly Sales (☐)	% of Total Sales	Cumulative Percent (Y)	XY
≤ 250000.00	205	49.16	49.16	32793791.80	18.91	18.91	0.0930
250000.01 - 500000.00	106	25.42	74.58	37151862.48	21.42	40.33	0.1025
500000.01 - 750000.00	36	8.63	83.21	21977517.66	12.67	53.01	0.0458
750000.01 - 1000000.00	23	5.52	88.73	20493296.76	11.82	64.83	0.0358
1000000.01 - 1250000.00	24	5.76	94.48	26252932.94	15.14	79.97	0.0460
1250000.01 - 1500000.00	15	3.60	98.08	20620503.88	11.89	91.86	0.0330
1500000.01 - 1750000.00	4	0.96	99.04	6649800.00	3.83	95.69	0.0092
1750000.01 - 2000000.00	4	0.96	100.00	7472900.00	4.31	100.00	0.0096
Total	417	100.00				∑xy	0.3749

Table 3: Gini-coefficient for dried fish markets in Nigeria-Cameroon-Chad border region

Total Revenue (☐)	Frequency	% of Actors (X)	Cumulative Percent	Total Value of Monthly Sales (☐)	% of Total Sales	Cumulative Percent (Y)	XY
≤ 250000.00	22	31.9	31.9	3626072.86	5.75	5.75	0.0183
250000.01 - 500000.00	14	20.3	52.2	4818756.23	7.65	13.40	0.0272
500000.01 - 750000.00	2	2.9	55.1	1274742.86	2.02	15.42	0.0045
750000.01 - 1000000.00	8	11.6	66.7	6748954.03	10.71	26.13	0.0303
1000000.01 - 1250000.00	6	8.7	75.4	6744339.58	10.70	36.83	0.0320
1250000.01 - 1500000.00	6	8.7	84.1	8157422.74	12.94	49.77	0.0432
1500000.01 - 1750000.00	2	2.9	87.0	3423763.78	5.43	55.20	0.0160
1750000.01 - 2000000.00	1	1.4	88.4	1957444.44	3.11	58.31	0.0085
2250000.01 - 2500000.00	2	2.9	91.3	4772470.59	7.57	65.88	0.0191
≥ 2500000.01	6	8.7	100.0	21503570.47	34.12	100.00	0.0870
Total	69	100.0					0.2861

GI = 0.71

Source: Field survey, 2016

Table 4: Gini-coefficient for smoked fish markets in Nigeria-Cameroon-Chad border region

Total Revenue (□)	Frequency	% of Actors (X)	Cumulative Percent	Total Value of Monthly Sales (□)	% of Total Sales	Cumulative Percent (Y)	XY
≤ 250000.00	85	20.83	20.83	15686349.39	4.19	4.19	0.0087
250000.01 - 500000.00	133	32.60	53.43	47895299.22	12.79	16.97	0.0553
500000.01 - 750000.00	40	9.80	63.24	24891632.09	6.64	23.62	0.0232
750000.01 - 1000000.00	22	5.39	68.63	18730566.38	5.00	28.62	0.0154
1000000.01 - 1250000.00	17	4.17	72.79	19515995.74	5.21	33.83	0.0141
1250000.01 - 1500000.00	15	3.68	76.47	20025886.23	5.35	39.17	0.0144
1500000.01 - 1750000.00	9	2.21	78.68	14661641.18	3.91	43.09	0.0095
1750000.01 - 2000000.00	19	4.66	83.33	35827519.91	9.56	52.65	0.0245
2000000.01 - 2250000.00	19	4.66	87.99	40758450.53	10.88	63.53	0.0296
2250000.01 - 2500000.00	15	3.68	91.67	35703262.69	9.53	73.06	0.0269
≥ 2500000.01	34	8.33	100.00	100924166.80	26.94	100.00	0.0833
Total	408	100.00					0.3049

GI = 0.70

Table 5: Gini-coefficient for frozen fish markets in Nigeria-Cameroon-Chad border region

Total Revenue (□)	Frequency	% of Actors (X)	Cumulative Percent	Total Value of Monthly Sales (□)	% of Total Sales	Cumulative Percent (Y)	XY
≤ 250000.00	3	50.0	50.0	496571.43	12.35	12.35	0.0618
750000.01 - 1000000.00	2	33.3	83.3	1644210.53	40.89	53.24	0.1775
1750000.01 - 2000000.00	1	16.7	100.0	1879944.44	46.76	100.00	0.1667
Total	6	100.0					0.4059

GI = 0.59

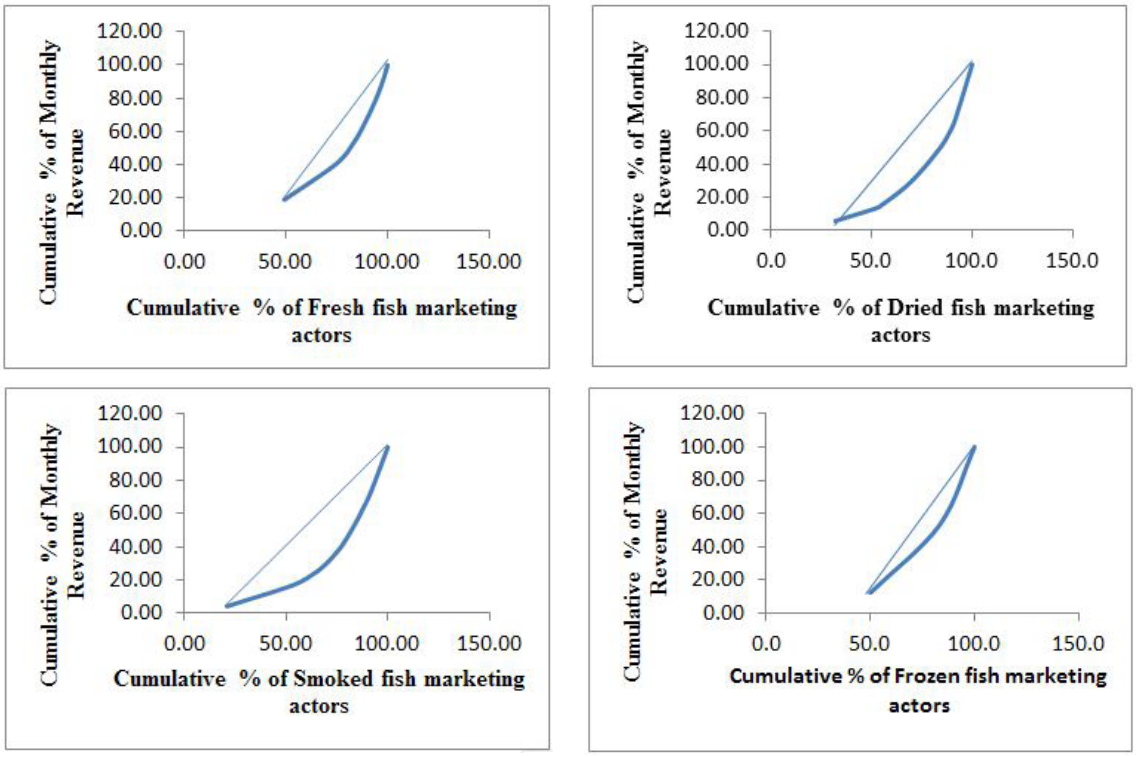
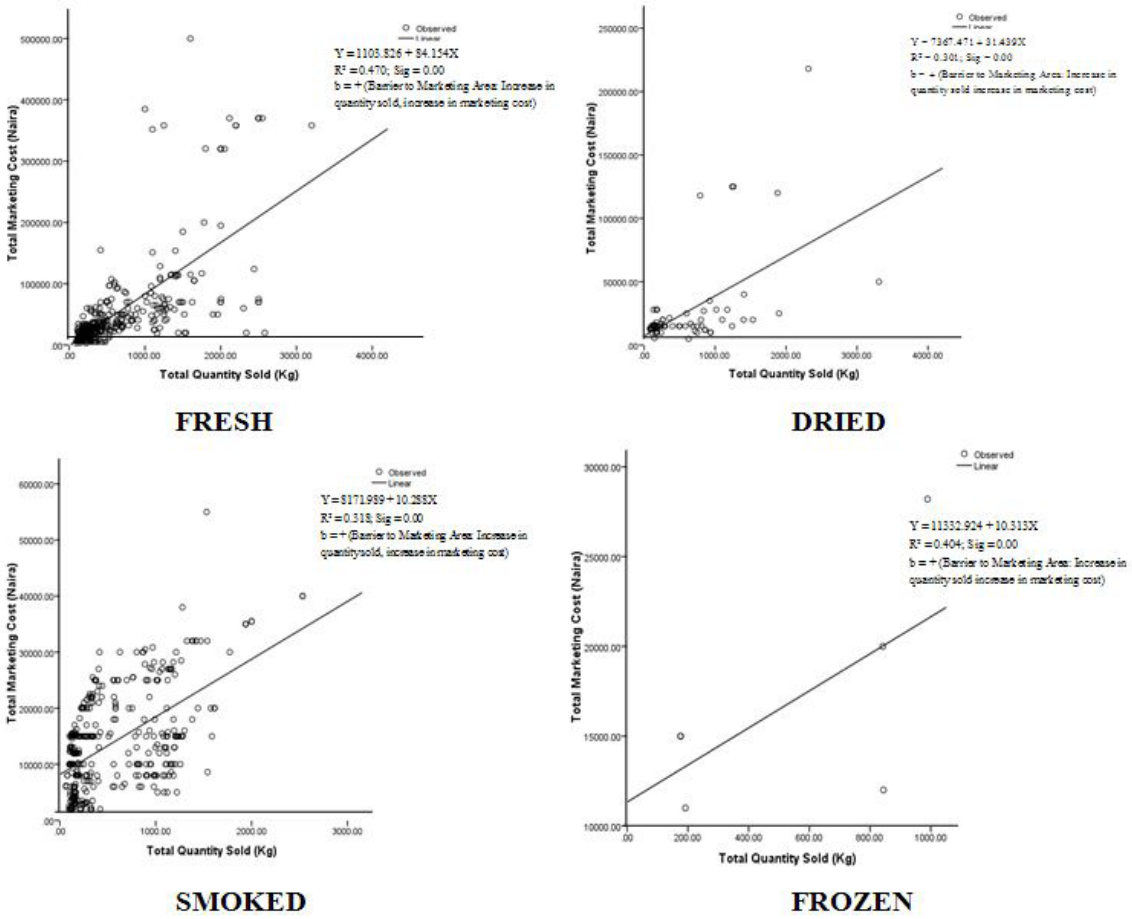


Figure 6-9: Lorenz curves for fish markets in Nigeria-Cameroon-Chad border region

Linear regression was used to assess the barriers to entry for the marketing participants into fish markets based on the coefficient of quantities of fish sold by the marketing actors as illustrated in figures 10-13. The coefficient of the explanatory variable was positive at 5% level of significance from the regression analysis for fresh, dried, smoked and frozen fish markets, which indicated the absence of economies of scale and presence of ease of entry into these fish markets for new entrants. New entrants were not discouraged from entering fresh, dried, smoked and frozen fish markets because they could produce at their level of initial investment and yet maximize profits and compete with the larger firms in these markets. Cost of storage and preservation, cost of refrigeration, extra cost of labour cost of transportation, extra cost of labour and processing, additional market space for storage could have contributed to increasing marketing cost as the quantity sold by fresh fish marketing actors increased. This was no barrier to entry because new entrants into the fresh, dried, smoked and frozen fish markets could maximize profit at any level of production. The actors in the fish marketing nodes did not have to increase the quantity of fish sold in order to reduce the cost of marketing and maximize profits. Similarly, Suleiman (2007) reported that there was no existence of barrier to entry into fish markets in his study area. However, this contradicts the findings of Ismail *et al.* (2014), who reported a negative coefficient of the quantity of dried fish marketed by wholesalers and retailers. This contradiction could be because processors of dried fish were also considered in this study.

Average Monthly Quantities, Profitability and Marketing Efficiency of Fish Products Marketed

As observed from figure 14, Akwa Ibom had the highest average monthly quantity of fresh fish sold. This could be as a result of the predominance of fishing activities in the State. Smoked and dried fish were sold more in Borno State in terms of average quantities per month. This implies the presence of high



Figures 10-13: Relationship between total marketing cost and total monthly quantity of fish sold in the States along Nigeria-Cameroon-Chad border

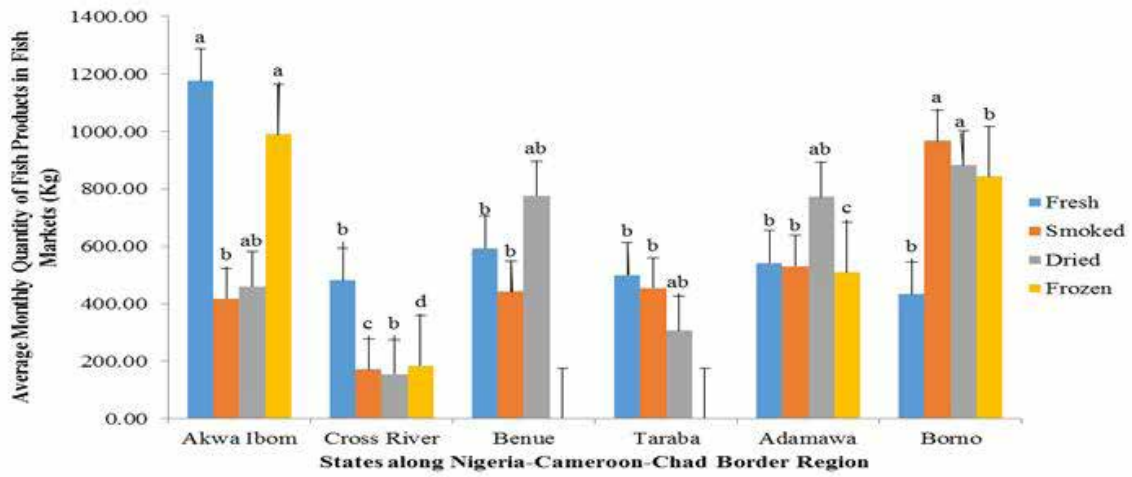


Figure 14: Average monthly quantities of forms of fish sold in fish markets in the States along Nigeria-Cameroon-Chad borderNote: Forms of fish with the same alphabet on error bar are not significantly different (P<0.05)

intensity of fish processing in that State. Frozen fish marketed more in Akwa Ibom State could mean extensive capture fisheries in the Atlantic Ocean bordering the State.

Fresh fish was the highest quantity of fish sold in a month by the marketing actors, though it had no significant difference from the average quantity of the other forms of fish marketed in a month in Nigeria-Cameroon-Chad border region as reported in table 6 below. The significant variation in the prices of the forms of fish could be as a result of value addition in the marketing nodes. The high marketing cost for fresh fish implies that the actors marketing fresh fish incurred a high cost for marketing fresh fish which reduced its marketing efficiency. This is because the production node for fish is labour intensive. The gross margin and marketing margin of dried fish was the highest across the forms of fish sold, making it more profitable than the other forms of fish sold, followed by smoked fish which had the statistically highest efficiency. Similarly, Adebo and Toluwase (2014) found smoked catfish marketing to be more profitable than fresh catfish in their study.

Average monthly quantities, costs, profitability indices and marketing efficiency of fish marketing nodes in Nigeria-Cameroon-Chad border region

As observed in table 7, there were significant differences ($P<0.05$) in the average monthly quantities, prices, costs, profitability indices and marketing efficiency across the marketing nodes in fish markets along Nigeria-Cameroon-Chad border region and this negates and rejects the null hypothesis I. Marketers in the marketing node had the highest buying and selling prices of fish because majority of them employ negotiation to fix their fish prices. This supports the assertion by Chiwaula *et al*. (2012) who opined that when buyers bid for fish, it would result in a more rewarding pricing mechanism for fishers. Marketing cost was highest at the production node because of the high cost of labour incurred by culture producers (fish farmers) producing on a large scale. However, the marketing node was more efficient in fish marketing in Nigeria-Cameroon-Chad border region because the highest average monthly revenue was realized in this node. Production node had the lowest marketing margin and gross margin, similarly, Osondu (2015) reported the least marketing margin for fishermen (production node). Fish processing node was more profitable because it had the highest mean gross and marketing margin in a month than the other marketing nodes for fish trade in Nigeria-Cameroon-Chad border region.

Trade Flow of Fish Products along Nigeria-Cameroon-Chad Border

This study revealed that trade flow of fish in its different forms (fresh, smoked, dried and frozen) existed and was carried out within the sampled States (Intra-State) and to other States in the region (Inter-State) and cross-border trades across the borders in the States along Nigeria-Cameroon-Chad border. In the trade flow, fresh fish was the highest volume of fish sold in intra-State marketing in terms of average quantity of fresh fish marketed within the sampled States in a month. Smoked fish marketers realized the highest average monthly revenue made by the fish marketing actors involved in intra-State trade. Fresh, smoked and dried fish were traded in inter-State inflow and fresh fish constituted the largest proportion of this trade.

The inter-State outflow trade had fresh, smoked, dried and frozen fish as the forms of fish sold. However, the bulk of this trade came from the quantity of smoked fish traded from the sampled States to other Nigerian States. The highest average monthly revenue made by the marketing actors involved in inter-State inflow and outflow trades was realized by the dried fish traders. Fresh, smoked and dried fish were the forms of fish traded intra-regionally (inflow) into Nigeria across the Nigeria-Cameroon-Chad border and dried fish constituted the bulk of this trade. Fresh, smoked and dried fish constituted the intra-regional outflow trade from Nigeria across the Nigerian-Cameroon-Chad border to neighbouring African Countries. Dried fish had the highest percentage of average quantity

Table 6: Average monthly quantities, profitability and marketing efficiency indices of the forms of fish marketed in the region

Variables	Fresh		Smoked		Dried		Frozen	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (Kg)	603.60[a]	582.11	532.65[a]	477.29	603.73[a]	567.73	536.58[a]	392.95
Buying Price (☐ Per Kg)	323.39[c]	337.03	1004.94[a]	499.51	783.12[ab]	327.57	696.67[b]	193.05
Selling Price (☐ Per Kg)	765.37[d]	322.04	1715.34[a]	505.91	1429.46[b]	416.42	1100.00[c]	401.25
Total Marketing Cost (☐)	49691.63[a]	31426.81	13651.84[b]	8710.74	26347.83[ab]	24815.80	16866.67[b]	6377.04
Total Monthly Revenue (☐)	415857.57[b]	384194.19	918188.16[a]	895554.23	913442.57[a]	858396.88	670121.07[ab]	654577.42
Gross Margin (☐)	245841.54[a]	159031.67	347331.12[a]	393850.24	445186.80[a]	387369.96	244252.46[a]	219549.57
Gross Margin/kg (☐)	434.51[bc]	257.86	622.93[a]	310.00	555.93[ab]	391.28	342.78[c]	267.63
Marketing Margin (☐)	322984.54a	309126.24	373843.26a	402853.05	480292.59[a]	704419.24	266169.12[a]	226991.32
Marketing Margin/kg	580.02ab	263.51	710.40a	313.93	646.34[a]	369.57	403.33[b]	250.73
Marketing Efficiency	16.49b	21.87	83.28a	82.52	44.35[b]	42.93	35.64[b]	27.68

Mean values with the same alphabet superscripts on the same row are not significantly different (P>0.05)
Source: Field survey, 2016

Table 7: Economic characteristics, profitability indices and marketing efficiency at fish marketing node in the study area

Variables	Fish Marketing Nodes					
	Production		Processing		Marketing	
	Mean	SD	Mean	SD	Mean	SD
Total Quantity Sold (Kg)	625.46[a]	586.79	504.71[c]	482.11	582.84[ab]	536.28
Buying Price (☐ Per Kg)	20.82[c]	4.50	688.70[b]	247.19	1122.84[a]	519.20
Selling Price (☐ Per Kg)	650.52[c]	238.21	1459.08[b]	377.24	1637.90[a]	641.31
Total Marketing Cost (☐)	58529.57[a]	79408.30	16000.01[b]	8141.30	19500.73[b]	30244.40
Total Monthly Revenue (☐)	377390.47[c]	337881.03	730659.75[b]	650706.41	942221.92[a]	851618.02
Gross Margin (☐)	273825.72[b]	265376.36	371559.91[a]	282965.56	275982.44[b]	232028.94
Gross Margin/kg	462.56[b]	253.77	653.95[a]	330.82	469.36[b]	295.28
Marketing Margin (☐)	369499.52[a]	327198.53	405394.09[a]	392255.64	298272.41[b]	244721.17
Marketing Margin/kg	642.06[b]	242.02	770.38[a]	318.74	516.66[c]	288.61
Marketing Efficiency	8.26[c]	5.10	50.66[b]	45.56	88.17[a]	84.93

Mean values with the same alphabet superscripts on the same row are not significantly different (P>0.05)

Table 8: Average monthly quantities and percentage of forms of fish entering fish markets along Nigeria-Cameroon-Chad border through inter-State, intra-State and intra-regional fish trade

Trade Flow (Inflow)	Fresh			Smoked			Dried			Frozen		
	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD	%
Intra-State Trade	564.13	552.27	87.41	523.89	474.19	95.22	551.86	463.23	86.11	536.58	392.95	100.00
Inter-State Trade	1250.64	703.53	11.92	494.88	408.10	1.59	795.00	63.64	3.82	NS	NS	0.00
Intra-regional Trade	558.29	369.52	0.67	1153.81	208.69	3.19	2098.00	306.88	10.07	NS	NS	0.00
Total	603.60	582.11	100.00	532.65	477.29	100.00	603.73	607.73	100.00	536.58	392.95	100.00

Table 9: Average monthly revenue from sales of fish entering fish markets along Nigeria-Cameroon-Chad border through inter-State, intra-State and intra-regional fish trade

Trade Flow (Inflow)	Fresh		Smoked		Dried		Frozen	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Intra-State Trade	393703.93	367164.83	893906.72	878026.54	822252.89	810582.18	670121.07	674577.42
Inter-State Trade	788744.74	482023.46	824659.06	814547.02	1140750.00	455023.21	NS	NS
Intra-Regional Trade	312733.33	170735.36	2625833.98	424981.57	3649800.00	240345.59	NS	NS

Table 10: Average monthly quantities and percentage of forms of fish sold from the fish markets along Nigeria-Cameroon-Chad border through inter-State, intra-State and intra-regional fish trade

Trade Flow (Outflow)	Fresh			Smoked			Dried			Frozen		
	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD	%
Inter-State Trade	1719.44	638.63	11.61	907.21	500.94	32.14	1049.82	524.51	32.76	NS	NS	0.00
Intra-Regional Trade	2175.00	275.38	3.46	1624.62	512.74	8.22	2205.11	987.43	15.88	NS	NS	0.00

Table 11: Average monthly revenue from forms of fish sold from the fish markets along Nigeria-Cameroon-Chad border through inter-State, intra-State and intra-regional fish trade

Trade Flow (Outflow)	Fresh		Smoked		Dried		Frozen	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Inter-State Trade	1149726.69	449409.14	1617968.31	958389.84	1649045.26	1034956.41	.	.
Intra-Regional Trade	1112500	125000	2634357.45	813701.64	3317327.74	2302822.44	.	.

NS- Not Supplied

traded in month in the intra-regional outflow trade.

The average monthly revenue made from this trade by dried fish traders constituted the highest percentage average revenue from inflow and outflow cross border trade made by intra-regional traders in a month. The pattern of fish trade in the study area as observed during the study revealed that in Ibeno fishing settlement in Akwa Ibom State, the fish caught by the fishermen were processed by the women in this settlement and they were sold at their markets to buyers coming from places as far as Abia, Abuja. Some processors came from Eket to buy fish from this landing site. Fish buyers travelled from as far as Abuja, Lagos, Port Harcourt, Uyo, to Ikang market in Cross River State to purchase fish. In Benue State, some fish processors and marketers usually travel to Adamawa, Taraba, Jigawa, Borno and Kebbi States to buy fish and sell to retailers in the market. Some dry fish marketers travel to Chad, Cameroon and Niger to buy fish during periods of low catch in Benue. Fresh fish marketers from Benue State go to Taraba and Nasarawa State with engine boat to buy fish for distribution to retailers and processors. Some respondents acknowledged that there is a group of fishermen in Cameroon that caught and sold fish to them, which they brought to sell in Nigeria. Some processors in Taraba State, after smoking the fish took it to other States like Benue to sell. At Gurin market in Adamawa State close to Cameroon border, majority of the smoked fish came from Cameroon. The Cameroonians processed the fish in their country and brought them to sell in Adamawa State in Nigeria. Fish marketers in Borno State sold smoked fish in other market locations in Delta (Asaba), Lagos, Enugu and Anambra States.

Conclusion and Recommendations

In conclusion, respondents in this study were generally middle aged men and women with moderate household sizes and had formal education that gave them the ability to make wise decisions that will improve their livelihoods. The processing node is the most profitable and the marketing node is the most efficient node of the fish marketing nodes identified in Nigeria-Cameroon-Chad border region. The measures of market concentration revealed an imperfect market structure, high concentration and some degree of competition in the industry, especially in dried, smoked and frozen fish markets. High degree of inequality was observed in the share of the market revenue (income) among the marketing participants involved in fish trade in fresh, smoked, dried and frozen fish markets along Nigeria-Cameroon-Chad border. There existed free market entry for new entrants to effectively compete in the fish markets. Hence, people are advised to go into fish marketing being a profitable enterprise in order to make a living.

It is pertinent to recommend the following based on these findings:

- Policies that will guarantee fish sale, price stability and improvement in infrastructural facilities should be put in place. These policies will go a long way to further increase the economic returns from fish marketing in the study area in particular and in the nation as a whole. This will also make the enterprise attractive to potential fish producers, processors and marketers and make the market perfectly competitive.
- Fish marketing actors should be encouraged to participate in intra-regional fish trade following the due process of registration and certification in order to increase foreign exchange earnings.
- Efforts should be made to train processors and marketers on efficient fish processing and storage techniques to improve the quality of processed fish handled by fish marketers, Attainment of such knowledge could help to reduce the level of losses and improve profit.

Acknowledgement

Special thanks to WorldFish Center, AU-IBAR and NEPAD Planning and Coordinating Agency (NPCA) for funding the research under

the Fish Trade Project, "Improving Food Security and Reducing Poverty through Intra-regional Fish Trade in Sub-Saharan Africa", following the Malabo Declaration at the 2014 Summit African Heads of States and Governments in Equatorial Guinea. The funding was made possible through the assistance from the European Union.

References

Adebo, G.M. and Toluwase, S.O.W. 2014. Comparative Analysis of Fresh and Smoked Catfish Marketing in Ekiti and Ondo States of Nigeria. Journal of Biology, Agriculture and Healthcare 4.19: 6-11.

Adeleke, M.L. and Afolabi, J.A. 2012. Appraisal of Fish Marketing in Ondo State, Nigeria. International Institute of Fisheries Economics and Trade (IIFET) Tanzanian Proceedings. 1- 4.

Agom, D.I., Etim, G.C. and Etuk, E.A. 2012. Analysis of Wholesale Frozen Fish Markets in Calabar, Cross River State, Nigeria. Trends in Agricultural Economics, 5: 61-69.

APEC. 2008. Market Liberalization and its relationship with Market Structure, Conduct and Performance of the Food Processing Industry in ASEAN Economics. APEC Agricultural Technical Cooperation Working Group, APEC#208-AT-01.2. 469pp.

Babalola, D.A., Bajimi, O. and Isitor, S.U. 2015. Economic potentials of fish marketing and women Empowerment in Nigeria: Evidence from Ogun State. African Journal of food Agriculture, Nutrition and Development. 15.2: 9922-9934.

Bain, J.S. 1968. Industrial Organization. 2nd Edition, John Willey and Sons, New York. ISBN- 978-0471042914. 694pp.

Bolwig, S., Ponte, S., du Toit, A., Riisgaard, I. and Halberg, N. 2010. Integrating poverty and environmental concerns into value chain analysis: A conceptual framework. Development Policy Review 28.2: 173-194.

Chiwaula, L., Jamu, D., Chaweza, R., Nagoli, J. 2012. The Structure and margins of the Lake Chilwa sheries in Malawi: A value chain analysis. The WorldFish Center, Penang, Malaysia. Project Report 2012-12. 34 pp.

Edwards, S., Allen, A.J. and Shaik, S. 2005. Market Structure Conduct Performance (SCP) Hypothesis revisited using Stochastic Frontier Efficiency analysis. Selected paper for presentation at the American Agricultural Economics Association Annual Meeting, Long Beach, California, July 23-26, 2006. 4-5.

Esiobu, N.S. and Onubuogu, G.C. 2014. Socio-economic Analysis of Frozen Fish Marketing in Owerri Municipal Council Area, Imo State, Nigeria: An Econometric Model Approach. Scholarly Journal of Agricultural Science 4.8: 449-459.

Esiobu, N.S., Nwosu, C.S and Onubuogu, G.C. 2014a. Economics of Pineapple Marketing in Owerri Municipal Council Area, Imo State, Nigeria. International Journal of Applied Research and Technology. 3.5: 3 – 12.

Esiobu, N.S., Onubuogu, G.C and Okoli, V.B.N. 2014b. Determinants of Income from Poultry Egg Production in Imo State, Nigeria: An Econometric Model Approach. Global Advanced Research Journal of Agricultural Science 3.7: 186-199.

FAO, 2016. Fish trade in Africa: An update by Amadou Tall. In: GLOBEFISH- Analysis and information on world fish trade. Food and Agriculture Organisation of the United Nations, Rome. Retrieved from www.fao.org/in-action/globefish/fishery-information/resource-detail/en.

FMARD. 2016. The Agriculture Promotion Policy (2016 – 2020), Building on the successes of the Agricultural Transformation Agenda (ATA), closing Key Gaps. Policy and Strategy Document, Federal Ministry of Agriculture and Rural Development, Abuja FCT, Nigeria. 20-25.

Garba, I.D., Sanni, S.A. and Adebayo, C.O. 2015. Analyzing the Structure and Performance of Shea Butter Market in Bosso and Borgu Local Government Areas of Niger State, Nigeria. International Journal of u- and e- Service, Science and Technology 8.2: 321-336.

Gichangi, A.W. 2010. Analysis of structure, conduct and performance of sewwt potato marketing: The case of Nairobi and Kisumu, Kenya. M.Sc. Thesis Submitted to the Graduate School in Partial Fulfillment for the Requirements for the award of

Master of Science Degree in Agricultural Economics of Egerton University. xi+58pp.

Gona, A., Tanko, L. and Mohammed, I. 2004. Analysis of Market Performance of the Food Service Industry in Sokoto State, Nigeria. Proceedings of the 23rd Annual National Conference of Farm Management Society of Nigeria, 14th – 17th December, 2009. 79-84.

Irhivben, B.O., Enyioko, O., Oluwafemi, Z. and Yusuf, S.A. 2015. Structure and Performance of Catfish Market in Ibadan Metropolis, Oyo State, Nigeria. International Journal of Social Science and Humanities Research 3.3: 428-433.

Ismail, A., Tijani, B.A., Abdullah, A.M. and Mohammed, B. 2014. Analysis of Marketing Channel and Market Structure of Dried Fish in Maiduguri Metropolis of Borno State, Nigeria. European Journal of Business and Management 6.7: 147-155.

Kwaghe, P.V., Gaya, H.I.M. and Patrick, T. 2008. The economics of Bushmeat Marketing in Maiduguri Metropolis of Borno State, Nigeria. Sahel Analyst 1.1: 21-28.

Lem, A., Bjorndal, T. and Lappo, A. 2014. Economic analysis of supply and demand for food up to 2030 – Special focus on fish and fishery products. FAO Fisheries and Aquaculture Circular No. 1089. Rome, FAO. 106 pp.

Lokuruka, M.N.I. 2016. Food quality perspectives in African fish products: practices, challenges and prospects. International Journal of Fisheries and Aquaculture Sciences 6.1: 15-32.

Madugu, A.J. and Edward, A. 2011. Marketing and Distribution Channel of Processed Fish in Adamawa State, Nigeria. Global Journal of Management and Business Research 11.4: 21-26.

Ndiaye, P.G. 2013. Fishing and fish products in West Africa: the untapped potential for a regional market. Bridges Africa 2.1. Retrieved from http://www.ictsd.org/bridges-news/bridges-africa/news.

Odebiyi, O.C., George, F.O.A., Odulate, D.O., Agbonlahor, M.U. and Olaoye, O.J. 2013. Value-Chain Analysis for Coastal Fisheries Development in Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary 13.11: 7-15.

Okereke, O. and Anthonio, Q.B.O. 1988. The Structural Characteristics of Market for Grains in Eastern Nigeria. In: T.O. Adekanye; Readings in Agricultural Marketing; Longman, Ibadan, Nigeria.

Olukosi, J.O., Isitor, S.U. and Ode, M.O. 2005. Introduction to Agricultural Marketing and Prices. Principles and Applications. G. U. Publication Abuja, Nigeria.

Omitoyin, S. and Okeowo, F. 2015. Enhancing the center of the plate through effective marketing: A case of catfish marketing in Lagos State. Paper presented at Aquaculture America meeting Abstract, 2015, New Orleans, Louisiana.

Omonona, B.T. and Udoh, E.J. 1999. Economic evaluation of beef marketing in Ibadan Metropolis, Oyo State. Book of Proceedings, 28th Annual NSAP Conference, 21-23 March, 1999, Ilorin. 427-431.

Onyango, C.O. 2013. Analysis of Structure, Conduct and Performance of small ruminant stock market participants of Isiolo-Nairobi trading market, Kenya. M.Sc Project. Agricultural and Applied Economics of Egerton University. xiii+93pp.

Oparinde, L.O. and Ojo, S.O. 2014. Structural Performance of Artisanal Fish Marketing in Ondo State, Nigeria. American Journal of Rural Development 2.1: 1-7.

Osondu, C.K. 2015. The market performance and determinants of net returns to artisanal fish in ndibe beach, Afikpo North LGA, Ebonyi State, Nigeria. Agrosearch 15.1: 1 – 28.

Oyinbo, O. and Rekwot, Z.G. 2013. Fishery production and economic growth in Nigeria: Pathway for sustainable economic development. Journal of Sustainable Development in Africa 15.2: 99-109.

Phiri, L.Y., Dzanja, J., Kakota, T. and Hara, M. 2013. Value chain analysis of lake Malawi fish: a case study of Oreochromis spp (Chambo). International Journal of Business and Social Science 4.2: 1-31.

Pomeroy, R.S. 1989. The Economics of Production and Marketing in Small-scale Fishing. In: Gregory J. S. Prices, Product and People; Analyzing Agricultural Markets in Developing Countries, Lynne Rienner Publishers, Inc Boulder, Colorado. 730p.

Rota, A. and Sperandini, S. 2010. Value chains, linking producers to the market. IFAD Livestock thematic papers, International fund for Agricultural Development, Rome, Italy. 1-12.

Suleiman, A. 2007. Economic analysis of artisanal fish marketing in Kebbi State of Nigeria. A Ph.D Thesis, Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria. xvi + 226pp.

The FishSite, 2015. Fish Trade in Africa: An Update. The Fish Site Article, 5m Publishing, Benchmark House, England.

Torres, C. and van Seters, J. 2016. Overview of trade and barriers to trade in West Africa: Insights in political economy dynamics, with particular focus on agricultural and food trade. European Centre for Development Policy Management, Discussion Paper No. 195. 1-74.

Udoh, A.J. and Nyienakuma, M.G. 2008. Examining socioeconomic characteristics and adoption trend of artisanal fishers of Akwa Ibom State in West Africa. Journal of Agriculture and Social Sciences 4: 141-146.

Umoinyang, M.A. 2014. Economics of fish marketing in Akwa Ibom State, Nigeria. M.Sc Dissertation, Department of Agricultural Economics, University of Nigeria, Nsukka. x+72pp.

World Food Programme, 2011. Market Analysis Framework Tools and Applications for Food Security Analysis and Decision-Making. Food Security Analysis Service and United Nations World Food Programme, 00148 Rome, Italy. 15-16.

WorldFish. 2015a. Pan-Africa Project to Focus on Potential of Fish Trade for Increased Nutrition and Income. WorldFish press release, retrieved from worldfishcenter.org.

WorldFish. 2015b. Fish trade for a better future program brochure. WorldFish, Penang, Malaysia. www.worldfishcenter .org.

WorldFish Center. 2009. World Fish Medium-Term Plan. 2010-2012. Reducing Poverty and Hunger by Improving Fisheries and Aquaculture. p. 99.

UNDERSTANDING FISH PRESERVATION METHODS, POST HARVEST LOSSES AND KEY SOCIO-ECONOMIC CONSEQUENCES ON LAKE KARIBA

Hampuwo Buumba[1], Haambiya Lloyd H[2] and Musuka Confred G[1]
[1]Kapasa Makasa University, Department of Agriculture and Aquatic Sciences, P.O. Box 480195, Chinsali, Zambia.
[2]Lake Tanganyika Fisheries Research Unit, P.O. BOX 420055, Mpulungu, Zambia.

Abstract

Different types of preservation methods are used to prolong shelf-life of fish products. A study was undertaken to appreciate some of the traditional processing methods in Sinazongwe district. Primary data were collected from 160 respondents sampled in nine selected fishing villages using a simple two-stage cluster sampling approach. A structured questionnaire was used to capture perceptions, ideas, opinions, and thoughts. Study results revealed that besides freezing, there were three main methods of processing and preservation namely; smoking, salting and sun-drying. Over 67% of fish processors were women and they constituted the large numbers of small-scale informal traders, who are usually marginalized by commercialization of fish trade. Results also revealed that majority of male fish processors adopted smoking, whilst females opted to sun-dry their fish. On a scale of 1-4, smoking was considered to be the excellent method in preventing fish spoilage whereas salted fish was considered more prone to contamination. Fifty three percent (53%) of the respondents revealed that well processed fish had high income prospects. Most sun-dried and salted fish was meant for home consumption whilst smoked fish was mainly targeted for distant markets. With regards post-harvest losses, 50% of the respondents claimed that they lost valuable time in processing their fish, whilst 8% claimed they lost nutrition value of fish and a further 26% indicated monetary value loss. The highest post-harvest losses were experienced in the rainy season, which was compounded by poor handling, insect infestation, bad weather and bacterial contamination being some of the main causative agents for spoilage. The difference in preference of processing methods by gender was linked to the amount of input (capital, time, labour, technology) required. It was concluded that different methods of processing fish had different effectiveness in reducing post-harvest losses. Study recommendations centred on improving technology, facilities and capacity.

Key words: shelf-life, post-harvest, small-scale, gender, processing, Kariba

Corresponding author email: haambiya@yahoo.co.uk

Introduction

Fish is one of the most important sources of high quality animal protein, amino acids and absorbable dietary minerals for maintenance of good health in human beings. Often times, fishers catch more fish than can be consumed immediately. Surplus fish needs to be kept in good condition for later consumption or ensure an all year round supply. Notably, fish is very perishable and prone to post-harvest loss, a general term used to describe all losses that occur to fish after harvest. Maintaining good quality of fish raw material for processing is vital. However, there are generally various ways through which the quality of harvested fish can deteriorate. Getu *et al*. (2015) and Tesfay and Teferi (2017) classified the type of losses that are encountered by fishers, fish processors and traders as either quality loss, economic loss, physical loss, market value loss, loss due to insect manifestation or loss due to processing method used. Therefore in order to prevent fish spoilage through contamination of its flesh by micro-organisms, such as Escherichia coli, Staphylococcus aureus, Salmonella typhimurium, Bacillus cereus, Shigella spp., Clostridium botulinium (Obodai *et al*., 2011), it is necessary to preserve fish if not consumed immediately. Fish preservation is the method of extending the shelf life of fish while upholding the quality of the products. Nonetheless, processing methods vary partly because of taste and preference among consumers, and partly because of the level of patience demanded in the process, and the labour and capital investments required (Medard *et al*., 2001).

Dried products are usually considered shelf stable due to their characteristic low water activity (Aw) and are, therefore, often stored and distributed unrefrigerated. A water activity of 0.6 will prevent the growth of microorganisms, including pathogenic bacteria and moulds while maintaining the fish in good nutritional and organoleptic quality (Abbas *et al*., 2009). The moisture content can be used as a pointer to the rate at which deterioration occurs in fish samples (Olagbemide, 2015). Dried fish typically has a moisture content of between 38% and 48%, depending on the product (Olaoye *et al*, 2012). However, whilst preservation methods aim at maintaining the quality of fish for a longer period of time, losses have still remained the order of the day among the small-scale handlers as they attempt to take care of excess produce, to store and transport. Abelti (2016) reported that postharvest losses in developing countries were estimated to be up to 50% of domestic fish production. The fish stocks of Lake Kariba are, undoubtedly, among the most important natural resources for people in the three lake riparian districts of Siavonga, Gwembe and Sinazongwe in Southern Zambia. However, considering that thousands of tons of fish are lost annually through poor handling, unhygienic treatment or inappropriate processing, a study was undertaken to investigate the traditional processing methods in-use on Lake Kariba, associated post-harvest losses and some of the key socio-economic consequences.

Sun-Drying

Sun-drying of fishes is simple and the oldest known method of fish preservation, common for its being least expensive yet often rudimentary and rarely hygienically practiced in rural areas (Immaculate *et al*., 2013). Sun-drying of fish removes water which inhibits bacterial and enzymatic actions but does not add any desirable taste and odor. The drying process is a physical process where fish is exposed to air and direct sunlight. The time it takes to dry fish products depends on the nature of the product, the intensity of the sun, and the surfaces used for drying. The simplest form of drying involves exposing the fish to heat from the sun by placing products either directly on the ground, on mats placed on the ground or on racks (Immaculate *et al*., 2013). Fish is typically sun-dried for days. Since traditional sun-drying is weather dependent, some losses in quality also result from inadequate drying.

Drying of fishes is susceptible to many types of spoilage which can affect the quality and shelf life. Physical and organoleptic qualities of many traditional sun-dried products

are unsatisfactory for human consumption (Nowsad, 2005). Damages occurring due to flies and insects are of great significance in open sun-drying and this is a serious problem in traditional drying. During rainy season, humidity levels are high, sufficient drying cannot be achieved using traditional methods; processed and stored dried fishes reabsorb moisture and become susceptible to insect attack resulting in losses.

Smoking

Smoking is one of the traditional fish processing methods aimed at preventing or reducing post-harvest losses. It involves application of heat to remove water which inhibits both bacterial and enzymatic actions (Kumolu-Johnson *et al*., 2010), giving the product a desirable taste and odor and providing a longer shelf-life. Smoking is one of the preferred methods of preservation because it dries the fish, melts down some fat, and reduces microbial growth. In spite of the later mentioned benefits of smoking fish, smoked fish can be a source of microbial hazards (Salán *et al*., 2006) attributed to the growing fuel wood crisis, as local processors usually selling products that are not adequately smoked for periods long enough to reduce moisture content that acts as a determinant in microbial infestation to the recommended 10% or lower (Abolagba *et al*., 2011). It is important to be aware that smoking requires large amounts of wood and can contribute to deforestation and posse healthy hazards to the smokers themselves.

Salting

Salting as a method of preserving fish has been used for centuries and in many places around the world such as Asia, Europe, and Latin America and almost throughout Africa. Salting is popular because it is a simple method of preservation, is less costly, and easily performed together with other preservation methods such as drying or smoking (Emere and Dibal (2013). Salting is a traditional method for preservation, involving salting and drying, of fish especially in rural areas (Immaculate *et al*., 2013). The quality of salted and sun-dried fishes are adversely affected by the occurrence of microorganism (Yam *et al*., 2015) and as such, determination of microbiological quality of such processed fish from either the market or place where the fish is processed is important in order to guarantee consumer health and hygiene.

Materials and Methods

Study area

Southern Province of Zambia covers an area of 85,823 km2 and a projected population of 1,853,464 in 2017. The province harbors the second largest water reservoir in Africa, by volume, that has made the districts that share its boundaries to be actively engaged in the fishing industry. Lake Kariba constructed in the late 1950s (277 km long; 5,364 km2; 160 km3; 29 m mean depth and 120 m max. depth) has its catchment area covering 663,817 km2 extending over parts of Angola, Zambia, Namibia, Botswana and Zimbabwe. The dam wall (128 x 580 m) was completed in 1960 and the filling phase lasted from December 1958 to September 1963 when the water reached the mean operation level at 485 m above mean sea level. The lake is shared by the two riparian countries of Zambia and Zimbabwe with 45% and 55% shares, respectively. The area along the lake on the Zambian side is divided into three local authorities namely; Siavonga, Gwembe and Sinazongwe. The study was conducted in Sinazongwe district (see Figure 1), originally built as a fishing and administrative center for the southern lakeshore area and currently mainly used as an outpost for Kapenta (Limnothrissa miodon) and bream fishing. It is also characterized by processing of fish using various methods.

Data collection

Nine fishing villages were selected using a systematic random sampling approach. Processors from each of the selected villages were randomly sampled proportional to zonal totals to give a sample size of 160 processors (some of whom were also fishers) who were

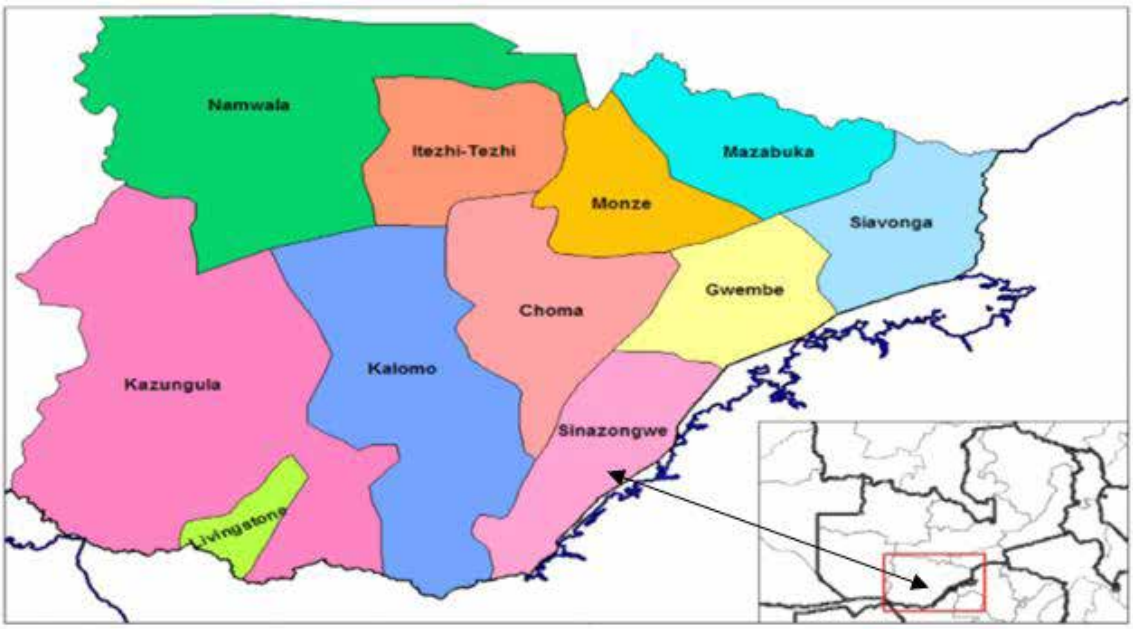


Figure 1: Map of Southern Province of Zambia showing position of study site

interviewed using a structured questionnaire to capture perceptions, ideas, opinions, and thoughts. The study adopted a simple two-stage cluster sampling approach. The field survey was conducted between March and July of 2017.

Data analysis

Most analyses for this study were run using SPSS and Excel computer software. Descriptive statistics were used for summarizing and presenting data from the survey and analysis for the parameters included means, frequency counts and percentages, which provided a distribution of respondents across the parameters. To investigate effectiveness of processing methods in preventing fish spoilage, freshness was assessed using sensory evaluation, a systematic assessment of the odour, flavour, appearance and texture of product on a scale of 1 to 3, where 1 = Poor (0-49%); 2 = Good (50-79%); and 3 = Excellent (≥80%).

Results

Fish processing methods by gender

The study revealed smoking, salting and sun-drying as the main traditional methods of fish processing and preservation used by small-scale processors in Sinazongwe. Results of the study showed that smoking was widely used as a method of processing among men (at 42%) as compared to salting (23%) and sun-drying (21%), however with the females the opposite was true. Smoking was the least used among the females (at 58%) with sun-drying ranking highest (at 79%) (see Table 1). The study revealed that women were more actively involved in fish processing as compared to their male counterparts.

Effectiveness of processing method in preventing fish spoilage

Judgement of level of effectiveness was on the basis of sensory evaluation (odour, flavour, appearance and texture) conducted against a scale of scores from 1 to 3. This was aimed at yielding a co-operative opinion to answering questions. Results of the study revealed that smoking and sun-drying had the highest number of male and female respondents, respectively, that considered it to be excellent in terms of preventing fish spoilage. On the other hand, the three processing methods were viewed to provide 50-79% effective prevention of fish spoilage by both male and female respondents. Salting was viewed to be

least effective (0-49%) by male respondents. Females claimed sun-drying was the most effective while males claimed smoking was the most effective (≥80%) (see Table 2).

Table 1: Fish processing methods by gender

Processing method	Gender	
	Female (%)	Male (%)
Sun-drying	79	21
Salting	77	23
Smoking	58	42

Table 2: Majority views over effectiveness in preventing spoilage

Processing method	Average core
Sun-drying	
Female respondents	3
Male respondents	2
Salting	
Female respondents	2
Male respondents	1
Smoking	
Female respondents	2
Male respondents	3

Scores: 1 = Poor (0-49%); 2 = Good (50-79%); 3 = Excellent (≥ 80%)

Income generation by method of processing

Results in Figure 2 show the percent distribution of respondents that realized some form of revenue from processing fish and those that processed fish for much lower incomes. Income increased progressively from sun-drying (44%) through salting (48%) to smoking (58%). The opposite was true for those that indicated there was no income generated with figures progressive decreasing from sun-drying (56%) through salting (52%) to smoking (42%). No income implied that products were consumed by the processors themselves due to limited quantities involved.

Type of losses encountered after processing the fish

The study revealed that 26% of respondents incurred monetary losses, 8% physical losses, 50% time loss while 16% claimed a combination of losses after they processed their fish (see Figure 3). Monetary loss implied economical loss as a result of reduction in value due to quality loss. Physical loss implied loss of part or of the entire product (e.g. fragmentation during packing and transportation) whereas time loss is physical wastage of valuable time that could have been used on other activities.

Causes of post-harvest losses

The study revealed the following causes of fish spoilage; 21% of the respondents indicated insect infestation, 16% poor fish handling, 13% weather, 5% bacterial contamination while 45% a combination of all the aforementioned causes (see Figure 4).

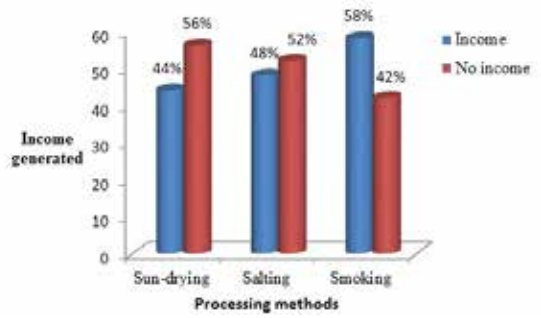


Figure 2: Income generation by method of processing

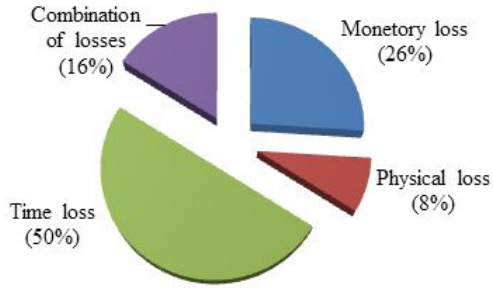


Figure 3: Type of losses encountered after processing the fish

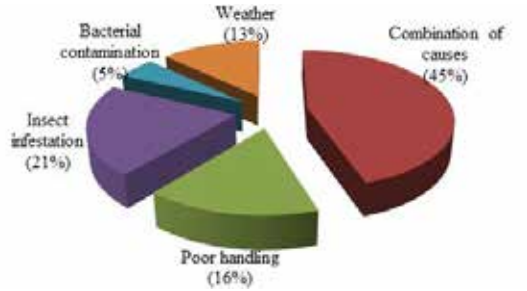


Figure 4: Causes of post-harvest losses

Discussion

The results of this study agree with findings reported by Chisanga *et al*. (2015) revealing that women were often responsible for post-harvest activities, such as processing and trading whereas men were more in the extractive processes. Findings similar to those of a study conducted on Lake Victoria by Medard *et al*. (2001) revealed that men preferred trading in smoked fish products while women preferred sun-dried fish products. Reasons range from cultural norms to the financial status of men and women. Women's involvement in post-harvest activities such as smoking, drying, and marketing was widespread and was regarded as an appropriate activity for women given their domestic tasks and responsibilities. Fishing predominantly involved men and was a common practice throughout the world.

The difference in preference of processing methods between men and women was linked to the amount of input (capital, time, labour, technology, etc.) required in each type of processing method. For instance, low access to credit facilities had been one of the problems that the females faced. Low access to bank loans was mentioned among women. This negatively impacted on women in the sense that they usually lacked capital to buy boats or invest in more money making sub-sectors of fisheries hence left at the receiving end. Most of these factors favoured men - they were physically stronger, they normally had transport (e.g. bicycles) and they had access to loan facilities. Loans from family and friends were the most common form of informal finance, an arrangement characterized by uncollateralized loans that carry little or no interest and featuring open-ended repayment arrangements with a strong focus on reciprocity. This partly explained why most women were associated with sun-dried fish products because they often required a lot of patience, required low capital investment and demand minimal labour.

From olden days, generally smoking of fish has been very common in Africa. The results of the study could be biased in that probably consumers said smoking was effective only because it was widely preferred in the respective communities. This agreed with results reported by Emere and Dibal (2013) that smoke drying was employed by remote fishing communities due to traditional preference of the local people for smoke dried fish and lack of sophisticated preservation techniques. Emere and Dibal (2013) reported that smoking deposited a coating of antimicrobial material or substance on the surface of the fish while at the same time impacting an attractive sheen and pleasant taste which was cherished by the local populace. This study revealed that spoilage causative agents like flies, insects, molds, fungal bacterial contamination were reported lowest in smoked fish as compared to other processing methods although lack of control over drying rate sometimes resulted in over-drying or under-drying.

Other reasons why, smoked fish was considered to be more effective in preventing spoilage could be due to the fact that most of the people involved in smoking fish had an aim of selling the fish, meaning that they put more effort in processing the fish so as to elevate its value and to prolong shelf life for transportation to markets in Lusaka and Copperbelt provinces. On the other hand sun-drying and salting were mostly done to preserve fish for home consumption – hence less effort dedicated and resulting in characteristic short shelf life and high rates of spoilage. In all the three methods of processing, there is need to reduce the water activity in products to 0.85 or below if the product will be stored and distributed unrefrigerated in a shelf stable state. For example, salting alone would never completely stop the spoilage of fish - that is why salted fish are dried, stored at low temperatures or treated other ways.

Results revealed that most processors who smoked their fish realized some income from selling their products. This was partly explained by Salán *et al*., (2006) who stated that smoking was not only a conservation method, but also a flavour-, aroma- and coloration-improving method and that these were attributes desired by consumers. On the

other hand, sun-drying of fish was mostly done by women for home consumption.

Getu *et al.* (2015) described post-harvest fish loss as fish that is either discarded or sold at a relatively low price because of quality deterioration. Results of this study indicated that 50% of the respondents bemoaned the amount of time they lost in processing fish which ultimately got spoiled – lamenting that they would have used that valuable time to venture into other enterprises. The lower percent of respondents (8%) claiming physical loss was similar to what was explained by FAO and smart fish project (2013) that poor fishing villages eat almost everything they catch in spite of low quality due to high household food insecurity in such communities. In fact, it was observed that even poor quality fish was processed and consumed locally. Similarly, a lower percent (26%) claimed monetary losses because most products are sold locally and/or target the low class of consumers in other markets. Losses could be improved through enhanced contact with extension agents, technology adoption, provision of facilities and capacity building.

Insect infestation was observed mainly in sun-dried fish with common insects being blowflies and beetle larvae. While knowledge of bacteria was limited among most respondents, microbial spoilage perpetuated by optimal weather conditions and poor handling undoubtedly led to huge fish losses. Fish processing was difficult during rainy season in that there was limited sun-light and intensive rainfall regimes, as well as limited access to dry wood for smoking. FAO (2010) also reports that higher losses during rainy season are due to the fact that processing of fish becomes difficult and a good fraction of fish gets insect-infested and spoiled. It was observed that most drying, salting, and smoking platforms as well as the holding, storage and distribution facilities at village level were not hygienically clean and could harbour lots of bacteria. Huss *et al.* (2003) observed that more than 80% of post-harvest losses were due to microbes. Post-harvest losses owing to poor infrastructure, storage facilities and transportation as well as a lack of sufficient knowledge of proper and hygienic fish handling affected most of the fish landed. As a coping strategy, small-scale fishers and processors of Sinazongwe require technical assistance and their knowledge base increased in the area of fish handling procedures, storage, product diversification, value addition and packaging thus enhancing obvious economic and social benefits.

Acknowledgements

We thank Kapasa Makasa University, Department of Agriculture and Aquatic Sciences for granting the funds to undertake the research that led to this paper.

Conclusion and Recommendations

Lack of affordable technology, facilities and adequate skill in fishing villages and the high rates charged by refrigeration service providers have rendered fishers/traders and processors alike opting to using traditional means of processing fish in order to deter spoilage, evidently viewed to have different degrees of effectiveness. In the lake Kariba fishery and particularly in Sinazongwe area, women are predominantly involved in fish processing and trading. Women's increased involvement in fishing related activities contributes to family income, constant supply of fish/food to improve family nutrition, generation of opportunities for self-employment, uplifting overall socio-economic conditions and improved skill. With urbanization, there is high demand for fish products at urban centres. While this creates an opportunity for processed products, post-harvest losses have still remained a challenge among local level processors employing traditional methods. There is need for women empowerment if they are going to thrive in this industry – offer them credit facilities to provide start-up capital. Post-harvest losses could be improved through enhanced technology adoption, provision of processing facilities and capacity built among processors, especially involving methods that they were already using.

Public Brief

Fish stocks of Lake Kariba are, undoubtedly, an important source of food, nutrition, income and livelihoods for hundreds of people. However, despite receiving massive acceptance among consumers, fish is highly perishable and hence susceptible to high post-harvest losses. Often times, fishers catch more fish than can be consumed immediately. It is for this reason that fish needs processing or storage immediately after capture if surplus is going to be kept in good condition for later consumption or ensure an all year round supply. On one hand, there are generally various ways through which the quality of harvested fish can deteriorate. On the other hand, different types of processing and preservation methods are used to prolong shelf-life of fish products. Results of a study on Lake Kariba revealed that besides freezing, there were three mainly used methods in Sinazongwe namely; smoking, salting and sun-drying. Women's increased involvement with fish contributes to family income, constant supply of fish/food to improve family nutrition, generation of opportunities for self-employment, uplifting overall socio-economic conditions and improved skill. While there is an opportunity, post-harvest losses have still remained a challenge among local level processors employing the aforementioned traditional methods. There is need for empowerment, especially among women and youth, if the industry is going to thrive. This could be in the form of enhanced accessed to credit facilities to provide start-up capital, improved technology adoption, provision of processing facilities and capacity building.

References

Abbas, K. A., Saleh, A. M., Mohamed, A. and Ola, L. (2009). The relationship between water activity and fish spoilage during cold storage: a review. Journal of Food, Agriculture and Environment 7(3/4):86-90

Abelti, A.L. (2016). Postharvest and nutritional loss assessment of fish at different handling stage from Genale River, Southeastern Oromia. International Journal of Fisheries and Aquatic Studies 4(6):263-266

Abolagba, O.J., Adekunle, A.T., Dede, A.P.O. and Omoigui, G.O. (2011). Microbial assessment of smoked fish (Clarias spp) in Benin metropolis, Edo State, Nigeria. Nigerian Journal of Agriculture, Food and Environment 7(3):55-58

Chisanga, M., Musuka, C.G. and Haambiya, L.H. (2015). Contribution of Fish Trade to Sustainable Livelihoods of Female Headed Households in Three Major Markets of Kitwe, Luanshya and Ndola on the Coppperbelt Province of Zambia, International Journal of Forestry and Horticulture 1(1):30-42

Emere, M.C. and Dibal, D.M. (2013). A Survey of the Methods of Fish Processing and Preservation Employed By Artisanal Fishermen in Kaduna City. Food Science and Quality Management 11:16-23

FAO (2010). Post-harvest losses in artisanal fisheries. Available at: http://www.fao.org/focus/e/fisheries/proc.htm

Getu, A., Misganaw, K. and Bazezew, M., (2015). Post-harvesting and Major Related Problems of Fish Production. Fisheries and Aquaculture Journal 6:154.

Huss, H.H, Ababouch, L, Gram, L. (2003). Assessment and management of seafood safety and quality FAO Fisheries Technical Paper. No. 444. Rome, FAO. 230p.

Immaculate, K., Sinduja, P., Velammal, A. and Jamila, P. (2013). Quality and shelf life status of salted and sun dried fishes of Tuticorin fishing villages in different seasons. International Food Research Journal 20 (4): 1855-1859

Kumolu-Johnson, C.A., Aladetohun, N.F. and Ndimele, P.E. (2010). The effects of smoking on the nutritional qualities and shelf-life of Clarias gariepinus. African Journal of Biotechnology 9(1):073-076.

Medard, M., Sobo, F., Ngatunga, T. and Chirwa, S. (2001). Women and gender participation in the fisheries sector in Lake Victoria. Paper presented at the workshop on the role of women in fisheries management, Kisumu-Kenya, 2001.

Nowsad, A.K.M. (2005). Low cost processing of fish in coastal Bangladesh. BGD/97/017 Field Doc, 05/2005. Food and Agriculture Organization of the United Nations. 88 p.

Obodai, E. M. (2011). Microbial profile of smoked sardine (sardine llaaurita) at smoking sites and market center of Tema, Ghana. Archive of applied sciences Research 3(3):443-453.

Olagbemide, P.T. (2015). Nutritional Values of Smoked Clarias Gariepinus from Major Markets in Southwest, Nigeria. Global Journal of Science Frontier Research 15(6):32-42

Olaoye, O.J., Odebiyi, O.C. and Abimbola. O.T. (2015). Occupational Hazards and Injuries Associated with Fish Processing in Nigeria. Journal of Aquatic Science 3(1):1-5.

Salán O.E., Juliana, A.G. and Marilia, O. (2006). Use of smoking to add value to salmoned trout. Brazilian Archives of Biology and Technology 49(1): 57-62.

Tesfay, S. and Teferi, M. (2017). Assessment of fish post-harvest losses in Tekeze dam and Lake Hashenge fishery associations: Northern Ethiopia. Agriculture and Food Security (2017) 6:4

Yam, B., Morteza, K., Sahar, A. & Maryam, S. (2015). Microbial Quality of Salted Dried Fish Sold. Scholarly Journal of Agricultural Science 5(6):215-219.

SHORT COMMUNICATION

FUMAGE DE POISSON EN COTE D'IVOIRE : LES CONDITIONS DE TRAVAIL IMPACTENT LA SANTÉ DES ACTEURS ET LA QUALITÉ DES PRODUITS

Marcelle A K A
Journaliste développement durable
Côte d'Ivoire, 01 BP 3162 Abidjan 10

Ces méthodes traditionnelles qui exposent aux maladies

Les femmes jouent un rôle important dans le secteur de la pêche artisanale, principalement dans le segment post-capture. Le fumage du poisson notamment est utilisé comme principale méthode en vue d'une meilleure conservation du poisson, satisfaire les préférences et diversifier les goûts des consommateurs. Cette technique permet un approvisionnement aisé aux populations, même dans les zones reculées. Malheureusement, ces poissons vendus sur les marchés sont fumés à travers des méthodes de fumage qui ont des conséquences sur la santé des acteurs, du consommateur et sur l'environnement. Dans quelles conditions ces femmes fument-elles le poisson et avec quels moyens?

Lundi 8 janvier 2018, 8 heures, grand marché de Koumassi, commune du District d'Abidjan, capitale ivoirienne. Dame Tano Ya, la cinquantaine, est aperçue en train de vendre du poisson fumé en bordure de la voie du bus de la Société de transport d'Abidjan (Sotra) assurant la ligne 26. « Il y a des brochets et des capitaines bien fumés », propose-t-elle aux clients. Approchée, Dame Tano Ya a confié qu'elle vit de la commercialisation du poisson et qu'elle prend sa marchandise avec des transformatrices installées dans plusieurs communes du district d'Abidjan. Les principaux sites de fumage identifiés. On trouve des communautés de femmes fumeuses de poisson à Vridi-Zimbabawé, un quartier précaire de la commune de Port-Bouët, à Abobo Macaci, sur l'axe Abobo-Adjamé, dans le bas fond à droite à la limite des feux tricolores. Un autre site est identifié à Abobodoumé dans la commune de Yopougon, non loin du village des pêcheurs. Et même à l'intérieur du pays dans la région des Grands Ponts, elles sont installées à Akradio, village du département de Dabou et Brafedon à Grand-Lahou.

Méthodes archaïques. A ces endroits, le constat est triste. Les poissons fumés dorés qui aiguisent l'appétit sont transformés à partir de fours traditionnels fabriqués à base de fûts métalliques, et recouverts de grillage. La capacité de fumage va de 10 à 20Kg de poisson avec le petit four et plus de 100 Kg avec les grands, selon Bintou Sawa transformatrice sur le site de fumage de Vridi-Zimbabawé. A ses côtés, Viviane Tabi la cinquantaine et mère de 3 enfants, qui retournait les poissons sur le feu avait les yeux larmoyants. « Nous travaillons dans de mauvaises conditions. A force de subir, et j'ai des problèmes d'yeux. En plus de travail est salissant et laborieux», a-t-elle fait savoir. Le pagne défraîchi et sale qu'elle arborait ainsi que la graisse de poisson qui recouvre ses doigt traduisent cette réalité. L'autre réalité est que la fumée qui sort des fours et se propage dans les airs pique la gorge, et à couper le souffle même de loin et près, elle est suffocante. C'est par ces odeurs qu'on repère ces sites de fumage. Avec la déforestation, le bois d'hévéas contenant du latex est de plus en plus utilisé par les actrices augment les risques

Exposition aux maladies. Des femmes se plaignent des conséquences. « Ma peau est abîmée et mon teint n'est plus éclatant », regrette Tra Fanta du côté d'Adjamé-Macaci. Des femmes tombent régulièrement malades et souffrent de maladies respiratoires dans la sphère Orl. « Je suis tout le temps enrhumée. J'ai très souvent des irritations au niveau de la gorge. Je rentre

Corresponding auhor email:kissakam@yahoo.fr; akamarcelle98@gmail.com

de l'hôpital et le médecin dit qu'il s'agit cette fois d'une infection pulmonaire », a révélé Mme Sahiwa Ouhon, brandissant son ordonnance médicale. D'autres se plaignent de leurs yeux. « Maintenant je n'arrive plus à lire et écrire. Je ne vois plus de loin », s'exprime Akroman Lydi. Les autres maladies dont souffrent les femmes sont la tension artérielle, la fièvre typhoïde et l'anémie.

Photo1: Enquête Marcelle AKA
Légende 1 : La fumée qui se dégage des fours traditionnels traduit la pénibilité du travail et les risques auxquels, les fumeuses de poisson sont exposées. (Photo: N.K.)

Photo 2: Enquête Marcelle AKA 2
Légende 2: Que d'efforts pour retourner le poisson mis sur le feu (Photo : N.k.)

Encadré 1 : L'alerte des chercheurs ivoiriens

Les chercheurs sont unanimes sur les risques sanitaires liés aux mauvaises conditions de travail. L'alerte a été donnée par les chercheurs de l'Institut de géographie de l'université Félix Houphouët-Boigny et le Laboratoire national d'appui au développement agricole (Lanada). Une étude réalisée par les chercheurs sur les femmes des communautés de pêche d'Abobodoumé dans le district d'Abidjan, capitale ivoirienne, de Grand-Lahou, région des Grands Ponts et de Guessabo ville située à l'ouest de la Côte d'Ivoire dans la région du Haut-Sassandra interpelle sur la question. Professeur Ano Kouassi Paul, spécialiste en géographie de la santé au cours d'un atelier en mai 2017 au siège de la Fao Côte d'Ivoire a rappelé les femmes des communautés de pêche utilisent des pratiques qui sont vétustes, très anciennes pour fumer les poissons. Elles utilisent des fours traditionnels fabriqués avec des fûts métalliques, qui ont des conséquences sur les ressources naturelles, c'est-à-dire, la forêt. Des conséquences sur la pollution de l'atmosphère par le rejet de gaz par effet de serre. Les chercheurs ont indiqué que le dépôt de fumée sur les tissus des poissons contient des produits qui peuvent malheureusement avoir des conséquences sur santé. Il peut favoriser le développement de maladies cancérogènes. Cette recherche a révélé que près de 30% des transformatrices du poisson, ont des affections de la sphère Orl. C'est-à-dire, des affections qui touchent, les narines et la gorge. Elles souffrent aussi de maux d'yeux. Les cas liés à la tension artérielle et d'anémie sont estimés à 17%. Aussi, 55% des actrices du secteur de fumage de poisson ont déclaré avoir des relations difficiles avec leurs conjoints parce qu'elles n'ont pas le temps de prendre soins de leurs corps. De même, 17% souffrirent de fièvre typhoïde. Les femmes qui accouchent, sont obligées de reprendre le travail quelques jours après la maternité parce qu'elles sont à leur propre compte. Ce sont donc les périodes l'allaitement qui sautent et les enfants ont parfois des problèmes de malnutrition. Par ailleurs, 55% autres ont déclaré avoir souffert de problèmes d'allaitement. Les chercheurs évaluent à 10% ces femmes qui ont perdu leurs empreintes digitales. N'guessan Juliette mère de 3 enfants est une victime. Cette dame qui était loin de s'imaginer les conséquences de son activité sur ses empreintes digitales l'a su lorsqu'elle devait se faire établir un

passeport. Le traitement des poissons tels que le capitaine, le brochet et le mérou avant le fumage, est délicat et use la paume des mains des actrices. « Les dents de ces poissons piquent et irritent notre paume, surtout au niveau des doigts», a témoigné N'guessan me montrant son pouce. Dion Sompléhi Michelline, présidente de la Coopérative des mareyeuses et transformatrices des produits halieutiques d'Abidjan (Cmatpha) pour renchérir, a évoqué que ''plusieurs femmes qui sont tombées malades sont décédées''.

Encadre 2/ Les fours modernes, une solution

L'activité de fumage du poison contribue à la durabilité du secteur et à la réduction des pertes après capture évaluée à 30% dont le ministère ivoirien des Ressources animales et halieutiques a évalué le préjudice à près de 7 milliards de Fcfa par an. Cependant, les mauvaises conditions de travail, les techniques inappropriées de fumage, les mauvaises conditions de stockage et à l'infestation par les insectes ainsi que la faible capacité de transformation des fours utilisés et les risques sanitaires sont les réalités vécues par les transformatrices. Dans la recherche de solutions, le projet Tcp/Ivc/3501 co financé par la Côte d'Ivoire et la Fao et mis en œuvre depuis 2014, vise la fabrication de fours améliorés dénommés Four TT Fao pour l'amélioration des conditions de travail des transformatrices de poisson. En attendant sa vulgarisation, 4 localités bénéficiaires de la phase pilote du projet. Ce sont Abobodoumé dans la commune de Yopougon, à Anoumnbo dans la commune de Marcory dans le District d'Abidjan. A l'intérieur du pays, Brafedon, une localité du département de Grand-Lahou, dans la région des Grands ponts et Guessabo dans la région du Haut-Sassandra. Ces fours TT FAO permettent de garantir la sécurité sanitaire des produits, offre des avantages écologiques, avec l'utilisation de peu de bois contrairement aux fours traditionnels. Ces facteurs permettent de préserver les micronutriments contenus dans les produits de pêche, constituant une source de protéines et d'autres nutriments essentiels pour le développement mental et physique des enfants et la santé des adultes. La consommation par tête d'habitant en Côte d'Ivoire évaluée 16,1 kg par an, selon la Fao, est l'une des plus élevée de l'Afrique dont la moyenne tourne autour de 9Kg.

Photo 3 : Enquête Marcelle AKA 3
Légende 3: Avec les fours améliorés les femmes travaillent dans de meilleurs conditions

AFRICAN UNION - INTERAFRICAN BUREAU FOR ANIMAL RESOURCES (AU-IBAR)

Bulletin of Animal Health and Production in Africa
Guide for Preparation of Papers
Notes to Authors

The Editor in Chief
March 2018

Aims and scope

The Bulletin of Animal Health and Production in Africa (BAHPA) of the African Union Interafrican Bureau for Animal Resources (AU-IBAR) is a scientific journal which publishes articles on research relevant to animal health and production including wildlife and fisheries contributing to the human wellbeing, food security, poverty alleviation and sustainable development in Africa. The bulletin disseminates technical recommendations on animal health and production to stakeholders, including policy makers, researchers and scientists in member states. The Bulletin is the African voice on animal resources issues specific to Africa.

The Bulletin of Animal Health and Production publishes articles on original research on all aspects of animal health and production, biotechnology and socio-economic disciplines that may lead to the improvement animal resources. Readers can expect a range of papers covering well-structured field studies, manipulative experiments, analytical and modeling studies of the animal resources industry in Africa and to better utilization of animal resources.

The BAHPA encourages submission of papers on all major themes of animal health and production, wildlife management and conservation, including:

- Veterinary microbiology, epidemiology
- Marketing, economics
- Infectious and non infectious disease
- Parasitology
- Genetic improvement and biotechnology
- Animal production, nutrition and welfare
- Science and policy in animal health and production
- Beekeeping and honey bees
- Ecology and climate change impacts on animal resources in Africa
- wildlife management
- Fisheries and aquaculture development
- Food safety and food hygiene
- One health
- Emerging and re-emerging issues in animal resources
- Biosecurity
- Animal resources trade and value chain
- Socio economics and economics of animal resources development

Language

The language of submission should be either in U.K. English or Standard French. The abstract is translated to the other three languages of the African Union (Arabic, English, French and Portuguese), by the editors, after acceptance. Full articles submitted in French will also be published in English.

Manuscripts Submission

Authors are invited to submit electronically their manuscripts via attachment only at bahpa@au-ibar.org in a secured PDF and word format. Manuscript can be sent by post in case of unavailability of internet services (authors should be aware that in this case it will take longer time to be published).

Authors submitting articles to the BAHPA must follow the guidelines in this document. Submissions that deviate from these guidelines will be returned to the corresponding authors for changes and compliance.

To be considered for publication in the BAHPA, any given manuscript must satisfy the following criteria:

- Originality. BAHPA does not accept manuscripts that have already been published elsewhere. However, studies that replicate results that are already in the literature may be considered for publication, as the independent confirmation of results can often be valuable, as can the presentation of a new dataset.
- Audience. Manuscripts submitted must be of broad interest to animal health and production professionals in general, they must capture and hold readers' attention.
- Usefulness. Manuscripts submitted must help researchers, trainers, educators and policy makers in all regions of Africa improve their effectiveness.
- Rigorous methodology. Manuscripts submitted must be based on valid and reliable information, documentation or sound concepts, empirically, logically and theoretically supported.
- Well written to ensure clear and effective presentation of the work and key findings. The BAHPA editorial staff does not copyedit the text of accepted manuscripts, it is therefore important for the work, as presented, to be intelligible. Perfect, stylish language is not essential but it must be clear and unambiguous. If the language of a paper is not clear, Academic Editors should recommend that authors seek independent editorial help before submission of a revision. Poor presentation and language is a justifiable reason for rejection.
- Experiments, statistics, and other analyses performed are described in sufficient detail. The research must have been performed to a technical standard to allow robust conclusions to be drawn from the data. Methods and reagents must also be described in sufficient detail so that another researcher is able to reproduce the experiments described.
- Conclusions are presented in an appropriate fashion and are supported by the data. The results must be interpreted appropriately, such that all conclusions are justified. However, authors may discuss possible explanations for their results as long as these are clearly identified as speculations or hypotheses, rather than as firm conclusions. Inappropriate interpretation of results is a justifiable reason for rejection.
- The research meets all applicable standards for the ethics of experimentation and research integrity. Research to be published must have been conducted to the highest ethical standards. A brief description of the most common of these is described in our Editorial and Publishing Policies.
- Because the guidelines are updated as appropriate, authors should check them again before they submit their articles. Manuscripts submitted for publication will be considered for acceptance on the understanding that they present original work which has not been published or submitted for publication elsewhere and that they are subject to peer review.

Types of contribution

Full papers providing accounts of original work: Research containing significant new findings. The material presented should be original and not have been published elsewhere, except in a preliminary form. Papers will be reviewed by three referees familiar with the subject matter of the paper.

Short Communications: are intended to provide quick publication of highly relevant and interesting information. Manuscripts will be peer reviewed by two reviewers and the Editor.

Review Articles: should cover subjects falling within the scope of the bulletin, which are of active current interest. Papers need not contain original work or ideas. They will be reviewed for completeness, accuracy, style and suitability of content by referees familiar with the subject and the Editor-in-Chief..

Editorial: articles are short articles describing news about the bulletin or the opinion of the editor-in-chief, the publisher or a guest editor of a thematic series.

Letters to the Editor: the bulletin welcomes letters to the editor. The purpose of Letters to the Editor is to provide a forum for positive and constructive views on articles and matters published in the bulletin. Letters to the Editor must not exceed 300 words. Letters to the editors include technical reports from countries or projects.

Key notes and special calls: The editor will, from time, invite selected key figures in the field of animal health and production for key notes on specific topics. Book Reviews: are accepted and should provide an overview of the work's contents and a critique of the work's value. Book reviews should be limited to 1000 words.

Conference Proceedings: Special Issues of the bulletin may be dedicated to publication of proceedings of key meetings/ conferences

Obituary articles to honor prominent African scientists that have made significant contribution to animal resources research and development

News and announcements: BAHPA is pleased to publish information on animal health and production activities/meetings. Please send the following information to the Editor: Date of the event, title, organization offering the event, location and contact information.

Submission Guidelines

Full papers of original research

All manuscripts submitted to BAHPA should include the following features:

1. On cover page of the manuscript, the following should be clearly written/inserted: the corresponding author, name of the institution, , title of the manuscript, names of the authors, the addresses of the authors and the e-mail address of the corresponding author. The corresponding author should ensure that all the other authors consent to their names being included. The consent should be sent directly by co-authors to the editor via email.
2. Each original article should be divided into Abstract and Keywords, Introduction, Materials and Methods, Results, Discussion, conclusion, Acknowledgments and References. A textbox containing a public brief on the study for the benefit of policy makers should also be provided. This textbox will not be included in the published article but will be compiled and published in a separate edition at the end of the year.
3. Title, which should be concise, preferably not more than 15 words long, followed by the author(s) name(s) and institution(s) to which work should be attributed and address for correspondence, if different.
4. The Abstract should not be longer than 300 words giving a synopsis of the work and should contain the objectives, briefs description of materials and methods, highlights of significant results, conclusions and recommendations. Up to six keywords should be provided..
5. The Introduction should contain the problem statement, the hypothesis and the objective of the work and cite recent important work undertaken by others.
6. Materials and Methods should describe materials, methods, apparatus, experimental procedure and statistical methods (experimental design, data collection and data analysis) in sufficient detail to allow other authors to reproduce the results. This part may have subheadings. The experimental methods and treatments applied shall conform to the most recent guidelines on the animal's treatment and care. For manuscripts that report complex statistics, the Editor recommends statistical consultation (or at least expertise); a biostatistician may review such manuscripts during the review process. Cite only textbooks and published article references to support your choices of tests. Indicate any statistics software used.
7. Results should be presented clearly and concisely, in a non-repetitive way. Subheadings may be accepted.
8. Discussion of significance should be focused on in the interpretation of results. Subheadings are not accepted in this section.
9. Acknowledgements. Where necessary acknowledgements of grants and technical assistance should be included under this heading. . Please also include any potential conflict of interests if appropriate. Suppliers of materials should be named and their location (town, state/county, country) included.
10. State the conclusions, and any implications that may be drawn from the study.

Short Communications: Manuscripts should contain original data and be limited to 1500 words. The number of tables and figures are limited to two. A limited number of references should be included. Headings are not allowed in short communications.

Sequence of Preparation

1. The data files must be PC/Windows-compatible. The text should be prepared using standard software (Microsoft Word) format; do not use automated or manual hyphenation. Please do not include footnotes.
2. Use Times New Roman 12 point font for all text except for tables and figures where Times New Roman 10 font should be used.
3. Use 1 inch margins on top, bottom, left and right margins,
4. Every line on the text should be numbered.
5. Use double line spacing for body of text. For Abstract, Figures, Tables and References use single line spacing.
6. Place page numbers in the lower right hand corner of your manuscript.
7. Run "the spell check" and "grammar check" on the entire file before submission using either the UK English or French standard.
8. Avoid using abbreviations for the names of concepts. Use ordinary words for variable names – not code names or other abbreviations. Use the same name for a variable throughout your text, tables, figures and appendices. Names of organizations and research instruments may be abbreviated, but give the full name (with abbreviation in brackets) the first time you mention one of these.
9. References should take the following form: In the text, a reference identified by means of an author's name should be followed by the date of the reference in parentheses. When there are more than two authors, only the first author's name should be mentioned, followed by ' .,'. In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter like 'a' and 'b' after the date to distinguish the works. Examples: Abayomi (2000), Agindotan .,. (2003), (Kelebeni, 1983), (Usman and Smith, 1992), (Chege, 1998; Chukwura, 1987a,b; Tijani, 1995,1993), (Kumasi ., 2001)

The use of reference managing software is encouraged

The authors should be cited in a chronological order by year and then by a or b; in the reference list they should be listed alphabetically.

Please ensure that references in the text exactly match those in the manuscript's reference list. Check each reference in the text to see that you have the complete citation in the reference section of the paper in the desired style. In the references section, references are listed in alphabetical order.

Examples of References

- *Journal Articles:* Ouyang D, Bartholic J, Selegean J, 2005. Assessing sediment loading from agricultural croplands in the Great Lakes basin. Journal of American Science, 1(2): 14-21.
- *Books:* Durbin R, Eddy SR, Krogh A, Mitchison G, 1999. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. London, Cambridge University Press.

- *Chapter in a Book:* Leach J, 1993. Impacts of the Zebra Mussel (Dreissena polymorpha) on water quality and fish spawning reefs of Western Lake Erie. In Zebra Mussels: Biology, Impacts and Control, Eds., Nalepa T, Schloesser D, Ann Arbor, MI: Lewis Publishers, pp: 381-397.
- *Reports:* Makarewicz JC, Lewis T, Bertram P, 1995. Epilimnetic phytoplankton and zooplankton biomass and species composition in Lake Michigan, 1983-1992. US EPA Great Lakes National Program, Chicago, IL. EPA 905-R-95-009.
- *Conference Proceedings:* Stock A, 2004. Signal Transduction in Bacteria. In the Proceedings of the 2004 Markey Scholars Conference, pp: 80-89.
- *Thesis:* Strunk JL, 1991. The extraction of mercury from sediment and the geochemical partitioning of mercury in sediments from Lake Superior, Unpublished PhD thesis, Michigan State University, East Lansing, MI.
- *Web links:* Cerón-Muñoz M F, Tonhati H, Costa C N, Rojas-Sarmiento D and Solarte Portilla C 2004 Variance heterogeneity for milk yield in Brazilian and Colombian Holstein herds. Livestock Research for Rural Development. Volume 16, Article #20 Visited June 1, 2005, from http://www.lrrd.org/lrrd16/4/cero16020.htm

Illustrations
Please send the figures as separate files and do not import them into the text file. Put all tables, figures, diagrams and artwork on separate pages. Each figure, table, and bibliographic entry must have a reference in the text. References to tables and figures in the text should be by number and not to "table below" or "figure below". The Editor will place them in the appropriate place in the text of article during the final edit. Tables and figures should be numbered consecutively. Please submit the data for figures in black and white.

Abbreviations, Symbols and Nomenclature
All specifications must be stated according to the S.I. system. Concentrations of chemical solutions are to be given in mol/l. All other concentrations should be given in % (volume or weight). Any abbreviations of chemical, biological, medical or other terms should only be employed when it is certain that they are internationally known. The full name must be stated in brackets when the abbreviation is first used. Names of micro-organisms and zoological names should be italicized in the manuscript.

Ethical guidelines
BAHPA adheres to the below ethical guidelines for publication and research. Experimentation will only be published if such research has been conducted in full accordance with ethical principles. Manuscripts containing experimentations must be accompanied by a statement that the experiments were undertaken with the understanding and written consent of each subject and according to the above mentioned principles. Editors reserve the right to reject papers if there are doubts as to whether appropriate procedures have been used.

1. When experimental animals are used the methods section must clearly indicate that adequate measures were taken to minimize pain or discomfort.
2. All studies using animal subjects should include an explicit statement in the Material and Methods section identifying the review and ethics committee approval for each study, if applicable. Editors reserve the right to reject papers if there is doubt as to whether appropriate procedures have been used.

Revising your article
When you submit a revised version of your article in response to the referees' comments, you must accompany it with a detailed list of the changes made (ignoring typographical errors, but mentioning additional paragraphs, changes to figures, etc) suitable for transmission to the referee. Where changes have been made in response to the referees' remarks it is important to mention this and indicate where they can be found. You may also wish to send in a second copy of your article with the changes marked or underlined.

You should go through the referees' comments and for each comment mention whether you followed their suggestion or whether you disagree and wish to respond to the comment. If a referee has misunderstood a point, it is not necessarily their fault and may have been caused by ambiguity or lack of clarity in your article which needs to be corrected. Some authors copy out each of the referees' comments in turn and include their response immediately after. In other cases responses can be made referring back to the reports. Finally, please make sure that you send your revised article to us and not simply the original version again. This is a common mistake, especially when authors send in their work electronically. Electronic revised articles should contain all text and graphics files needed to generate the revised version, and not just those files that have changed.

By observing these guidelines you will be assisting the referees, who give up their time to review manuscripts. If you prepare your article carefully, this can save valuable time during the publication process.

Appeal of Decision
Authors who wish to appeal the decision on their submitted paper may do so by e-mailing the editorial office with a detailed explanation for why they find reasons to appeal the decision within 14 days.

Proofs
One set of proofs will be sent to the author to be checked for printer's errors and should be returned within three days.

Offprints
25 offprints of each article will be supplied free of charge. Additional offprints may be ordered and paid for at the proof stage. Each extra offprint costs US $5.00.

Subscriptions
The annual subscription fee, including postage (surface mail) and handling is USD 100.00. Air mail charges are available upon request.

Back volumes
Back issues are also obtainable upon request at similar charges.

Desktop Publisher
Fahim Franz Kremeier