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Livelihood Diversification among Artisanal Fishery Households in North-Central and North-Western Nigeria

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ABSTRACT

The earnings from non-farm activities are increasingly becoming important back-up income for most rural households in many developing countries. The study estimates the determinants of livelihood diversification among artisanal fisherfolks in North-central and North-western Nigeria. Primary data were collected from 267 fishery household heads through field survey with the aid of pre tested questionnaire. Data collected were analyzed using Simpson Index of Diversification (SID) and censored Tobit regression model. Although both activities were important sources of income for all the fishery households sampled, fishing activities were the most important source of income (57.3%) which is in tandem with *a priori* expectation. Result showed that majority of the rural fishery households who seek for off- and non-fish activities used the proceeds to remedied food and basic items (40%) or purchase fishery inputs (22.1%) for their primary occupation. The determinants of livelihood diversification revealed that adjusted household size, capital expenditure and canoe owned were the significant factors that influenced both the share of fishery income and level of diversification (SID). However the influence was not by same coefficients, magnitude, and structure but virtually in the same direction. Artisanal fishery households should form a formidable social organization to benefit from economy of bulk purchase of fish inputs and access to modern fishing techniques. The rural labour force must also find a way to improve their incomes in rural areas such as farming by irrigation activities aquaculture and livestock rearing. However, in interim, it is recommended that the non-fishery activities should also be developed among fisher folks households to cater for rural households that are left fallowed during off-fish season.

Keywords: Determinants of livelihoods, fishery households, income diversification, non- farm

INTRODUCTION

Reardon *et al.* (2006) argued that the traditional vision of rural economies in developing countries as purely agricultural is clearly obsolete. Most artisanal fishery households in Nigeria and across the developing world earn an increasing share of their income from non-fishery sources (Oladimeji, 2013). Evidence from literature also revealed that there has been an increasing recognition recently that the rural economy is not confined to the agricultural sector, but embraces the broad spectrum of needs of all rural people including provision of social service, economic activities, infrastructure and natural resources (Csaki and Lerman, 2000; Davis and Bezemer, 2004; Oladimeji *et al.,* 2015).

Household motives for diversification, as well as the opportunities available to them, differ significantly across settings and income groups, suggesting an important distinction between push and pull factors in diversification (Reardon *et al.,* 2006). Yet, both push factors and pull factors (e.g. changing terms of trade, perceptions of improved opportunities) may be involved in spurring on the process of livelihood diversification. And this process may become more important and more common in the future, although much of the evidence to say that this is already happening is anecdotal (Ellis, 1997, 2000). It suffice to note that most artisanal fishery households' diversification are driven largely by push factors such as diversification undertaken to manage risk, cope with shock, or escape from agriculture in stagnation or in secular decline. In other words, to sustain their livelihood or cushion food shortage experienced by the households, settle domestic obligations and buy back

some inputs needed for fish farming operations (Oladimeji *et al.,* 2015).

The impact of livelihood diversifications among artisanal fisher folks is exhaustive, complex and sometimes it is debatable. On one hand, researchers like Bernard *et al.,* (2014), Nse-Nelson *et al.* (2016) argue that non-farm diversification opportunities may take able farm labours from the agriculture sector and that eventually may cause a decline in farm productivity. On the other hand, there are scholars who argue that livelihood diversification by increasing farm household income can enhance farm investment used for adopting new farm technology resulting in a boost in farm productivity (Schwarze and Zeller, 2005, Adepoju and Obayelu, 2013, Ajao and Oladimeji, 2013).

In this study, Livelihood diversification among artisanal fisherfolks will encompass on-fish farm, off-fish farm and non-fish farm activities in line with Ellis, (2000) classification. Fishery income is mostly and mainly income gained either through fishing activities or income generated from using their canoes/boats for water transportation (Oladimeji *et al.,* 2013). Off-fishery income includes income generated from labour wage working for other fisherfolks and other farm related activities within agriculture sector (Kassie, 2013) as well as engaging in boat/canoe building, net making and repair, engine repair and maintenance and operating irrigated and rainfed crop farming activities at the bank of river which provide additional farming related employment and income opportunities in inland fishing communities. On the other hand, non-farm or non-fish income refers to income from non-agricultural sources like wood carving, carpentry, non-farm salary employment, urban-to-rural remittances, rental income, non-farm rural-wage, and other income from engaging in native artisans if any.

Problem Statement

Agriculture is sub-divided into food/tree crop, livestock and fishery sub-sector. Fisheries are very much an integral part of agriculture sector which comprises of artisanal fisheries and aquaculture, employ about 4.3 percent of Nigeria population, constituting about 50 percent of animal protein intake and maintain a steady contribution of 3.5 to 4 percent to total gross domestic product (GDP) between 2008 and 2012 in Nigeria. This translates to about 10 percent of agricultural GDP, which itself contributed between 35 and 40 percent within the same period to overall Nigeria GDP (Oladimeji, 2013, Oladimeji *et al.,* 2013). Artisanal fishery as a livelihood activity is associated with both aquatic and technical constraints. The aquatic constraints include fish breeding, reproduction, nutrition, health control, water quality management and technology while the technical constraints is embedded in socio-economic and rural development factors such as extension contacts, credit availability, labour intensity, basic infrastructure facilities, finance and basic human needs and sanitation which are also important towards artisanal fishery development (Oladimeji *et al.,* 2013b). Other constraints include accessibility to fuel for motorized canoes, climate variability, infestation by hyacinth and inadequate storage facilities (Oladimeji *et al.,* 2013c). For example, the implication of the problem of scarcity of fishing gears often leads to over exploitation of near river reef fisheries and resort to cheap but destructive fishing practices. This may lead to overfishing and harvesting of immature fishes which derailed fish catch levels.

In addition to artisanal fishery constraints, a good proportion of the Nigerian fishing households are subsistence small holder, relying heavily on the use of non-motorised canoes and fishing nets under a traditional system characterized by low technology, low capital investment, high labour intensive practices and low productivity (Oladimeji, 2013). The consequence of the ubiquitous presence of the above factors among rural artisanal fisheries in Nigeria is widespread diversification. The study focused livelihood activities of rural fishery households and examine the determinants of fishery households to off-fishery and non-agricultural activities mainly off-fish farm and non-farm diversification.

Study Framework

A simplified livelihood framework that leads to our empirical studies follows the spirit of the basic livelihood framework process by Ellis, (2000) and, Ellis and Freeman (2004) that considered household as the main social unit **(Fig. 1)**. The basic framework is predicated on the assumption that rural fishery households are faced with varieties of vulnerability context compose of shocks and seasonality. The framework also helps in conceptualizing the causes and consequences of rural livelihood diversification. The basic framework is predicated on the assumption that a rural household's diversification to non-farm activities portfolio and how they impact on well-being is decided based on selected micro-economic constraints and incentives created through access to public and private resources embodied in assets, markets and institutions as depicted in **Fig. 1**. By assets, we are referring to the natural, physical, social, financial and human resources of value to the household (Asmah, 2011). Changes in the portfolio of assets, their productivity and the extent to which households have access to them are the attributes that are critical in determining livelihood diversification and ultimately household welfare (Dorward *et al.,* 2003). The limitations from access to credit and lack of education, for example, have been highlighted by Bezabih *et al.* (2010) and Kassie, (2013) in their case study on Ethiopia and Asmah (2011) in Ghana and Oladimeji *et al.* (2013) in North Central Nigeria respectively.

Kassie, (2013) opined that livelihood framework could also serve as an input for designing macro level rural development policies at local and community level. But more importantly, the livelihood diversification framework can be used as a tool to analyze micro-level policies and interventions, such as micro credit policies

focused on the improvements of livelihood of rural communities and helping to analyze institutional set up and framework (Ellis, 2000). Studies by Nicodemo, (2007), De Janvry *et al.* (2005), Oladimeji *et al.* (2015) on rural households have revealed involvement of rural households in non-farm activities which exhibit higher potentials of increasing household income and reduce shocks and vulnerability.

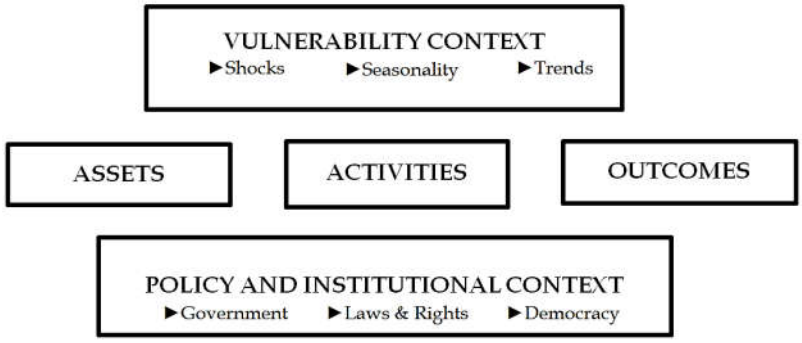

Figure 1: The Basic Livelihoods Framework (BLF). *Source: Ellis & Freeman 2004 (cited in Kassie, 2013)*

MATERIAL AND METHODS

The Study Area

Nigeria lies between Longitudes 2° 49'E and 14° 37'E and Latitudes 4° 16'N and 13° 52' North of the Equator (Oladimeji *et al.,* 2017a). The climate is tropical, characterized by high temperatures and humidity as well as marked wet and dry seasons, though there are variations between South and North. It has a total land area of 923,769 km^2 and 139 million in 2006 (NPC, 2006) with average population and agricultural densities of approximately 150 person km^{-2} and about 3.3 farm families km^{-2} respectively. The latest United Nation (UN) and National Population Census (NPC) office estimate in early 2017 at growth rate of 2.48% put the country at about 190 million with average human density of 204 person km^{-2} (Oladimeji *et al.,* 2017a). Between 60-70% of about 190 million people are involved in agriculture and agricultural related industries which maintain a steady contribution of 35 to 40% to total Gross Domestic Product (GDP) between 2008 and 2012 (FAO, 2013). Total rainfall decreases from the coast northwards. The South (below Latitude 8°N) has an annual rainfall ranging between 1,500 and 4,000 mm and the extreme North between 500 and 1000 mm.

More importantly, Nigeria is blessed with a vast expanse of inland freshwater and brackish ecosystems. Their full extent cannot be accurately stated as it varies with season depending on rainfall. Suffice it to note that the country has rich vegetation consisting largely of a great expanse of arable land, rich fertile soil and abundant water resource, with about 214 billion m^3 of surface water and 87 km^3 of ground water both of which are capable of supporting a large population of capture fishes and aquaculture in the study area **(Fig. 2)**. The country is also endowed with coastline of about 800 km, a continental shelf of about 256,000 km^2 and exclusive economic zone area of 210,900 km^2 (Oladimeji, 2013). In addition, the topography of the coastal area is straddled by the drainage systems of Rivers Niger and Benue as well as their main tributaries (Oladimeji, 1999, oladimeji *et al.,* 2013a & b).

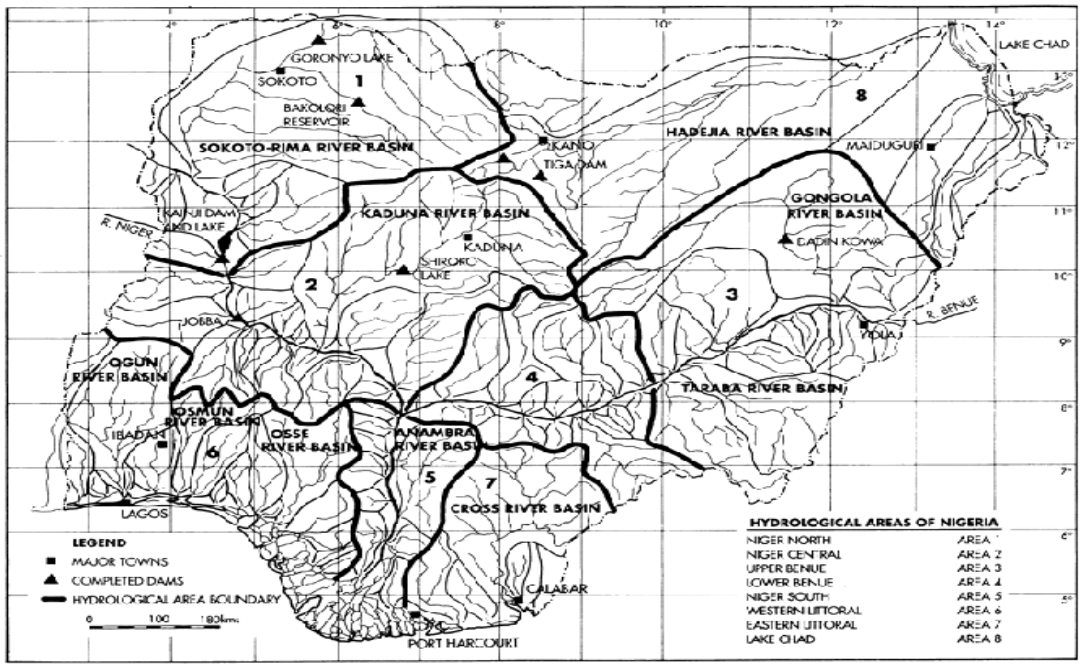

Figure 2: Hydrological map of Nigeria showing the major inland waters (FAO, 1989)

The approximate extent and distribution of the major inland water system in Nigeria is given in **Fig. 3** aggregated to about 12 million ha with mean of 2.3 million ha and standard deviation of 3.3 million ha. And rivers are indispensible freshwater systems that are necessary for agricultural production such as inland fishery. Nigeria is also blessed with about 14 million of hectares of reservoirs, lakes and major rivers estimated at 12.0% of the total surface area of Nigeria (FDF, 2007), capable of supporting agricultural production activities such aquaculture and artisanal fisheries for both home consumption and export.

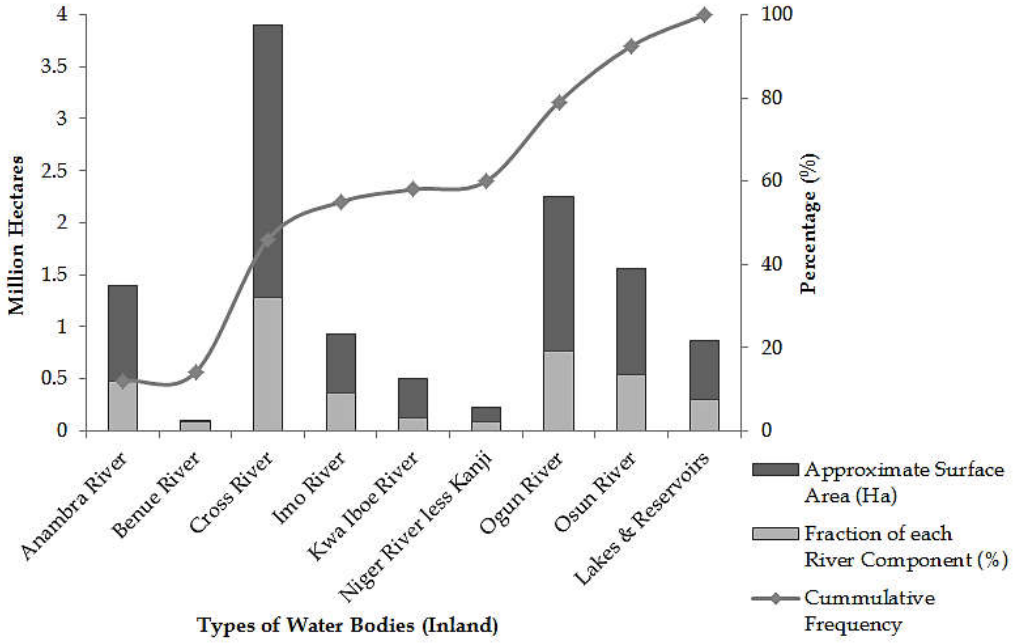

Figure 3: Major inland water resources of Nigeria. *Source: Ita, (1985); Oladimeji, (1999); Oladimeji and Abdulsalam, 2014*

The water system of Nigeria is dominated by two great river systems, the Niger-Benue and the Chad systems. With the exception of a few rivers that empty directly into the Atlantic Ocean such as Cross River, Ogun, Oshun, Imo, Qua Iboe and a few others, all other flowing waters ultimately find their way into the Chad Basin or down the lower Niger to the sea. Therefore, it can be concluded that Nigeria is endowed with ample water resources over a wide range of agro ecologic zones to produce enough aquatic food most especially fisheries products not only for domestic consumption but also for export.

Specifically, the study was conducted in North-central and North- western Nigeria 40° 00′ N and 75° 09′ W. The two region falls within the tropical Guinea and derived savannah zone of Nigeria with mean annual rainfall and temperature ranges from 787mm to 1500mm and 29.5°C - 35°C respectively. Specifically, North Central lies between latitudes 7°N to 12° N and longitude 2° 30′ E to 12° E while Kebbi State lies between latitudes 10°8'N and 13°15'N and longitudes 3°30'E and 6°02'E (NPC, 2006). (See details of Kebbi and Kwara State features in Oladimeji *et al.*, 2016a and Oladimeji *et al.*, 2017a, b and c).

Sampling Procedure and Sampling Size

Data were collected from 267 fisherfolks using an interviewed questionnaire in 2013/2014/2015 fishing activities from Kwara and Kebbi States (see details of basis for purposeful selection of the 2 States in Oladimeji *et al.*, 2015a, Oladimeji *et al.*, 2016a & Oladimeji *et al.*, 2017a).

The first stage involved the purposive selection of 2 States: Kwara and Kebbi States from the north central and north western Nigeria respectively. The second stage involved the random selection of eight villages each from the list of fishing villages in two states. The selected fishing settlements in Kebbi State: Ngaski, Lolo, Bagudo, Koko, Besse, Ulaira, Dolekaina and Yauri and in Kwara State include: Yimagi, Rogun, Ellah, Sunkuso, Ikpata-Jebba, Lafiagi, Patigi and Gbaradogi fishing settlements.

Then, the list of rural fisherfolks' households in each village selected was compiled through their co-operatives for random selection (through combined efforts of Agricultural Development Project staff and 'Sarkin Ruwa' or village heads). The size of each sample from the two States was determined by adopting Ozkan *et al.*, 2004 and Namdari, 2011 method of sample determination given as:

$$n = \frac{\sum N_{cw} S_d}{N_{cw} D^2 + \sum N_{cw} S_d^2} \quad \ldots\ldots\ldots (1)$$

Where; n is the required sample size; N is the number of holdings in target population; 'N_{cw} is the number of the population in the North-central and North-western Nigeria, S_d is the standard deviation in the two zones, S^2_d is the variance of in the two zones; d is the precision level, z is the reliability coefficient (1.96 which represents the 95% reliability); $D^2 = d^2/z^2$.

Based on Equation 1, the sample size was calculated as 267 comprising 129 and 138 fisherfolks in Kebbi and Kwara State respectively.

It is pertinent to note that artisanal fisheries production is much favoured in both Central and North West part of Nigeria as a result of numerous tentacles of inland water and streams as well as flood plains of the River Niger that stretches from Niger Republic to Kebbi State {from Lolo (Bagudo LGA) to Ulaira (Ngaski LGA)} then to Niger State with prominence in Kainji lake reservoir {Borgu and Agwara Local Government Areas, (LGAs)} through Kwara State {from Jebba (Moro) LGA to Lafiagi/Patigi (Edu) LGA) to Lokoja in Kogi State.

Data Collection Method

Primary data were collected from artisanal fishery households through interview and structure questionnaire which was subjected to a pre-survey. The questionnaire content and face validity were confirmed in line with the work of Afor, 2011; Oladimeji *et al.*, 2015; David, 2016; Oladimeji *et al.*, 2016 a & b) as follows: The study questionnaire was an extended version of another tested and used questionnaire from another study searched from literature review. The questionnaire was satisfied to have clarity and appropriate of phrase and integrity of formulations hence reliability. The internal consistency which is a function of reliability estimates for every component of each dimension satisfied the minimum Cronbach alpha levels. This was because the extended questionnaire used has an alpha coefficient value of 0.68 which was considered good, while values between 0.50 and 0.70 were considered acceptable and adequate.

Analytical Technique

Descriptive statistics, Simpson index and the mean of income shares approach were used to estimate the income shares obtained by the fishery households in the North-central and North-western Nigeria. This approach estimates the shares of incomes at the individual household level (Davis *et al.*, 2007, Bernard *et al.*, 2014, Oladimeji *et al.*, 2015a, Oladimeji *et al.*, 2016) by finding the share of each income source in Total Fisherfolks Household Income (TFH_i) for each household. The mean share for each income source for all households was then found. The general Mean of Income Shares (MIS) formula is given as:

$$MS_i = \frac{\sum_{h=1}^{n} {y_{ih}}/{Y_h}}{n} \quad \ldots\ldots..(2)$$

Where *i*= the income source, *Y*=Total Income, *y*= income from particular activity, *h*=the household, *n*= the number of households. Equation (2) is applied in this study as:

The sum of Total Household Income (THI) is given as:

$$THI = \sum_{j=1}^{16} Y_j \quad \ldots\ldots..(3)$$

Where: THI=Total Household Income, thus income coming from all sources *j* j=1, 2, 3, 4….16, fish, off-fish and Non-fish income.

(a) The mean Share of Fish Income (SFI) is given as:

$$SFI = \sum\left(\frac{\sum aft_{/thi}}{n} + \frac{\sum wti_{/thi}}{n} + \frac{\sum fni_{/thi}}{n} + \frac{\sum cbi_{/thi}}{n} + \frac{\sum cei_{/thi}}{n} + \frac{\sum mpi_{/thi}}{n}\right) \quad \text{.....(4)}$$

Where: thi is total household income,, n= number of household heads engaging in each activity, af_i = actual fishing income, wt_i = water transport income, fn_i = fish net making and repairs income, cb_i = canoe building income, ce_i = canoe engine services and repairs income, mpi = fish marketing and processing income.

(b) The mean Share of Off-fish Income (SOI) is given as:

$$SOI = \sum\left(\frac{\sum cpi_{/thi}}{n} + \frac{\sum lpi_{/thi}}{n} + \frac{\sum aoi_{/thi}}{n} + \frac{\sum bhi_{/thi}}{n} + \frac{\sum wli_{/thi}}{n}\right) \quad \text{…(5)}$$

where: cp_i = crop production income, lp_i = livestock and poultry income, ao_i = agric. input and output processing, sales and marketing, , bh_i = Bee keeping and bee hunting income, wl_i = agric. wage labour income.

(c) The mean Share of Non-fish Income (SNI) is given as:

$$SNI = \sum\left(\frac{\sum wdi_{/thi}}{n} + \frac{\sum cai_{/thi}}{n} + \frac{\sum mci_{/thi}}{n} + \frac{\sum nfi_{/thi}}{n} + \frac{\sum rgi_{/thi}}{n}\right) \quad \text{…(6)}$$

where: wd_i = *wood carving income, ca_i = carpentry and other artisans income, mc_i = commercial motorcycle income, nf_i = non-farm wage income, rg_i = remittance and gifts.*

Estimating the Degree of Income Diversification (Simpsons Index of Diversity)

There are various indicators that measures livelihood diversification such as number of income sources and their share, Simpson index, Herfindahl index, Ogive index, Entropy index, Modified Entropy index, Composite index, Entropy index (Shiyani and Pandya, 1998) among others. In this study, descriptive statistics, Simpson index of diversity and the mean of income shares approach were used to estimate the income shares obtained by the fishery households in the North-central and North-western Nigeria. This approach estimates the shares of incomes at the individual household level (Davis *et al.*, 2007, Bernard *et al.*, 2014, Oladimeji *et al.*, 2016b) by finding the share of each income source in Total Household Income (THI) for each household. The Simpson index measured the number of income sources or the level of income diversification. A value of one indicates complete dependence on a single income source while a value of 1/s represents perfectly equal earnings across income sources, where there are s different income source categories analyzed. The SID was used because it takes into consideration both the number of income sources as well how evenly the distributions of the income between the different sources are (Joshi *et al.*, 2003; Minot *et al.*, 2006; Bernard *et al.*, 2014). The SID was designated originally for the number of species present, as well as the relative abundance of each species in ecology study. As species richness and evenness increase, so diversity increases. Hence,

$$SD = 1 - \frac{\varepsilon n(n-1)}{N(N-1)} \quad \text{..... (7)}$$

n = the total number of organisms of a particular species, N = the total number of organisms of all species. This was modified in livelihood diversification study to:

$$SID = I - \sum_{i=1}^{n} p_i^2 \quad \text{... ...(8)}$$

SID=Simpsons Index of Diversity, *n*=number of income sources, *Pi*=Proportion of income coming from the source *i*.

The SID model is expressed in this study as:

$$SDI = 1 - \sum_{i=1}^{16}\left(\left(\frac{afi}{thi}\right)^2 + \left(\frac{wti}{thi}\right)^2 + \left(\frac{fni}{thi}\right)^2 + \left(\frac{cbi}{thi}\right)^2 + \left(\frac{cei}{thi}\right)^2 + \left(\frac{mni}{thi}\right)^2 + \left(\frac{cpi}{thi}\right)^2 + \left(\frac{lpi}{thi}\right)^2 + \left(\frac{aoi}{thi}\right)^2 + \left(\frac{bhi}{thi}\right)^2 + \left(\frac{wli}{thi}\right)^2 + \left(\frac{wdi}{thi}\right)^2 + \left(\frac{cai}{thi}\right)^2 + \left(\frac{mci}{thi}\right)^2 + \left(\frac{nfi}{thi}\right)^2 + \left(\frac{rgi}{thi}\right)^2\right) \ldots\ldots(9)$$

where all variables were define in equations 4, 5 and 6.

Determinants of Livelihood Diversification of Fishery Households

Factors influencing diversification of fishery household heads to off-fish and non-fish income were determined using Tobit model. This was measured by the share of fishery income (from all activities) in total fishery household heads' income. In a second model, I examine the factors influencing the overall mix of the income using the SID as dependent variable but with same set of explanatory variables. The diversity index of zeros indicated no diversification in the dependent variable using SID for some respondents necessitated the use of the censored and truncated Tobit regression. De javy and Sadoulet, (2001); Schwarze and Zeller, (2005); Bernard *et al.,* 2014, Oladimeji *et al.* (2016 a & b) had used Tobit model in similar settings. Thus:

$$Y_i^* = \sum X_i\beta + \mu_i \quad \ldots\ldots(10)$$

Where:

Y_i^* is the vector of variables indicating the dependent variables in the two models;

$$Y_i = P_i = (X_i\beta, \mu_i), \text{if } P_i > P_i^* \ldots..(11)$$

$$0 = (X_i\beta, \mu_i), \text{if } P_i \leq P_i^* \quad \ldots\ldots..(12)$$

i= 1, 2..., 267

Where: $Y_i^*$is the vector of variables indicating the share of income from fishing in total household income and SID. β is a vector of unknown co-efficient and μi is an independently distributed error term. Xi is a vector of explanatory variables stated explicitly in equation 13 below. P_i and P_i^* is the intensity of impact before and after diversification. The model was estimated using maximum likelihood estimation procedure.

$$SDI = \beta_0 + \beta_1 age + \beta_2 adjusted\ household\ size + \beta_3\ level\ of\ education + \beta_4 maritalstatus + \beta_5 credit\ accessed + \beta_6 coorporative\ society + \beta_7 LGA\ (market\ access) + \beta_8 remittance\ \&\ gifts + \beta_9 percapita\ expenditure + \beta_{10} extcontact + \beta_{11} canoe + \beta_{12} local\ govt\ area + \varepsilon$$

….. (13)

where: ε = error term

RESULTS AND DISCUSSION

Classification of Livelihood Diversification

In the literature, there has been a wide range of different systems in classifying sources of income and livelihood diversification. However, this study adopts classification proposed By Barret *et al.* (2001) according to sectors: agriculture and non-agriculture and functions: wage and self-employment **(Fig. 4)** and also adopted by Schwarze and Zeller, (2005) for livelihood diversification of rural households in Central Sulawesi, Indonesia. The Simpson index of diversity used as a measure of overall diversification was calculated by using sixteen different income sources identified **Table 1.** In the basic classification, fishery component (main) was divided into six while the diversification otherwise known as off-fish and non-agriculture was differentiated into five components each. The result shows that fisherfolks had varieties of livelihood activities to engage in which corroborate studies by Csaki and Lerman, 2000; Davis and Bezemer, 2004; Nicodemo, 2007; Idowu *et al.,* 2013; Oladimeji *et al.,* 2015 and Oladimeji *et al.,* 2016b on rural households involvement in non-farm activities which exhibit higher potentials of increasing household income and reduce shocks and vulnerability.

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Table 1: Depicts a livelihood diversification in rural artisanal fisheries in the study area

Items	Sectors		
	Agricultural activities		Non-agric. activities
	Main occupation	Diversification (off- & non-farm activities)	
	Fishery income	Off-fish income	Non-farm income
	-Actual fishing	-Crop production	-Wood carving
Self-employment	-Transportation	-Livestock/poultry	-Artisans: carpentry
	-fish net making & repairs	-Agric. input or output processing, sales & markt	-Commercial motorcycle
	-Canoe building	-Apiculture/beekeeping	-Non-farm rural wage
	-Engine services	-Agric. wage labour	-Remittance & gifts
Wage-employment	-fish processing & marketing		

Source**:** *Author survey, 2014/2015.*

The sixteen livelihood activities identified in **Table 1** were illustrated in **Fig. 4** to show the extent of involvement of sampled fisherfolks in each activity. It could be deduced from the result that the bulk (89%) of respondents engages in actual fishing in addition to one or more off- and non-fish activities. This confirmed the findings of Oladimeji *et al.* (2016c) that fishing and related activities is the major occupation of people living in the coastal and riverine areas. This is, in addition, to other activities associated with off-fish farm such as livestock and backyard poultry (39.7%), agriculture wage (36.7%) as well as non-fishing activities mostly non-farm wage (24.7%) and self-employed non-farm (artisans) works. Thus, this supports Reardon *et al.* (2007) observation that farm households across the developing world earn an increasing share of their income from non-farm sources.

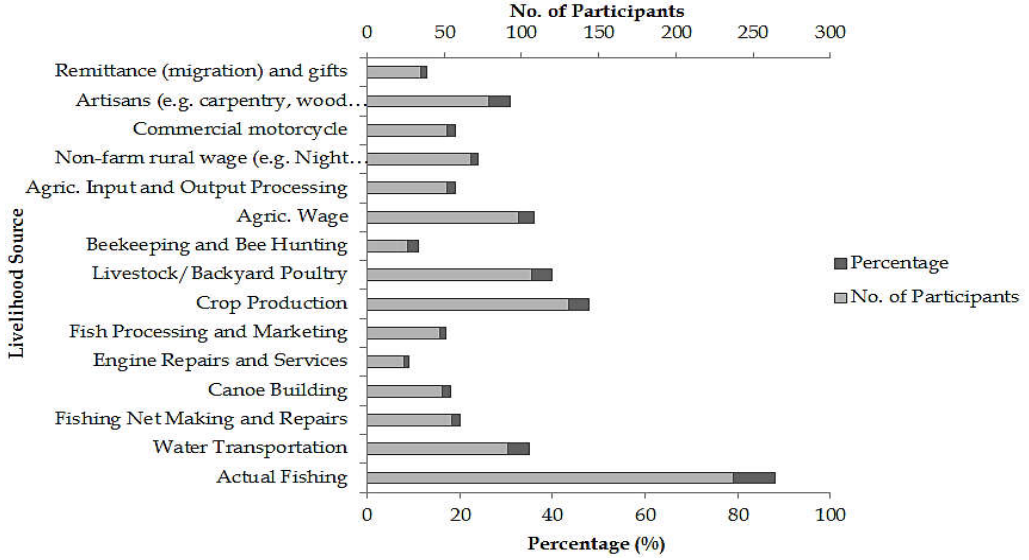

Figure 4: Percentage of fishery household heads engagement in various livelihood sources
Source: *Author survey, 2014/2015; Note: Each livelihood activities is out of total sample size of 267respondents*

Summary statistics of the data reported in **Table 2** revealed that the share of off-fish and non-fish income was 0.32 and 0.11 respectively. This implies that on the average the off- and non-fish income activities contributed about 43% of the total income of artisanal fishery households. Fishery household heads were male dominated (94%); average age of 49 years and married (92%) with mean adjusted household size of 8. The estimated mean years of schooling of sampled fisherfolks were 3.5 years, largely skewed towards the informal education and below 2015 UNDP mean education index of 5 years for Nigeria. Therefore, the socio-economic and institutional characteristics and number of motorized canoes owned shows that artisanal fishery and fishery practices are still not developed and are largely subsistent and rudimentary and this culminated in fishery households in alternative activities as a mean of income generating for livelihood subsistence. The results are comparable with studies of Oladimeji *et al.* (2015a & b).

The results of the skewness and kurtoss of the share of fish income (1.78:2.80), credit beneficiaries and amount

(1.840:2.41), market accessibility (1.69:2.00), extension contact (1.8:2.4) and per capital income (1.73:2.04) shows that the values obtained tends to be asymmetric and heavy tails which implies there was wide difference among the mean of these variables. However, the skewness and kurtosis values for adjusted household size, level of education, per capita expenditure and remittance/gifts tends toward symmetric and light tails. This suggests that changes in these variables have low mean difference which was also manifested in their standard deviation.

Meanwhile, result in **Fig. 5** shows the plan usage of income earned from off- and non-fish activities. It was found that majority of the rural fishery households who seek for off-fish and non-fish activities in the rural areas or migrate temporarily to urban centres either in the formal or informal sector used the proceeds to upset food and basic items (40%) or purchase fishery inputs (22.1%) for their primary occupation.

Table 2: Measurements and descriptive statistics of the households' variables used in the regression models

Variables	Min.	Max.	Mean	Stdev.	Skewness	Kurtosis
Simpson Income of Diversity	0.09	0.69	0.43	0.22	1.16	1.50
Share of off-fish income	0.15	0.49	0.32	0.32	1.02	1.28
Share of non-fish income	0.00	0.23	0.11	0.05	1.78	2.92
Number of income/activities	1	16	3.02	0.99	1.08	0.99
THHI/month ('000₦)	5.34	69.2	43.5	623.9	1.98	2.80
Age of household head (years)	23	71	49	12.04	1.00	0.87
Adjusted household size (No)	4	17	≈8	0.86	0.87	0.92
Level of education (years)	0	15	3.50	0.22	0.56	0.91
Marital status (married =91.7%)	-	-	-	-	-	-
* Credit accessed for prod. (₦)	0	500,000	75,348	23,053	1.80	2.41
Cooperative membership (Years)	3	41	≈20	3.3	1.03	1.10
Market access (Km)	1.5	36	8.4	7.5	1.69	2.00
Remittance and gifts/month (₦)	0	8,000	3722.5	381.4	0.62	0.89
Per capital expend./month ('0₦)	76.5	299.0	120.8	19.30	0.41	0.59
Extension contacts/session (No)	0	2	0.99	0.52	1.83	2.40
Canoe owned (1=Motorized)		-	≈29% M	-	-	.
Per capital income ('000₦)	0.98	5.12	1.63	902.7	1.73	2.04
Gender (male= 94%) {dummy}	-	-	-	-	-	-
LGA dummy (Urban=1)	0	1	-	-	-	-

Source: *Field survey,* 2014/2015; *credit beneficiaries; THHI = Total Household Head Income

Other reasons mentioned were to foster education of their wards and family health care (12.7%) and repairs and construction of residential building (6.4%). This shows that rural households are aware of value of education and health care and, decent and comfortable abode which are grossly lacking in the study area. This confirmed the studies by Damisa *et al.* (2011) and Ali, (2013; 2014); Oladimeji *et al.* (2015a) as well as assertion by Akangbe *et al.* (2006) that economic factors are often the most important determinants of searching for off- and non-farm job by rural households.

The shares of incomes from different livelihood activities are summarized by sectors in **Table 3** and by activities in **Fig 6.** Although both activities were important sources of income for all the fishery households sampled, fishing activities were the most important source of income (57.3%) which is in tandem with *a priori* expectation and studies of Oladimeji *et al.*, 2013a & b; Oladimeji *et al.* 2015a.

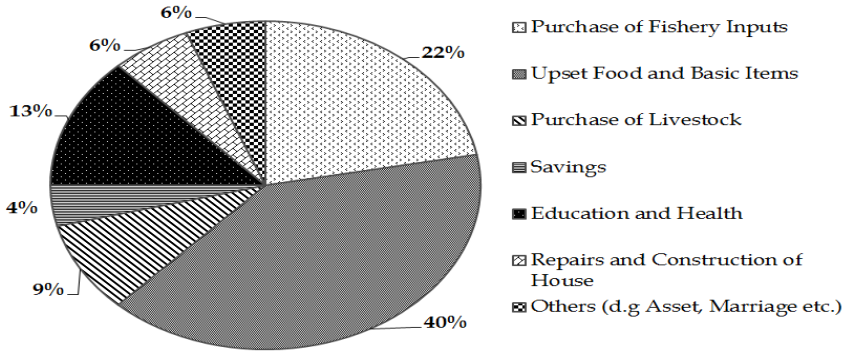

Figure 5: Planned usage of off-fishing and non-fishing income (***Source:*** *Field survey,* 2014/2015)

Activities and Sector distribution of extent of diversification

However, off-fish activities which gulped 32% of total household income were largely made up of crop and livestock/poultry production both of which constitute about 62% of off-fish sectorial activities. Others such as apiculture (19%), wage labour (18.8%) and agriculture input or output items (7.8%) were also captured **(figure 6)**. Oladimeji *et al.* 2015a; Femi and Adelomo, 2016; Nse-Nelson *et al.* 2016 documented similar findings that households engaged in diversification activities for sustaining their livelihood such as cushioning food shortage experienced by the households or settling domestic obligations and buying back some inputs needed for farming operations.

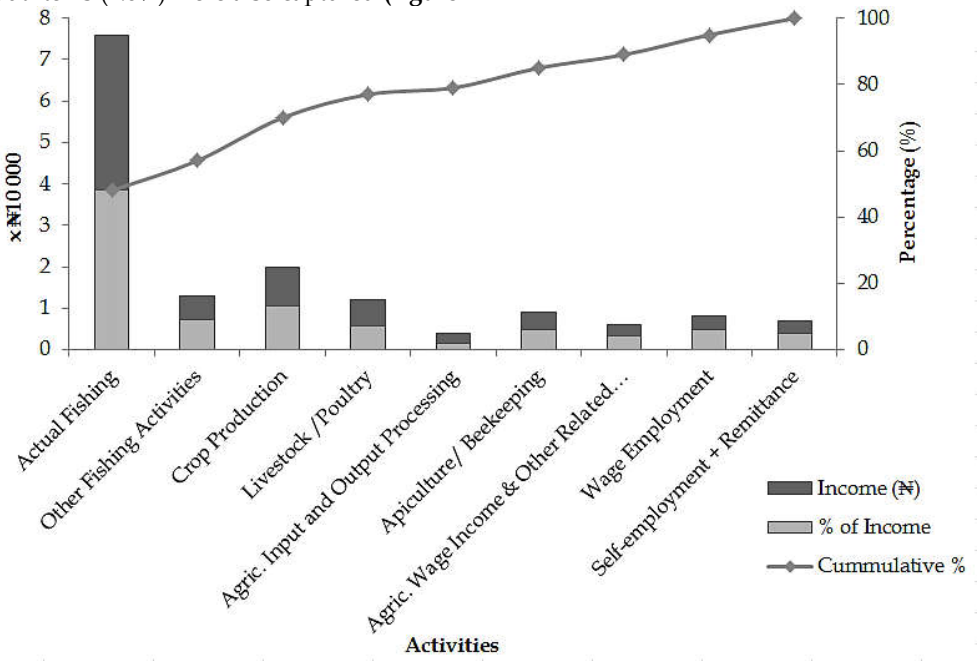

Figure 6: Average income shares from fishing and non-agricultural activities per household head per season; ***Source:*** *Field survey,* 2014/2015

Table 3: Average income shares from fishing and non-agricultural activities per household head per season by sector

Activities	Sectorial total (₦)	% of income	Cum. %
A. Fishing activities	90,505.9	57.3	57.3
B. Off-fish income	51,051.75	32.2	89.5
C. Non-farm income	16,591.50	10.5	100.0

Degree of Income Diversification of Fishery Households

The pooled data had a mean degree of income diversification of 0.43 (43%) was found by the study (**Fig. 7**). The North-central region had average SID of 0.45 with Asa, Edu, Moro and Patigi LGAs comprising the region recorded 0.52, 0.37, 0.46 and 0.36 respectively. The nearness of Moro and Asa LGAs to urban centres and the State capital where we have both services and manufacturing sub-sectors could have accounted for relatively their higher SID values. This promotes non-farm business activities such as involvement in construction, commercial transport and sale of agricultural products especially food crops and vendors which fetches relatively higher prices than the other studied LGAs. The low observed degree of income diversification in Edu and Patigi shows that the fisherfolks in the area are less diversified in relation to the income generating activities they engage in. This implies that fishery households tend to concentrate their sources of income more closely in fishery activities. In this regard, Bernard *et al.* (2014) and Oladimeji *et al.* (2015a) opined that there is a need to support farm households to enhance the incomes generated from the primary farming activities they engage in, to avoid part-time farming which may become the dominant farm model.

Conversely, the average SID for North-western region (0.38) and generally for the LGAs namely Lolo-besse (0.41), Ngaski (0.32), Ulaira (0.43) and Yauri (0.38) were found to be lower than North-central region. It could imply that fisherfolks in the North-western region were more specialized relying more on fish related activities for sustaining their livelihood. Furthermore, the stream of income generated as a result of the engagement in non-fishery activities by North-western fisherfolks as

also observed by Bernard *et al.* (2014) for farm households in Ghana was found to be generally low and in some cases, some activities yielded no income leading to the low degree of diversification observed in the entire study area. The results of SID are comparable to studies of Babatunde and Qaim, (2009) of 0.479 in Nigeria, Bernard *et al.* (2014) of 0.338 of Ghana and Oladimeji *et al.* (2016b) of 0.4 also in Nigeria.

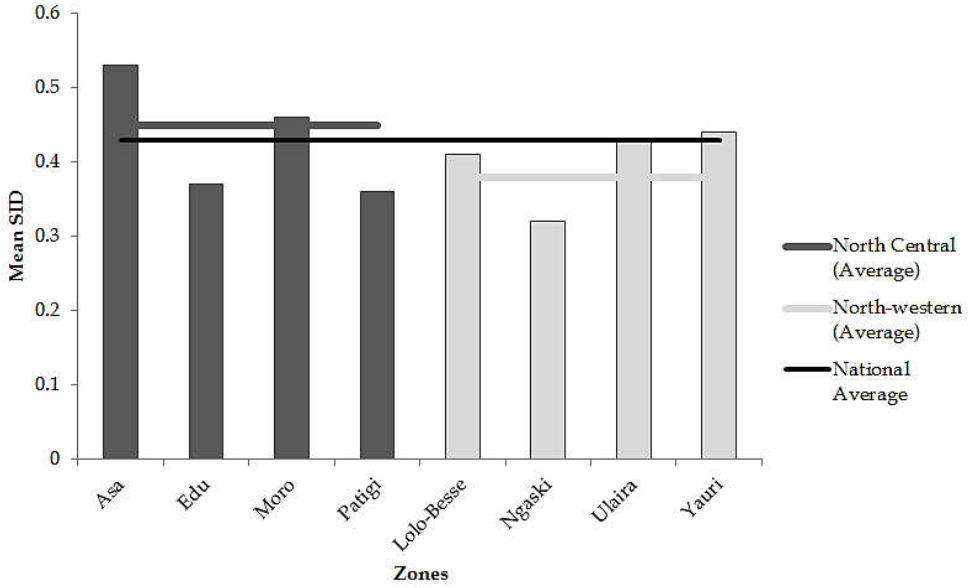

Figure 7: The mean SID degree of income diversification

Determinants of Livelihood Diversification to Off- and Non-Fishery Activities among Fishery Households

Table 4 shows the determinants of livelihood diversification using income as proxy and level of diversification using Simpson Index of Diversification (SID) among fishery households in North-central and North-western Nigeria. Both dependent variables in either cases are continuous variables but with a limited range between zero and 100 (using income for diversification) and, 0.09-0.68 adopting SID respectively. In the first regression on the share of fishery income in total household income, variables such as Age ($p<0.05$), adjusted household size ($p<0.01$), market access ($p<0.100$), capital expenditure ($p<0.01$) and canoe owned ($p<0.05$) were the factors statistically significant determined fisheries among rural artisanal fisherfolks in Nigeria.

In the second regression, adjusted household size ($p<0.05$), remittance and gifts ($p<0.05$), per capita expenditure ($p<0.01$), canoe owned ($p<0.01$) and LGA ($p<0.01$) had significant influence on SID. The negative sign on coefficient of remittance and gifts implies low SID. It is worthy to mention that capital expenditure and canoe owned had significant positive effect on both livelihood diversification and SID of the sampled respondents. This suggested that better-off households through productive assets such as motorized canoes diversify more to fishery activities and were able to fulfilled their than less privileged. This seems to be consistent with several studies: Schwarze and Zeller, (2005); Oladimeji *et al.* (2015a); Femi and Adelomo, (2016) and Oladimeji *et al.* (2016b) that found some socio-economic variables influencing income diversification among Indonesia, North Central Nigeria and South Western Nigeria respondents respectively.

CONCLUSION AND RECOMMENDATIONS

The SID revealed that fisheries income was the most important source of income for fisherfolks in the study area. This contributed about 57% to total household income and 32.2% and 10.5% stemmed from off- and non-fish activities respectively. Therefore, concerted effort by all stakeholders must encourage continuous fishing throughout the year to avoid part time fishing which may become the dominant fish-farm model, and could become a significant retardation of fishery growth based on migration to industrial and service sectors

The determinants of fishery income among rural artisanal fisherfolks include age, adjusted household size, market access; capital expenditure and canoe owned. However, adjusted household size, remittance and gifts, per capita expenditure, canoe owned and LGA had significant influence on SID.

Table 4: Determinants of fishery households' livelihood diversification to off- and non-fisheries activities

Variables	Share of fishery income			SID		
	Nigeria β(t-value)	N-west β(t-value)	N-central β(t-value)	Nigeria β(t-value)	N-west β(t-value)	N-central β(t-value)
Age	0.199(-2.38)	0.105(1.04)	0.109(1.52)	0.099(1.03)	0.023(1.41)	-0.486(1.90)
Adj. household size	0.116(2.51)	0.329(2.72)	0.436(2.49)	0.227(2.34)	-0.218(2.10)	-0.076(1.89)
Level of education	0.231(1.02)	-0.086(0.75)	0.103(0.62)	-0.066(0.41)	-0.142(0.32)	-0.204(0.83)
Credit accessed	-0.212(0.59)	-0.100(1.07)	0.103(1.21)	0.265(1.24)	-0.521(0.72)	0.265(0.43)
Co-operative soc.	0.277(0.73)	0.008(0.59)	0.421(2.31)	0.006(0.98)	0.082(0.99)	0.510(3.92)
Market access	0.076(1.93)	0.276(2.00)	0.200(2.62)	-0.223(0.93)	-0.087(2.05)	-0.321(3.08)
Remittance & gifts	0.244(0.96)	0.071(0.09)	0.004(1.41)	-0.088(2.03)	0.214(2.20)	0.215(2.02)
Capital expenditure	0.299(2.53)	0.384(3.06)	0.492(2.81)	0.188(2.90)	0.322(1.04)	0.203(1.21)
Extension contacts	0.195(1.34)	0.421(2.52)	0.065(1.04)	0.066(1.02)	0.087(0.80)	0.207(0.78)
Canoe owned	0.065(2.26)	0.078(1.72)	0.117(2.38)	0.002(2.51)	-0.003(2.20)	-0.005(2.01)
LGA (urban=1)	0.043(1.53)	0.001(0.78)	0.004(1.04)	0.033(4.52)	0.032(2.73)	0.018(2.11)
Constant	0.044(1.05)	-0.098(2.00)	0.304(1.96)	-0.002(0.84)	0.199(0.62)	-0.151(0.71)
No of observation	267	129	138	267	129	138
Prob.> chi square	0.003	0	0.001	0	0	0.003

Source: Field survey, 2014/2015 t-values implies significant at 10% (≥1.65-1.98), 5 %(≥1.99-2.49) and 1%(≥2.50) respectively

The key determinants of livelihood diversification among fishery households using income diversification and SID were adjusted household size, per capital expenditure and canoe owned. Therefore, it could be concluded that income from both fishery and non-fishery activities could be combined to minimize income stress, fluctuation and shocks and the proceeds from non-fishery activities could be valuable for remedying consumption, fostering education of their wards and buy fishery inputs. This practice could enable fishery households smoothen their sources of income all year round.

Artisanal fishery households should form a formidable social organization to benefit from economy of bulk purchase of fish inputs, farm advisory services, increased access to micro-credit, and access to modern farm techniques. The rural labour force must also find a way to improve their incomes in rural areas particularly off-fish farm through continuous farming by irrigation activities, aquaculture, keeping livestock such as poultry and ruminant. However, in interim, it is recommended that the non-fishery activities should be developed among fisherfolks households to cater for rural households that are left fallowed during off-fish season.

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REFERENCES

Adepoju AO and Obayelu OA. 2013. Livelihood diversification and welfare of rural households in Ondo State, Nigeria. J. of Dev. and Agric. Econs, **5(12)**: 482-489.

Afor, EA. (2011). Economic analysis of farmers' livelihood diversification strategies under the fadama II programme in Kebbi Staten Nigeria. Unpublished Msc thesis, Ahmadu Bello University, Zaria, Nigeria

Ajao, AM and Oladimeji, YU. 2013. Assessment of contribution of apicultural practices to household income and poverty alleviation in Kwara State, Nigeria. International J. of Sci., and Nat, **4(4)**: 687-698.

Ali, M. 2013. Status of informal work force in urban masses: a case study of northern Ethiopia. Int. J. of Sc. Res, **2(3):** 192-198.

Ali, M. 2014. Socio-economic analysis of daily labourers in urban masses: a case study of northern Ethiopia. Ethiopian J. of Env. Stud. & Mangt, **7(1):** 50-58.

Asmah, EE. 2011. Rural livelihood diversification and agricultural household welfare in Ghana. J. of Dev. and Agric. Econs, **3(7):** 325-334.

Babatunde, RO and Qaim, M. 2009. The role of off-farm income diversification in rural Nigeria: driving forces and household access. Conference paper presented on 23 mar 2009 at the Centre for the Study of African Economies (CSAE), Economics Department, Oxford. http

/conferences/2009-EDiA/papers/051-Babatunde.pdf-[28/02/10].

Barrett, CB, Reardon, T and Webb, P. 2001. Non-farm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. Food Policy, **26 (4):** 315-331.

Bernard, ASA, Samuel, A and Edward EO. 2014. Determinants of income diversification of farm households in the estern region of Ghana. Quarterly J. of Int. Agric, **53 (1)**: 55-72.

Bezabih, M, Gebreegziabher, Z GebreMedhin, L and Köhlin, G. 2010.Participation in off farm employment, rainfall atterns, and rate of time preferences: The Case of Ethiopia (find in Kessie, 2013).

Csaki, C and Lerman, Z. 2000. Agricultural transition revisited: issues of land reform and farm restructuring in East C. Europe and the former USSR. Washington DC: WB.

Damisa, MA, Sanni, SA Abdoulaye, T Kamara, AY and Ayanwale, A. 2011.Household typology based analysis of livelihood strategies and poverty status in the sudan savannah of Nigeria: Publics. J. of Agric. and Envi. Studies, **2(1):** 146- 160.

David, I A. (2016). Analysis of livelihood Diversification By Farming Household in Selected Local Government Areas of Kaduna State, Nigeria, An Unpublished M.sc thesis of Ahmadu Bello University Zaria. Nigeria

Davis, J and Bezemer, D. 2004. The development of the rural non-farm economy in developing countries and transition economies: key emerging and conceptual issues. Chatham, UK: Natural Resources Institute.

Davis, B, Winters, PG Carleto, GK Covarrubias, KE Zezza, K Stamoulis, GB and Diguiseppe, S.2007. Rural income generating activities: A cross country comparison. Agric. Development Economics Division, FAO, Rome, Italy. ESA Working paper 5, No 2:7-16.

De Janvry A and Sadoulet, E. 2001. Income strategies among rural households in mexico. The role of off- farm activities. World Dev. **29(3):** 467-480.

Dorward, A, Poole, N Morrisson, J Kydd, J Urey, I. 2003. Markets, institutions & technology: missing links in livelihood analysis, Dev. Policy Rev. **21(3):** 319-332.

Ellis, F. 2000. The determinants of rural livelihood versification in developing countries. J. of Agric. Econs, 51 (2): 289-302.

Ellis, F and Freeman, H A. 2004. Rural livelihoods and poverty reduction strategies in four African countries. J. of dev. Stud. **40(4)**: 1–30.

Federal Department of Fisheries, FDF, 2007. Fisheries Statistics of Nigeria, FDF Publication, Abuja, Nigeria. Pp 11-24.

Femi, MO and Adelomo BS. 2016. Farm households income sources diversification behavior in Nigeria. J. of Nat. Sci. Res. **6(4):** 102-111.

Food and Agriculture Organization, FAO, 2013. FAO Country Programming Framework (CPF) federal republic of Nigeria, Fiat Panis, Pp 1-41.

Idowu, AO, Ojiako, IA and Ambali, OI. 2013. Participation and wage of rural female headed households in Nigeria non-farm employment. Euro. Sci. J. **9(13):** 194-219.

Ita, EO. 1993. Inland fisheries resources of Nigeria. CIFA. Occasional Paper, No. 21. FAO, Rome, 52 Pp

Joshi, PK, Gulati, AA Birthal, PS and Twari, L. 2003. Agriculture diversification in south Asia: pattern, determinants and policy implications. Discussion Paper No. 57. Market Structure studies Divison, International Food Policy Research Institute, Washington, D.C.

Kassie, GW. 2013. Livelihood diversification and sustainable land management: the case of north east Ethiopia. MSc thesis, Ritsumeika, Asia Pacific University.

Minot, N, Epprecht, M and, TTT and Trung, QL. 2006. Income diversification and poverty in the northern uplands of Vietnam. IFPRI Research Report, **145:** 1-111. Washington, D.C.

Namdari, M. 2011. Energy use and cost analysis of watermelon production under different farming technologies in Iran. Int. J. of Env. & Sci, **6:** 1151-1160.

National Population Commission, NPC, 2006. Population Census of the Federal Republic of Nigeria. Analytical Report at the National Population Commission, Abuja, Nigeria.

Nicodemo, C. 2007. Participation andwage equations for married women in European countries. A preliminary paper prepared from University of Tor Vergata, Rome.

Nse-Nelson, FA, Igwe, KC and Iroadighiogu, M. 2016. Income diversification for reducing rural poverty among farm households in umuahia north lga of Abia State, Nigeria. Nigerian J. of Agric. Food and Env. **12(3):**169-174.

Oladimeji, YU, 2013. Analysis of poverty and welfare measures among artisanal fishermen in asa and patigi fishing settlements of kwara state, Nigeria. Res. J. of Agric. Sci. **4(5/6):** 594-601.

Oladimeji, YU, Abdulsalam, Z and Damisa, MA. 2013a. Socio-economic characteristics and returns to rural artisanal fishery households in asa and patigi LGAs of Kwara State, Nigeria. Int. J. of Sci. and Nature, **4(3):** 445-455.

Oladimeji, YU, Abdulsalam, Z Damisa, MA Ajao, AM and Sidi, AG. 2013b. Empirical analysis of artisanal fishery practices and constraints: a synergy to poverty alleviation and sustainable fishery development in North Central, Nigeria. Ethiop. J. of App. Sci. & Tech. **4(2):** 85-102.

Oladimejl, YU, Damisa, MA Abdulsalam, Z and Omokore, DF. 2013c. Estimating the determinants of poverty among artisanal fishing households in Edu and Moro local government areas of Kwara State, Nigeria. Agric. and Bio. J. of N. America, **4(4):** 422.429.

Oladimeji, YU. (2014). Poverty determinants among artisanal fishing households in Nigeria. LAP Labert Academic Publishing. OmniScriptum Gmbh & Co. KG, Deutschland/Germany. ISBN: 978-3-659-51977-2

Oladimeji, YU and Abdulsalam, Z. 2014. An economic analysis of dry season irrigated farming in asa river, kwara state, Nigeria: Implications for Poverty Reduction. J. of Sust. Dev. in Africa, **16(7):** 1-15.

Oladimeji, YU, Abdulsalam Z Damisa, MA and Omokore, DF. 2015a. Determinants of participation of rural farm households in non-farm activities in kwara state, Nigeria: a paradigm of poverty alleviation. Ethiop. J. of Env. Stud. & Mangts, **8(6):** 635 – 649.

Oladimejl, YU, Adepoju, SA Abdulsalam, Z. 2015b. Reviving pottery enterprise: an impetus to poverty alleviation and self-reliance among women folks in Ilorin, Kwara State, Nigeria. Int. J. of Dev. and Sust. **4(2):** 145-160.

Oladimejl, YU, Abdulsalam, Z and Ayandotun, BW. 2016a. Rural household fuel consumption and energy crisis: a synopsis of poverty trend in north central Nigeria. Ethiop J. of App. Sci. and Tech. **7(1):** 59-76.

Oladimeji, YU, Abdulsalam, Z Abdullahi, AN Adefalu, LL and Yakubu, A. 2016b. Determinants of participation of public servants in fish pond production in kwara state, Nigeria. Paper presented in 2nd International Conference on Drylands, Bayero University, Kano, Nigeria (12th – 16th December 2016).

Oladimeji, YU, Abdulsalam, Z Damisa, MA and Ajao, AM. 2016c. Determinants of income diversification of public servant households to agricultural activities in Kwara state, Nigeria. Samaru J. of Agric. Educ. **7 1);** 9-18.

Oladimeji, YU, Ajao, AM Abdullahi, AN Abdulsalam, Z and Damisa, MA. 2017a. Adoption of improved technologies and management practices among bee farmers in north central and north western Nigeria towards Sustainable Development Goals. Ethiop. J. of App. Sci. and Tech. **8(1):** 1-13.

Oladimeji, YU, Abdulsalam, Z Ajao, AM Abdulrahman, S and Abdulazeez, RO. 2017b. Profit efficiency of broiler production among public servant household heads in kwara state, Nigeria: a coping strategy. Asian J. of Econs. Bus. and Acc. **2(2):** 1-8.

Oladimeji, YU, Ajao, AM and Abdulsalam, Z. 2017c. Arable crop farming and adoption of bee pollination services among farming households in kwara state, Nigeria. Asian J. of Agric. Ext., Econs & Soc. **15(2):** 1-10.

Ozkan. B, Akcaoz. H Karadeniz. F. 2004, Energy requirement and economic analysis of citrus production in Turkey, Energy Conv. and Managt, **45:** 1821–1830.

Reardon, T, Berdegué, J Barrett, CB and Stamoulis, K. 2007. Household income diversification into rural nonfarm activities (chapter 8) forthcoming in steven haggblade, peter hazell and thomas reardon, editors, transforming the rural nonfarm economy (Baltimore: Johns Hopkins University Press, 2006).

Schwarze, S and Zeller, M. 2005. Income diversification of rural households in central sulawesi, Indonesia. Quarterly J. of Int. Agric. **44(1):** 61-73.

Shiyani, RL and Pandya, HR. (1998) Diversification of agriculture in Gujrat: A spatio-temporal analysis. Indian J. Agric. Econs. **53(4):** 627-39.