Determinants of livelihood diversification among rural artisanal fisherfolks 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. This 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 the fishery households sampled, fishing activities were the most important source of income (57.3%) which is in tandem with *a priori* expectation. Result shows that majority of the rural fishery households who seek for off- and non-fish activities used the proceeds to purchase food and basic items (40%) or purchase fishery inputs (22.1%) for their primary occupation. The determinants of livelihood diversification indicate that household size, capital expenditure and canoe ownership were the common 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, fishery advisory services, increased access to credit, and access to modern fishing techniques. The rural labour force must also find a way to improve their incomes in rural areas particularly through off-fish farm notably continuous farming by irrigation activities, aquaculture, keeping livestock such as poultry and ruminant.

Keywords: Agricultural activities, fishery households, income diversification, non- farm income

INTRODUCTION

Reardon *et al.* (2007) 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. 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 (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.*, 2007). Yet, both push factors and pull factors for example changing terms of trade, perceptions of improved opportunities) may

be involved in spurring on the process of livelihood diversification. 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, 2000). 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 (Reardon *et al.,* 2007). 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 effect of livelihood diversifications among artisanal fisher folks is exhaustive, complex and sometimes it is debatable. On one hand, researchers like Bernard, Samuel and Edward (2014), Oladimeji *et al.* (2015), Nse-Nelson, Igwe and Iroadighiogu, (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 non-farm household income can enhance farm investment used for adopting new farm technology resulting in a boost in farm productivity (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, Abdulsalam, and Damisa, 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 (Oladimeji *et al.,* 2015). Bearing in mind the classification of occupational activities among artisanal fisherfolks elucidated above, the study therefore, intends to examine factors that determine the effect and the share of non-fishery occupations among rural fisherfolks households in North-central and North-western Nigeria.

RESEARCH METHODOLOGY

The Study Area
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 787 mm to 1500 mm and 29.5°C- 35°C respectively. Specifically, North Central lies between Latitudes 7^oN 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 (National Population Commission, NPC, 2006, Oladimeji *et al.,* 2016, Oladimeji *et al.,* 2017).

Sampling Procedure and Sampling Size
Sample fisherfolks were randomly selected from the two States Kwara and Kebbi. Data were administered to 267 randomly selected fisherfolks through the administration of questionnaire and interview schedule in 2013/2014 fishing season. The two states were purposively selected due to the predominance of fishing activities from the inland water inland. The flood plain of the River Niger stretches from Niger Republic to Kebbi State {from Lolo (Bagudo LGA) to Ulaira (Ngaski LGA)}. This springs to Niger State with prominence in Kainji lake reservoir {Borgu and Agwara Local Government Areas, (LGAs)}. The river then springs to Kwara State {from Jebba (Moro) LGA to Lafiagi/Patigi (Edu) LGA) to Lokoja in Kogi State. Sixteen fishing settlements were randomly selected from both 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.

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 (Bernard, Samuel and Edward, 2014; Oladimeji *et al.,* 2015; 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 calculated. The general Mean of Income Shares (MIS) formula is given as:

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

(Bernard *et al.*, 2014; Oladimeji *et al.*, 2016)

Where *i*= the income source (Naira, ₦), *Y*=Total Income (Naira, ₦), *y*= income from particular activity (Naira, ₦), *h*=the household (Number of persons), *n*= the number of fisherfolks. Equation (2) was applied in this study as:
The sum of Total Household Income (THI) is given as:

$$THI = \sum_{j=1}^{16} Y_j \quad \ldots\ldots\ldots\ldots\ldots\ldots.(2)$$

(Schwarze and Zeller, 2005; Bernard *et al.*, 2014)

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:

$$SFI = \sum \left(\frac{\sum afi/_{thi}}{n} + \frac{\sum wti/_{thi}}{n} + \frac{\sum fni/_{thi}}{n} + \frac{\sum cbi/_{thi}}{n} + \frac{\sum cei/_{thi}}{n} + \frac{\sum mpi/_{thi}}{n} \right) \quad …..(3)$$

(Schwarze and Zeller, 2005; Bernard *et al.*, 2014; Oladimeji *et al.*, 2015)

Where: *thi* is total household income (Naira, ₦),, n= number of household heads engaging in each activity (persons), af$_i$ = actual fishing income

(Naira, ₦), wt$_i$ = water transport income (Naira, ₦), fn$_i$ = fish net making and repairs income (Naira, ₦), cb$_i$ = canoe building income (Naira, ₦), ce$_i$ = canoe engine services and repairs income

(Naira, ₦), mpi = fish marketing and processing income (Naira, ₦).

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

$$SOI = \sum \left(\frac{\sum cpi/thi}{n} + \frac{\sum lpi/thi}{n} + \frac{\sum aoi/thi}{n} + \frac{\sum bhi/thi}{n} + \frac{\sum wli/thi}{n} \right) \quad ...(4)$$

Where: cp$_i$ = crop production income (Naira, ₦), lp$_i$ = livestock and poultry income (Naira, ₦), ao$_i$ = agric. input and output processing, sales and marketing (Naira, ₦), bh$_i$ = Bee keeping and bee

hunting income (Naira, ₦), wl$_i$ = agricultural wage labour income (Naira,₦).

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

$$SNI = \sum \left(\frac{\sum wdi/thi}{n} + \frac{\sum cai/thi}{n} + \frac{\sum mci/thi}{n} + \frac{\sum nfi/thi}{n} + \frac{\sum rgi/thi}{n} \right) \quad ...(5)$$

Where: wd$_i$ = wood carving income (Naira, ₦), ca$_i$ = carpentry and other artisans income (Naira, ₦), mc$_i$ =

Simpsons Index of Diversity

It is pertinent to note that 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 :

commercial motorcycle income (Naira, ₦), nf$_i$ = non-farm wage income (Naira, ₦), rg$_i$ = remittance and gifts (Naira, ₦). 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 (Bernard *et al.*, 2014).

This was modified in livelihood diversification study to

$$SID = I - \sum_{i=1}^{n} p_i^2 \quad ....(6)$$

(Bernard *et al.*, 2014; Femi and Adelomo, 2016)

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:

$$SDI = 1 - \sum_{i=1}^{16} \left(\left(\frac{afi}{thi}\right)^2 + \left(\frac{wti}{thi}\right)^2 + \left(\frac{fni}{thi}\right)^2 + \left(\frac{cbi}{thi}\right)^2 + \left(\frac{cei}{thi}\right)^2 + \left(\frac{mni}{thi}\right)^2 + \left(\frac{cpi}{thi}\right)^2 + \left(\frac{lpi}{thi}\right)^2 \right.$$
$$+ \left(\frac{aoi}{thi}\right)^2 + \left(\frac{bhi}{thi}\right)^2 + \left(\frac{wli}{thi}\right)^2 + \left(\frac{wdi}{thi}\right)^2 + \left(\frac{cai}{thi}\right)^2 + \left(\frac{mci}{thi}\right)^2 + \left(\frac{nfi}{thi}\right)^2$$
$$\left. + \left(\frac{rgi}{thi}\right)^2 \right) \quad ....(7)$$

(Bernard *et al.*, 2014; Oladimeji *et al.*, 2016), where all variables were defined and measured in equations 4, 5 and 6.

4

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 the 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. Thus:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \varepsilon_i \quad (13)$$

Where: Y_i is the vector of variables indicating the share of income from fishing in total household income and SID; X_1= Age (years); X_2= Household size (number of persons per fisherfolks); X_3= Level of education (years); X_4= Marital status (dummy, male=1 and 0 otherwise), X_5= Credit accessed (Naira); X_6= Cooperative society (years); X_7= Market access (Access=1 and 0 otherwise); X_8= Remittance and gifts (Naira); X_9= Per capita expenditure (Naira); X_{10}= Extension contact (number of contacts); X_{11}= Type of canoe owned (Motorized=1 and paddle=0), X_{12}= Local government area (Urban=1 and 0 otherwise); β_0= Constant; β_1- β_{12} are coefficients to be estimated and ε = error term.

The model was estimated using maximum likelihood estimation procedure (MLE).

RESULTS
Classification of Livelihood Diversification

The Simpson index of diversity used as a measure of overall diversification was calculated by using sixteen different income sources enumerated in 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 sixteen livelihood activities identified in Table 1 were illustrated in Fig. 1 to show the extent of involvement of sampled fisherfolks in each activity.

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**
Self-employment	-Actual fishing	-Crop production	-Wood carving
	-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		
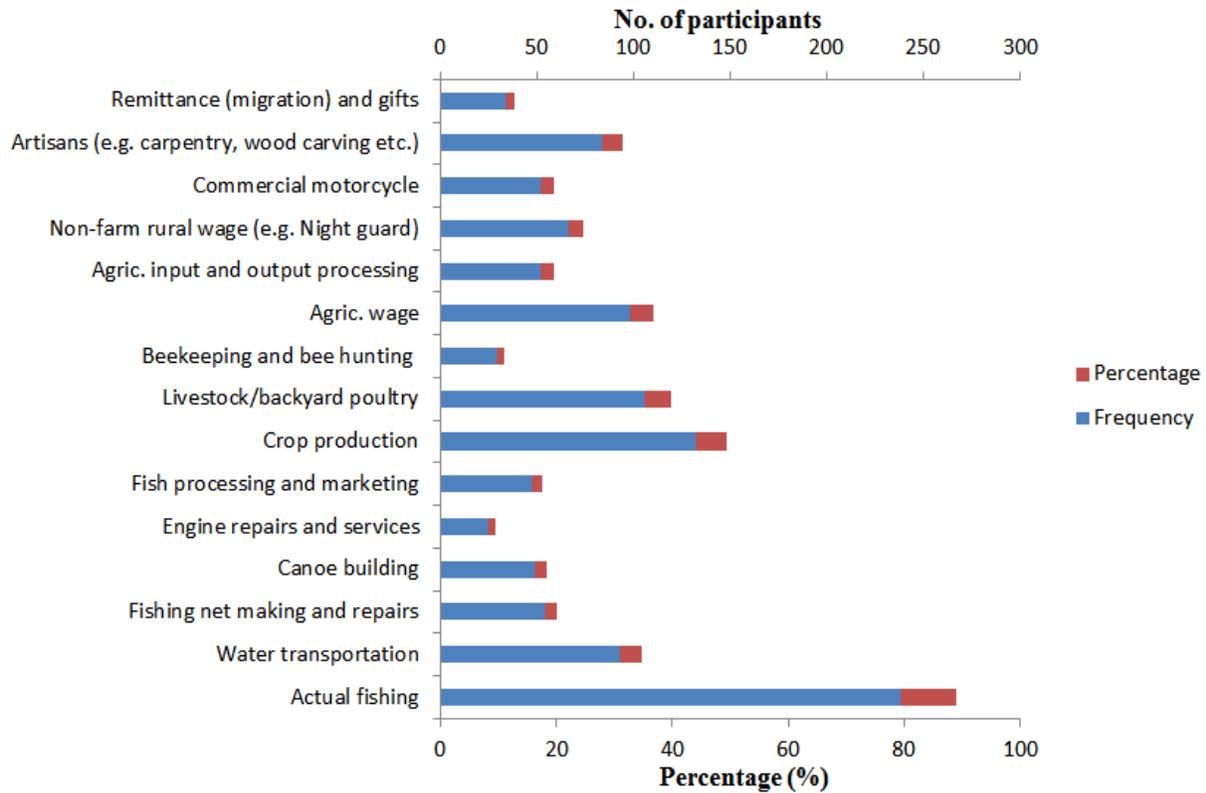
Fig. 1: Percentage of fishery household heads engagement in various livelihood sources

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. The results also 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).

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	-	-	-	-

*credit beneficiaries; THHI = Total Household Head Income

The result in Fig. 2 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 to work in formal or informal sector used the proceeds to upset food and basic items (40%) or purchase fishery inputs (22.1%) for their primary occupation. Other reasons were to foster education of their wards and family health care (12.7%) and repairs and construction of residential building (6.4%).
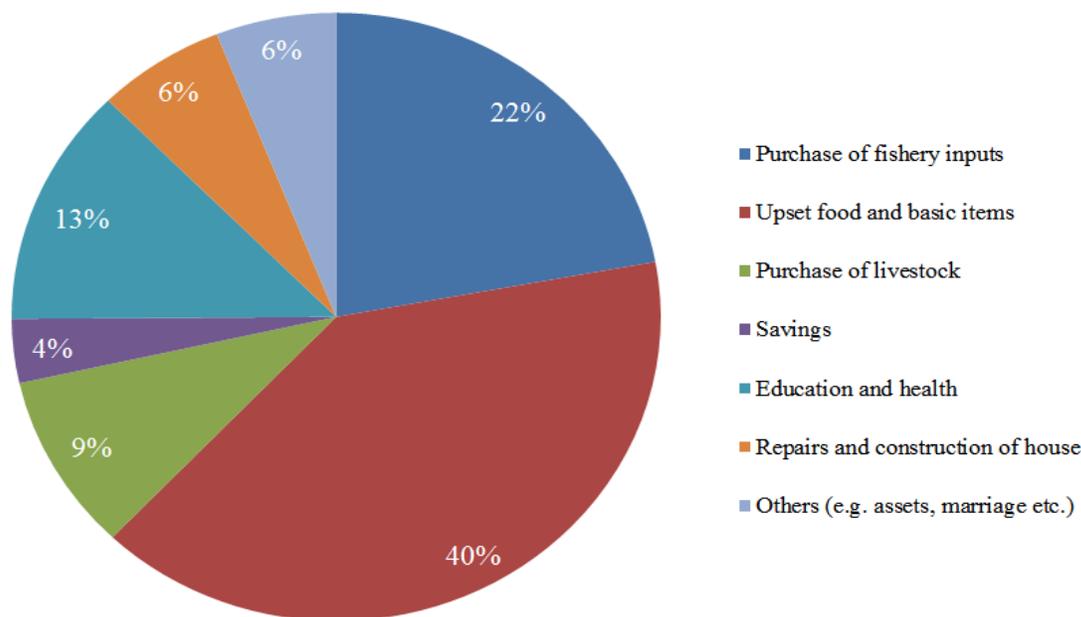
Fig. 2: Planned usage of off-fishing and non-fishing income (***Source:** Field survey,* 2014/2015)

Activities and Sector distribution of extent of diversification

The shares of incomes from different livelihood activities are summarized by sectors in Table 3 and by activities in Fig 3. 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. 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.

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

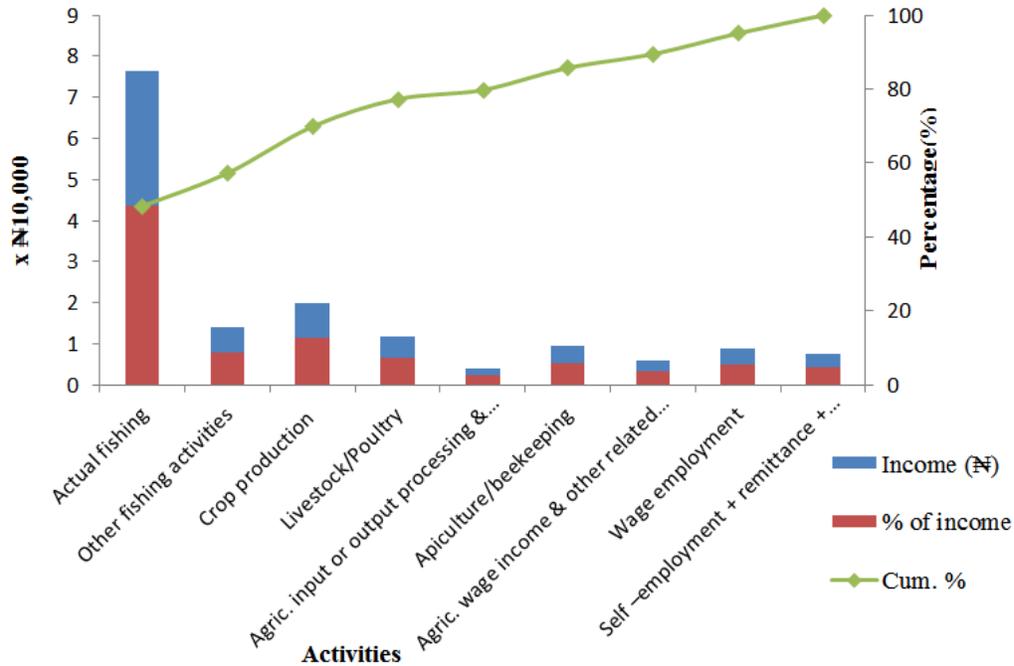| Activities	Sectorial total (₦)	% of income	Cum. %
A. Fishing activities	90,505.9	57.3	57.3
B. Off-fish income	51,051.75	32.2	89.5
C. Non-farm income	16,591.50	10.5	100.0

Fig 3: Average income shares from fishing and non-agricultural activities per household head per season; *Source: Field survey,* 2014/2015

Degree of Income Diversification of Fishery Households

A mean national degree of income diversification of 0.43(43%) was found by the study (Fig. 4 below). 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. 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.
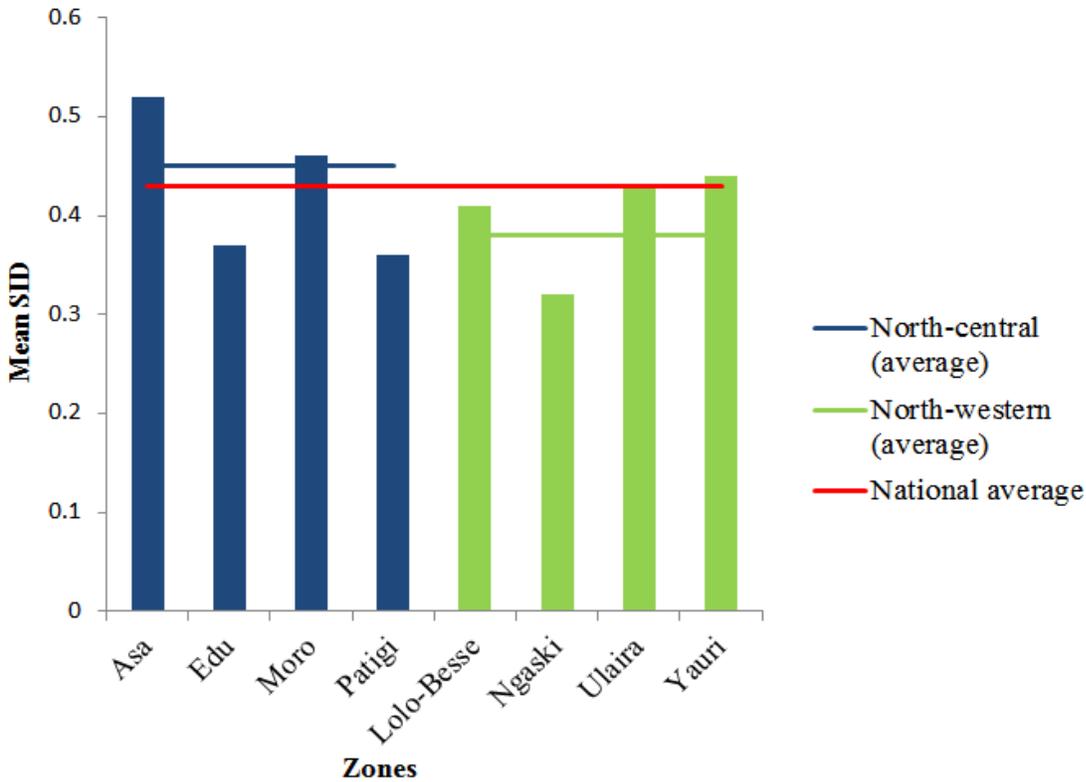
Fig. 4: Degree of Livelihood diversification by settlements and region

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 for livelihood diversification 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 (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.

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

variables	Share of fishery			SID		
	N-central β(t-value)	**N-west** β(t-value)	**Nigeria** β(t-value)	**N-central** β(t-value)	**N-west** β(t-value)	**Nigeria** β(t-value)
Age	0.109(1.52)	0.105(1.04)	0.199(-2.38)	-0.486(1.90)	0.023(1.41)	0.099(1.03)
Household size	0.436(2.49)	0.329(2.72)	0.116(2.51)	-0.076(1.89)	-0.218(2.10)	0.227(2.34)
Level of education	0.103(0.62)	-0.086(0.75)	0.231(1.02)	-0.204(0.83)	-0.142(0.32)	-0.066(0.41)
Credit accessed	0.103(1.21)	-0.100(1.07)	-0.212(0.59)	0.265(0.43)	-0.521(0.72)	0.265(1.24)
Co-operative	0.421(2.31)	0.008(0.59)	0.277(0.73)	0.510(3.92)	0.082(0.99)	0.006(0.98)
Market access	0.200(2.62)	0.276(2.00)	0.076(1.93)	-0.321(3.08)	-0.087(2.05)	-0.223(0.93)
Remittance & Gifts	0.004(1.41)	0.071(0.09)	0.244(0.96)	0.215(2.02)	0.214(2.20)	-0.088(2.03)
Capital expenditure	0.492(2.81)	0.384(3.06)	0.299(2.53)	0.203(1.21)	0.322(1.04)	0.188(2.90)
Extension contact	0.065(1.04)	0.421(2.52)	0.195(1.34)	0.207(0.78)	0.087(0.80)	0.066(1.02)
Canoe owned	0.117(2.38)	0.078(1.72)	0.065(2.26)	-0.005(2.01)	-0.003(2.20)	0.002(2.51)
LGA(urban=1)	0.004(1.04)	0.001(0.78)	0.043(1.53)	0.018(2.11)	0.032(2.73)	0.033(4.52)
Constant	0.304(1.96)	-0.098(2.00)	0.044(1.05)	-0.151(0.71)	0.199(0.62)	-0.002(0.84)
No of observation	138	129	267	138	129	267
Prob>chi-square	0.001	0.000	0.003	0.003	0.000	0.000

t-values in parenthesis implies significant at 10% (≥1.65-1.98), 5% (≥1.99-2.49) & (≥2.50) respectively

DISCUSSION

The result showed that fisherfolks had varieties of livelihood activities to engage in which exhibit higher potentials of increasing household income and reduce shocks and vulnerability. 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 corroborates the findings of Davis and Bezemer, 2004 and Oladimeji *et al.,* 2015 on rural households' involvement in non-farm activities that fishing 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 agriculture wage as well as non-fishing activities mostly non-farm wage and self-employed non-farm (artisans) works. According to Reardon *et al.* (2007), farm households across the developing world earn a share of their income from non-farm sources.

The estimated mean years of schooling of sampled fisherfolks was largely skewed towards the informal education and below 2015 UNDP mean education index of 5

years for Nigeria. The result of skewness and kurtosis 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. 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.

Result shows that fishery households used substantial part of the proceeds to upset food and basic needed items (40%) or purchase fishery inputs (22.1%) for their primary occupation. This confirmed the studies by Damisa *et al.* (2011) 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. According to Damisa *et al.* (2011), Nse-Nelson, Igwe and Iroadighiogu, (2016) 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.

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 in 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.,* (2015) 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.

It could also imply that fisherfolks in the North-western region were more specialized relying more on fish related activities for sustaining their livelihood. This was because 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.* (2016) of 0.4 also in Nigeria.

The results of the diagnostic characteristics in Tobit regression indicated that the critical chi-square values were statistically significant at 1% level of significance. This showed that the predictors' regression coefficients considered jointly exert a significant influence on the livelihood diversification of the fisherfolks. This is an indication that all or some of the slope coefficients are significantly different from zero. It therefore means that the model is capable of showing and explaining the determinants of livelihood diversification among artisanal fisherfolks in the study area. The pooled data from the share of fishery income of Tobit regression revealed that age, household size, market access, capital expenditure and canoe owned were determinants of livelihood diversification to off- and non-fishery activities among fishery households in the study area. The negative and statistically significant coefficient of age means that relatively, the older a fisherfolk becomes, the less it would undergo vigorous activity and the more he would increase his livelihood diversification to off- and non-fisheries activities.

The coefficients of household size, market access, capital expenditure and canoe owned were positive and statistically significant. These imply that a unit increase in any of these variables would increase the fisherfolks propensity to engage in fishery activity. Thus, the larger the household size, the market accessibility, availability of

capital expenditure and number of canoes owned, the higher the probability of a fisherfolk engaging in fishery ventures. This suggested that better-off households through large household size and productive assets such as motorized canoes diversify more to fishery activities and was able to fulfill their household needs than less privileged.

Similarly, the pooled data from the Simpson index of diversity (SID) of Tobit regression showed that household size, remittance and gifts, capital expenditure, canoe owned and location were determinants of livelihood diversification to off- and non-fishery activities among fishery households in the study area. The negative and statistically significant coefficient of remittance and gifts imply that fisherfolks without access to remittance and gifts will be more willing to diversify to off- and non-fishery activities among fishery households in the study area. On the other hand, the positive and statistically significant of household size, capital expenditure, canoe owned and location imply that fisherfolks are more likely to engage in fishery ventures. This result isi consistent with several studies: Schwarze and Zeller (2005); Oladimeji *et al.,* (2015) and Oladimeji *et al.* (2016) that found 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. 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. The rural labour force must devise 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.

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.

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