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ASSET BASED WELLBEING OF POVERTY OF ARTISANAL FISH FARMERS IN DELTA STATE, NIGERIA

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ABSTRACT

This research carried out in Delta State, Nigeria, focuses on the empirical application of Principal Component Analysis (PCA), an asset based measure of wellbeing which can be used to assess level of poverty among households in rural areas of developing countries. The study employed questionnaire-based household survey data collection methods. The final wealth index was derived using data collected from 430 artisanal fishing households in riverine Delta State communities. Data on 16 variables measuring multiple aspects of household wealth status were used to extract the set of principal components utilized in the construction of the index. Two key statistical tests, the KMO and Bartlett's tests, showed the appropriateness of the data for PCA. Results revealed that five major factors influence the wealth status and hence the wellbeing of households: home infrastructure, energy sources, durable home assets, water sources and mobility. Therefore, it is suggested that any efforts to improve the wellbeing of farm households in the study area as well as in other regions with similar socio- economic settings should consider these factors as entry point to poverty alleviation.

KEYWORDS: Asset Based Wellbeing; Principal components analysis; Wealth index; Artisanal fishing households;

INTRODUCTION

Poverty measurement using income and consumption expenditure are met with many problems. Income measurements are often confronted with measurement error, high variability and do not reflect the households' actual standard of living. Consumption expenditure on the other hand which has been adjudged a more reliable measure also has the disadvantage of depending on the demographic of the household and most often the respondents sampled rely mostly on memory recall as most of the variables under study are not recorded as such erroneous information might be used in the analysis. To cub these problems, measuring the level of poverty can focus more on the asset based well-being indicator of the households under study. In asset wellbeing measurement, all or an aspect of capital assets of the households is the basic unit being measured.

The capital assets also known as the livelihood resources includes human assets (household labour capacity), natural assets (total/cultivated farm lands), physical assets (ownership of cattle, bicycles, radios, television etc.), financial assets (access to cash, credit and remittances); and institutional /social assets (access to social networks and membership of associations).The physical asset aspect of the capital assets is the unit used for this study. In measuring the physical asset, the proportion of the population that are poor are adjudged poorly endowed and the well-endowed proportion of the population are the non-poor. This study looks at the assets of the artisanal fisherfolks in Delta State, Nigeria.

METHODOLOGY

Sampling Procedure and Data Collection

A multistage sampling procedure was adopted for this study. First, the State was stratified into the three

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agricultural zones as delineated by the Delta State Agricultural Development Programme (ADP) to obtain State wide coverage. Thereafter, two LGAs were selected using simple random sampling technique. In the third stage, four communities were randomly selected in each LGA to make a total of 24 communities. Thereafter, using simple random sampling technique a total of 430 respondents were selected for the study.
Primary data for the study was collected between February and August 2019 with structured questionnaire, using mainly interview schedule that was conducted by enumerators that were fluent both in English language and the local dialects of the artisanal fishers. The numerators were monitored on a fortnightly basis.

ANALYTICAL TECHNIQUE
The Method of PCA
PCA is a multivariate statistical technique that reduces the number of variables in a dataset into smaller number of dimensions or factors (Hoque, 2014). PCA finds the linear combination of variables with maximum variance; usually the first principal component (A_{ij}) and a second linear combination of the variables, orthogonal to the first with maximum remaining variance and so on. This technique extracts the few orthogonal linear combinations from the set of variables that captures the common information most successfully (Langyintuo 2008, Bamire *et al;* 2010).
PCA starts by specifying each variable normalized by its mean and standard deviation (Langyintuo, 2008)

$a_{ij}=(a_{ij}^{*} - a_{i}^{*}) / S^{*}$ (1)
Where a_{ij} = mean of a^{*}_{ij}
S_i^{*} = standard deviation
These selected variables are expressed as linear combinations of a set of underlying component for each household.
$a_{1j} = v_1 A_{1j} + v_2 A_{2j} + \ldots + v_{1k} A_k$ (2)
$\forall = 1, \ldots, j$
$ak_{ij} = v_{k1} A_{1j} + v_{k2} A_{2j} + \ldots + v_k A_k$ (3)
where;
A = components
v= the coefficient on each component for each variable

The linear combination of the variable with maximum variance is taken as the principal component 1 (PC_1) and a second with maximum remaining variance as PC_2 and so on. The first PC is used as an index for each household and lastly the assigned weights are then used to construct the wealth index.

Tests for Appropriateness
Two key statistically tests; the Kaiser-Meyer-Olkin (KMO) and Bartletts test showed the appropriateness of the data for PCA. The KMO statistic (also known as the measure of sampling adequacy) adopted by Mooi and Sarstedt (2011) is used to indicate whether the correlations between variables can be explained by other variables in the data set. The Bartletts test of sphericity on the other hand, tests the null hypothesis that the correlation matrix is a diagonal matrix. This test of sphericity shows that all non-diagonal elements are zero in the sample. The result of the PCA will further be analyzed for communality. Communality indicates how much variance of each variable can be reproduced through factor extraction.

Wealth Index
A wealth index was computed for each household. To compute the wealth index, the first principal component will be expressed in terms of the original (un-normalized) variables and an index for each household is based on the expression;

$A_{ij} = F (a_{ij}^{*} - a_i^{*}) (S^{*}) + \ldots + F_{ik} (G_k^{*} - a_k^{*)}) (S_k^{*})$ (4)
Technically this solves the equation;
$(R-\lambda_i)v_n = 0$ for λ_i and v_n
Where R = matrix of correlations between scaled variables
v_n= vector of coefficients on the n^{th} component for each variable
λ_n= Eigen value of R (and their associated Eigen vectors, v_n
The resulting asset scores will be standardized (using assigned weights), which in turn are used to construct the overall wealth index. Given by;
$W_j = \sum_{i=1}^{k} [b_i (a_{ji} - x_i)] / S_i$ (5)
Where
W_j = a standardized WI for each households
b_i= the weights (scores) assigned to the (k) variables on the first PC
a_{ji}= the value of each household on each k variables
x_1 = the mean of each of the k variables
s_1 = the standard deviation
These standardized scores were then used to create the breakpoints that define wealth categories from lowest to highest. This study used a mean index of zero. A household above the mean is well endowed and households below mean are poorly endowed.

RESULTS AND DISCUSSION

Table 1 shows the home infrastructure and durable home goods of all respondents in the study area.

Home Infrastructure

The entire Delta States' home infrastructure showed that more artisanal fishers build their homes with moulded blocks amounting to 63.7% while the other categories of building materials account for the other 36.3%. For the roofing materials used, only 2 classes of materials were identified, those fishers that roofed with zinc or asbestos; making up 87% of the fisherfolks while the other 13% used thatch as their roofing material. About 61.9% of the fisherfolks used concrete/cement walls while 17.4% made use of mud for their walls. Some 13.3% used planks and lastly 7.4% of the fishers used tiles to beautify the walls of their homes. This finding is in line with the study of Adade and Ada-Okungbowa (2017), who found 49.3% oil palm farmers in an out-grower scheme, used improved wall quality.

The flooring materials used by different artisanal fishers were tiles, concrete, mud and plank. From the result, about 53.1% of the fishers made use of concrete as their choice of flooring materials. The other choice of flooring materials used by the fisherfolks was 46.9%, with tiles constituting 24%, mud 12% and planks 10.9%. This finding is in line with the study of Adade and Okungbowa (2017), who found oil palm farmers in an out-grower scheme to have 53.3% with improved concrete flooring. The type of floors used in homes is an important measure for multidimensional poverty studies and about 77% of the artisanal fishers in the study area have adopted good floors for their homes. Improved floor is a necessary condition for the well-off fishers but not sufficient criterion to state that the fisherfolks in Delta state are not poverty.

Of the 430 artisanal fishers, 264 were connected to the general electricity grid while 166 respondents had no connectivity to the main electricity source. However, for the different sources of electricity only 45.8% of the fishers claimed they depended solely on electricity while 25.2% of them used generators most of the time. The fisherfolks making use of lanterns, torch, and candles made up 28.4%. From this result, the fisherfolks in Delta State have inadequate energy source for lighting their homes which is an indication of a fishers that are not well-off.

For cooking fuel used, 35.5% of the fishers used stoves followed by 26.7% who used gas/electricity cookers. About 23.5% of them made use of coal while the other 14.2% made use of firewood. As earlier mentioned, one of the criteria to be non-poor in a MPI measure is to have adequate cooking fuel; the fisherfolks in the study area are lacking in this criteria.

Five drinking water sources were identified during the course of this study. Private boreholes had more fisherfolks (42.1%) making use of the water while government supplied water and wells each accounted for 22.1% of the fishers. However, the more recent trend "sachet water" made up 12.3% of the fisherfolks. This source of water as well as those from private boreholes is not proven safe for consumption. Only about 1.2% of the fisherfolks consumed treated water in plastic bottles that are sufficiently safe for consumption. It can then be concluded that sufficiently safe water for drinking is only available to, and consumed by 23.3% of the artisanal fisher folks.

For the domestic water usage, borehole also topped the list. Usage of water from rivers/or streams was also popular amongst the fisherfolks with about 23.3% of the fishers depending on these water source(s). About 17.4% of the fishers depended on the Government water agency for supply of their domestic water while water from wells was used by about 16.3% of the fishers.

The water cistern (WC) is the most popular singular toilet facility in the localities studied. About 38.8% of the total fishers owned this facility and made use of them. Other facilities in use for defecation by the fisherfolks include rivers/streams (24.4%), pit (19.1%), bush (13%) and bucket toilet (4.7%). From the study, on the whole, the other unsanitary mode of feacal disposal accounts for a total of 61.2% of the artisanal fishers in the entire study area. This is a characteristic of the poor who reside is mainly rural areas. This could manifest in poor health and loss of income on the long run.

Table 1 **Home Infrastructure**

	Type	Frequency	Percentage	Cumm. Frequency
Building Materials	Block	274	63.7	63.7
	Plastered mud	53	12.3	76.0
	Mud	61	14.2	90.2
	Wooden	39	9.1	99.3
	Iron sheets	3	0.7	100.0
Roofing Materials	Zinc/asbestos	374	87	87.0
	Thatch	56	13	100.0
Flooring Materials	Tiles	103	24	24.0
	Concrete	228	53	77.0
	Mud	52	12.1	89.1
	Plank	47	10.9	100.0
Wall Materials	Tiles	32	7.4	7.4
	Concrete	266	61.9	69.3
	Mud	75	17.4	86.7
	Plank	57	13.3	100.0
Lighting	Solar	2	0.5	0.5
	NEPA	197	45.8	46.3
	Generator	109	25.3	71.6
	Lantern	101	23.5	95.1
	Candle	6	1.4	96.5
	Torch	15	3.5	100.0
Cooking Material	Gas/electric	115	26.7	26.7
	Stove/kerosene	153	35.6	62.3
	Firewood	61	14.2	76.5
	Coal	101	23.5	100.0
Drinking Water Sources	Bottled water	5	1.2	1.2
	Government	95	22.1	23.3
	Borehole	181	42.1	65.4
	Sachet water	53	12.3	77.7
	Wells	96	22.3	100.0
Domestic Water Sources	Government	75	17.4	17.4
	Borehole	185	43	60.4
	Wells	70	16.3	76.7
	River/streams	100	23.3	100.0
Toilet Facilities	WC	167	38.8	38.8
	Pit	82	19.1	57.9
	Bucket	20	4.7	62.6
	Bush	56	13	75.6
	River	105	24.4	100.0

Source: Computed from Field Survey Data, 2019

From the result on home infrastructure, we see that despite their labour intense means of livelihood and rural location, the artisanal fishers have some basic housing facilities such as good flooring and building materials however, this does not apply to adequate sources of energy, improved cooking fuel and sufficiently safe water for drinking as well as feacal disposal facilities with about 62% of fishers not having access to the more sanitary WC for their toilet facilities, this is in line with the study of Osei-Amposah *et al* (2010), who in their study on marital status and household size as determinants for poverty among fishmongers in Tema Ghana, found that majority of their fisher folks (97%) had to use seashore as their toilet place. These indices are important for determining the multidimensional poverty status of individuals and households, as such; individuals lacking these facilities can be said to be suffering from multidimensional poverty.

Durable Home Goods

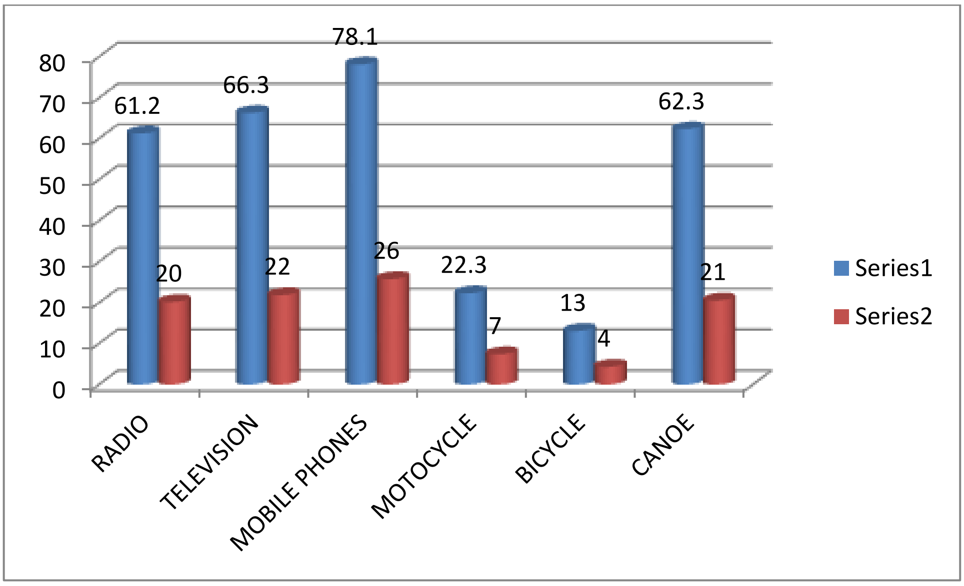

Fig 1. Durable Home Goods Ownership

Shown in figure 1 are durable home goods for the study area. In this study area, Households owned and had access to different physical assets. About 61% of the respondents owned a radio, 66.3% a television, 78%, a mobile phone 22.3% motorcycle, 13% bicycle and 62% a canoe. In general over 50% of the respondents owned a radio, television, mobile phone and canoes. From the results, more respondents had mobile phones and television; respondents indicated that television and radios where the most common medium through which information was received about their business and mobile phones were used mainly to contact their buyers when they were ready to sell their catch. Majority of the fishers had no means of transporting their catch. For instance, about 77% and 88% of the respondents had no motorcycle or bicycles respectively. However, 54% of the fisherfolks had canoes which are a necessary tool for their means of livelihood. Only 8.1% had no canoes. About 166 fishers had more than one canoe. This result that 0.5 as barely acceptable.

for ownership of canoes is expected since it is a major tool for the artisanal fishing trade. This result implies that customers and fishers have contact with each other, thus, marketing and spoilage of their catch was not a problem.

Statistical Test of Appropriateness

Table 2 shows the results for the Kaiser-Miller- Oklin (KMO) and Bartletts Test. These tests verify the statistical adequacy of the data set for Principal Component Analysis (PCA). The KMO test was calculated for individuals and it represents the ratio of the squared correlation between variables to squared partial correlation between variables. The KMO statistic range from 0 (sum of partial correlation is large relative to sum of correlation hence inappropriate for PCA) to 1 (indicating patterns of correlation are relatively compact and so PCA should yield distinct relative factors). Kaiser (1960) recommends values greater

Table 2 Test for Statistical Adequacy

KMO		0.83
Bartlett's Test of Sphericity	Chi-Square	2946.463
	Df	120
	Sig	0.000

Source: Computed from field survey data

As presented on Table 2, the study area had KMO of 0.83 which is termed a 'meritorious KMO' (Antony and Rao, 2007) or 'great KMO' (Field, 2015). Antony and Rao (2007) also classified this value 'marvelous KMO'. However, Moi and Sarsted (2011) opined that KMO values greater than 0.70 are usually considered appropriate.

Another test of strength of the relationship among variables was done using the Bartletts test of Sphericity. This test of sphericity tests the null hypothesis that the variables in the population correlation matrix are uncorrelated. From the study, the Bartletts test of sphericity χ^2 (120) = 2946.46, p>0.000 indicates that the relationship between variables were sufficiently large for PCA and significant at 1% level if significance. It can be concluded that the strength of the relationship among variables is high and the correlation matrix is not an identity matrix. An identity matrix is that which the variables correlates badly with all other variables and the coefficients are close to zero.

FACTOR EXTRACTION USING PRINCIPAL COMPONENT ANALYSIS (PCA)

Communality

Presented on Table 3, are communalities for the variables after extraction. Communality is the proportion of common variance within a variable. It looks at the variance that is accounted for by the factor solution. As a rule, the factor solution should account for at least half of each original variable's variance. In other words after extraction, the new communalities are a percentage of the variance associated with a variable that is retained that is, some part of the information are lost or not accounted for.

Before extraction, all variance are assumed to have common variance hence a communality of 1 is attached to all variables, by making this assumption; we merely transpose our original data into constituent linear components (PCA). After extraction, the emerging communalities represent multiple correlations between each variable and factors extracted

From the Table 3, the communalities in the column labeled 'extraction' reflect the common variance. From the result, for instance, for the first component we say that 75.3% of the variance associated with type of building is shared.

Table 3: Communality for the Study area

	Initial	Extraction
Type of building	1.000	0.753
Roofing material	1.000	0.503
Flooring material	1.000	0.813
Wall materials	1.000	0.768
Electricity usage	1.000	0.753
Electricity source	1.000	0.818
Cooking fuel used	1.000	0.679
Drinking water	1.000	0.746
Domestic water	1.000	0.761
Toilet facilities	1.000	0.683
Radio	1.000	0.577
Television	1.000	0.725
Mobile phones	1.000	0.651
Bicycle	1.000	0.267
Motorcycle	1.000	0.757
Canoe	1.000	0.720

Source: Computed from Field Survey Data, 2019

Explained Variance

Using Kaiser's criterion of extracting factors with Eigen value of ≥1, only five factors with Eigen value greater than one are retained in the analysis. This criterion is accurate when the communalities after extraction are greater than 0.7 or where the sample size exceeds 250 and average communality is 0.6. For this study, the average communality after extraction is 0.685 which is approximately 0.7 thus Kaiser's criterion stands. As such the factors retained after extraction was 5 for the study area.

The result of the PCA using verimax rotation shows five factors accounted for 68.59% of the total variance in the data retained for the construction of household wealth status. For the first factor, that accounts for nearly 33% of variation, type of building, flooring material and wall materials showed markedly high positive loadings. In the second factor, electricity usage and source shows high positive loadings, this accounts for 13% of variation. In the third factor, accounting for about 9% of total variation is radio, television and mobile phone ownership showed positive high loading. While in the fourth factor, drinking and domestic water sources had positive high loading but accounts for about 8% and for the fifth factor, motorcycle ownership had a high positive loading but accounts for 6% of total variation.

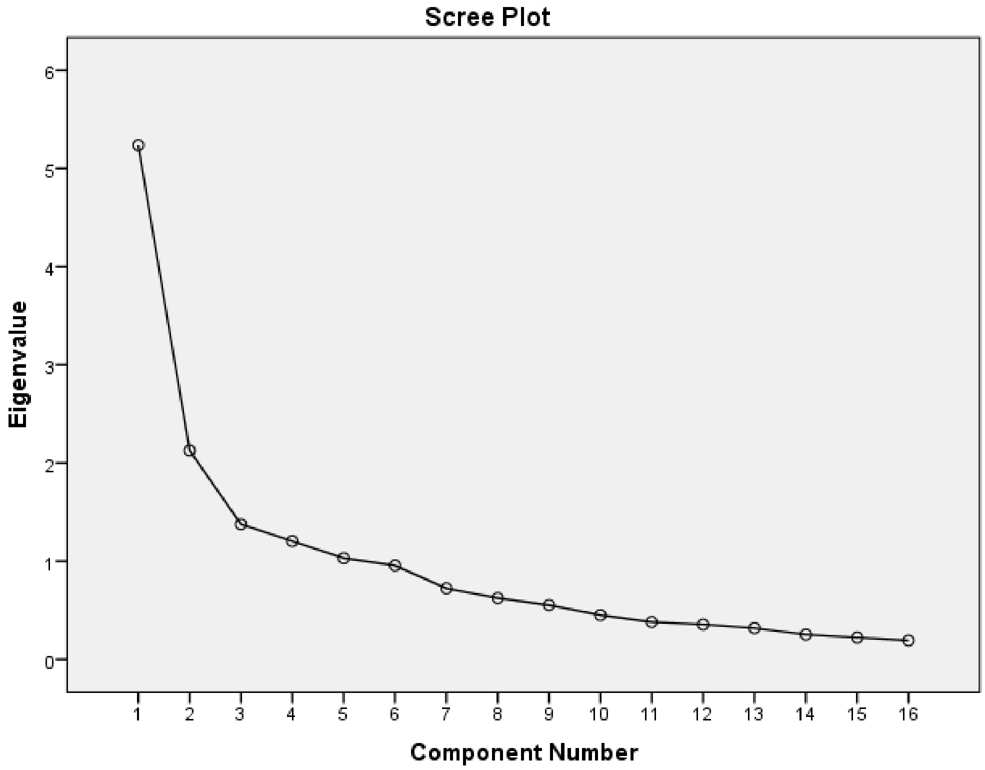

Fig 2: Scree Plot

For the study, the graphical method known as Cartell's (1966) scree test is also used. This technique as advocated by Cartell plots each of the Eigen value (Y axis) against the factors with which it is associated (X axis). By graphing the Eigen values, the relative importance of each factor becomes apparent. The point at which the tail of the graph begins to taper off is the cut of points of the factors explained. From the figure above, this is at component five on the horizontal axis where the Eigen value was 1. This study satisfies both the scree plot and Kaisers (1960) criterion retaining all factors with Eigen value greater than one as such only 5 factors were extracted.

Rotated Component Matrix

Presented on Table 5 is the rotated component matrix. This matrix shows how the values load to the components on the matrix. From these results, in determining the wealth status of artisanal fish farmers, home infrastructure (component 1) represented by type of building, flooring and wall materials contributes the highest loading value and positive influence on wealth status. This is followed by lighting infrastructure (component 2) represented by electricity usage and source. The third factor durable home assets (component 3) represented by ownership of transistor radio, television sets and mobile phones. The fourth factor is water (component 4). Availability of water to any class of individual cannot be over emphasized. This is shown in the sources of water both for drinking and domestic usage. The last important factor is means of mobility (component 5) which is shown in the ownership of motorcycles. From these results, in determining the wealth status of artisanal fish farmers, the type of building, lighting infrastructure, durable home goods/physical assets as well as means of mobility are of utmost importance. This is in line with the finding of Adade and Okungbowa (2017). Thus in times of poverty alleviation model, these factors individually and collectively will play a major role. Tefera *et al*, (2016), in their study on measuring multidimensional rural poverty using combination of methods in Southern Ethiopia, found the factors affecting wealth group to be natural resource endowment, asset holding, human capital and access to institutional support and market.

Wealth Index

The results for the wealth index are shown in table 6. The results show that wealth status indices of the sampled households were significant across the entire study area at 1% level of significance.

Table 4: Explained Variance for Delta State

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.237	32.733	32.733	5.237	32.733	32.733	3.609	22.554	22.554
2	2.127	13.295	46.029	2.127	13.295	46.029	2.479	15.496	38.050
3	1.376	8.598	54.627	1.376	8.598	54.627	2.028	12.677	50.727
4	1.205	7.529	62.155	1.205	7.529	62.155	1.629	10.184	60.912
5	1.030	6.440	68.595	1.030	6.440	68.595	1.229	7.684	68.595
6	.956	5.974	74.570						
7	.722	4.514	79.084						
8	.625	3.904	82.988						
9	.552	3.452	86.440						
10	.451	2.816	89.256						
11	.380	2.377	91.633						
12	.354	2.216	93.848						
13	.318	1.988	95.836						
14	.252	1.577	97.413						
15	.222	1.385	98.798						
16	.192	1.202	100.000						

Source: Computed from Field Survey Data, 2019

Table 5: Rotated Component Matrix

	Component				
	1	2	3	4	5
Type of building	0.***842***	0.169	-0.042	0.090	0.074
Roofing material	0.672	-0.067	0.192	0.021	-0.098
Flooring material	***0.858***	0.261	0.014	0.097	-0.001
Wall materials	***0.853***	0.130	-0.007	0.139	0.068
Electricity usage	0.196	***0.832***	0.094	0.108	0.039
Electricity source	0.192	***0.859***	0.186	0.074	0.056
Cooking fuel used	0.624	0.502	0.067	0.179	-0.021
Drinking water	0.216	0.099	0.091	***0.823***	0.056
Domestic water	0.184	0.212	0.163	***0.809***	0.036
Toilet facilities	0.603	0.486	0.032	0.273	0.090
Radio	-0.091	0.038	***0.715***	0.008	0.237
Television	0.080	0.314	***0.778***	0.121	-0.008
Mobile phone	0.139	-0.075	***0.774***	0.158	-0.038
Bicycle	0.082	0.165	0.334	-0.302	0.173
Motorcycle	0.112	0.233	0.054	0.065	***0.826***
Canoe	-0.145	-0.448	0.274	-0.032	0.650

Source: Computed from Field Survey Data, 2019

Table 6: Wealth Status Distribution in the Study Area

	Delta North		Delta South		Delta Central		State wide	
	Freq	%	Freq	%	Freq	%	Freq	%
Not well endowed	45	45.5	108	52.17	45	36.3	196	45.6
Well endowed	54	54.5	99	47.83	79	63.7	234	54.4

Source: Computed from Field Survey Data, 2019

A household was characterized as being poorly endowed if the wealth index negative and well of if it is positive. Based on the wealth index, as shown in Table 6, 45.6% of the respondents in Delta State were characterized as being poorly endowed with an index below zero. The well-of household had a wealth index of 1 as such 54.4% where well-endowed and non-poor. From the zones, Delta Central had the widest gap between the well-endowed (63.7%) and the poorly endowed (36.3%) households.

A number of livelihood indicators for the households according to the different wealth categories have been summarized in Table 5. As expected, well-endowed households own more physical assets than the poorly endowed households. This result in line with the study of Kalinda et al (2014) who in their study of characterizing maize producing household in Southern Zambia found

63% of their respondents to be well endowed with more physical assets and livestock such as ox-drawn plows and harrows, cultivators, value of livestock and others. The study of Bamire et al (2010) also found their well-endowed households to be 32% to have assets with highest impact such as ownership of cultivable farm, radio, remittances, motorcycle, television sets, mobile phones, draft animal to name a few; as against their poorly-endowed household which made up 62% of the population.

CONCLUSION AND POLICY IMPLICATIONS

This paper used PCA to create a wealth index for artisanal fishing households in Delta State. The PCA is found to be an effective alternative for poverty or well-being measurement since it avoids some of the measurement errors found in the money metric measurement of income and consumption. In line with this notion, the study found that home infrastructure, energy source, durable home assets, water availability and mobility are important determining factors for wealth of the artisanal fisher folks. Households who are better off in these five major factors are wealthier than those who less endowed in these factors. Therefore, any efforts to improve living standards of the artisanal fisher households in the study area with similar socio-economic settings should concentrate on these factors as a yardstick for assisting the vulnerable members of the State.

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