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Demographic factors and forest income inequality among proximate communities of Trial Afforestation Research Station (TARS) plantation in Kaduna State, Nigeria.

Olarotimi, N.O and Zaman, E. Y*

Trial Afforestation Research Station, Kaduna, Forestry Research Institute of Nigeria.
*Correspondence author: ezamanyuyu@gmail.com

ABSTRACT

Incomes from the sale of forest products constitute a vital part of the livelihoods of forest communities. The study was carried out to assess the interplay of demographic factors on income inequality among households proximate to the Afaka Forest Reserve in Kaduna State, Nigeria. Data were collected using structured questionnaires from four communities, from which 120 household heads were randomly sampled as respondents. Descriptive statistics, Chi-square, dependent t-tests, and Gini coefficient were used for data analysis. The results revealed that education and occupation were significantly associated ($p< 0.001$). Forest products income sources were considered under two categories – firewood and other forest products income. Firewood was most collected by respondents with adult (non-formal) education (56 percent), while Farmers constituted 93 percent of firewood collectors. The Gini coefficients for firewood, other forest products, and aggregate forest incomes were 0.16, 0.25, and 0.13 respectively. This implied that not only were most members of the community involved the collection of these products, but the income distribution across collectors had very little disparity which is a good index poverty for poverty reduction. The study recommends the establishment of community woodlots to meet the high usage of firewood in the area, and broadening the access to formal education and invariably expanding livelihoods beyond the forest resource milieu as well as reducing the pressure on the fast depleting forest cover in Nigeria.

Keywords: Demographic factors, forest income, inequality, Gini coefficient

Introduction

Communities contiguous to forests derive several benefits from such forests which could be in form of products or ecosystem services. At least 350 million people live inside or close to dense forests, largely dependent on them for subsistence and income, with about 60 million indigenous people almost wholly dependent on forests (World Bank, 2006). More than 1.6 billion people around the world depend to varying degrees on forests for their livelihoods (World Bank, 2016). The variations in forest incomes could be attributed to differences in the quantum of the resources exploited, and their market values. But it is not enough that forests provide incomes to households in communities situated close to them, the distribution of such incomes is very crucial especially against the background that inequality is a major cause of poverty (UNRISD, 2010; Idoko and Ikpeze, 2014; World Bank, 2016).

The significance of this study is therefore premised on the fact that inequality engenders and sustains poverty (which is higher in rural communities) and understanding the nature (and causes) of inequality is pivotal to the eradication of extreme poverty as targeted by the year 2030, under the Sustainable Development Goals (SDGs). The findings of this study will therefore be useful to the

management of Trial Afforestation Research Station (TARS), Afaka, Kaduna in evaluating and improving their community impact. It will also provide policy makers in the environment sector on the contribution of forest resources to incomes.

Theoretical Framework

Forests and forest dependent livelihoods

Forests are essentially large areas of land where the vegetation is predominated by trees. The forest is a: "Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use" (FAO, 2010).

Forests offer many benefits to nearby communities. They provide ecological services, sources of a wide range of plant and animal products important as food and raw materials (Sheil and Wunder, 2002; FAO, 2010). In Nigeria, households adjacent to forests commonly rely on forest products as their off-farm income sources (Jimoh *et al*., 2013; Suleiman *et al*., 2017).

Demographic decomposition of income inequality

Income inequality can be decomposed in various dimensions. Decomposition could be by income sources as offered by Shorrocks (1982) as well as by Lerman and Yitzhaki (1985). In the same manner, demographic factors such as: sex, age, household size, education, and occupation determine inequality (Haughton and Khandker, 2009; Idoko and Ikpeze, 2014; Makoudjou *et al*., 2017) and therefore constitute a basis for income inequality decomposition. This approach constitutes the traditional approach to gini analysis (Cowell and Fiorio, 2010).

Methodology

The Study Area

The study was carried out in four communities situated around the Trial Afforestation Research Station forest in Afaka, Kaduna State. The communities were Angwan-Gwari, Rigasa, Mando and Afaka. The research station is located within Igabi Local Government Area, but the Afaka Forest Reserve spreads across Igabi and Chikun Local Government Areas of Kaduna State along Kaduna – Lagos Express-way, occupying an area of about 7,093.12 hectares of land and lies between Latitudes 10° $36^{'}$ $18^{'}$ N and 10° $37^{'}$ $48^{'}$ N and Longitudes 7° $14^{'}$ $34^{'}$ E and 7° $21^{'}$ $58^{'}$ E (JICA, 1991; Otiwa, 2015; Yahaya, 2015).

Sampling Procedure

Data was collected through multistage sampling. First, six communities which were very close to the Afaka Forest Reserve were purposively selected. The second stage was the random selection of four out of the six contiguous communities. Finally, simple random sampling technique was used in selection of respondents from the four communities studied. 30 copies questionnaire were administered to each of the communities giving the total of 120 copies of the questionnaire.

Data Collection

Primary data were used for the study. These were collected using structured questionnaires. The questionnaires were designed to cover information on demographic characteristics such as age, sex, occupation. Other areas were the utilization of the forest products from the Stations' forest plantation by the host communities.

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Data Analysis

Data were analyzed using descriptive and inferential statistics. In particular, Chi-square analysis, and Gini coefficient inequality decomposition were used to measure relationship between demographic factors, and how forest income inequalities exist within and between these demographic factors.

Chi-square analysis

For this research, chi square analysis was used to measure independence or association between some demographic categorical variables.

The Chi square statistic formula proposed by Dean and Illowsky (2013) and Kirk (2008) applied in this test is given by:

$$\chi 2 = \sum_{i,j}^{k} \frac{(O_{ij}-E_{ij})^2}{E_{ij}} \qquad (1)$$

Where $\chi 2$ = Chi square statistic

k = degrees of freedom
i, j = categorical variables being tested for independence (such as education and occupation)
O_{ij} = Observed values of variables i and j;
E_{ij} = Expected values of variables i and j.

Gini coefficient

The Gini index (which is associated with the Lorenz Curve) measures the spread or inequality of a distribution. It has been widely used for analysis of income and wealth across individuals or households (Fisher, 2004). It is a ratio with values between 0 and 1. The Gini coefficient was used in this study to evaluate forest incomes from firewood and other products on income inequality in the study area using the Gini coefficient model proposed by Lerman and Yitzhaki (1985) and adopted by Idoko and Ikpeze (2014).

This is given by:

$$G_k = 2\frac{COV[Y_k, F(Y_k)]}{\mu_k} \qquad (2)$$

Where; G_k = the forest products income of the household (i.e. firewood and other forest products income sources)
F (Y_k) = the cumulative distribution of income source k, and
μ_K = mean household income.

Results and Discussion

The findings of this study are discussed as follows:

Demographic characteristics of respondents

These characteristics are summarized in Table 1. The sex distribution of the respondents who were household heads showed that 91percent were males. This may be explained by the fact that many rural households are male-headed, and men do not welcome male extension workers interacting with their wives as asserted by Ozo-Eson (2000). The age bracket of 40-49 years was the highest, followed by 39-40 years constituting 43percent and 41 percent, respectively, making a cumulative percent of 81% of the sample. This was even higher but in tandem with the findings of Anamayi *et al.* (2005) who found out that 70% of the collectors of *Parkia biglobosa* around the Afaka axis were within the age range of 31 – 50 years, implying that forest related activities just like agriculture was dominated by able-bodied men and women.

Table 1: Demographic characteristics of respondents

Variables	Frequency	Percent
Sex		
Female	8	8.60
Male	85	91.40
Total	93	100.00
Age (years)		
20-29	8	8.60
30-39	38	40.86
40-49	40	43.01
= 50	7	7.53
Total	**93**	**100.00**
Marital Status		
Single	10	10.75
Married	68	73.12
Widowed	15	16.13
Total	**93**	**100.00**
Educational Level		
Primary	15	16.13
Secondary	20	21.51
Tertiary	10	10.75
Adult education	48	51.61
Total	**93**	**100.00**
Primary Occupation		
Farming	85	91.40
Trading	3	3.23
Civil-servant	3	3.23
Artisan	2	2.15
Total	**93**	**100.00**
Residency (years)		
1-5	8	8.60
6-10	23	24.73
11-15	56	60.22
>15	6	6.45
Total	**93**	**100.00**

Source: Survey data (2006).

Forest Products Incomes

Forest products are important to the livelihood of forest communities by providing subsistence, and cash income from forest products which contribute to a large proportion of their economy. The study analyzed these products under two categories, wood and other forest products. In Table 2, a comparison is made between wood income and incomes from other products using paired t-test. This was not found to be different statistically ($p<0.05$).

Table 2: Difference in wood and other forest products' incomes

Variable	Observation	Mean	Std Error (SE)	Std. Dev,	t	p>[t]
Wood income	80	703.75	22.0359	197.0952	-1.6098	0.1114*
Other forest income	80	789.38	41.5645	371.7640		
Difference		-85.625	53.1909	475.7535		

Note: * not significant @ 5%
Source: Field survey (2006).

Relationship between Demographic factors and Forest Incomes

The average weekly income categories of the respondents were determined for firewood which formed the basis of comparison with demographic factors namely, education and occupation. However, it is important to note that there was a significant relationship (p< 0.001) between education and primary occupation in the study area (Table 3). The results revealed that the preponderance of the respondents who were involved in firewood collection had adult education (74). This is in harmony with the *a priori* assumption that education determines occupational choice and access to jobs (Dabla-Noris *et al*., 2015).

Table 3. Relationship between education and primary occupation.

Education	Primary Occupation (Frequency)				
	Farming	**Trading**	**Civil servant**	**Artisan**	**Total**
Primary	9	0	0	4	9
Secondary	16	2	0	0	18
Tertiary	6	0	2	0	8
Adult(non-formal)	43	0	0	2	45
Total	**74**	**2**	**2**	**2**	**80**

Pearson chi^2 (9) = 26.8348 Pr = 0.001 (significant @ 1%)
Source: Survey data (2006)

Although, the relationship between education and income categories for firewood (Table 4), was not statistically significant, it is important to note that those with non-formal education were more in number (45, representing 56 percent). This may not be unconnected with the fact that most of them were farmers. The finding was in harmony with *a priori* expectation that the lower the education the fewer the job opportunities outside the traditional farming occupation and forest products gathering activities (Kabubo-Mariara, 2008). But 31of those with non-formal education (representing 69 percent) had weekly average income from firewood ranging from ₦400 to ₦700

Table 4. Association of education with firewood income categories

Firewood mean income/week (₦)	Educational Level (Frequency)				
	Primary	**Secondary**	**Tertiary**	**Non-Formal Education**	**Total**
400	0	3	0	7	10
500	0	1	1	10	12
600	1	2	1	6	10
700	1	4	2	8	15

800	3	4	0	4	11
900	3	1	1	5	10
1000	1	3	3	5	12
Total	**9**	**18**	**8**	**45**	**80**

Pearson chi^2 (18) = 19.8714 Pr = 0.340 (not significant @ 5%)

Source: Survey data (2006).

Farming with highest the frequency (13) was the primary occupation with the highest participation in firewood collection (Table 5) for those with mean weekly income category of ₦700.00. Most (74 out of 80) of the respondents collecting firewood were farmers representing 92 percent is in tandem with the findings of most studies which have shown that majority of forest communities are farmers (Shackleton and Shackleton, 2004; Malleson *et al*., 2014; Roland and Oyelana, 2014).

Table 5. Association of primary occupation with firewood collection income categories.

Firewood mean income/week (₦)	Primary Occupation (Frequency)				
	Farming	**Trading**	**Civil-servant**	**Artisan**	**Total**
400	9	1	0	0	10
500	12	0	0	0	12
600	9	1	0	0	10
700	13	0	1	1	15
800	10	0	0	1	11
900	10	0	0	0	10
1000	11	0	1	0	12
Total	**74**	**2**	**2**	**2**	**80**

Pearson chi^2 (18) = 14.5094 Pr = 0.695 **(**not significant @ 5%)

Source: Survey data (2006)

Inequality in Forest Incomes

The distribution of forest income is not uniform on the aggregate even among the component income sources. The income share of firewood income alone in total forest income in the study area was found to be 45 percent (Table 6) while the other forest incomes made up the remaining 55 percent. However the gini index of firewood was lower (0.16) as against that of other forest incomes (0.25), implying that incomes from firewood were better in reducing inequality and invariably poverty than other forest incomes combined. The overall gini index for forest income was 0.13 which was much lower that the forest income Gini index of 0.718, reported by Fonta *et al.* (2010) in their study in South Eastern Nigeria. The relatively lower index for firewood may be explained by the fact that firewood prices was almost uniform in the area and all the respondents who collected forest products also collected firewood.

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Table 6. Decomposition of the Gini index of all forest incomes by major income sources

Sources	Income Share (S_K)	Gini Corr. (R_K)	Gini Index (G_K)	Absolute contribution ($S_k*R_k*G_k$)	Relative Contribution ($S_k*R_k*G_k/G$)
Firewood income	0.4535	0.3464	0.1563	0.0245	0.1825
Other products	0.5465	0.7920	0.2540	0.1099	0.8175
Total	**1.0000**	**-**	**-**	**0.1345**	**1.0000**

Source: Survey data (2006).

The Lorenz curves (Figure 1) further corroborate the relatively higher inequality from other forest products income as indicated by the lower curve, which is farther away from the straight line (which designates the benchmark for perfectly equal income distribution).

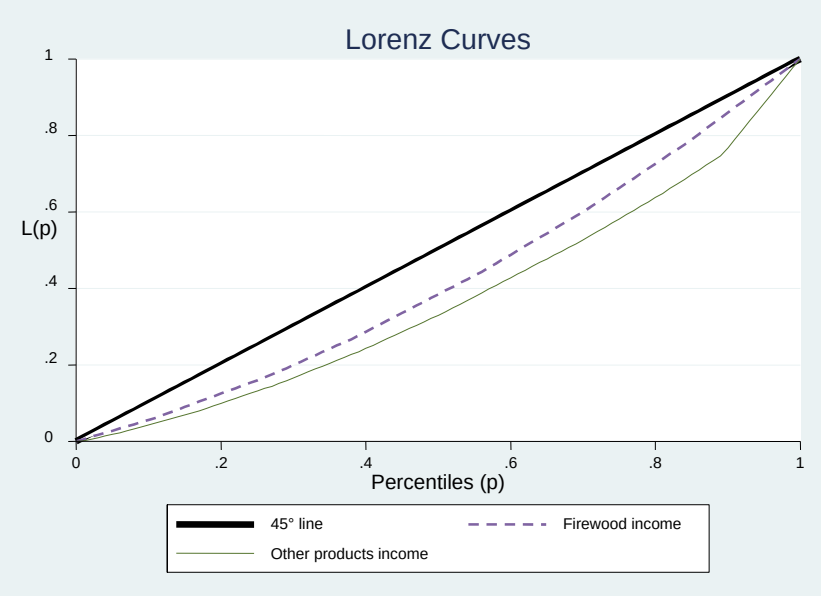

Figure1. Lorenz curve of forest income.
Source: Survey data (2006).

Conclusion

Forest incomes are an essential aspect of the benefits derived by people living proximate to forests such as the Afaka Forest plantation by serving as safety nets and gap-fillers (complementing other incomes sources, especially farming). But the distribution of these incomes is hardly equal as the interplay of demographic factors was found in this study to be very crucial on both component and aggregate income sources. The Gini indices were low, for both individual and

aggregate income sources, meaning that forest incomes were relatively fairly distributed. Most of the respondents had adult (non-formal) education which restricted their livelihood options. This calls for broadening the access to formal education and invariably expanding livelihoods beyond the forest resource milieu so as to reduce the increasing pressure on the fast depleting forest cover in Nigeria.

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