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ANALYSIS OF AGROFORESTRY PRACTICES ENGAGED BY RURAL FARMERS IN EBONYI STATE, NIGERIA

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ABSTRACT

The study analyzed the effects of agroforestry practices engaged by rural farmers in Ebonyi State, Nigeria. Agroforestry practices have the potentials to improve environmental and socio-economic welfare of the farmers. Hence, this study specifically described the socio-economic characteristics of the rural farmers; ascertained the rural farmers' perception of agroforestry practices; ascertained the agroforestry practices engaged in by the rural farmers. The hypothesis tested is; the socioeconomic characteristics of the rural farmers do not significantly influence their agroforestry practices. Multistage sampling technique was used in the selection of agroforestry farmers. A total of 351 farmers were sampled using structured questionnaire. Data obtained were analyzed using descriptive and inferential statistics. The result revealed that 68.7% of the farmers were males. The mean age was 48.5years. Majority (72.4%) were married, having an average household size of 5 persons. On education of the farmers, 91.5% of them received formal education, with an average farm size of 1.2ha and average monthly income of N67,523. Majority (71.5%) were members of social organization, with 89.5% having access to extension service, while 62.1% and 34.2% accessed agroforestry information from Ebonyi State Agricultural Development Programme and Agrodealers respectively. Increased farm productivity ($\bar{X}$ = 3.6), and increased household income ($\bar{X}$ = 3.5), amongst others, were the dominant perceptions of respondents on agroforestry practices used, while taungya farming (76.9%) and home garden (72.1%) were the dominant agroforestry systems practiced. The regression result showed that the coefficients for education, household size, farm size, monthly income and extension contact were the socio-economic characteristics that influenced agroforestry practices. There were many types of agroforestry practices for the farmers and their socio-economic characteristics significantly influenced the practices. The study recommended the improvement of farmers' education and extension service delivery which in turn enhances agroforestry practices in the study area.

KEYWORDS

agroforestry, practices engaged, rural farmers, Ebonyi State.

Introduction

Agro-forestry is among the ancient land-use farming practices around the world. It has been estimated to exist for more than 1,300 years (Brookfield and Padoch, 1994), with over 1.2 billion people practicing it world-wide (Zomer, R. J., Coe, R., and Place, F., 2009). Agro-forestry is becoming more popular, especially in sub-Saharan Africa, regarding its contributions to climate change adaptation (Nenova and Behrend, 2016). Basically, agro-forestry allows farmers to produce several products in the same unit of land, in an integrated manner to address a broader array of demand. There are different definitions of agroforestry. However, they agree on certain essential features. For example, the presence of at least one woody perennial component, and at least one annual crop or animal component which are deliberately managed or cultivated (De-Baets, N., Gariepy, S., and Vezina, A., 2007). These systems generate more than one output with interactions existing among the components.
The World Agroforestry Centre defined agroforestry as an ecologically-based natural resource management system that integrates trees (for fibre, food and energy) with crop/ or animal on farms, with the aim of diversifying and sustaining income and production, while maintaining ecosystem service (International Centre for Research in Agroforestry [ICRAF], 2000). De Baets*et al.* (2007) defined agroforestry as an integrated system of rural land resources management, based on combining shrubs and trees with crops and/or livestock whose interactions generate economic, environmental and social benefits.

Agroforestry systems and practices vary widely depending on the available resources, management, purpose, as well as the social, economic, cultural attributes of an individual, family or group. Agroforestry practices in Nigeria can be broadly classified into farm-based and forest-based practices. Farm- based practices deal with tree planting on and around agricultural fields, tree wood lots (a cluster of trees) and commercial crop under shade trees of food crops, inter-planted with commercial trees (Olajide, 2003). The forest-based practices involve specific agricultural practices associated with forests where farmers collect food, fruits and gums (Oni, 2015). De Baets*et al.* (2007) classified agroforestry systems into three types based on their component compositions, namely; Agrisilvo culture (Crop and trees), Silvo-pastural (Pasture, animal and trees), Agrisilvo-Pastoral (Crop, pasture and trees). On the varieties of agroforestry systems practiced in Nigeria, Amonum*et al.* (2015) listed them to include; Taungya farming, Integrated taungya, Alley cropping, Alley farming, Wind breaks, and Home gardens.

De Baets*et al.* (2007) reported that a variety of agroforestry systems are being used around the world. They are complex and diverse, existing in different places and need to be classified into different categories in order to evaluate them and develop some action plans for their improvement. These systems were thus classified into system's structure (composition and arrangement of components), functions, socio-economic scale of management and ecological spread. However, there are only three basic sets of components that are managed in every agroforestry system namely – woody perennials (usually referred to as trees), herbaceous plants or crops and animals. According to Nair (1991), a logical step is to classify agroforestry based on their component composition. Thus, there are three basic types of agroforestry systems which are:

1. Agrisilvi culture (crop and trees)

2. Silvo pastoral (pasture/animal + trees)

3. Agrisilvo pastoral (crop + pasture + trees)

Other specified agroforestry types can also be defined as e.g. apiculture (bees with trees), aquaculture (fishes with trees and shrubs).

It therefore becomes necessary to:

- describe the socio-economic characteristics of the rural farmers in the study area;
- ascertain the rural farmers` perception about agroforestry; and
- ascertain the agroforestry practices engaged in by the rural farmers;

The hypothesis of the study

The study hypothesized that the socioeconomic characteristics of the rural farmers do not significantly influence their agroforestry practices.

Methodology

This study was conducted in Ebonyi State, Nigeria. It lies within longitudes 7º30'E and 8º 30'E and latitudes 5º 40'N and 6º 45'N (Nigerian Metrological Agency; NIMET 2017). The State has a population of about 4,339,136 people, and a land area of about 6,400 kilometer square (National Population Commission (NPC), 2006; National Bureau of Statistics (NBS 2016).
The state enjoys luxuriant vegetation with high forest zone (rain forest) in the south and sub-savannah forest in the northern fringe (https://www.cometonigeria.com/region/south-east/ebonyi-state/). Farming is the predominant occupation of the people of Ebonyi State.

The population of the study comprised all farmers that practice agroforestry in Ebonyi State, Nigeria. Multi-stage sampling technique was used for the selection of the farmers. The first stage involved purposive selection of the three agricultural zones to achieve a well representative sample.

In the second stage, three Local government Areas (LGAs) from each of the zones, namely; Ezza South, Ezza North and Ikwo (Ebonyi Central), Ohaukwu, Izzi and Ebonyi (Ebonyi North), Afikpo North, Ohaozara and Afikpo South (Ebonyi South) were purposively selected based on the dominance of agroforestry practice in the LGAs and their representation of the three agricultural zones. The third stage involved the selection of two (2) communities from each of the selected LGAs, using purposive sampling technique to give a total of eighteen (18) communities. At the community level, the community heads provided list of households practicing agroforestry in the area. The list from the various community heads was merged to form the sampling frame of 630. From the list, 20 households practicing agroforestry were selected from each of the eighteen communities using simple random sampling technique to give the sample size. In all, a total of 360 agroforestry farmers were used as the sample size for the study.

Data for the study was generated from primary source. This was achieved with the aid of a structured questionnaire, and complemented by Focus Group Discussion (FGD).

Descriptive and inferential statistical tools were used to analyse data for the study. Specifically, the objectives were achieved using frequency count, percentages and Likert-type rating scale.

The null hypothesis (H_0) was tested using multiple regression model analysis which is implicitly expressed as follows:
$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, e)$
Where:
Y = Agroforestry practices engaged in by the farmers (total number).
X_1 = Age (Years)

X_2 = Sex (Dummy; male = 1, Female = 0)

X_3 = Level of education (No. of years spent in school)

X_4 = Farming size (Hectares)

X_5 = Marital status (Dummy: Married = 1 otherwise = 0)

X_6 = Monthly income (Naira)

X_7 = Household Size (Number of persons)

X_8 = Extension contact (Dummy; Yes = 1 otherwise = 0)

X_9 = Membership of social organizations (Dummy; Yes = 1 otherwise = 0)

e = error term.

RESULTS AND DISCUSSION

Socio-economic characteristics of the rural farmers

The socio-economic characteristic of the rural farmers is presented in Table 1.

The distribution of the farmers according to age in Table 1 indicated that the mean age was 48.5 years. This implies that the farmers were young adults and were likely to be active in agroforestry practices. This result agrees with Ugwoke*et al.* (2005) who found that young farmers are more likely to increase agricultural productivity.

The sex distribution shows that 68.7% of the farmers were males and the remaining (31.3%) were females. This suggests that agroforestry practices in the study area were gender sensitive. The dominance of male farmers could be linked to socio-cultural factors that give men higher access to natural resources such as land than their female counterparts. This result is consistent with the findings of Kipot and Franzel (2011) who reported gender disparity in participation in agroforestry.

The distribution by marital status shows that majority (72.4%) of the farmers were married. This implies that these farmers have family responsibilities which agroforestry produce had helped to carry. Also, labour requirement of the practice could be met by pool of family labour force. This result is in agreement with the findings of Oluwasegun (2013) who opined that married farmers support their spouses in farming, thus enhancing the sharing of agricultural information and provision of labour.

As regards to education majority (91.5%) of the farmers received one form of formal education or the other but much of them (39.3%) received secondary education. The implication is that the farmers were educated and could incorporate modern techniques of agroforestry practices for more benefits. This result corroborates the findings of Gasperini (2000) who reported that a World Bank survey on the relationship between education and agricultural efficiency found out that educated farmers were more productive than their uneducated counterparts.

The distribution according to household size revealed that majority (67.5%) of the farmers had a household size of 4 – 6 persons. The average household size of the farmers was found to be 5 persons. This implies that the farmers had relatively large households. The implication is that it connotes more responsibility to the head of household. Anigbogu*et al.* (2015) noted in agreement with the result of this study that a large household size would increase the dependency ratio of the farmers.

The result further shows that the mean farm size was 1.2 ha. This suggests that the respondents were smallholder farmers who need to expand their farms for efficient performance. The implication of small farm size is that farmers might limit their scale of practicing agroforestry systems in the study area. This result is in line with FAO (2018) which found that Nigeria farmers own 0.5 hectares of farm size on the average.

The distribution by membership of social organization shows that majority (71.5%) of the farmers were registered members of social organizations such as farmers' cooperative society. The implication of being member of a joint group for production could be beneficial in providing financial help in form of credit and knowing more about new technologies in agroforestry practices needed for their operation. This result agrees with Ojiagu and Uchenna (2015) who found that membership of cooperative societies improved members' income, increased members' agricultural profitability and access to credit and inputs.

The result revealed that the average monthly income was ₦67, 523. This implies that the farmers were moderate income earners which need to be increased by increase hectarage and other farm production activities. The

implication of earning moderate income is that it could limit the farmers' ability to invest and diversify in agroforestry practices.

The distribution of the farmers according to their access to extension service shows that majority (89.4%) of the farmers had access to extension service but at varying degrees. The implication of this result is that many of the farmers were denied knowledge of modern techniques of agroforestry practices, which in turn would manifest in their low performance.

Result revealed that the farmers accessed information on agroforestry practices from multiple sources. However, the majority (62.1%) of them obtained their information through Ebonyi State Agricultural Development Programme (EADP). It could, however, be drawn from the result that the farmers never relied on only one source of obtaining production information for agroforestry.

Table 1: The socioeconomic characteristics of the rural farmers

VARIABLES	FREQUENCY (F)	PERCENTAGE (%)	MEAN
Age (Years)			
41-50	125	35.6	48.5
51-60	74	21.0	
Sex			
Male	241	68.7	
Female	110	31.3	
Marital Status			
Married	254	72.4	
Single	66	18.8	
Educational Qualifications			
Non-formal education	30	8.5	
Primary	88	25.1	
Secondary	138	39.3	91.5
Tertiary	95	27.1	
Household size			
4-6	237	67.5	
7-9	47	13.4	5 persons
Farm size (Ha)			
<1.0	96	27.3	
1.0	141	40.2	1.2 ha
≥ 1.5	114	32.5	
Membership of social organization			
Member	251	71.5	
Non-member	100	28.5	
Monthly Income			
61,000 – 80,000	160	45.6	N67.523
121,000 – 140,000	20	5.7	
Access to extension service			
Frequently	32	9.1	
Occasionally	170	48.4	
Rarely	112	31.9	
Never	37	10.6	
Sources of agroforestry information			
EADP	218	62.3	
Agro-dealers	120	34.2	
Farmers group	114	32.5	

Friends	91	25.9
Neighbours	84	23.9

***Source**: Field Survey Data, 2020*

Farmers' perception about agroforestry

Table 2 shows that all the statements on agroforestry practices were perceived to be true (agree) by the farmers. They agreed that agroforestry Increased farm productivity ($\bar{X}$ = 3.6), Increased household income ($\bar{X}$ = 3.5), has high financial returns ($\bar{X}$ = 3.5), encourages the utilization of unproductive land ($\bar{X}$ = 3.4) and Provision of fodder for livestock ($\bar{X}$ = 3.4). The grand mean ($\bar{X}$)of the distribution was found to be 3.3 indicating that the farmers agreed with all the statements provided. This implies that the farmers slightly varied in their perception of agroforestry practices. This is consistent with Oladele and Fawole (2007) who reported that farmers in Nigeria differed in their perceptions of agroforestry practices.

During the Focus Group Discussion (FGD) with selected farmers' cooperative society members, many of them had diversity of perception towards agroforestry. However, their perception revolved around positive and negative feelings about the practice. Response on the positive perception by some of the farmers was noted as follows;

"Agroforestry has really benefited us in terms of high productivity, income, sufficient food and our general welfare enhancement".

But most still on the negative perception responded that;

"It is good to mention that agroforestry practices is difficult to practice as it requires both high capital and technical know-how, which most of us may not have".

Table 2: Distribution of farmers according to their perception on agroforestry practices

Perception statement	**S.A**	**A**	**D**	**S.D**	**Total**	**Mean ($\bar{X}$)**	**Rank**
Increase farm productivity	265	61	5	20	351	3.6*	Accept
Increase household income	193	150	0	8	351	3.5*	Accept
High cost of establishment/difficult to practice	160	136	23	32	351	3.2*	Accept
Has high financial returns	218	108	10	15	351	3.5*	Accept
Encourages the utilization of unproductive land	205	100	31	15	351	3.4*	Accept
Encourages self-sufficiency in forest management	149	165	10	27	351	3.2*	Accept
Trees suppress weed growth	160	122	18	51	351	3.1*	Accept
Trees conserve soil fertility and moisture	158	15	141	37	351	2.8*	Accept
Trees protect crops from wind	170	121	40	20	351	3.3*	Accept
Trees compete with crops for nutrient	210	90	10	41	351	3.3*	Accept
Agroforestry promotes food security	185	56	100	10	351	3.2*	Accept
Agroforestry provides construction materials	150	178	13	10	351	3.3*	Accept
Agroforestry provides fuel woods	201	100	10	40	351	3.3*	Accept
Agroforestry provides fodder for livestock	220	80	24	27	351	3.4*	Accept
Total	**2644**	**1482**	**435**	**353**	**4914**	**3.3**	**Accept**

Discriminating index $\bar{X}$ = 2.5; Grand $\bar{X}$ = 3.3* Perceived statements; S.A: Strongly Agreed, A: Agreed, D: Disagreed, S.D: Strongly Disagreed

***Source**: Field Survey Data, 2020*

Agroforestry systems practiced by the farmers

Table 3 result revealed that the farmers practiced diverse agroforestry systems. The dominant systems practiced included taungya farming (76.9%), which involves production of combination of food crops and trees, home garden (72.1%) which involves the combination of trees, arable crops and rearing of animals, alley farming (59.0%) which involves the combination of hedge row cropping and forage crop, and alley cropping (54.7%) which involves arable intercropping between tree crops. However, the least preferred system was apiculture (19.9%) which involves production of bees for honey. The result implies that the farmers practiced diverse agroforestry systems.

The implication of the farmers' practice of diverse agroforestry systems is as a result of their perceived benefits and suitability to the farmers' environment. Also, the practice of several agroforestry systems by the farmers might be due to the various purposes agroforestry serves. This result conforms with the findings of Mbow*et al.* (2013) who reported that many smallholder farmers in Africa practiced several agroforestry systems, in spite of the various attempts to perpetuate monoculture.
Further, different agroforestry practices can be relevant for different agro-ecological zones, and many systems with a range of different compositions can be fulfilled on landscapes. The findings of Amonum*et al*. (2015) that agroforestry makes little use of resources and offers numerous benefits corroborates this finding. They reported that many agroforestry systems are practiced in Nigeria and the common ones included; taungya farming, integrated tuangya, home garden, alley cropping and alley farming.

Table 3: Distribution of farmers according to agroforestry systems practiced

Agroforestry systems practiced	Frequency* (f)	Percentage (%)	Ranking
Taungya farming (food crops with trees)	270	76.9	1st
Home garden (trees/crops/animals)	253	72.1	2nd
Alley farming (hedgerow intercropped with forage crop)	207	59.0	3rd
Alley cropping (arable intercrop between trees)	192	54.7	4th
Windbreaks (protection of farmlands with trees)	185	52.7	5th
Integrated taungya farming (arable food crops interplanted with trees at onset)	105	29.9	6th
Aquaforestry (aquaculture)	88	25.1	7th
Apiculture (bees for honey)	70	19.9	8th

***Multiple responses recorded**
***Source**: Field Survey Data, 2020*

Influence of socio-economic characteristics on agroforestry practices of the farmers.

Table 4 showed the results of analysis of the influence of socio-economic characteristics of the agroforestry farmers to their practice of agroforestry. Four functional forms of the Ordinary Least Square multiple regression model ((Linear, semi-log, double log and exponential forms) were tried and the results showed that the double-log was the lead function because it had the highest R^2 value of 0.509, highest F-value of 33.44 and highest number of significant variables. The F-ratio is significant at 1% level of probability, indicating the overall significance of the model. The empirical result is consistent with the theoretical postulations of the model. The coefficient of multiple determination of 0.509 indicates that about 51% of the variation in the practices of agroforestry was explained by the joint action of the explanatory variable in the model. This clearly showed that the model is reliable and has predictive ability.

The coefficients for educational qualification (X_4; t = 4.877), farm size (X_6; t = 4.34), monthly income (X_8; t = 3.415) and extension contact (X_9; t = 10.02) were statistically significant at 1% level, while household size (X_5; t= 2.17) was significant at 5% level. Being statistically significant shows that they influenced agroforestry

practices. All the variables of the model except membership of social organization had positive sign. This implies that they were positively related to agroforestry practices. Increases in some of them increased practice of agroforestry.

The coefficient for education was significant and has positive relationship with the practice of agroforestry. This implies that the more educated the farmers are the more likely they are to practice agroforestry. This result strongly aligned with the findings of Kinyili*et al*. (2020) who reported that in arid and semi-arid sub-Saharan Africa, agroforestry practices were better adopted and practiced by farmers who received formal education.

The coefficient for farm size also has a positive significant relationship with the practice of agroforestry. This suggests that the larger the farm size, the more likely the farmers are to practice agroforestry. Large farm size enables farmers to enjoy economies of scale. The finding of Mugi-Ngenga*et al.,* (2016) showed that scarcity of land was the main limiting factor in the adoption of agroforestry practices in Eastern Kenya, and this corroborates with the result.

The coefficient for monthly income was also found to be significant and positively related with the practice of agroforestry. This indicates that farmers with higher income were more likely to practice agroforestry probably because they can afford the cost of labour, inputs and implements. In support of this result, Adnan *et al*. (2014) found that in Swat, Pakistan, farmers with higher income practiced agroforestry more than those with lower level of income.

Extension contact is necessary in the practice of agroforestry technologies as it brings the techniques to the farmers and equips them with the necessary skills. This result aligned with the findings of Linger *et al*. (2011) that extension service significantly increased the usage of improved agroforestry technologies in Sub-Saharan African.

Table 4: Regression result of the socio-economic characteristics influencing the agroforestry practices of the rural farmers in four functional forms.

Variable	Linear	Exponential	Semilog	Double log+
Constant	1.904 (5.084)***	0.675 (10.511)***	- 6.071 (- 2.95)**	- 0.868 (- 1.910)
Age (X_1)	0.002 (0.458)	0.002 (1.93)*	0.172 (0.839)	0.056 (1.230)
Sex(X_2)	0.153 (1.287)	0.029 (1.402)	0.321 (1.395)	0.074 (1.452)
Marital status (X_3)	0.343 (2.66)**	0.028 (1.202)	0.182 (0.705)	0.044 (0.763)
Education (X_4)	0.065 (5.009)***	0.012 (5.12)***	0.467 (4.53) ***	0.111 (4.877)***
Household size (X_5)	0.012 (0.849)	0.003 (1.022)	0.371 (2.55)**	0.070 (2.17)**
Farm size (X_6)	0.373 (2.916)**	0.121 (4.39)***	0.595 (4.218)***	0.136 (4.34) ***
Membership of social organization (X_7)	-.0.117 (- 0. 953)	- 0.027 (- 1.222)	- 0.293 (- 1. 211)	-0.069 (- 1.282)
Monthly income (X_8)	0.009 (3.211)***	0.00015 (2.863)**	0.632 (3.56)***	0.134 (3.415)***

Extension contact (X_9)	0.177 (2.25)**	0.127 (10.13)***	1.206 (9.99)***	0.268 (10.02)***
R^2(R-adjusted)	0.223	0.509	0.502	0.509
F-ratio	9.269***	33.39***	32.43***	33.44***

*** Significant at 1; ** Significant at 5%; Values in parenthesis are t-value; Double log (+) = Lead equation
***Source**: Field Survey Data, 2020*

Conclusion and recommendations

There were many types of agroforestry practices for the farmers and their socio-economic characteristics significantly influenced the practices. Their characteristics were also positively related to the practice of agroforestry. The socioeconomic factors with positive and significant influence on the practice of agroforestry were educational attainment, household size, farm size, monthly income, and extension contact.

Farmers education and extension service delivery in agroforestry practices should be significantly improved since it has been found to have positive and significant impact on the practice of agroforestry.

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