

ANALYSIS OF FARM PRODUCTIVITY IN INTEGRATED TREE CROPPING SYSTEMS OF SOUTHWESTERN NIGERIA.

ABSTRACT

After 1971 seasons, Cocoa and other tree crops production have declined substantially in recent times owing to several agricultural complex constraints which have affected the morals of the farmers and the sustainability of agricultural production. Productivity is the main determinant of sustainable agricultural production. Thus, this study investigates the farm productivity in integrated tree cropping system in Southwestern Nigeria. A multistage sampling procedure was used to elicit information from 250 farmers. Data were analysed with the use of descriptive statistics, total factor productivity and multiple regression model. Descriptive statistics revealed that the farmers have organized social groups with average age of 50.18($\pm$ 13.50) in Lagbedu, 51.52($\pm$ 11.72) in Iwara, 52.58($\pm$ 13.75) in Osunwoyin, and 55.12($\pm$ 15.56) in Akindele. Farmers' experience in farming (in years) was 26.48($\pm$ 13.4) in Lagbedu, 29.54($\pm$ 15.79) in Akindele, 29.9 ($\pm$ 14.41) in Iwara, and 30.3($\pm$ 16.15) in Osunwoyin. An average household size (in ha) was 9.04($\pm$ 4.38) in Osunwoyin, 9.26($\pm$ 6.33) in Lagbedu, 10.12 ($\pm$ 5.21) in Iwara, and 10.34($\pm$ 5.97) in Akindele. Majority of the household cultivate cocoa in the study area. Majority of the respondents identified inadequate funds, land issues, non-availability of agro-inputs, pests and diseases infestation as major constraint to production. The average productivity level was 0.61kg/₦ in the study area. The determinants of farm productivity in the study area were farm size ($p < 0.1$), improved varieties ($p < 0.01$), hired labour ($p < 0.01$), fertilizers ($p < 0.01$) and extension visit ($p < 0.05$). In accordance with the findings of the study, intensive teaching programmes on the use and advantage of improved seed varieties and fertilizer by virile extension services should be encouraged as well as providing input as form of credit.

KEYWORDS: Productivity, Cropping System, Crop Combination

INTRODUCTION

The traditional agricultural cropping system of forest zone of southwestern Nigeria are based on growing crops in mixtures, a system most commonly referred to as mixed cropping (Osiru, 1982). The system has long been recognized as a common practice among subsistence small-scale farmers in the traditional semi-intensive system of the tropics characterized by low-input, small land size (Amujoyegbe, 2012), lack sufficient capital with plentiful labour (Hildebrand, 1976; Vandermeer, 1992 and Ntare, 1989).

Comment [AL1]: ?

Comment [AL2]: ?

35 Crop combination are of several permanent tree crops, (cocoa (*Theobroma cacao*), oil palm
36 (*Elaeis guineensis*), Kola nut, walnut as well as plantain/banana, arable farmland located around
37 the vicinity of the homestead or at another farm location. In recent time, arable-permanent crops
38 in mixture is mostly being preferred in the forest zone. The concept of mix cropping according to
39 Willey (1979) is to bring together, crops with different maturity time, architecture, nutrient
40 requirement etc into a mixture at the same time, under the same management for maximum
41 utilization of nature for the benefit of man.

42 Despite the importance of intercropping permanent crops with other category of crops, cocoa
43 production, a major cash crop in southwestern Nigeria have been observed to decline
44 substantially in recent times owing to several agricultural complex constraints which have
45 affected the morals of the farmers. The need to carry out an on-farm survey to identify the
46 constraints and determine the farm productivity with its determinants becomes imperative in
47 order to suggest likely improvement strategy that could improve productivity in tree cropping
48 system in Southwestern. Consequently, this study investigates farm productivity in integrated
49 tree cropping systems of Southwestern Nigeria. Specifically, it describes the socio-economic
50 characteristics of farmers; identifies the types of crops grown; identifies the constraints to
51 production in integrated tree cropping system; and determines the levels of farm productivity and
52 determinants of farm productivity.

53 MATERIAL AND METHODOLOGY

54 A multi-stage sampling approach was used to select farmers in the process of surveying the on-
55 farm productivity and constraints that have been inimical to improving tree crops production
56 among small holder farmers. Two states were purposively selected from the southwestern

Comment [AL3]: Methodology is the systematic, theoretical analysis of the methods applied to a field of study.

57 Nigeria where integrated tree cropping system is practiced. A total of five local governments and
 58 subsequently five growing communities were purposively selected from each of the states based
 59 on integrated tree cropping system practiced in the area. Five farmers were randomly selected
 60 from each of the communities to have a total of 250 smallholder farmers.

61 **Analytical Technique**

62 63 **Descriptive Statistics**

64 Descriptive statistics was used to describe the socioeconomic characteristics of farmers, identify
 65 the types of crops grown and constraints to production in integrated tree cropping system.

66 **Total Factor Productivity**

67 Production requires combination of inputs. This consequently reflects in productivity.
 68 Productivity measures the rate of technical change in production (Chambers, 1988). Productivity
 69 is the ratio of the value of total farm output to the value of the total inputs used in farm
 70 production. Following Key and McBride (2003) approach, the productivity of a farmer was
 71 determined using the following formula:

$$72 \quad TFP_i = Y_i / \sum P_i X_i \quad \dots\dots\dots 1$$

73 where, TFP_i = total factor productivity (K~~K~~g/₦); Y_i = quantity produced (Kg); P_i = unit price of
 74 variables input (₦); X_i = quantity of variables input used.

Comment [AL4]: why Kg, if you agree change all

75
 76 **Multiple Regression Model**
 77 Multiple regression model was used to determine the factors influencing the farm productivity in
 78 integrated tree cropping system. The double log model is specified as follows:

$$79 \quad \ln TFP_i = a_1 \ln X_1 + a_2 \ln X_2 + a_3 \ln X_3 + a_4 \ln X_4 + a_5 \ln X_5 + a_6 \ln X_6 + a_7 \ln X_{27} + a_8 \ln X_8 + a_9 \ln X_9 + \\ 80 \quad a_{10} \ln X_{10} + a_{11} \ln X_{11} + a_{12} \ln X_{12} + e_i \quad \dots\dots\dots 2$$

81 where,
 82 TFPi is total factor productivity (kg/ha); X₁ is sex of respondent (male=1, female=0); X₂ is age of
 83 the farmers (years); X₃ is years of education; X₄ is fertilizer used (Kg); X₅ is improved varieties
 84 used (Yes = 1, No =0); X₆ is farm size (ha); X₇ is years of farming experience; X₈ is land tenure
 85 (own land=1, otherwise= 0); X₉ is household size (#); X₁₀ is hired labour (manday); X₁₁ is family
 86 labour (person day); X₁₂ is number of contact with extension agent (#); X₁₃ is primary
 87 occupation (1= farming, 0= otherwise); X₁₄ is Access to credit (access=1, otherwise= 0); e_i =
 88 Error term.

89 Rationale behind the inclusion of these variables in the model was based on a prior expectation
 90 of variables. These variables are expected to influence productivity among smallholder farmers.
 91 In productivity studies, influence of hired labour is controversial. Increase in hired labour could
 92 increase cost of production, thereby decreasing productivity or otherwise. Labour shortages may
 93 responsible for high costs of production at times. Education encourages the adoption of
 94 productivity enhancing technologies and efficient farm management practices. Also, education
 95 provides farmers with skill and more responsive to risk. It is assumed to positively influence the
 96 productivity (Nwaru, 2004). Use of high-yielding, disease resistant and early maturing, brings
 97 relative high returns to investment when compared with the local varieties (Ahmed et al., 2003;
 98 Mbam and Edeh, 2011). Land tenure was hypothesized to increase productivity Reddy (1998). Land
 99 tenure refer to the right a farmer has over land. Farmers can use land to secure loans required for
 100 productivity thus enhancing investments (Xaba, 2013). Farm size was hypothesized to increase
 101 productivity (Adebayo, 2007; Bezabih and Hadera 2007). Increased productivity could be as a
 102 result of economies of scale (Xaba, 2013). Due to labour intensive nature of agriculture, male
 103 farmers are expected to be more productive than their female counterpart. Family labour means

104 the availability of economically active labour in the household. It is assumed that family labour
 105 would increase in the productivity of farmers (Xaba, 2013). Fertilizer was assumed to increase
 106 productivity. Access to credit facilities enable the farmers to purchase improved varieties and
 107 other technologies, hence increase productivity at farm level (Xaba, 2013). Extension service
 108 introduce farmers to new better methods of improving productivity, hence increase productivity.

109 Table 1. Description of the independent variables used in productivity model

Variables	Units	Expected signs
Age	Years	±
Education	Years spent in school	+
Land Tenure Status	Access; yes=1, no=0	±
Farming experience	Years	±
Farm house hold size	Number of members	±
Extension visit	Yes=1, No=0	+
Membership of association	Member=1, Non- member=0	+
Access to Credit	Access; yes=1, no=0	+
Farm size	Hectares	±
Gender of House hold Head	Female=0, Male= 1	±
Fertilizer	Kg	+
Improved varieties	(Yes = 1, No =0)	+
Hired labour	Man-day	±

Family labour	Man-day	±
Primary occupation	(Yes = 1, No =0)	+

RESULTS AND DISCUSSION

Socioeconomic characteristics of the respondents

The socio-economic characteristics of farmers were presented in Table 2. There was variations in the average age of the respondents within the range of 50 years across the four communities. For example, 55.12(± 15.56) in Akindele, 50.18(± 13.50) in Lagbedu, 52.58(± 13.75) in Osunwoyin, and 51.52(± 11.72) in Iwara. This could indicate that an average farmer is relatively old in the study area. This conforms to the study of Adedeji *et al.* (2013). The mean household size of respondent across communities falls within the range of 9 to 10 members with Akindele (10.34 ±5.97) having the highest number of household members. This reiterates the fact that household is the major supplier of labor to agriculture. This agrees with the findings of Ekong (2010). The average years of schooling in the study area ranged from 6.0(±5.07) years to 6.70 (±4.99). This implies that the literacy level of sampled farmers was relatively high. Education could help to achieve high level of productivity. This aligns with the study of Yusuf (2014). Farmers in Osunwoyin (30.3 ±16.15) have numerous years of farming experience in farming than farmers in other communities. This could boost their agricultural productivity. This finding agrees with Ajewole, 2010. Farmers in Lagbedu (9.51±6.04) recorded the highest number of farm size in the study area. This could indicate that enough farmland to experiment productivity enhancing technologies. Majority of the sampled farmers have organized social group. Across the villages, farmers in Lagbedu recorded the highest (82%), farmers in Iwara (78%), Akindele (66%) and the smallest Osunwoyin (46%). Membership of a social group allows interactions among members in terms of the information dissemination (Akinola, 2008).

Comment [AL5]: ? add all

132 **Table 2: Socioeconomic characteristics of the farmers**

Variables	Field site			
	Osun state		Oyo state	
	Iwara	Osunwoyin	Akindele	Lagbedu
Age	51.52(11.72)	52.58(13.75)	55.12(15.56)	50.18(13.50)
Household size	10.12(5.21)	9.04(4.38)	10.34(5.97)	9.26(6.33)
Years of formal education	6.70(4.99)	6.18(6.04)	6.0(5.07)	6.98(4.28)
Years of farming experience	29.9(14.41)	30.3(16.15)	29.54(15.79)	26.48(14.5)
Total farm size	8.37(7.72)	9.02(6.88)	7.64(6.17)	9.51(6.04)
Membership of cooperative	78	46	66	82

133 Figure in parenthesis () represents standard deviation

134 **Source:** Data analysis, 2015

135

136 **Crops Grown in Integrated Tree Cropping System**

137 Globally, there were different crop enterprises grown in the study area as shown in Table 3.

138 Across the villages, the major crop grown is cocoa. In Akindele village, other crops grown in

139 decreasing order of importance are cassava, yam, plantain/banana, oil palm and maize. In

140 Lagbedu village in Ogo-Oluwa LGA of Oyo state, crops grown in descending order of importance

141 are cassava, yam, cashew, oil palm, maize e.tc. Other crops grown in Iwara include walnut,

142 pineapple, mango, rice, pear, bitter-kola, pepper, coffee, okro and cashew. Others crops grown in

143 Osunwoyin village includes oil palm, cassava, maize, yam, cocoyam, tomato, vegetables,

144 plantain, soybean and kolanut/bitter-kola, orange, cowpea, cashew, pineapple and pepper.

145 **Table 3: Crops Grown in Integrated Tree Cropping System by Order of Importance**

Ranking of Crops	Field Sites			
	Osun state		Oyo state	
	Iwara	Osunwoyin	Akindele	Lagbedu
1 st	Cocoa	Cocoa	Cocoa	Cocoa
2 nd	Cassava	Oil palm	Cassava	Cassava
3 rd	Yam	Cassava	Yam	Yam
4 th	Maize	Maize	Plantain/banana	Cashew
5 th	Oil palm	Yam	Oil palm	Oil palm

6 th	Plantain/banana	Cocoyam	Maize	Maize
7 th	Kolanut	Tomato	Orange	Orange
8 th	Orange	Vegetables	Kolanut	Guinea corn
9 th	Cocoyam	Plantain	Walnut	Tomatoes
10 th	Walnut	Soybean	Watermelon/Cucumber	Vegetables
11 th	Pineapple	Kolanut/Bitter-kola	Pepper	Pepper
12 th	Mango	Oil palm	Pineapple	Groundnut
13 th	Rice	Orange	-	Cowpea
14 th	Pear	Cowpea	-	Pineapple
15 th	Bitter-kola	Cashew	-	Cucumber
16 th	Pepper	Pineapple	-	Kolanut
17 th	Coffee	Pepper	-	Banana/plantain
18 th	Okro	-	-	-
19 th	Cashew	-	-	-

Source: Data analysis, 2015

Constraints to Production in Integrated Tree Cropping system

Constraints to production in the integrated tree cropping system was presented in Table 4. The three main constraints among problems listed were inadequate funds, land issues and non-availability of agro-inputs in Iwara; pests and diseases, low productivity/yield and poor quality pesticides in Osunwoyin; termite infestation, financial problems and die-back disease were identified in Akindele, and marketing, funds and diseases in Lagbedu. Identified areas of intervention in Lagbedu are: provision and multiplication of disease-free improved cocoa seedlings. In Osunwoyin, promoting high-yielding vegetable crops and appropriate agro-inputs were listed as potential areas of intervention. In Iwara, capacity building of farmers through training on the efficient use of farm resources and how best to source for funds, encouraging increased land allocation to crop enterprise activities that result from an optimal farm plan, and providing access to improved crop varieties for cocoa, maize and cassava are the main areas of immediate intervention. In Akindele, raising seedlings, preventing post-harvest losses by using

recommended preservatives and embarking on value addition processing activities, and increasing their involvement in profitable enterprises were identified areas of intervention. Farmers' interest in livestock keeping, particularly poultry production, as well as fish production was also noted in all the field sites.

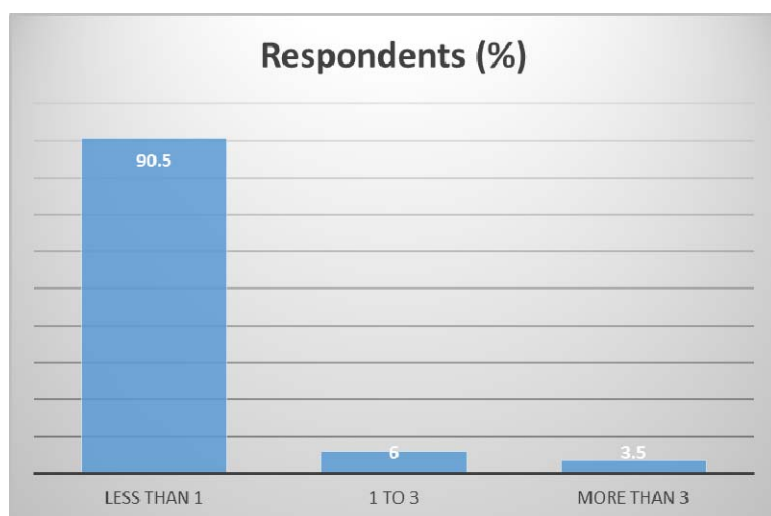
Table 4: Constraints to production in the integrated tree cropping system

S/No	Field Sites				Ranking of Constraints
	Osun State		Oyo State		
	Iwara	Osunwoyin	Akindele	Lagbedu	
1	Inadequate funds	Pests and diseases	Termite infestation	Marketing (price)	1 st
2	Land issues	Low productivity/yield	Financial	Financial	2 nd
3	Non-availability of agro-inputs	Poor quality pesticides	Die back disease	Disease	3 rd
4	Marketing problems	Black pod disease	Lack of seedlings	Politics	4 th
5	Pests and diseases	Low quality seedlings	Stem borers	Pests/ parasites	5 th
6	Lack of skill	Low production scale	Defoliators	Seedlings	6 th
7	Poor roads	Post-harvest processing	Black pod disease (Cherelles)	Access to land	7 th
8	Post-harvest processing (flash dryer)	Marketing	Inadequate labour	Bush burning	8 th
9	No improved varieties	-	Post-harvest processing	Post-harvest processing	9 th
10	-	-	Improper packaging of produce	-	10 th

Source: Data analysis, 2015

171 **Productivity level in the integrated tree cropping system**

172 Farmers' productivity levels in the integrated tree cropping system were presented in Figure 1.
173 An average level of productivity was observed to be 0.61kg/₦ in the study area. Majority
174 (90.5%) of the respondents had productivity levels of less than 1kg/₦. This implies that the
175 farmers were not productive at the time of the study. Hence, the little returns to their investments
176 in the integrated tree cropping system.



177
178 **Figure 1: Levels of productivity**
179 Source: Data analysis, 2015
180
181

182 **Determinants of level of productivity in the integrated tree cropping system.**

183 Table 5 reveals the factors affecting the level of productivity among farmers in the integrated
184 tree cropping system. Farm size ($p<0.1$), use of improved varieties ($p<0.01$), hired labour
185 ($p<0.01$), fertilizers ($p<0.01$) and extension contact ($p<0.05$) significantly influenced level of
186 productivity among farmers. The coefficients of farm size ($p<0.1$), extension contact ($p<0.05$)
187 and hired labour ($p<0.01$) were positive. This implies a unit increase in farm size, extension

188 contact and hired labour increases the level of productivity by their magnitude of coefficient;
 189 0.57, 0.01 and 0.006 units, respectively. The coefficients of improved varieties and fertilizers
 190 were negatively signed. This suggests that a unit increase in the use of improved varieties and
 191 fertilizers decreases level of productivity by the magnitude of their coefficients; 2.25 and 0.77
 192 units, respectively. This could be ascribed to the fact that these technologies requires high
 193 technical know-how. Inappropriate use of them would result into decreased productivity. This
 194 may be that the farmers do not receive adequate and necessary information from extension agent.

195 **Table 5: Determinants of total farm productivity in the integrated tree cropping system**

Variable	All Respondents (n=200)
Age (years)	-0.9586 (0.98)
Household size (#)	-0.5359 (1.02)
Education (years)	0.399 (1.19)
Farm experience (years)	-0.711 (1.17)
Primary occupation (%)	-0.072 (0.11)
Farm size (ha)	0.572 (1.74)*
Improved seed (kg)	-2.254 (3.58)***
Hired labour (%)	0.005 (3.06)***
Family labour (Man-day)	-0.580 (1.52)
Fertilizer (kg)	-0.770 (5.93)***
Land tenure (%)	0.367 (0.18)
Extension contact (%)	0.005 (2.02)**
Access to credit (%)	-2.497 (1.35)
R-square	0.370
Adjusted R-square	0.323
F-value	7.77

196 *** very highly significant at 1%, ** highly significant at 5%, * significant at 10%

197 Figures in parentheses () represent t-values.

198 Source: Data analysis, 2015

199

200 **CONCLUSION**

201 Majority of the sampled farmers are old, experienced, and have organized social group. Cocoa is

202 the major crop grown by the farming households in Southwestern Nigeria. The main constraints

to production were inadequate funds, land issues, non-availability of agro-inputs, pests and diseases, poor quality pesticides, termite infestation, financial problems, among others. The study concluded that the farmers were not productive at the time of the study. Farm size ($p<0.1$), use of improved varieties ($p<0.01$), hired labour ($p<0.01$), fertilizers ($p<0.01$) and extension contact ($p<0.05$) significantly influenced level of productivity among farmers. These variables remains the policy variables that could boost productivity among cocoa farmers in the study. Therefore, intensive teaching programmes on the use and advantage of improved seed varieties and fertilizer by virile extension services should be encouraged as well as providing input support services in the form of credit. This would help the farmers to manage their resource economically. Hence, improve their productivity.

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