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SUSTAINABLE LAND MANAGEMENT PRACTICES AND INCOME DIVERSIFICATION AMONG RURAL CASSAVA-BASED AND YAM-BASED SMALLHOLDER FARMERS IN IMO STATE

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ABSTRACT
The purpose of this study was to analyze the sustainable land management practices and income diversification strategies among rural cassava-based and yam-based smallholder farmers in Imo State, Nigeria, using cost-route data on a sample of 120 farmers. Descriptive statistics, Sustainable Land Management Index (SLMI), t-test and binary probit model. The results showed that all the cassava-based farmers adopted mixed and intercropping (100.00%), mulching (95.00%) and compost and farm manure (96.67%). While majority of yam-based farmers adopted mixed and intercropping (98.33%), mulching (91.67%) and compost/farm manure (90.00%). Majority of the cassava-based (61.67%) farmers combined on-farm and non-farm activities as a diversification strategy, with a mean monthly income of ₦52,335.33k; while majority of yam-based farmers (68.33%) combined on-farm, off-farm and non-farm activities as a diversification strategy, with a mean monthly income of ₦71,617.37k. The t-values for the associated income from mixed on-farm and off-farm strategies (-2.112) of cassava-based farmers and mixed on-farm, off-farm and non-farm strategies (-2.226) of yam-based farmers were significant at 5% level. This shows that yam-based farmers earn higher income than cassava-based farmers. The probit analysis showed that mixed on-farm and off-farm strategies of cassava-based farmers has positive and significant influence on sustainable land management practices; while on-farm strategy of yam-based farmers also has a positive and significant influence on sustainable land management practices. Major constraints namely, high labour cost, insufficient land and inadequate supply of organic manure, were common to both groups of farmers, but to slightly varying degrees. Based on the results, sustainable labour-saving land management techniques need to be explored and integrated into cassava and yam production systems and complemented with commercial supplies (markets) of organic manure in the study area. To adopt sustainable land management practices, farmers' access to arable land and titles should be improved through pragmatic land reform regimes. Further, the labour market participation and income earning capacity of rural women, who dominate cassava production, will be enhance if some targeted rural entrepreneurship programme that incorporate their social roles and responsibilities are put in place.

Keywords: sustainable land management, income diversification, cassava-based, and yam-based

Introduction

Nigeria is one of the leading producers of cassava and yam in the world, contributing as much as two-thirds of global yam production each year (NBS, 2013). Farmers who engage in cassava and /or yam production do so to improve household food security generate income and as well diversify their livelihood sources (Sanginga, 2015). Cassava is grown throughout the year, hence its high preference among resource poor farm households who rely on its low nutrient requirements and capacity to survive harsh environmental and micro-climate conditions. Yam is by far more labour-intensive and required

more external input than cassava. These are some of the facts that underpin the cultural dichotomy in some places whereby cassava is termed a woman's crop and yam a man's crop (Forsythe et al, 2016 and Ezeibe et al, 2015). Income diversification is the scope and combination of activities and choices (Liu and Liu, 2016); and a means of gaining adequate stocks and flows of cash to meet basic needs (Hilson, 2016). Increase in income earning opportunities increases the ability of farmers to effectively adopt better land management practices (Raufu & Adetunji, 2012). Babalola and Olayemi (2013) identified common sustainable land management practices (SLMP), namely, structural and mechanical erosion control practices (SMECP) which include contour bund, and construction of ridges across the slope; agronomic practices (AP) which include multiple cropping, mulching, and crop rotation; soil management practices (SMP) which include compost and farm manure; and cultivation practices (CP) which include minimum tillage. The factors influencing the adoption of sustainable land management techniques could be classified into three categories, namely: on-farm, off-farm and non-farm income. Low on-farm income affects farmers' ability to purchase organic manure to improve the soil fertility (Hainmueller, Michael, Hiscox and Maja, 2011). In some cases high non-farm income increases the probability to adopt unsustainable practices such as purchase and over use of agro chemicals. The use of chemical fertilizer has important implications for soil quality (Imfeld and Vuilleumier, 2012), as most agricultural land degradation results from the over-use of agrochemicals.

Land is an important resource in farming (Babalola and Olayemi, 2013). Inappropriate land management practices (agronomic and soil fertility management practices) and low farm income are among the problems of agricultural sector in Nigeria (Daudu, Oladipo, Bolarin, Bello, Kayode & Salami, 2016). Low farm income drives farmers to look for other income sources. Different forms of income diversification represent important strategies of farmers to either cope with the changing economic conditions (Weltin et al., 2017). An integrated rural income diversification and sustainable land management strategy is required in order to minimize the low income profile of cassava-based and yam-based farmers. Kassie (2017) argued that the type of income diversification activities engaged by the farmers may have either positive or negative effects on the rural land management system. Sherren et al., (2016) identified on-farm, off-farm and non-farm activities as the rural income diversification strategies. Therefore, to institute credible interventions aimed at improving the income and land management practices of cassava-based and yam-based farmers, it is important to assess the sustainable land management practices and income diversification strategies of the farmers and establish the effect of income diversification strategies on sustainable land management practices of cassava-based and yam-based farmers.

Methodology

Study Area

Imo State is in the southeast zone of Nigeria. The state is made up of twenty-seven Local Government Areas. Imo State lies between Latitude 5°12′ and 5°56′ North of the Equator and between Longitudes 6°38′ and 7°25′ east of the Greenwich meridian. The state is bordered by Abia State on the east, by the River Niger on the West, by Anambra State to the north and River State to the south (Imo State Government, 2001). Imo State occupies a land mass of about 5,530 km^2 with a total population of approximately 3.93 million persons (NPC, 2006). The State has two dominant seasons, that is, rainy and dry seasons. Rainfall is between April and October, while the dry season starts from November to early March. Agriculture is assumed to be one of the major sources of income of most of rural dwellers. The major food crops include cassava, yam, cocoyam, maize, and melon.

Data Collection

Panel data were generated from a sample of 156 root crop famers comprising 78 cassava-based, and 78 yam-based farmers selected by multi-stage procedure. The multi-stage procedure entailed purposive selection of one local government area from each of the three (3) agricultural zones that make up Imo state. The next stage was random selection of two communities from each of the selected local government areas. At the third stage, a list of cassava-based and yam-based farmers was drawn

using the ADP enumerator approach. From the list, 13 cassava-based and 13 yam-based farmers were selected randomly to give a sample of 26 farmers per community and 156 farmers form the six communities. Data collection commenced in March, 2015 and was concluded in November, 2016. Regular on farm visits including direct participation and measurements were conducted by the researchers with the assistance of Imo State Agricultural Development Project (ADP) staff and staff of Local Government Councils. The visits were conducted on a bimonthly basis and staggered across the selected communities. At the end of data collection, collation and editing, a final sample of 10 cassava-based and 10 yam-based farmers whose data were considered complete enough for analysis, was drawn from each community. This yielded a total final sample of 60 cassava-based and 60 yam-based of farmer (120 farmers) used for the analysis.

Analytical Techniques

Data for this study were analyzed using descriptive statistics, Sustainable Land Management Index (SLMI), t-test, and Probit model. Following Kassie (2017), the sustainable land management index (SLMI) was constructed from eight (8) different sustainable land management indicators, and practices based on Babalola and Olayemi (2013), which were prevalent in the study area. The indicators include, contour bund, intercropping, mulching, crop rotation, compost and farm manure, minimum tillage, terracing and fallowing. The extents to which the farmers adopted these sustainable land management practices were measured. These were then added and divided by eight (8) to determine the Sustainable Land Management Index (SLMI) for individual farmer. The SLMI is stated as in Kassie, (2017):

$$SLMI_i = \left(\sum_{n=1}^{8} \frac{S_n}{8}\right) \ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where, $\boldsymbol{S_n}$ represents eight different sustainable land management practices. A cutoff point was derived to specifically classify farmers that adopt up to 50% or above of the sustainable land management practices. That is, $SLMI_i < 0.5$ is an indication that the i[th] farmer adopted other land management techniques that are not sustainable, while $SLMI_i \geq 0.5$ implies that the ith farmer adapted sustainable land management practices. This then forms the dependent variable (dichotomous variable) coded as:

$SLMI_i < 0.5 =$
$> 0\ (unsustainable\ practices)$
$SLMI_i \geq 0.5 =$
$> 1\ (sustainable\ practices)$

On the other hand, the income diversification strategies may affect the land management system of the farmers. The assumption is that in a given period at the disposal of its asset endowment, a rational household head chooses among the mutually exclusive income diversification strategies that could offer the maximum utility (Yizengaw, Okoyo & Beyene, 2015). The income diversification strategies of the farmers were grouped into three major activities which include on-farm, non-farm, and off-farm activities. On-farm strategies involve income derived from cassava or yam-based production. Off-farm strategies involve income derived from agricultural activities which take place outside the farmer's own farm or the agricultural work at another farmer's farm; while non-farm strategies involve income derived from activities that take place outside the agricultural sector. However, the effect of income diversification strategies on sustainable land management practices was analyzed using the Probit model for the cassava-based and yam-based farmers. Given the sustainable land management index, the cassava-based or yam-based farmer is observed adapting sustainable land management practices if y_i^* crosses the threshold value 0. That is, $y_i = 1\ if\ y_i^* \geq 0, if\ the\ i^{th}\ farmer\ adapts\ SLMP,$ $y_i = 0\ if\ otherwise$. The probit model is specified as:

$$y_i^* = \beta Z_i + U_i \quad \ldots\ldots\ldots\ldots..(2)$$

$$y_i = \begin{cases} 1\ if\ y_i^* \geq 0 \\ 0\ if\ y_i^* < 0 \end{cases} \ldots\ldots\ldots\ldots\ldots (3)$$

Where,

y_i = Observed dichotomous dependent variable (1, when i[th] farmer adapts SLMP and 0, otherwise);

y_i^* = Underlying latent variable;

β = Vector parameter estimate;

Z_i = Vector exogenous variables, which are the on-farm, off-farm and non-farm strategies.

Z_1 = Income derived from on-farm activities only (naira)

Z_2 = Income derived from on farm and off farm activities (naira)

Z_3 = Income derived from on farm and nonfarm activities (naira)
Z_4 = Income derived from on farm, off farm and nonfarm activities (naira)
U_i = Standard Normally Distributed Error Term,

Results and Discussion

Socioeconomic Characteristics of cassava-based and yam-based farmers

Table 1 shows the socioeconomic characteristics of cassava-based and yam-based farmers in the area. Results showed that the mean age of cassava-based farmers was 42 years, while that of yam-based farmers was 50 years. The t-value (-2.101) was significant at 5% level. This implies that yam-based farmers were older than cassava-based farmers in the area. The implication is that cassava-based farmers are younger than yam-based farmers in the area, and both crop-based farmers are in their active age. This implies that at this youthful age, cassava-based and yam-based farmers can diversify their income into other livelihood sources. This finding is in agreement with Ohen et al., (2014) who reported that farmers within the age range of 41 to 50 years are active, more receptive to innovation and could withstand the stress and strain involved in crop production. In addition, since cassava is a women's crop (Forsythe et al., 2016), and yam production dominated by male farmers as reported by Oluwatusin and Shitu (2014), this implies that female farmers are younger and active than male farmers in the area. Results also showed that majority of cassava-based (78.33%) and yam-based (75.00%) farmers were married, with mean household size of 6 persons (cassava-based farmers) and 9 persons (yam-based farmers). This implies that married farmers in yam production have more family labour to enhance production and reduce the cost of hired labour than cassava-based farmers. The t-value (-0.998) was not significant. This implies that there is no significant difference in household size of cassava-based and yam-based farmers, and the slight difference is negligible. Majority of cassava-based (50.00%) and yam-based (56.67%) farmers had primary education. This is an indication that cassava-based and yam-based farmers had training in formal education. Therefore, increase in literacy level of these farmers exposes them to sustainable techniques in food production and increases the opportunity to engage in activities outside the farm sector as reported by Seng (2015).

Results showed that the mean years of experience were 21 years and 23 years respectively, and the t-value (-1.033) was not significant. It implies that there is no significant difference in years of experience between yam-based (male) farmers and cassava-based (female) farmers, and that the mean difference indicating that yam-based (male) farmers have more years of experience in food crop production than cassava-based (female) farmer in the area is negligible. Increase in experience of farmers improves their technical know-how in food crop production and income earning activities. More experienced farmers adopt sustainable land management techniques to improve soil fertility, minimize the use of highly expensive practices and labour intensive techniques. Majority of cassava-based (66.67%) and yam-based (76.67%) farmers owned their farm lands. Land ownership in the area results from customary land law and purchases. This implies that these food crops are cultivated in farmers' own lands. Ownership of lands encourages farmers to adopt sustainable land management techniques and improve the soil fertility, as reported by Tittonell et al (2005) that soil fertility is influenced by both land use and soil management practices of the smallholder farmers. Majority of cassava-based farmers adopted mixed and intercropping (100.00%), mulching (95.00%) and compost and farm manure (96.67%). While majority of yam-based farmers adopted mixed and intercropping (98.33%), mulching (91.67%) and compost/farm manure (90.00%). This implies that cassava-based and yam-based farmers adopted mixed and intercropping, mulching and compost and farm manure in the study area. This is in agreement with Onubuogu, Esiobu, Nwosu and Okereke (2014) who asserted that cassava producers adopt mixed and intercropping system to ensure food security/food availability all year round, increase income and reduce incidence of pests and diseases. According to Branca et al., (2011), intercropping is designed to ensure differential nutrient uptake and use between crops, nitrogen-fixing and enhance soil fertility, reduce reliance on chemical fertilizers, and enrich nutrient supply to subsequent crops.

Table 1: Socioeconomic characteristics of cassava-based and yam-based farmers

	Cassava-Based farmers			Yam-Based farmers			
Variables	**freq**	**%**	$\bar{X}$	**freq**	**%**	$\bar{X}$	**t-value**
Age (years)			42			50	-2.101**
a. 21-30	6	10.00		3	5.00		
b. 31-40	10	16.67		8	13.33		
c. 41-50	41	68.33		10	16.67		
d. 51-60	3	5.00		35	58.33		
e. 61-70	0	0.00		4	6.67		
Marital Status							
a. married	47	78.33		45	75.00		
b. single	13	21.67		15	25.00		
Household Size			**6**			**9**	-0.998
a. 1-4	11	18.33		9	15.00		
b. 5-8	46	76.67		8	13.33		
c. 9-12	3	5.00		43	71.67		
Education							
a. primary	30	50.00		34	56.67		
b. secondary	14	23.33		10	16.67		
c. tertiary	10	16.67		2	3.33		
d. none	6	10.00		14	23.33		
Years of Experience in farming			**21**			**23**	-1.033
a. 1-10	6	10.00		3	5.00		
b. 11-20	21	35.00		15	25.00		
c. 21-30	30	50.00		36	60.00		
d. 31-40	3	5.00		6	10.00		
Land Ownership							
a. own	40	66.67		46	76.67		
b. commune	17	28.33		13	21.67		
c. rent	3	5.00		1	1.67		
Land Management Practices							
a. contour bund	**5**	8.33		8	13.33		
b. intercropping	**60**	100.00*****		59	98.33*****		
c. mulching	**57**	95.00*****		55	91.67*****		
d. crop rotation	**21**	35.00		26	43.33		
e. compost and farm manure	**58**	96.67*****		54	90.00*****		
f. minimum tillage							
g. terracing	**14**	23.33		7	11.67		
h. fallowing	**8**	13.33		3	5.00		
	17	28.33		11	18.33		

*major practices (Multiple response); freq (frequency); $\bar{X}$ (mean); **Significant at 5%
Source: Field survey data, 2017

Income Diversification Strategies and the Associated Income

Table 2 shows income diversification strategies and the associated income of farmers. Results showed that majority of cassava-based (61.67%) farmers combined on-farm and non-farm activities as an income diversification strategy, with a mean monthly income of ₦52, 335.33k; while majority of yam-based farmers (68.33%) combined on-farm, off-farm and non-farm activities as a diversification strategy, with a mean monthly income of ₦71,617.37k. The t-values for mixed on-farm and off-farm strategies (-2.112) and mixed on-farm, off-farm and non-farm strategies (-2.226) were significant at 5% level. This implies that yam-based farmers engaged in mixed on-farm, off-farm and non-farm activities earn higher income than cassava-based farmers. The income size of the female farmers (cassava-based farmers) which is lower

than the male farmers (yam-based farmers) could be attributed to other responsibilities such as home chores and taking care of a large household which could not allow them to engage in more activities and earn more income. This could also be said that female farmers in the area mostly engage in on-farm and non-farm activities, while male farmers engage mostly in on-farm, off-farm and non-farm activities to widen their earning opportunities since cassava and yam are respectively female and male crops. As opined by Anang (2017) that the decline in farm wages and emerging opportunities for work outside the farm sector can promote farmers' participation in rural non-farm work. On the other hand, Garibaldi, Gemmill-herren, Annolfo, Graeub, Cunningham and Breeze (2016) reported that farm households with higher non-farm income are greater adopters of sustainable land management practices. The more income farmers earn from different sources, the more they adopt sustainable practices. According to Hainmueller, Michael, Hiscox and Maja (2011) low farm income affects farmers' ability to improve the soil fertility that has been depleted due to unsustainable practices.

Table 2: Income Diversification Strategies and Associated Income

Strategies	Cassava-Based farmers			Yam-Based farmers			
	freq	%	Mean monthly Income (₦)	freq	%	Mean Monthly income (₦)	t-value
a. On-farm only	6	10.00	32,534.21	9	15.00	43,330.23	-0.025
b. On farm + off farm	2	3.33	36,122.14	11	18.33	52,478.60	-
c. On farm + non farm	37	61.67	52,335.33	2	3.33	63,446.44	2.112**
d. On farm + off farm + non farm	15	25.00	58,409.34	38	68.33	71,617.37	-1.112 - 2.226**

****significant at 5% level**
Source: Field survey data, 2017

Influence of Income Diversification Strategies on Sustainable Land Management Practices adopted by Cassava-Based and Yam-Based farmers

Table 3 shows the probit estimates of the influence of income diversification strategies on sustainable land management practices adopted by cassava-based and yam-based farmers. The McFadden R^2 value was 0.6014 for cassava-based farmers, while that of yam-based farmers was 0.6214. This is an indication that the independent variables included in the Probit models explained about 60.14% and 62.14% of the variations respectively in cassava-based and yam-based farmer's decision to adopt sustainable land management practices. However, the number of cases correctly predicted by Probit model were 88.3% and 85.0% respectively for cassava-based and yam-based analyses. Considering the nature of probit model, the estimated coefficients cannot give the correct measure of the effect of the explanatory variables on the dependent variable. Therefore the signs are used to interpret the likelihood decisions of the farmers. The statistically significant coefficients showed the income diversification strategies that influence farmer's decision to adopt sustainable land management practices in the study area. Results showed that on-farm combined with off-farm strategy for cassava-based farmers was positive and significant at 5% level, indicating that on-farm combined with off-farm strategy has a positive influence on sustainable land management pratices. The implication is that increase in on-farm-off-farm strategy by 1%, increases the probability to adopt sustainable land management practices. This finding builds on the report of Amsalu and Graaff (2007) that off-farm income has negative influence on sustainable land management. Relying on off-farm strategy reduces investment in sustainable land management practices, but when combined with on-farm activities, farmer's adoption of sustainable land management increases. In addition, on-farm and on-farm combined with non-farm strategies were negative and also

significant at 5% level. This indicates that on-farm and on-farm combined with non-farm strategies has negative influence on sustainable land management. This also implies that increase in these strategies by 1%, decreases the probability to adopt sustainable land management practices. This could be linked to the fact that increases in farmer's income increases the adoption of other practices that are not sustainable. Such practices include purchase and over-use of inorganic fertilizer and other agro chemicals. According to Imfeld and Vuilleumier (2012), the arrival of chemical fertilizers drastically modified the function and structure of microbial communities, altering the terrestrial ecosystems, which has important implications for soil quality. Lal (2015) asserted that unbalanced use of chemical fertilizers can degrade soil quality and deplete soil organic contents (SOC).

Table 3 shows the probit estimates of the influence of income diversification strategies on sustainable land management practices adopted by cassava-based and yam-based farmers

Strategies	**Cassava-Based Farmers**		**Yam-Based Farmers**	
	Coeffs	p-value	Coeffs	p-value
On farm	-3.32e-05	0.016**	4.31e-05	0.001*
On farm + Off farm	5.719e-05	0.021**	-1.083e-06	0.882
On farm + Non farm	-2.833e-05	0.014**	9.53e-06	0.158
On farm +Off+ Nonfarm	-1.324e-08	0.366	-2.52e-05	0.003*

Mean dependent var	0.666667	Mean dependent var	0.466667
McFadden R-squared	0.601445	McFadden R-squared	0.621356
Log-likelihood	-15.22114	Log-likelihood	-15.69684
Schwarz criterion	50.91401	Schwarz criterion	51.86540
S.D. dependent var	0.475383	S.D. dependent var	0.503098
Adjusted R-squared	0.470524	Adjusted R-squared	0.500744
Akaike criterion	40.44229	Akaike criterion	41.39368
Hannan-Quinn	44.53836	Hannan-Quinn	45.48974

Number of Observations = 60	Number of Observations = 60
Cases 'correctly predicted' = 53 (88.3%)	Cases 'correctly predicted' = 51 (85.0%)
f(beta'x) at mean of independent vars = 0.475	f(beta'x) at mean of independent vars = 0.503
Likelihood ratio test: Chi-square = 45.9394 [0.0000]*	Likelihood ratio test: Chi-square = 51.5171 [0.0000]*
*significant at 1%, **significant at 5%	

Source: Field Survey and Gretl Computed Results, 2017

Results showed that on-farm strategy for yam-based farmers was positive and significant at 1% probability level. This is an indication that on-farm strategy has a positive influence on sustainable land management practices. This implies that increase in on-farm strategy by 1% increases the probability to adopt sustainable land management practices by yam-based farmers. The on-farm combined with off and a non-farm strategy was negative and also statistically significant at 1% level. This is an indication that on-farm combined with off and a non-farm strategy has a negative influence on sustainable land management practices. This implies that increase in this strategy by 1%, decreases the probability to adopt sustainable land management practices. The implication is that combining on-farm activities with off-farm and non-farm engagements empowers yam-based farmers to adopt unsustainable labour-saving practices such as use of herbicides, inorganic fertilizers and insecticides. Unlike non-diversified yam-based farmers (On-farm strategy only) who use sustainable farm inputs mostly internal and affordable resources due to their limited number of income sources, on-farm combined with off and a non-farm strategy of more income diversified yam-based farmers increases their capability to purchase external farm inputs such as agrochemicals, which in the long run degrade the soil structure and hence the fertility of the soil. According to van Leeuwen et al. (2015) good soil

structure is important for the sustainable production of agricultural lands, and sustainable Land management is one of the key factors in soil structure quality and aggregate stability (Wick et al., 2015). García-Orenes et al. (2010) reported that unsuitable land management can lead to a loss in soil fertility. Cerdà et al. (2009); Barbera et al. (2013) found that unsustainable land management and agriculture system evolution is the main reason for land degradation.

Problems Militating against Sustainable Land Management Practices

Table 4 shows multiple response and distribution of cassava-based and yam-based farmers by problems militating against sustainable land management practices in the study area. Results showed that the major problems encountered by cassava-based farmers were high labour requirement (95.00%), insufficient land(88.33%) and inadequate organic manure (81.67%); while that of yam-based farmers were insufficient land (98.33%), inadequate organic manure (91.67%) and high labour cost (93.33%). This is an indication that high labour requirement, insufficient land, inadequate organic manure and high labour cost are the factors limiting cassava-based and yam-based farmers from adopting sustainable land management practices in the area. The finding is in agreement with Rahman, Wiederholt and Chen (2009) who also reported that organic manure application is highly challenged by unavailability of manure resource in the required amount particularly in areas where there is no large number of livestock population. According to Waithaka *et al* (2007), manure and compost require much labour to carry and spread on the field. Farm labour scarcity would mean inadequate manure and compost application. Adequate manure application enriches the soil and improves yield. Alberta Agriculture, Food and Rural Development (AAFRD, 2004) reported that organic manure is an excellent source of nutrient and can improve soil structure and water holding capacity. On the other hand, high labour cost or requirement poses a serious challenge in food crop farming. Sanginga (2015) reported that cassava farming is highly labour intensive especially in applying sustainable land management practices, as this increases the total production costs.

Table 4: Multiple Response and Distribution of Cassava-Based and Yam-Based Farmers by Problems Militating against Sustainable Land Management Practices.

	Cassava-Based farmers		Yam-Based farmers	
Constraints	**frequency**	**%**	**frequency**	**%**
a) Low farm income	21	35.00	16	26.67
b) High labour requirement	57	95.00*****	33	55.00
c) Insufficient land	53	88.33*****	59	98.33*****
d) Soil erosion	34	56.67	28	46.67
e) Low productivity	12	20.00	26	43.33
f) Inadequate organic manure	49	81.67*****	55	91.67*****
g) Unsuitable agricultural landscape	8	13.33	17	28.33
h) Non-availability of Credit	15	25.00	12	20.00
i) Inadequate Knowledge of SLMP	11	18.33	30	50.00
j) High Labour Cost	55	91.67*****	56	93.33*****
k) Transportation Problems	31	51.67	24	40.00
l) Low Produce Price	28	46.67	19	31.67
m) High pest and disease infestation	28	46.67	17	28.33
n) Insufficient Extension Services	12	20.00	33	55.00

***major problems (multiple response)**
Source: Field Survey Data, 2017

Conclusion

The study recommends that stakeholders in cassava production and gender issues should devise other income earning activities (or strategies) mostly from off-farm opportunities that will suit the role and responsibilities of female (cassava-based) farmers. This will not only increase the income source of cassava-based farmers but improves the

welfare of rural female (cassava-based) farmers and eliminate the gender inequality in opportunities among rural farmers in the area. Considering the fact that high labour requirement and costs, insufficient land and inadequate organic manure are the factors limiting the adoption of sustainable land management techniques by cassava-based and yam-based farmers in the area, sustainable labour-saving techniques and common markets for organic manure especially those from livestock droppings should be put in place. More lands should also be allocated to yam and cassava farmers to facilitate improvement in sustainable land management practices in the state. This will not only encourage farmers to adopt sustainable land management techniques in Imo State, but ensure sustainable livelihood since farming is a livelihood source in the area

References

Alberta Agriculture, Food and Rural Development, (2004). Manure management. A Book. CABI Publishing. Canada.

Amsalu, A. and J. de Graaff (2007) Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. *Ecological Economics*, 61**:**294-302.

Anang, B. T (2017) Effect of non-farm work on agricultural productivity: Empirical evidence from northern Ghana. WIDER Working Paper 2017/38

Awoyinka, Y.A., Akinwumi, J.A., Okoruwa, V.O. and Oni, O.A. (2009). Effects of Livelihood Strategies and Sustainable Land Management Practices on Food Crop Production Efficiency in South-West Nigeria. *Agricultural Journal* 4(3),135-143

Babalola, D.A and Olayemi, J.K (2013). Determinants Of Farmers' Preference For Sustainable Land Management Practices For Maize And Cassava Production In Ogun State, Nigeria. Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia

Barbera, V., Poma, I., Gristina, L., Novara, A., and Egli, M (2013) Long-term cropping systems and tillage management e_ects on soil organic carbon stock and steady state level of C sequestration rates in a semiarid environment, Land Degrad. Dev., 23, 82–91, doi:10.1002/ldr.1055,

Branca, G., McCarthy, N., Lipper, L. and Jolejole, M. (2011). *Climate-Smart Agriculture: A Synthesis of Empirical Evidence of Food Security and Mitigation Benefits from Improved Cropland Management.* Food and Agriculture Organization of the United Nations, Rome, Italy. 43pp.

Cerdà, A., Flanagan, D. C., le Bissonnais, Y., and Boardman, J (2009) Soil erosion and agriculture Soil Till. Res., 106, 107–108, doi:10.1016/j.still.2009.10.006

Daudu, A. K; Oladipo, F. O; Bolarin, O; Bello, G. O; Kayode, A. O and Salami, O. S (2016) Gender Perception on Soil Fertility Management Practices among Smallholder Arable Crop Farmers in Kwara State, Nigeria. *PAT June,12 (1): 67-79*

Ezeibe,A. B., Edafiogho, D. O., Okonkwo, N. A and Okide, C.C (2015) Gender differences and challenges in cassava production and processing in Abia State, Nigeria. *African Journal of Agric., Research, 10(22)2259-2266*

Forsythe, L., Posthumus, H and Martin, A (2016) A crop of one's own? Women's experiences of cassava commercialization in Nigeria and Malawi. *Journal of Gender, Agriculture and Food Security, 1(2):110-128,*

García-Orenes, F., Guerrero, C., Roldán, A., Mataix-Solera, J., Cerdá, A., Campoy, M., Zornoza,R., Barcenas, G. and Caravaca, F. (2010) Soil microbial biomass and activity under di_erent agricultural management systems in a semiarid Mediterranean agroecosystem, Soil Till. Res.,109:110–115.

Garibaldi, L. A., Gemmill-herren, B., Annolfo, R. D., Graeub, B. E., Cunningham, S. A., and Breeze, T. D. (2016). Farming approaches for greater biodiversity, livelihoods, and food security. *Trends in Ecology & Evolution, xx,* 1–13. doi:10.1016/j.tree.2016.10.001

Hainmueller, J., Michael J. Hiscox, M. J.and Maja T. (2011). *Sustainable Development for Cocoa Farmers in Ghana*. Cambirdge (MA): MIT and Harvard University.

Hilson, G. (2016). Farming, small-scale mining and rural livelihoods in Sub-Saharan Africa: A critical overview. *The Extractive Industries and Society, 3*:547–563. doi:10.1016/j.exis.2016.02.003

IMSG (2001). , Imo State Government. Examination Ethics Commission, Ministry of Education, Owerri, Imo State

Imfeld, G. and Vuilleumier, S. (2012) Measuring the e_ects of pesticides on bacterial communities in soil: a critical review, Eur. J Soil Biol., 49, 22–30

Kassie, G. W (2017) The Nexus between livelihood diversification and farmland management strategies in rural Ethiopia. *Cogent Economics & Finance* 5:1275087. http://dx.doi.org/10.1080/23322039.2016.1275087.

Lal, R (2015) Restoring Soil Quality to Mitigate Soil Degradation. *Sustainability*, *7*:5875-5895; doi:10.3390/su7055875

Liu, Z. and Liu, L. (2016). Characteristics and driving factors of rural livelihood transition in the east coastal region of China: A case study of suburban Shanghai. *Journal of Rural Studies*, *43*:145–158. doi:10.1016/j.jrurstud.2015.12.008

NPC (2006). National Population Commission, Provisional Population Result Figures 2006, Abuja, Nigeria.

Ohen, S B; D.E Ene & G.E Umeze (2014). Resource Use Efficiency of Cassava farmers in Akwa Ibom State, Nigeria**;** J. Bio. Agric. and Healthcare Vol.4, No.2, 2014(Online), ISSN 2224-3208 (Paper) ISSN 2225-093X

Oluwatosin, F. M. and Shittu, G. A. (2014). Effect of socio-economic characteristics on the farm productivity performance of yam farmers in Nigeria. *New York Science Journal*; 7(2):66-72.

Onubuogu, G. C., Esiobu, N.S., Nwosu, C. S and Okereke, C. N (2014) Resource use efficiency of smallholder cassava farmers in Owerri Agricultural zone, Imo State, Nigeria. *Scholarly Journal of Agricultural Science, 4(6):306-318*

Owusu, V., A. Abdulai, and S. Abdul-Rahman (2011). 'Non-Farm Work and Food Security Among Farm Households in Northern Ghana'. *Food Policy*, 36: 108–18.

Rahman, S. Wiederholt, R. and Chen, Y. (2009). Land Application of Manure and Environmental Concerns. North Dakota State University press.

Raufu, M. O and Adetunji, M. O (2012) Determinant of Land Management Practices among Crop Farmers in South-Western Nigeria. *Global Journal of Science Frontier Research Agriculture & Biology, 12(1)1:9-14.*

Sanginga, N. (2015) Roots and tuber crops (Cassava, yam, potato and sweet potato). In Proceedings of the An Action Plan for African Agricultural Transformation Conference, Dakar, Senegal, 21–23 October 2015.

Seng, K. (2015). 'The Effects of Nonfarm Activities of Farm Households' Food Consumption in Rural Cambodia'. *Development Studies Research*, 2(1): 77–89.

Sherren, K., Loik, L., and Debner, J. A. (2016). Climate adaptation in "new world" cultural landscapes: The case of Bay of Fundy agricultural dykelands (Nova Scotia, Canada). *Land Use Policy*, *51*:267–280. doi:10.1016/j.landusepol.2015.11.018

Tittonell P., Vanlauwe B., Leffelaar P.A., Rowe E.C and Giller K.E., (2005) Exploring diversity in soil fertility management of smallholder farms in western Kenya: Heterogeneity at region and farm scale, *Agric. Ecosyst. Environ*, 110:149-165

Vanlauwe, B., Descheemaeker, K., Giller, K.E., Huising, J.,Merckx, R., Nziguheba, G.,Wendt, J. and Zingore, S. (2015). Integrated soil fertility management in sub-Saharan Africa: unravelling local adaptation. Soil,1:491–508.

Waithaka, M., P. K. Thornton and K. Shepherd (2006) Bio-economic evaluation of farmers' perceptions of viable farms in western Kenya. *Agricultural Systems*, 90**,** 243-271.

Weltin, M., Zasada, I., Franke, C., Piorr, A., Raggi, M. and Viaggi, D (2017) Analysing Behavioural Differences of Farm Households: An Example of Income Diversification Strategies Based on European Farm Survey Data. *Land Use Policy 62:172–184*

Wick, A.F., Daniels, W.L., Nash, W.L. and Burger, J.A., (2015). Aggregate recovery in reclaimed coal mine soils of SW Virginia. Land Degrad. Dev. http://dx.doi.org/10.1002/ldr.2309.

Yizengaw, S. Y., Okoyo, E. N. and Beyene, F (2015) Determinants of livelihood diversification strategies: The case of smallholder rural farm households in Debre Elias Woreda, East Gojjam Zone, Ethiopia. *African Journal of Agricultural Research, 10(19):1998-2013*