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Econometric analysis of suitability and marginal value productivity of farmlands for cassava production in Imo State, Nigeria

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Indiscriminate allocation of farm farmlands beyond efficient level affect farmers return, hence suitability and standard value of lands for cassava production for optimal use were investigated. Data were obtained using a multi-stage sampling technique, from a sample of 203 cassava farmers in the state and were analysed using descriptive statistics, land productivity ratio and econonometric tools. Most farmers are female of 55.7 6.8 years of age and post primary education status. Nutrient ammendment is at the rate of 442.36 ± 102.73 Kg/Ha and at mean cost of N36401.77 ± 28575.84/Ha. The performance rate of 0.96 tons/person/Ha was obtained. The suitability index ranges from 0.139 to 0.908 with 46.3% cultivating on non-suitable land of 0.0-0.339 while only 20.7% cultivated on suitable lands of above 0.723 suitability index with a smaller mean area of 1.48Ha. The performance rate across these classes of land ranges from 0.44 tons/Ha/person to 2.11 tons/Ha/person for non-suitable land and suitable lands respectively. Suitable lands had the highest land productivity of 5.71 while moderate and non suitable lands had only 4.00 and 3.72 respectively, hence about 53.4% and only 7.5% increase in production is achieved as a piece of land is improved from non-suitable and moderately suiatble lands respectively to suitable land in the area. The MVP ranges from N302429.76/Ha for non-suitable lands to N718535.2/Ha for suitable lands. The study noted that suitable lands have higher opportunity cost than others for cassava production, hence recommentds that opportunity cost of land must be based on higher MVP for optimal use.

Key words: Farmland, suitability, marginal, value, productivity, cassava.

INTRODUCTION

Land is a portion of the earth surface that houses the biosphere, soil with its geological properties (which include the hydrological portion) and the atmosphere (FAO, 1976). Each of these portions is subject to some natural and human factors that have advertently, accounted for its development and value. The framework of farmland comprises of economic and social attribute that enhances its value (Anyigo, 1982). Farmland has a

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derived demand and its demand is for the minerals and nutrient it has for crop production (Olayide and Heady, 1982). Hence, its value (opprotunity cost) is therefore, the amount (of money, goods or services) that is considered to be a fair equivalent for its use and or what the land can produce. This means that land must be suitable having possessed a high potential for maximum output. Hence suitable farmland produces a relatively increased quantity of crop per unit area than other parcels of land within the same area.

Suitable farmlands are linked with increased opportunity cost. Such lands are productive, hence attract more opportunity cost than other areas (Okere, 2013). Land productivity is the ratio of output per unit piece of land used in crop production (Olayide and Heady, 1982), hence a suitable piece of land is at a high productivity potential. Land with high marginal value products (MVP) must have equivalent high marginal factor cost (MFC) to attract optimum allocation (Olayinde and Heady, 1982). Al-Kaisi (2012) noted that soil conservation practices can play a significant role in sustaining soil quality and suitability even in adverse himan activities and climate change. This implies that with good soil conservation and management practices, productivity of agricultural land will be sustainably high, thus making such land more valuable for crop production. Agricultural Lands are valued based on their suitability for crop production and its productivity.

Agricultural lands are no doubt scarce with high opportunity cost when project and infrastructural development are present. However, the value is to a greater extent, determined by the MVP of the farmland (Bassey, 2008). Although climate change and environmental degredation have been fingered for the low productive potentials of most arable land used for cassava production in Nigeria, the mining of sand and graver deposits (of solid and liquid minerals) as well as excavation of topsoils for urban development, have left extensive tracts of exposed subsoils with adverse soil chemical and physical properties that do not support plant growth (Hornick and Parr, 2010). Such degraded and marginal soils properties or destructions result to infertile (low in organic matter), often acidic and are subject to severe erosion and surface runoff.

Soil ammendment and conservation practices increase the suitability of soil for crop production and consequently the value system (Al-Kaisi, 2012). Research has shown that proper soil management practices such as liming and timely use of organic amendments such as animal manures and sewage sludge compost on lands can restore increased land productivity (Oyekale, 2008; Hornick and Parr, 2010; Al-Kaisi, 2012). Hence, the relative suitability of land is mainly dependent on the available soil management practices, which farmers adop t to gradually return improvised farm lands to a suitable land for crop production. This presupposes that lands can be classified into different value systems based on its degree of suitability to arable crop production (Oyekale, 2008).

Cassava adapt to marginal soils though, its productivity varies within soils in the same location and between locations in geographical space depending on the constituent minerals and management practices. Projects Coordinating Unit (2003), noted that though Enugu and Imo dominated the production of cassava in the South East with an output of 0.56 tonnes/per person in 2002 the output is not commensurate with the area of land allocated to it and farmers returns has not improved their consumption and welfare need. As a food security component, its ability to close food gap is declning. The dietry need of man with his livestock and industrial needs for cassava products have intensified (without careful management), the use of farmland, thus making lands vulnerable to farming farming risk and low output that fall short of its demand (FDALR, 1982; Ehirim et al., 2006).

To bridge this rising food gap, efforts need to be made by farmers to improve land productivity so that output can be raised to meet the food consumption needs (Adetunji and Adeyemo, 2012). Low level of farm size, technical and economic inefficiency of food and primitive technology may be a draw back to the effort to achieve the progress in food production (Adetunji and Adeyemo, 2012). The arguement that increased crop production requires increased use of farm inputs, which of cause does not exclude expanded use of land, may not translate to production efficiency (Olayide and Heady, 1982). Therefore, an optimal allocation of land base on its MVP placed cassava enterprise at a ventage position for maximum profit and economic sustainability. This study investigated the the productivity of different suitabilty levels of land for cassava production and the expected opportunity cost so that allocation of resources especially for land will generate optimum returns for cassava farmers in Imo state.

MATERIALS AND METHODS

The study used a multi-stage sampling technique to draw 203 cassava farmers for the study. First was a purposive selection of the three agricultural zones for proper representation of the state. Second was a purposive selection of three Local Government Areas (LGA) with evidence of erosion, high and moderate topography, and traditional farming systems such as bush burning, continuous cropping and excessive grazing form each zone, thus giving a total of nine (9) LGA's. The LGA's selected were Ngor Okpala, Owerri North and Owerri West LGA's from Owerri zone while Orsu, Isu and Nwangele LGAs were from Orlu zone and Isiala Mbano, Obowu and Okigwe North from Okigwe Zone. Third is random selection of cassava farmers from the list of cassava farmers with ADP's in each of the selected LGA. The study sampled about 316 (70%) of the total registered farmers from these LGAs and only 203 of the responses were found useful for data analysis.

Data on socio-economic features of the farmers, the type, quatity and prices of farm inputs especially the opportunity cost of land as well as quantity and prices of cassava output and the various land management and soil conservation practices used were collected. Data were analysed using both descriptive, partial productivity of land and econometric tools.

Land suitability index was used to classify land into suitable, moderately suitable and non suitable for cassava production. The suitability index was obtained from the number of ‘yes’ response (as it affect farmers) on the improved land managementand and or soil conservation practices as well as “no” responses to bad management farm and or soil conservation practices on his land. The practices are application of fertilizers or organic manure to the soil, the use of lime or wood ash for soil acidity, the use of mulch materials to protect the soil, use of bush fallow or shifting cultivation, the use of disease resistant varieties, construction of drainages and trench to remove excess or water logging, crop rotation system in case of mixed crop farming as well as ensuring adequate spacing distance and early planting. Others are bad management practices of the farmers in which a “no” response are expected. They include bush burning, continuous cropping, excessive grazing, making ridges along the slopes, deforestation and the use of heavy machines for tilling the soil. A total of 8 yes response and 6 no response gave a total of 14 responses that suitabily sustain the marginal value productivity of the farmland (FAO, 1991; Oyekale, 2008).

Suitability index is therefore, the ratio of the actual aggregate number good management practices and bad practices avoided to the total score. This is expressed as;

$$SI = \frac{V}{N} \quad \text{and} \quad 0 \le SI \le 1 \quad (1)$$

Where SI = Suitability index, V = Actual number aggregate good land management practices and bad practices avoided by an ith farmer in the area and N = The Total number of both good land management activities that farmers responded yes and the bad practices avoidable as used in this study. As the SI approaches 1, then the land is very suitable for arable crop production but if it approaches 0, then it is non-suitable inbetween these extreems lies moderately suiatble land for cassava production. This is statistically classified using normal distribution approach adopted by Olowu and Oladeji (2004). The estimated mean and the standard deviation of the distribution were used to classify the land into three classes; Suitable, moderately suitable and non-suitable.

$$SC = S\bar{I} \pm SD \quad (2)$$

Where; SC = Suitability class, $S\bar{I}$ = Mean suitability index and SD= Standard deviation

Partial productivity of land is the ratio of total output of an ith class of land to a unit area of that land cultivated by cassava. This is expressed as:

$$A = \frac{Y}{L} \quad (3)$$

Where, A = Productivity of land; Y = Output of cassava tubers from an ith class of Land in kg, and L = Area of an ith class of land in hecatres.

The value placed on each class of farmland is based on the MVP of such farmland in the area. The suitability potential of farmlands determines its MVP, hence allocation of farmland for cassava production is efficienct where the ratio of MVP and the MFC is equal to unity.

$$Optimum\ Allocation\ of\ Land = \frac{Marginal\ Value\ productivity}{Marginal\ factor\ Cost} = 1 \quad (4)$$

$$\text{Marginal Value Productivity (MVP)} = MPP_L\ X\ P_Y \quad (5)$$

Where MPP_L is the marginal physical product of cassava from an ith class of land and P_Y is the unit market price of cassava produced in the area. The marginal physical product of cassava from an ith class of land is simply an additional unit of cassava from an additional unit ith class of land (Olayide and Heady, 1982). This is obtained as a partial derivative from a linear production function of cassava from an ith class of land in the area. The model is implicitly expressed as;

$$Q_c = f\left(Labour + Farmsize + Pl_{mat} + capital + \varepsilon\right) \quad (6)$$

Where; Q_c = Output of cassava in kg, Pl_{mat} = Plant Materials in naira, Labour = man-days, Farm size = hectares and Capital = sum of depreciation of fixed inputs, rent and interest in naira. ε = the error term.

RESULTS AND DISCUSSION

Socio-economic features of cassava farmers in Imo State

Table 1 shows that majority (40.4%) of cassava farmers falls within 50 to 59 years while only few (3.0%) of them are between 30 to 39 years. The mean age of the cassava farmers is 55.7 years. This implies that cassava farmers in the State are relatively old. This finding is supported by Alfred (2001) that farming is now in the hands of old farmers whose risk absorption, adoption of innovation and productive effort per unit of labour may be declining. Again farming may go extinct with older men dominating the occupation. The result also showed that majority (40.9%) of cassava farmers in the State had post primary education and 17.7% of them had up to tertiary education.

However, only 9.4% of the farmers had relatively no formal education in the area and the mean formal education attainment is 9.5 years. This implies that at average, the farmers most have acquired post primary education. Williams (1984) noted that secondary education can equip farmers with some managerial skills for agri-business and may help in understanding innovations. The result showed mean farming experience of 26.4 years with 48.8% of the cassava farmers having between 11 and 20 years. Only less than 1% has planted cassava in less than 10years. This showed that cassava farming is an old enterprise and can increase mastering of different technologies. This finding is consistent with Ehirim et.al. (2006) who observed that changes is expected over time due to high farming experiences. It could be deduced from the result that extension contact to cassava farmers is small with a mean extension visit 8 visits per farmer in a planting season. Majority (75.9%) of cassava farmers have extension visit of only less than 10 times and 10.8% of them had less than 15 times visit per farmer in a farming season. The result showed that 19.2% of the cassava farmers have less than 4 members per household and 34.5% of them have less than 8 members per household. The mean household size per farmer is about 7 persons per household. This shows that

Table 1. Socio-economic characteristics of cassava farmers in Imo State.

Variable	Frequency	Percentage	Mean ± SD
Age			
30-39	6	3.0	
40-49	43	21.2	
50-59	82	40.4	
60-69	65	32.0	
70-79	6	3.0	55.7 ± 6.8
≥ 80	1	0.5	
Total	203	100	
Education			
0	19	9.4	
Less than 2 Years	8	3.9	
Not more than 6 years	57	28.1	
7 – 12 Years	83	40.9	9.5 ± 2.3
13 – 18 Years	36	17.7	
Total	203	100.0	
Experience			
Less than 10	2	1.0	
11-20	99	48.8	
21-30	31	15.3	
31-40	34	16.7	
41-50	24	11.8	26.4 ± 5.8
≥ 51	13	6.4	
Total	203	100.0	
Extension contact			
Less than 5	25	12.3	
5-10	154	75.9	
11-15	22	10.8	
≥ 16	2	1.0	8.0 ± 2.0
Total	203	100.0	
Household size			
Less than 4	39	19.2	
4-8	70	34.5	
9-12	62	30.5	
≥ 13	32	15.8	7.0 ± 3.0
Total	203	100.0	
Gender			
Male	95	46.8	
Female	108	53.2	
Total	203	100.0	
Marital status			
Single	72	35.5	
Married	81	39.9	
Divorced	35	17.2	
Widowed	15	7.4	
Separated	0	0.0	
Total	203	100.0	

Source: Field Survey, 2010.

Table 2. Descriptive statistics of input and output of cassava production in imo state.

Variable	Units	Mean	Standard deviation
Farm size	Ha	1.62	1.38
Rent	₦	9459.36	6016.25
Labour	Manday	25.00	9.81
Wage		15957.88	14470.42
Plant material	₦	13759.36	1397.50
Cost of improving land	₦	36401.77	28575.84
Soil nutrients	₦	442.36	1002.73
Depreciation	Kg/Ha	1257.07	1246.63
Output	₦	9584.19	2016.56

Source : Field Survey, 2010.

cassava farmers in the area have a relatively large household size to supply the family labour neede for cassava production in the area. This finding is supported by Nweke et al. (2002) about the significant population of cassava growers in Nigeria. The enterprise is female dominated with 53.2% of them as females and 46.8% as males. This finding is supported by the works of Ugwoke et al. (2004) who observed that agricultural activities are female dominated in Imo State.

Decriptive statistics of inpus and output of cassava in Imo State

The reuslt in Table 2 showed a mean area of land cultivated is 1.62 ± 1.38Ha. This implies that cassava production is still within small scale production as a relatively small fragment of land is allocated to its production in the area. A mean labour size of 25 ± 9.81 man-days and a mean wage of ₦15957.88 ± ₦14470.42 per labour per hectare is spent per farmer. This finding implies that the quantity of labour allocated to cassava production in the area is very small as a farmer can hardly make more than one visit to his farm in every 2 weeks within a cropping season. The mean depreciation of all fixed inputs used in the production of cassava in the area is ₦1257.07 ± ₦1246.63. Soil nutrient is applied at the rate of 442.36 ± 1002.73 kg/ha. The wide standard deviation for soil nutrient could be as a result of extensive application of the nutrient in the areas where arable crop lands are not suitable. The mean cost of improving land (which include construction of irrigation and drainage facilities etc) for cassava production is ₦36401.77 ± 28575.84/Ha is very high. There is a slight increase in rate of performance of 0.56 tonn/person in 2002 (PCU, 2003), to 0.96 tons/person in the area during the study.

Land suitability, productivity and mariginal value productivity for cassava production in Imo State

The suitability index ranges from 0.139 to 0.908. Majority (46.3%) of the farmers cultivated on non-suitable lands with suitability limit of between 0 to 0.339 while 33.0% of them cultivated cassava on moderately suitable lands of 0.340 to 0.722 (Table 3). Only a few of them (20.7) had cultivated their cassava on suitable lands of between 0.723 to 1.00 suitability index. Non Suitable land is relatively larger in area of about 2.08 ha, it has a relatively smaller output performance rate of 0.44 tons/Ha/person than suitable land that has about 28.8% lower land area but demonstarted a high performance rate of 2.11 tons/ha/person. The increased performance could be due to suitability of land cassava production. This finding is consistent with Oyekale (2008) that improved land use system can ensure a high performance rate than degraded lands.

Similarly, suitable land had the highest land productivity of 5.71. This is greater than the land productivity of moderatel and non suitable lands of 4.00 and 3.72 respectively. There is about 53.4% and only 7.5% increase in production as a piece of land is improved from non-suitable and moderately suiatble lands respectively, to suitable land in the area. This shows that non-suitable lands have higher potential productivity with intensified sustainable land management practices. This will make the non-suitable lands most suitable for crop production in the area. This can be achived by applying suitable soil ammendments and soil conservation practices.

In a similar way, the marginall physical productivity estimates from cassava production function showed the changes in the quantity of cassava produced as farmsize increased by 1 unit. The estimated model for the three different classes of land is shown in Table 4. It could be deduced from the result that an increase in farmsize by 1 hectare will increase output of cassava tubers by 2351.42 kg in non-suitable farmlands, 2087.45 kg in moderately suitable farmlands and 4959.52 kg in suitable farmlands.

Again, the MVP of land in Imo State is very high for all classes of farmland. The value ranges from ₦302429.76 in non-suitable land to ₦718535.2 in suitable lands. This implies that areas with suitable farmlands must attract

Table 3. Land suitability classes and rate of performance in cassava production in Imo State.

Variable	Non suitable land	Marginal suitable land	Suitable land
Suitability index class limit	0 to 0.339	0.340 to 0.722	0.723 to 1.000
Frequency	94	67	42
Relative frequency (%)	46.0	33.0	20.7
Area cultivated mean (std error) (ha)	2.08 (0.92)	1.32 (0.74)	1.48 (0.92)
Mean output (std error)	9327.78 (6087.89)	10365.31 (7083.60)	31191.95 11087.89)
Rate of performance (tons/ha)	0.444	0.79	2.11
Mean Land productivity (std error)	3.72 (2.32)	4.00 (2.47)	5.71(3.22)
Percentage change in productivity	-	7.5	53.5
Marginal productivity of land (std error) (kg)	2351.42 (650.70)***	2087.45 (823.03)***	4959.52 (2000.03)***
Unit price of cassava	₦144.88/kg	₦144.88/kg	₦144.88/kg
Value marginal product of land	₦302429.76/ha	₦340673.73/ha	₦718535.20/ha

The mean suitability is 0.5304 and standard deviation is 0.1913); Source: Field Survey, 2010.

Table 4. Linear production model showing the marginal productivity of the various classes of lands in Imo State.

Variable	Suitable lands		Moderately suitable lands		Non-suitable lands	
	Co-Efficient	t-Value	Co-efficient	t-Value	Co-efficient	t-Value
Constant	-3972.52	1.011	5176.54**	2.352	13380.83***	7.087
Labour	269.70**	2.376	-35.76	0.46	-09.18**	2.390
Farm size	4959.52**	2.48	2087.45***	2.536	2351.42***	3.614
Plant Materials	30.51	1.35	45.92	1.140	8.32	0.389
Capital	-0.974	0.355	0.516	1.175	-0.75	0.749
R2	0.505		0.437		0.611	
Adj R^2	0.451		0.304		0.483	
F-value	9.420***		12.275***		36.13***	
No. of observation	42		67		94	

Source: Field Survey, 2010.

higher opportunity cost than others. Again, there is only a marginal difference in MVP of Moderately suitable land and non suitable land. This could be due the slight differences in their marginal productivities. The study suggests an equal opportunity cost with MVP on suitable farmlands for efficient resource allocation in the area. It is therefore suggested that land use intensification through soil ammendements and conservative practices will make no only make non-suitable lands sustainable but increases its value and returns.

CONCLUSION AND RECOMMENDATION

There is a strong evidence that land allocation for agriculture does not follow its productivity. Standard value of land are estimated from the MVP, hence the comparism with the opportunity cost for oprimal land use system. The study disintegaterd arable farmlands in Imo State based on their suitability for cassava production, hence estimated the MVP for each so as to establish a standard value for their optimal allocation. The study revealed that productivity follows suitability level and to increase the suitability farmers need to employ soil conservative and good management practices as listed in the study to increase the MVP. The study recommends that opprotunity cost of different suitability level of farmlands should based on their corresponding MVP for oprimal allocation.

REFERENCES

Adetunji MO, Adeyemo KE (2012). Economic Efficiency of Pig Production inOyo State, Nigeria: A Stochastic Production Frontier Approach. Am. J. Exp. Agric. 2(3):382-394. SCIENCEDOMAIN international. www.sciencedomain.org

Alfred SDY (2001) Socio-economic and Psychological Factors Affecting Adoption of Agricultural Innovation by Farm Household in Kogi State. Unpublished Ph.D. Thesis, Federal University of Technology. Akure. P. 58.

Al-Kaisi M (2012). Conservation Practices Saves Soils and Sustains Agriculture.*Integrated Crop* Management News Department of Agronomy, Iowa State University, USA.

Anyigo N (1982). The need for Land Resource services in Agricultural Production in Anambra State and Nigeria.In Proceedings of the First National Seminar on Agricultural Land Resources,Kaduna, Federal

Department of Agricultural Land Resources. P. 225.
Bassey EE (2008). The Effect of Land tenure on Natural Resource conservation in Nigerian Rainforest Ecosystem. www.environsecurity.org/espa/PDF/ESA-DRC.
Ehirim NC, Odurukwe SN, Ajaero, J, Emenyonu CA (2006). Socio-economic Analysis of Farming Risk in Cassava Production in Owerri, Nigeria. Int. J. Natural.Appl. Sci. 2(2):89-95.
F.A.O (1991). Nigerian Land Resources management study. Main Report and Annex 1. Rome FAO 1:17-24.
FAO (1976); A framework for Land Evaluation. Report on the Agro-ecological zones. Soils Bull. Fao Rome 32:72.
Federal Department of Agricultural Land Resources (FDALR) (1982). The Need for Land Resource Services to State. In proceedings of the First National Seminar on Agricultural Land Resources, Kaduna, Federal Department of Agricultural Land Resources. P. 273.
Hornick SB, Parr JF (2010). Restoring the productivity of marginal soils with organic amendments Ecological Agriculture Projects, McGill University (Macdonald Campus) Ste-Anne-de-Bellevue, QC, H9X 3V9 Canada Am. J. Alternat. Agric., 2(2): 64-68.
Nweke FI, Spender DSC, Lynam J (2002). The Cassava Transformation: Africa's Best Kept Secret. Michigan State University Press, East Lansing, Michigan, USA.
Olayide SO, Heady EO (1982); Introduction to Agricultural Production Economics. Department of Agricultural Economics University of Ibadan. University Press Ibadan. pp. 9-247.
Olowu AO, Oladeji JO (2004). Research Method in Agricultural Extension. Agricultural Extension Society of Nigeria (AESON). Agricultural and Rural Management Training Institute (ARMTI) Ilorin.
Oyekale SA (2008). Suitability of land, Journal of sustainable development. Department of Agricultural Economics, University of Ibadan.
Project Coordinating Unit (PCU) (2003). Crop Area Yield Survey. Abuja, Nigeria: Federal Ministry of Agriculture and Rural Development: Project Coordinating Unit.
Ugwoke FO, Odurukwe SN, Oguamah .C (2004). Gender Roles and Impacts of Oil Palm Commercialization on Intra-Household Dynamics in Imo State, Nigeria. Int. J. Agric. Rural Develop. 1(9);12-18.
Williams SKT (1984). Identification of Local Leaders. In A Manual of Agricultural Extension Workers in Nigeria. Les Shyraden, Ibadan, Nigeria. pp. 41-45.