Effect of Wetland on Cassava Production in Orhionmwon Local Government Area of Edo State, Nigeria

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ABSTRACT
The effect of wetland condition, a perennial environmental externality has become critical within the household livelihood framework. The study assessed the effects of wetland condition on cassava production in Orhionmwon Local Government Area of Edo State, Nigeria. The specific objectives of the study were to describe the socio-economic characteristics of cassava farmers; estimate and compare the cost and returns on cassava production between farmers in wetland and arable land; estimate and compare the technical efficiency between farmers operating on wetland and arable land; and finally estimate the differences in the yield between farmers in wetland and arable land. Farm level data were collected from 96 cassava farmers sampled through a multi-stage sampling procedure across four wetland and four arable land communities. A structured questionnaire was pre-tested and administered and data subjected to descriptive analysis, Gross margin analysis, Stochastic Frontier Production Frontier Analysis while t-test was used to assess differences in yield. The results showed that the mean farm size of respondents who operated their cassava farming operation on wetland areas was 1.4ha, while farmers operating on arable land was 1.7ha. The gross margin of farmers on wetland was ₦ 179, 605 as against gross margin of ₦ 527, 089 of farmer on arable land. The coefficient of soil status was negative and statistically significant at 5 percent showing an inverse relationship, while the coefficient of labour in man-days was positive and statistically significantly at 5%. Finally, a statistically significant difference exists between yield of farmers in wetland and farmers in arable land. The study recommend that farmers reduce their operation in wetland and employ off-farm income generating activities to augment their income.
Keywords: Wetland condition, Arable land, Gross Margin, Cassava Farming operation, and Household.

INTRODUCTION

The effect of climate change globally has led to the initiation of several fora such as the Intergovernmental Panel on Climate Change (IPCC) in taking affirmative actions towards mitigating and responding to its negative externalities (Awake, 2008). Our ability to change the environment through man's negative interactions has increased faster than our ability to predict the effect of such changes. Wetland a condition in our environment is one of the major long-term effects of man's negative interactions with the atmosphere which has ultimately led to heavy rainfall and ocean surge. Wetland occurs when soils have very-high moisture content while at the same time the water table is very close to the earth surface. It is a long-term weather-related effect. In Nigeria, we have four types of wetlands namely: marshes, swamps, bogs and ferns. The wetland ecosystem plays a critical role in supporting the livelihood of millions of people. The wetland is mainly located in the South-South region of Nigeria (Olarewaju *et al*, 2014).

The major agricultural problems associated with wetlands soil are; abundance of water, weeds, diseases and pest and poor crop yielding potentials (Paul *et al*, 2020). Various workers have reported adverse effects of wetlands on crop production. (Aghanenu and Onemolease, 2012; Adiele, 2020; Olarewaju *et al*, 2022). The effect is proportional to the level or amount of the wetland condition. The effect of wetness on the properties of soils have also been the subject of several empirical studies. Effects on root crop production is not an isolated studies.

Nigeria accounts for at least 21% of global cassava production, Nigeria exports cassava to various nations, Cassava has always been important to Nigeria's economy; it is the most abundant staple food in Nigeria after rice, notably, it contributes to about 45% of Nigeria's agricultural Gross Domestic Product GDP (NBS, 2020). However, wetland condition is a problem to cassava production. There is therefore a need for continuous research on the problem associated with wetland condition in Nigeria. Hence, this particular research effort had as its main objectives, (i) to describe the socio-economic characteristics of cassava farmers in the study area (ii) to examine the effect of wetland conditions on cost and return as well as yield of cassava production and (iii) to examine its effect on cassava farmers technical efficiency.

2.0 Methodology

Study Area

The study was carried out in wetland communities of Edo state, the selection was based upon the researcher's knowledge of this area as wetland communities. Edo state has 18 Local Government

Area with the capital in Benin city, it is predominantly a rainforest region. It is made up of three major tribe, namely Benins, Esans and Afemai. The state is between the geographical co-ordinates of 5° 04' East and latitude 5° 44' North of Greenwish Meridian the state is characterised by a tropical climate which ranges from humid to subhumid at different times in the year.

Study population and Scope of study

The population under study were small-scale cassava farming household engaged in cassava-farming in wet region and others in adjacent arable region which acted as a control. The study covered communities in Edo state which have been impacted in 2020-2024 agricultural year. This period allows for sampling of representative communities.

Sampling Techniques

A two-stage sampling procedure was employed to sample respondents for the study.

The first stage involves a purposive sampling of four wetland communities of study, they are Abudu Igbanke, Ogan and Evbobanosa, this was based on researchers a priori knowledge of this communities as wetland communities, whilst a corresponding four adjacent communities with arable land were also purposively sampled.

The second stage involve a random sampling of 12 local cassava farmers from the list of registered cassava farmers from the wetland communities while corresponding 12 local cassava farmers were also randomly sampled as above. Thus, giving a total of 96 cassava farmers for the study.

Data collection

The data used for this study were farm level data generated as primary data. This was administered through structured questionnaire to elicit information while secondary data were obtained from journals, internet and libraries.

Data verification

The questionnaire was checked by an expert in Department of Agricultural Economics and Resource Management of the University of Benin after which the questionnaire was checked per day taking the interview granted. These were methodically rechecked after collecting all data and coded prior to entering into computer software.

Data Analysis and Model Specification

Descriptive statistics which include, percentages, mean & frequency tables and t-test statistics were used to achieve the description of socio-economic characteristics.

To estimate and compare the cost and return as well as yield between farmers in wetland region and farmers in arable land, the Gross Margin analysis was used. The model is specified below:

GM=TR−TVC ---------- (1)

Where:

TR=Total revenue

TVC=Total variable cost (N)

GM=Gross margin

TR = P × Q

Where: P = unit price, Q = Quantity

TVC = TC × TFC

Where TC = total cost

TFC = Total fixed cost

To estimate and compare technical efficiency between cassava farmers in wetland communities and cassava farmer in Arable land communities. The stochastic Cobb-Douglas Stochastic frontier model was used. The implicit model is as specified below:

Y = F (Xi ,βi)e - (2)

e =Vi –Ui - (3)

Where:

Y=output

βi = parameters to be estimated

Xi =vectors of input

e = error terms

The explicit form of the model is specified below:

$\log Yi = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta 3 \log X_3 + \beta_4 \log X_4 + \beta_5 \log X_5 + \beta_6 \log X_6 + Vi - Ui$ ------(4)

Where:

log=Natural logarithms

Y=cassava output in kg

X_1 =Stem-cuttings

X_2 = Fertilizers in kg

X_3 = Labour (man days)

X_4 = Agrochemicals in Litters

X_5 =Land status (wetland=1; otherwise=0)

X_6 = Farm size in ha

V = Random errors which are assumed to be independent of U, identical and normally distributed with zero and constant variance.

U = non-negative random errors.

To determine and compare the yield of cassava production between farmers operating on wet land and farmers operating on arable land. The output of cassava production was measured as specified below:

Yield = Quantity × kg/tuber - (5)

While the comparison between the yield of wet land and arable land was done by using T-statistical test.

Hypothesis

The hypothesis shall be tested in the null form that there is no significant relationship between the yield of cassava production between farmers in wetland communities and farmers in arable communities.

The t-test is specified as follows:

$$T(comp) = \frac{\bar{X}_1 - \bar{X}_2 - (N1 - N2)}{\sqrt{\frac{S^2_1}{n_1} + \frac{S^2_2}{n_2}}} \quad - (6)$$

Where:

X_1 = Sample means of selected socio-economic variable of farmers in wetland

X_2 = Sample means of selected socio-economic variable of famers in arable land

N1 = Sample size of selected socio-economic variable of farmers in wetland

N2 = Sample size of selected socio-economic variable of farmers in arable land

S_1 = Sample variance of selected socio-economic variable of farmers in wetland
S_2 = Sample variance of selected socio-economic variable of farmers in arable land

3.0 RESULTS AND DISCUSSION

The socio-economic characteristics of cassava farmers

The results of the socioeconomic characteristics is presented in Table 1, the results showed that in wetland communities 58.70% of the respondents forming a simple majority were males, this is in contrast to arable land communities where 52.27% were female respondents. The reasons for the differences might not be unconnected to cultural limitation and inhibition of woman folk which is more pronounced in the formal than latter location. The results of the socioeconomic analysis also show that 45.65% of the respondents in wetland communities had a household size range of 5-8 persons while in arable land communities 62% of the household farmers had household size range of 5-8 persons in a household, with a mean household size of 5 and 7 person, for wetland and arable land communities respectively.

The results of Table 1, further showed that 56.52% and 25.00% of the respondents in wetland and arable land communities had an age range of 30-50 years. The reason for variation in age range could not be ascertained as at the time of data collection. The results of Table 1, again showed farm size of 1.4 ha and 1.7 ha for farmers in wetland communities and arable land communities respectively, it can be inferred that the difference in land size might likely be due to land loss due to environmental and climate processes.

Table 1: Socio-economic profile of respondents

Characteristics		Wetland			Arable land		
		Freq.	%	mean	Freq.	%	mean
Age range (years)	30 – 40	11	23.91		3	6.82	
	41 – 50	15	32.61		8	18.18	
	51 – 60	13	28.26		13	29.55	
	61 +	7	15.22	50	20	45.45	58
	Total	46	100.00		44	100.00	
Marital status	Single	5	10.87		0	.00	
	Married	38	82.61		41	93.18	
	Divorced	3	6.52		3	6.82	
	Total	46	100.00		44	100.00	
Gender	Female	19	41.30		23	52.27	
	Male	27	58.70		21	47.73	
		46	100.00		44	100.00	
Education	None	6	13.04		1	2.27	
	FSLC	2	4.35		4	9.09	
	JSS	3	6.52		2	4.55	
	SSS	25	54.35		19	43.18	
	OND/NCE	5	10.87		11	25.00	
	HND/BSc	5	10.87		5	11.36	
	MSc/PhD	0	.00		2	4.55	
	Total	46	100.00		44	100.00	
Household size (range)	1 – 4	20	43.48		4	9.09	
	5 – 8	21	45.65		30	68.18	
	9+	5	10.87		10	22.73	
	Total	46	100.00	5	44	100.00	7
Farming experience range (years)	1 – 10	17	36.96		11	25.00	
	11 – 20	26	56.52		24	54.55	
	21+	3	6.52		9	20.45	
	Total	46	100.00	14	44	100.00	17
Farm size (ha)				1.4			1.7

Source, field survey, 2025

Gross margin analysis results

The results of Table 2 showed the estimation of the gross margin of cassava farmers in wetland and cassava farmers in arable land in the study area. The result showed that the mean farm size of respondents who operated their farming activities on a wetland was 1.4 ha while the mean farm size of farmers on arable land was 1.7 ha. The mean cost of stem cutting used by cassava farmers in wetland was ₦ 20,760.30 with a standard deviation of ₦ 7,033.40 while that of farmers operating on arable land was ₦ 408,549.55 with a standard deviation of ₦ 9,305.20. The mean cost of fertilizer used by cassava farmers in Wetland was ₦ 106,793.43 with a standard deviation of ₦ 69,871.70 while the mean cost for farmers in the arable land region was ₦ 118,238.64 with a standard deviation of ₦ 82,672.00. The mean cost for Labour of farmers in a Wetland region was ₦ 98,130.43 with the standard deviation of ₦ 83,650.00 while the mean cost for labour among farmers in arable land region was ₦ 93,704.55 with a standard deviation of ₦ 76,766.50.

Furthermore, the mean cost of agrochemicals used by farmers in wetland communities was ₦ 35,478.26 with a standard deviation of ₦ 25,306.80 as against ₦ 52,931.82 mean cost with a standard deviation of ₦ 37,011.00 for cassava farmers operating on arable land communities. The mean cost of renting land was ₦ 24,130.43 with S.D of ₦ 6,236.10 while for arable was ₦ 25,454 with S.D of ₦ 4,488.60. The mean Total variable cost of farmers in the wet region was ₦ 472,141.30 with a standard deviation of ₦ 128,252.80 while that for farmers in arable land was put at ₦ 698,909.11 with a standard deviation of ₦ 296,244.30. Subsequently, the mean of the total revenue of farmers in wetland was ₦ 651,746.67 with standard deviation of ₦ 522,870.30 while the mean total revenue of farmers in arable land was ₦ 1,225,998.87 with a standard deviation of ₦1,105,120.82. Thus, the gross margin computation for farmers in wetland region had a mean of ₦ 179,605.32 while the GM of farmers in arable land region had a mean of ₦ 527,089.26. The profitability analysis from the study showed that the positive average annual gross margin per hectare for both groups of farmers indicates that farmers were able to cover their total operating expenses per hectare, which implies that though production was profitable for both farmers operating in wetland and arable land communities. However, the GM of farmers on arable land was thrice as much as the GM of farmers in

wetland. This might not be unconnected to the effect of wetland condition.

Table 2: Cost and Return Structure (average per farmer)

Item	Wetland		Arable land	
	Mean	SD	Mean	SD
Stem cutting	207,608.70	77,033.40	408,579.55	95,305.70
Fertilizer	106,793.48	69,871.70	118,238.64	82,672.00
Labour	98,130.43	83,650	93,704.55	76,766.80
Agrochemical	35,478.26	25,306.80	52,931.82	37,011.20
Land	24,130.43	6,236.60	25,454.55	4,488.60
TVC	472,141.30	282,523.80	698,909.11	296,244.30
Depreciation	29,021.74	11,333.70	36,651.16	12,183.90
TC	501,163.04	293,857.50	735,560.27	308,428.20
REVENUE				
Output	105.01	75.8	184.55	130
price/bag	6,206.52	1,561.00	6,643.18	1,597.90
TR	651,746.67	522,870.30	1,225,998.87	1,105,107.80
GM	179,605.37		527,089.76	
Profit	150,583.63	105,553.60	490,438.60	221,560.00

Source: Computed from field survey 2025.

Estimated Production function

The maximum likelihood (ML) estimates of the production function parameters of cassava production in wetland and arable regions of Orhionmwon Local Government area of Edo State, Nigeria is presented in Table 3. The choice of using stochastic frontier is that it has a higher intercept term and its representation of a non-neutral upward shift of the average production function, this result is consistent with Coelli *et al* .,(2005).

The coefficients of the estimated parameters have the desired signs. The coefficient of labour in man-days is positive and statistically significant at 5 percent indicating a direct relation relationship between labour and technical efficiency, thus implying that the higher the farmers labour utilization the more efficient the farmer would be.

The coefficient of soil status, a dummy variable whereby (wet land = 1 and arable land = 2) was negative and statistically significant at 5 percent indicating an inverse relationship between soil status and technical efficiency this implies that as the degree of wetness of the land increase, the cassava farmers get less technically efficient around the production frontier. The coefficient of the other estimated coefficient parameters is statistically in significant and therefore are not worth discussing.

SOURCE OF TECHNICAL INEFFICIENCY

The determinants of technical in efficiency in cassava production in wet and arable land communities are presented in Table 3. The coefficient age is not significant at 5 percent, ditto for the rest variable as such, they are not worth discussing and deliberating upon.

Table 3: Technical Efficiency Estimates
Final MLE estimates:

		Coefficient	Standard-error	T-ratio
Beta 0	Constant	-27.362	0.995	-27.492
Beta 1	Stem Cutting	0.618	0.621	0.995
Beta 2	Fertilizer	0.518	0.345	1.498
Beta 3	Man/days Per Session	4.467	0.934	4.783
Beta 4	Agrochemical	0.410	0.350	1.172
Beta 5	Land status	0.221	0.374	0.590
Beta 6	Farm size	23.907	0.996	24.009
Beta 7	Depreciation land (wet/ arable)	-0.184	0.424	-0.433
Inefficiency model				
Delta	Constant	0.079	0.751	0.105
Delta	Age	0.113	0.078	1.462
Delta	Gender	-0.148	0.856	-0.172
Delta	Education	-1.033	3.055	-0.338
Delta	Household size	0.108	0.606	0.179
Delta	Farming experience	-0.223	0.266	-0.837
Sigma-squared		98,435	0.997	98.770
Gamma		0.001	0.011	0.098

Log likelihood function = -330.90
LR test of the one-sided error = 3.74; with number of restrictions = 7
Note that this statistic has a mixed chi-square distribution
Source: computed from field survey 2025

Hypothesis Testing

Table 4, reveals the results of independent t-test for the null-hypothesis that, there is no significant difference in the yield of cassava production between farmer operating on wet-land and cassava farmer operating in arable land in the study area. The results of levene's Test for equality of variance reveals that a significant difference exist between the cassava yield ($p \leq 0.05$) of farmers operating in wet land and that of farmers operating in arable land. This might not be unconnected to wetland condition which empirical literature show affect growth rate and yield of cassava crop.

Table 4: Levene's Test for equality of means

Levene Test for equality of Variance		**T- test for equality of means**						
Variable		**F**	**Sig**	**E**	**af**	**Sig(2 tailed)**	**Mean diff**	**Std. error differance**
Cassava yield	**Equal variance assumed**	**5.646**	**0.18**	**2.447**	**4.23**	**.018**	**0.478**	**0.194206**
	Equal variance not assumed			**2.493**	**47.334**	**.013**	**0.478**	**0.190565**

Computed from field survey 2025

4.0: Conclusion

It can be deduced from the result of the study that, although cassava crop can thrive in most agro-ecological condition, but there is a level it can tolerate wet land condition.

The cassava farmer operating on arable land had more profit and yield than those operating on wetland conditions, it is therefore recommended that cassava farmers be enlightened on loss of income and therefore the need to employ off-farm activities to augment their income.

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