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EFFECT OF LAND DEGRADATION ON MAIZE YIELD IN OBUDU LOCAL GOVERNMENT AREA OF CROSS RIVER STATE, NIGERIA

[1]Osuafor, O. O., [2]Ude, K. D. and [1]Ositanwosu, C.O.

[1]Department of Agricultural Economics and Extension, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
[2]Department of Agricultural Economics, University of Nigeria, Nsukka
Corresponding Authors' email: oo.osuafor@unizik.edu.ng, ORCID: 0000-0003-1737-4909

Abstract
This study analysed the effects of land Degradation on maize yield in Obudu Local Government Area (LGA) of Cross River State. The study adopted the use of primary data and the instrument of data collection was a structured questionnaire administered on100 and 60 respondents for maize farmers in degraded and non-degraded lands respectively. The methods of data analysis used were both descriptive and inferential statistics. Descriptive statistics results on socio-economic characteristics shows that majority (67.0%) of the maize farmers were males, married (86.0%) and had mean age of 43.6years. Result on land degradation types revealed erosion (2.27), flooding (2.11) and desertification (2.02) as most common types of land degradation experienced by maize farmers in the study area. Over-grazing (35.0%) and poor farming method (35.0%) were the major causes of land degradation. Independent sample t-test statistic result comparing maize yield of degraded and non-degraded lands indicated a t-calculated value of 13.100 at 0.05 level of significance, implying significant difference in maize output between degraded and non-degraded lands in the study area. The OLS multiple regression model result with linear functional form as best fit equation of factors affecting output of maize, revealed coefficient of multiple determination (R squared) value of 0.840 which is an indication that 84.0% of the variation in maize output cultivated on degraded lands is explained by explanatory variables included in the regression model viz: cost of fertilizer (-0.002) and cost of seed (-0.006), all significant at 5% confidence level. The value of F-statistic (27.535) was significant at 1% significance level which explains that the explanatory variables jointly had effect on maize yield, therefore the null hypothesis was rejected and the alternate hypothesis accepted. The study recommended subsidization of fertilizer and seed cost for sustainability/better yield in maize production.

Keywords: Effect, Land Degradation, Maize, Yield

Introduction

Land is the basic natural resource that provides habitat and sustenance for living organisms, and a major focus of economic activities (Morufu and Ebuete, 2019). Nigeria is endowed with enough land which strengthens household security, national development, transboundary cooperation and regional integration to transform trade, and create new opportunities for sustainable development (Osabuohien *et al*, 2020). In recent times, it has been found that due to poor adoption of land management practices by local farmers on land use, has resulted to a decline in the productive content of many lands. Land degradation hinders agricultural food prices, increased poverty and malnutrition problem widen in different dimensions (Oladimeji *et al*, 2020). Land degradation in an agrarian economy can lead to unsustainable agriculture and development, thereby precipitating starvation and poverty, the physical impact of land degradation is reflected in irreversible loss of productive land through erosion, declining soil fertility resulting in reduced crop production.

Land degradation has been analysed and viewed by different authors. Heyi and Mberegwa (2012) defined land degradation as a temporary or permanent lowering of the soil's productive capacity. They further identified the major types of land degradation as; water erosion, chemical degradation processes (depletion of organic matter and soil pollution) and the physical degradation processes (such as, waterlogging). Land degradation as viewed by Orchard *et al*. (2016) is a persistent deterioration of land's productivity and often focuses on the soil component. The cause of land degradation is largely human and it is affected by economy, socio-

cultural, policy and institutional circumstances of the people (Babalola and Olayemi, 2013). Some of these processes of land degradation arise from human activities and habitation patterns, such as the effect of soil erosion caused by wind or water, deterioration of the physical, chemical and biological or economic properties of soil and the long-term loss of natural vegetation which has led to a reduction in the quality and quantity of food crops especially that of maize (Kiage, 2013).

Maize (*Zea mays L.*) is a member of the grass family (*Gramineae*), originated from South America and introduced to West Africa by the Portuguese in the 10th century. Maize has become the second most important staple food in the world and a staple food of great socio-economic importance in the sub-Saharan Africa (Santpoort, 2020). Maize is also grown in several regions of the world and is referred to as the world best adapted crop. Overtime, maize does not only serve as a source of food for man and livestock, but also a source of income and foreign exchange. Cheong *et al.* (2013) reported that maize dominates the agricultural sector, employing 60% of the work force and 28% of the Gross domestic products (GDP). In Nigeria, it is the third most important cereal in terms of area cultivated and volume of production (Osundare, 2017). Maize has grown to be the local 'cash crop' most especially in the south-south part of Nigeria where at least 30% of productivity has strengthened food security in the country. The production of maize by small scale farmers can overcome hunger in households and the aggregate effect could double food production in Africa (Andersson and Souza, 2014). Poor agricultural production has led to decline in the level of welfare among rural and urban households, for as the cropland has been devoted to small scale maize production under various cropping system. However, efforts have been made by both colonial and post-colonial governments to halt and reverse the ugly trend of land degradation in most countries (Selemani, 2014).

The current trends of land degradation suggest that the present levels of land management practices adoption are inadequate. Despite the Nigerian government aspiration to grow the agricultural sector so as to reduce food insecurity, agricultural productivity in Nigeria is low and declining (Osuafor *et al*, 2020). As recent as 2019, the degraded land in Nigeria was 104994km^2 representing 18.02% of the total surface area (Bai *et al*, 2020). Therefore, there is need for sustained investment in optimizing and adapting land management technologies to their specific environments to improve agricultural productivity and most important, curb the problem of land degradation. Considering, the general decline on maize production in Nigeria over the years as a result of degraded lands, this study seek to address the following research questions: What are the socio-economic characteristics of farmers in the study area? What are the types of land degradation? What are the causes of land degradation? Are there significant differences in maize output from degraded and non-degraded lands and what are the factors influencing maize output in degraded land? The overall objective of this study is to establish the effects of land Degradation on maize yield in Obudu LGA of Cross River State.

Methodology

The study Area is Obudu LGA of Cross River State. Cross River State is located in the South-South region of Nigeria with 18 LGAs. Obudu LGA is located between latitude 6˚20″ - 6˚40″ North of the equator and longitude 8˚4″ - 9˚0″East of Greenwich Meridian. It covers a land mass of 379,164 square meters to the west and has a population of well over 161,457 (Uyang *et al*, 2013). Obudu is in the North-East part of Cross River State, bordered to the North by Vandeikya in Benue State, to the East by the commune of Akwaya in the Republic of Cameroon, and to the South and West by the LGAs of Boki and Bekwarra. The Local Government is in the Northern senatorial district of Cross River State having ten wards: Alege/Ubang, Angiaba/Besiaka, Begiading, Ipong, Obudu-urban1, Obudu-urban2, Utugwang central, Utugwang North, and Utugwang South. Obudu is home to six clans: Bette, Obanlikwu, Bendi, Utuwang, Ukpe-Alege and Utanga-Becheve, all of which thrived as independent villages with the headquarters in Bette clan.

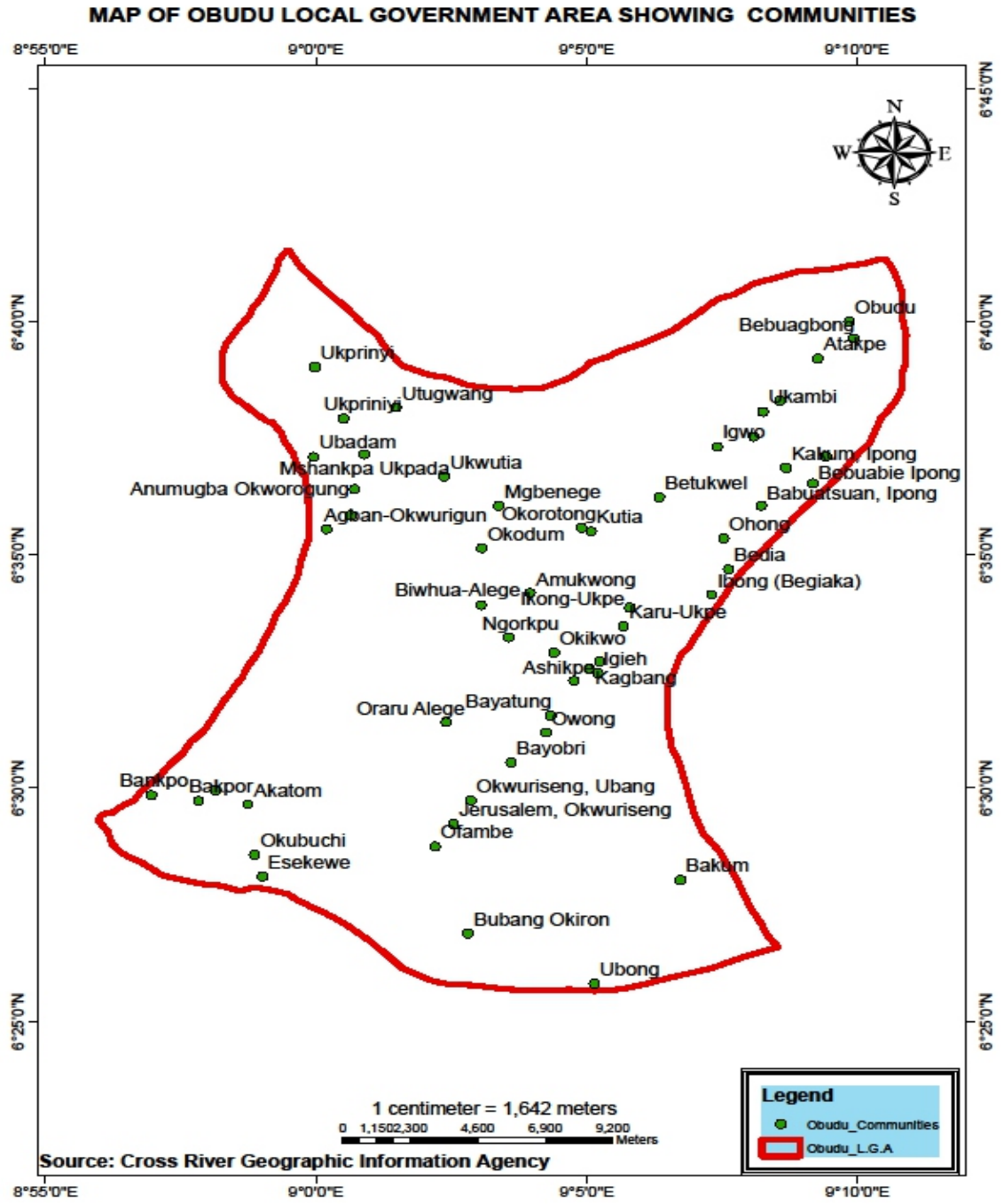

Figure 1: Map of Obudu L.G.A Showing Communities
Source: Oden *et al*. (2012)

Obudu is dominated by undulating terrain with much of the area being below 183m (600ft) above sea level. Surface drainage is generally good with almost all the rivers being seasonal. The climate is tropical sub humid with the mean annual rainfall between 1,200 and 200mm (47 and 79); Agriculture is the mainstay of the people with available land for livestock rearing. Over 90% of the population are directly engaged in peasant farming of virtually all kinds of food crops with concentration on yam, maize, groundnut, cassava, sweet potatoes, citrus, rice and millet.

A multistage sampling technique was used for the study. In the first stage, five wards were purposively selected based on degraded lands which include; Obudu-urban 1, Obudu-urban 2, Ipong, Begiading and Angiaba/Besiaka. In the second stage, a purposive sampling of two villages from each of the selected wards was carried out to give ten villages in all. Finally, sampling frames were developed for each village using a proportional allocation of 10% across board. Therefore a round up total figure of 100 respondents was used for the study as stated in the Table 1. In addition, 60 maize farmers were randomly selected from regions labelled as non-degraded lands to ascertain maize yield for comparative purposes.

Table 1: Sample size determination

Wards 1 More Predominant MF in degraded lands	Purposive selection of Villages with degraded lands	Sample frame	Sample size (10.0%)	Random selection of Villages with non-degraded land	Sample frame	Sample size (10.0%)
Obudu-Urban 1	Bebuawhang	97	9.7	Abonkib	54	5.4
	Bebuabung	89	8.9	Atiekpe	36	3.6
Obudu-Urban 2	Ukwel-Obudu,	50	5.0	Bebuagam	76	7.6
	Ukanbi	92	9.2	Kutiang	73	7.3
Ipong	Kakem	99	9.9	Bebuatsuan	34	3.4
	Bebuagbong	87	8.7	Igwo	62	6.2
Begiading	Uwhong	79	7.9	Bebuabie	84	8.4
	Betukwel	94	9.4	Akorshie	74	7.4
Angiaba/Besiaka	Bedia	68	6.8	Ukpe	63	6.3
	Ibung	82	8.2	Begiaba	51	5.1
	Total	936	93.6		607	60.7
		Round up value	**100.0**		**Round down value**	**60.0**

MF= Maize farming/farmers. Source: Authors computation (2019)

Primary data was used for this study. This was collected with the aid of a structured questionnaire administered to the selected households. The questionnaire was divided into four sections. Section *A* consist of the socio-economic characteristics of the farmer, section *B* consist of the comparison between output of degraded and non-degraded lands, section *C* consist of the causes and types of land degradation, section *D* consist of the effects of the factors of land degradation on maize output. The objectives of the study were analysed using descriptive and inferential statistics. The research instrument (questionnaire) was validated by pilot testing and passed through experts in the College of Agricultural Economics and Extension of the Federal University of Agriculture, Makurdi to ensure it possessed both construct and content validity.

The model is specified thus;

$$Y = b_o + \ln b_1 X_1 + \ln b_2 X_2 + \ln b_3 X_3 + \ln b_4 X_4 + e_i$$

Where,

Y= maize yield (kg)

X_1= Size of land degraded (ha)

X = Cost of land degraded (naira)

X_2= Cost of fertilizer (naira)

X_3= Cost of seed (naira)

Ln = Natural logarithms, b_o = Intercept, e_i = Stochastic term, b_1-b_n = Regression coefficients, X_1-X_4 = Independent variables (factors). The three commonly used algebraic (functional) forms are: linear, semi- log and double log which will be fitted to the data. The lead equation will be selected based on statistical and econometric reasons such as number of significant coefficients, magnitude of the F-ratio, highest value of coefficient of multiple determinations (R^2) and the conformity of the variables to *a priori* expectations.

Results and Discussion

Socio-economic Characteristics of Respondents

The results in Table 1 revealed the socio-economic characteristics of maize farmers in the study area. The result on age shows that majority (58.0%) of maize farmers in the study area were in the age range 41 and 60 years, with mean age of 43.6 years, implying that majority of respondents are still in their productive age to participate effectively in agricultural activities. This result does not agree with the findings of Zongoma *et al*. (2015) who reported that majority of maize farmers fall within the age range of 21 to 40 years. The result on gender shows that majority (67.0%) of respondents were males, while a few proportion (33.5%) were females, depicting the rigorous nature of maize farming through the processes of land preparation, tillage and harvesting which may be less burdensome to males than their female counterparts. The findings agreed with Zongoma *et al*. (2015) who reported that maize farming is mostly attributed to men. The marital status showed that majority (86.0%) of respondents were married, while small proportion (13.0%) were single. This coincides with the finding of Simon *et al*. (2013) who reported that most farmers are married and that farming provides extra income to cater for the needs of the family. Results on level of education showed that majority had secondary education, 28.0% had primary education, while 22.0% had tertiary education and 14.0% had no-formal education.

The result on household size shows that majority (53.0%) of household had between 6 and 10 persons in the house, with mean household size of 9 persons. This agrees with the findings of Baffoe-Asare *et al*. (2013) who reported that most farming households had a range of between 1 and 10 persons in the house which is a good source of farm labour. Majority (50.0%) had farming experience of less than 10years, with mean farming experience of 13.19years. The mean annual income of

maize production was ₦216,100.00 and according to Iken and Amusa (2014), most lucrative farmers earn greater than 100,000 naira annually. With respect to farm size, majority (53.0%) of respondents own between 2.51 and 4.0hectares, whereas, very few proportion (30.0%) have more than 5.0 hectares, with mean farm size of 3.82 hectares. This coincides with the finding of Ikponmwosa (2015), who reported that farmers have farm size of between 3 and 5hecteres of land for agricultural practices.

The result on size of degraded land shows that majority (63.0%) of the maize farmers agreed that less than a hectare of land was degraded. This agrees with the findings of Anyanwuyi *et al.* (2007), who reported that erosion is mostly the problem of arable crop farmers in Nigeria. With respect to farmer's access to credit, majority (75.0%) of farmers do not have access to credit facilities. This result agrees with the findings of Ijioma and Osondu (2015) who reported that most rural farmers do not have access to credit facilities due to delays in loan approval and disbursement. This explains why the farmers in the area are predominantly small scale farmers. Again, majority (73.0%) do not belong to cooperatives. Azubugwu and Osuafor (2019) noted in their study that non-membership in cooperatives hinders farmers from having access to credit. Hence, this possibly explains why the farmers could not have access to credit. Majority (71.0%) of the maize farmers own land through inheritance, 16.0% purchase and 13.0% lease. This coincide with the findings of Adeyemo *et al.* (2010) who noted that most (78%) of the farmers in Nigeria acquired land through inheritance. The migration status of farmers in the study area shows that majority (76.0%) are natives, while 24% are non-natives. This is true because most of the farmers in the study area are predominantly dwellers of the community and this explained clearly why they use inherited land in farming.

Table 2: Descriptive Statistics on the Socio-Economic Characteristics of Maize Farmers

Socio-economic characteristics	Frequency	Percentage	Mean
Age (years)			
21-40	42	42.0	43.60
41-60	58	58.0	
Sex			
Male	67	67.0	
Female	33	33.0	
Marital status			
Single	13	13.0	
Married	86	86.0	
Divorced	1	1.0	
Level of education			
Non-formal	14	14.0	
Primary	28	28.0	
Secondary	36	36.0	
Tertiary	22	22.0	
Household size			
Less than 5	29	29.0	8.51
6-10	53	53.0	
11-15	10	10.0	
Equal to or > 16	8	8.0	
Farming experience			
<11	50	50.0	13.19
11-20	32	32.0	
21-30	18	18.0	
Annual farm income			
<50,000	2	2.0	216,100
50,001-100,000	22	22.0	
100,000-150,000	10	10.0	
>150,001	66	66.0	
Farm size			
<1	1	1.0	3.82
2-2.5	16	16.0	
2.51-4.0	53	53.0	
>5	30	30.0	
Size of degraded land			
<1	63	63.0	
1.5-2.0	26	26.0	
>3.0	11	11.0	
Access to Credit			
Yes	25	25.0	
No	75	75.0	
Member of cooperative society			
Yes	23	23.0	
No	77	77.0	
Source of land			
Inheritance	71	71.0	
Purchase	16	16.0	
Lease	13	13.0	
Migration status			
Native	76	76.0	
Non-native	24	24.0	

Source: Field Survey, 2019

Perceived types of land degradation on yield of maize

Results in Figure 1 revealed the perceived types of land degradation on yield of maize. A cut off mean of 2.0 was considered as the bench mark. Perceived types of land degradation with mean above the bench mark of 2.0 are; erosion, flooding, desertification with 2.27, 2.11 and 2.02 respectively, indicating that these are the perceived major types of land degradation that affected the yield of maize in the study area. These findings agree with Hammad *et al*. (2006) who reported that lands experiencing erosion are not cultivable and such yield of crops cannot be realized in such area of land. Also Iken and Amusa (2014) was of the view that flooded lands are not used for most crops and such, crops like maize, groundnut are not suitable for flooded plains and thus during period of flood, these crops yield reduce greatly.

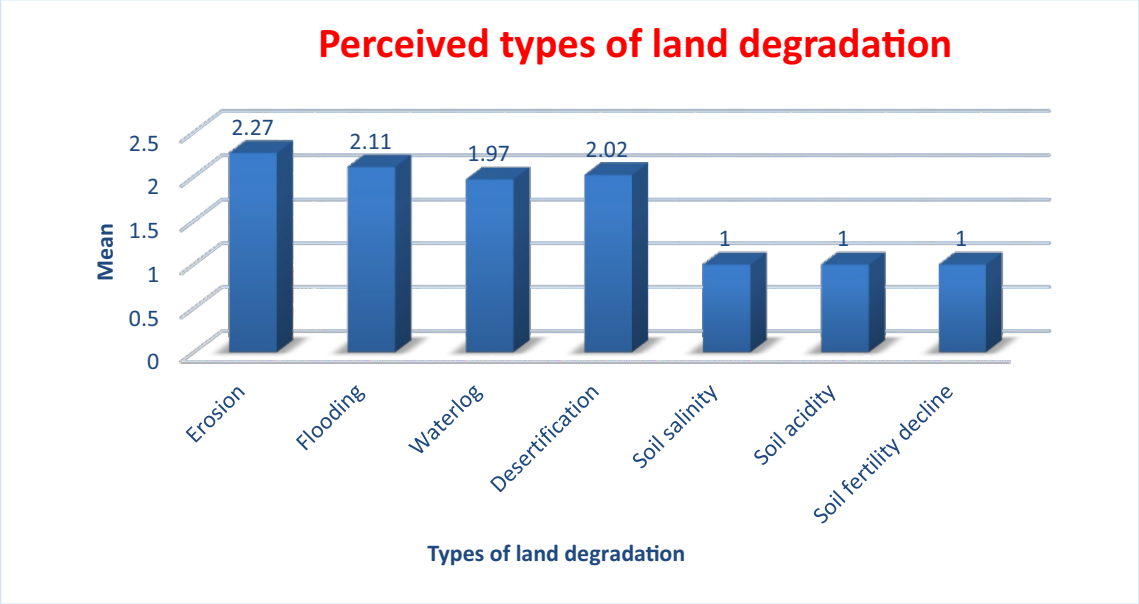

Figure 2: Descriptive Statistics on the Perceived Types of Land Degradation on Yield of Maize. Cut off mean=2.0

Causes of land degradation

Result in Figure 2 revealed the causes of land degradation in the study area. The result shows that many (35.0%) were of the view that over grazing and poor farming methods mostly caused land degradation. This is true because Nyakudya and Stroosnijder (2015) reported that poor farming methods like bush burning used in land preparation exposes the land to erosion and loss of the top soil which is fertile for crops. Also Dunne and Dietrich (2011) reported that trampling of herds of cattle's on land exposes the soil to erosion and eroded land are not good for cultivation, especially where there is severe gulley erosion. Other causes of land degradation are deforestation, natural or severe weather events with 12.0% and 18.0% respectively.

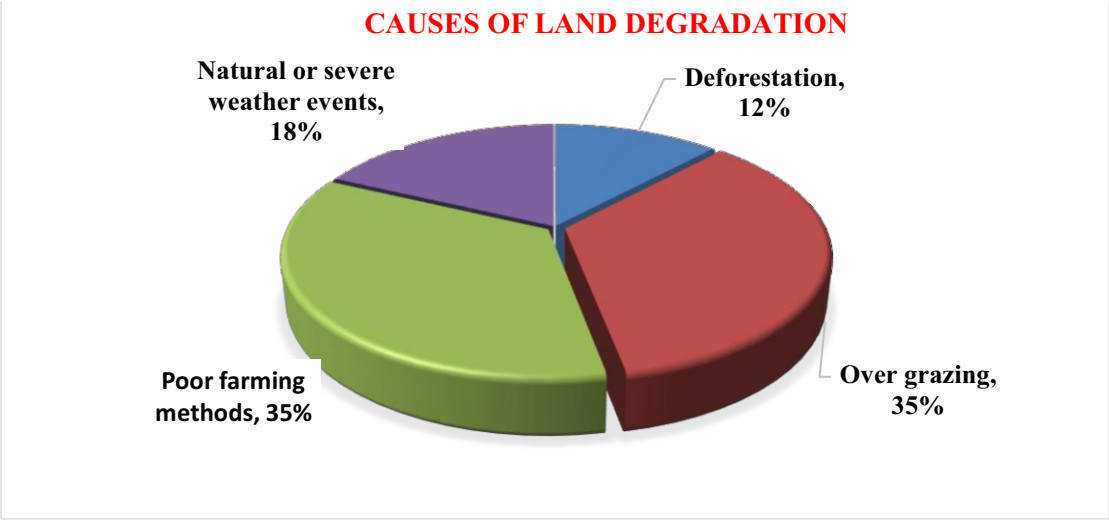

Figure 2: Descriptive Statistics on Causes of Land Degradation
Source: Field Survey (2019)

Comparing the Output of Maize in Degraded and Non-Degraded Land

Table 3 shows the independent sample t-test results on the comparison of output of maize on degraded and non-degraded lands. Maize output on degraded land has a mean of 838kg from 100 respondents, a standard deviation of 231.28701, while maize output on non-degraded land have mean of 354kg from 60 respondents and a standard deviation of 243.05032. From the Levene's test for equality of variance, the F ratio is 1.443 with a p-value of 0.033, which is less than alpha value of 0.05 (i.e. $p<0.05$). This indicates that there is a significant statistical difference in the mean ratings of response of respondents on degraded land and non-degraded land in the study area so we reject the null of Levene's test and conclude that the variance in maize output from degraded land is significantly different from that of non-degraded farms. The mean output from degraded land is significantly less than the mean output from non-degraded lands.

Table 3: Independent sample t-test Statistic result used to compare the Output of Maize in Degraded and Non-Degraded Land

Levene's test for equality of variance	F ratio	Significance	t-statistics	Degree of freedom	Sig. (2 tailed)	Mean difference	Std. error difference
Equal variance assumed	1.432	0.033	13.100	99	0.001	478.0	432.0
Equal variance not assumed			15.343	98	0.000	478.0	431.0
Group statistics	**N**	**Mean**	**S.D**	**Std. error mean**			
Output in kg of degraded land	100.0	838.0	231.28701	23.2870			
Output in kg of non-degraded land	60.0	354.0	243.05032	24.3050			

Effects of the factors of land degradation on maize output

Table 4 shows results of multiple regression analysis of effect land degradation on output of maize. Three multiple regression functional forms were used viz: linear, semi-log, and double-log. Linear model was selected as the lead equation based on the criteria of low mean square error, high coefficient of multiple determination, and number of significant variables and conformity of variables to *a priori* expectations. The coefficient of multiple determination (R^2) is 0.840, indicating that about 84.0% of the variance of the dependent variable being studied is explained by the variance of the independent variables or rather it indicates how much of the total variation in the dependent variable (output) can be explained by the independent variables. The F-statistic which explains the joint significant level of independent variables has a coefficient of 27.535 at 1% level of significance, indicating that the variables used were good. Cost of fertilizer has a negative coefficient of -0.002 which is significant at 5.0% level, indicating that increase in fertilizer will reduce the output of maize. This is true because area of land that is degraded through erosion; when fertilizer is bought and applied on the land, erosion will wear it away and thus, lead to yield reduction and consequently a drop in the output of maize. Cost of seed also had a negative coefficient of -0.006 significant at 5.0% level indicating that increase in the cost of seed will decrease output of maize. This is true because low seed cost increases the purchase of improved seeds and with good agronomic practices there will be increase in the output of maize in the study area.

Table 4: Regression estimates of Effects of Land Degradation on the output of Maize

Variable	Coefficient (t-ratio)
Constant	892.168 (18.197***)
Size of land degraded	-342.861(3.577***)
Cost of land degraded	-0.003 (-0.923)
Cost of fertilizer	-0.002** (-2.940)
Cost of seed	-0.006** (-2.682)
R^2	0.840
Adj. R^2	0.820
MSE	38.20
F-test	27.535***

Source: Field Survey, 2019. *, ** and *** =10%, 5% and 1% level of significance respectively; Values in parentheses represents the t value

Conclusion

The study analysed the effect of land degradation on maize yield in Obudu LGA of Cross River State, Nigeria. The study revealed that most perceived type of land degradation in the area is erosion, flood and desertification and the leading causes are overgrazing and poor farming methods. Over grazing and poor farming methods were the most important causes of land degradation in the study area. Also, cost of fertilizer and cost of seed had negative and significant effect on maize

output in the study area. Yield of maize in degraded land is less compared to that of non-degraded land showing how land degradation can reduce output production. The study concludes that land degradation significantly has negative effect on output of maize. The study recommended that farmers should be involved in land reclamation awareness campaigns, agronomic practices should be taught to the farmers through extension agents on how to manage and control erosion, flood and desertification, and ranches should be established to avoid free range grazing of livestock which leads to over grazing (a cause of land degradation). Agricultural technologies should also be utilized in full capacity to curb the problem of land degradation for increased yield/output of maize and other arable crops to enhance food security. Finally, subsidization of fertilizer and seed cost are very necessary for sustainability and better yield in maize production.

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