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Full Length Research Paper

Farmers perceived effects of soil degradation on the yield of improved cassava varieties in south east Nigeria

Nwaiwu J.C

Department of Agricultural Economics, Extension and Rural Development, Imo State University Owerri

Email: juanhyginus04@yahoo.com, Tel.: +2348039511468

Abstract

Improved cassava varieties have been developed and disseminated to farmers in the study area but the yield of cassava have been limited by poor farming practices which has led to soil degradation. This study therefore analyse the farmers' perceived effect of soil degradation on the yield of improved cassava varieties. 342 randomly selected farmers from 3 states that make up the south eastern zone where interviewed with a structured questionnaire. Data collected include; farming practices employed by the farmers, soil degradation experienced, perceived effect of soil degradation on yield of cassava. Also, the study hypothesized that the farming practices employed by farmers have no significant effect on soil degradation. The data obtained was analysed using both descriptive and inferential statistical techniques. The result revealed that most of the farmers (96.2%) cleared and burnt their farmland before use, practiced complete tillage (88.3%) and makes use of pesticides (74.8%). The types of soil degradation observed by most of the farmers include; water erosion (88.8%), deforestation (83.3%), and wind erosion (83.2%). The grand mean of 2.55 as indicated by the likert type scale shows that farmers perceived that soil degradation affects the yields of cassava irrespective of the variety planted. The result of the probit multiple regression was significant at 5%, therefore the hypothesis was rejected. The study recommends among others, that the Nigerian government with the help of the research institutes should concentrate more on ways to conserve the degraded soil of the south east than carrying out research on more improved varieties as the degraded soil is affecting the yield of the improved varieties.

Keywords: Cassava, Improved variety, Soil degradation, Effect, Nigeria

Introduction

Cassava (*Manihot esculenta*) is one of the world's most important food crops. In Nigeria, as in most developing countries, it is one of the most important carbohydrate sources. The crop plays a dominant role in the food security of rural households because of its capacity to yield under marginal soil conditions and its tolerance to drought (Ezedinma *et al*., 2006). According to FAO, (2003) cassava is a cheap and reliable source of food for more than 700 million people in the developing world. Cassava is a major root crop grown throughout Nigeria for cash, food, feed and raw material for agro-allied firms for the production of starch, alcohol, pharmaceuticals and confectioneries (Onwumere *et al*., 2006).

It had been suggested that before modern research on cassava started in Nigeria in 1954 at the research institutes in the country, there were numerous local ecotypes of traditional colonies. These varied in their tuber yields and general tolerance for prevailing pest and diseases. "Oloronto" (53101) a local cultivar was used in crosses in 1967 which led to the release of improved varieties such as 60444, 60447 and 60506 for the white county (CBB) became a scourge for cassava in the country, only 60306 and few local types tolerated the disease. Breeding work at international institute of tropical research(IITA) later identified improved colonies which were released after 1976 namely TMS30211 and TMS30295, rapidly followed by TMS30572, TMS30001, TMS300017, TMS30110, TMS30337, TMS30555,

TMS4(2)1425, TME419 and others (IITA 1984). Recently (2011), another variety of yellow cassava rich in vitamin A and high level of β-carotene was produced. The names are UMUCASS 36, UMUCASS 37 and UMUCASS 38.

The yields of all these improved varieties are constrained due to degraded nature of the soils in the South East. Soil degradation is the decline in soil quality caused by its improper use, usually for agricultural, pastural, industrial or urban environmental problem and may be exacerbated by climate change. It encompasses physical, chemical and biological deterioration. Examples of Soil degradation includes loss of organic matter, decline in soil fertility, decline in structural condition, erosion, adverse changes in salinity,acidity or alkanity and the effect of toxic chemical pollutants or excessive flooding.

It is estimated that 72%of Nigerian arable land and 31% of pasture lands have already been degraded as a result of erosion (Chukwu *et al*, 2013). Fragile soils with poor buffering capacity have been particularly susceptible to this type of degradation when cultivated continuously. This has caused a 7% loss of agricultural productivity on irrigated lands 14% loss on rainfed crop land and 45% loss on range land (Osabuomen and Okogie, 2011).

In Africa alone, productivity of some land have declined by 50% due to soil degradation while yield reduction resulting from soil degradation range from 2-40% with a mean loss of 8.2% (Eswaran *et al*., 2011). Southgate (1994) reported that soil degradation is a naturally occurring process which presently ranks as the most important degradation problem that affects the soil surface in developing countries, particularly in the tropics. In another dimension, Barbier (1997) and Scherr (1999) argued that by the year 2020, the increasing wave of soil erosion may pose a serious threat to food production in rural areas as well as urban livelihoods particularly, in poor and densely populated areas of the developing world including Nigeria. They further claimed that effects of soil degradation on production and profitability largely depend on the extent (spread) and intensity of erosion, the type of crop grown and the agro-ecological location of the land area. They advocate for polices that will encourage soil nutrient retention strategies if developing countries are to sustainably meet the food needs of their population.

The problems of arable crop farmers in Nigeria and in fact the South east is not on provision of improved cassava varieties but on how to check the degraded and eroded soils. It therefore becomes necessary to analyse the farmers' perceived effects of soil degradation on the yield of improved cassava varieties with the following objective:

1. To ascertain the farming practices employed by farmers
2. Identify the type of soil degradation experience by the farmers
3. Identify the type of cassava cultivated by the farmers
4. Examine the perceived effect of soil degradation on yield of cassava

Also the study hypothesized that the farming practices employed by farmers have no significant effect on soil degradation.

Materials and Methods

South east agro ecological zone was the study area. This zone lies between latitude 4°20' and 7°51'N and longitude 50°25' and 80°51'E covering a land area of about 109,524, 59sq.km (Monanu. 1975). It has a population of about 18.92million or 21.48% of the total population of Nigeria (NPC, 2006). It is one of the most thickly populated agricultural zones in Nigeria (Iloka and Anuebuwa, 1995). About 60-70% of the inhabitants are engaged in agriculture; mainly arable crop farming except the Riverine areas such as the Ijaws are mainly fishermen (Unamma *et al.,* 1985).

A purposive sampling technique was adopted to select three states (Abia, Anambra and Imo) in the zone. These are arable crop producing states with its large expanse of land prone to soil degradation. One hundred and twenty (120) arable crop farmers were randomly selected from each state giving a sample size of 360 respondents but only 342 questionnaires were properly filled and retrieved. Data was collected through the use of structured questionnaire administered to the respondents. Data were analyzed using both inferential and descriptive statistical tools while the hypothesis was tested using probit multiple regression parameter.

Result and Discussion

Farming practices employed by arable crop farmers

From the result presented in Table 1, most (96.2%) of the respondents cleared and burnt their farmlands before cropping. Majority of the farmers (80.7%) also allowed their farmlands to be left fallow for just between two and three years before farming on it again, while the remaining 19.3 percent allowed their farm lands to be left fallow for more than 3 years. This finding is in line with Kumar (1993) who opined that long period of bush fallow is no longer a common practice among farmers in West Africa because of population pressure on available land.

Allowing farmlands to be left fallow for long periods increases soil fertility, crop yield and reduces disease and pest population build up on farm land as well as lowering the rate of soil degradation. Most (88.3%) of the farmers practiced zero tillage, which agrees with the assertion of Ike, (2008) that intensive cropping could be avoided without hindering crop yield. Mixed cropping was also a common practice by most (85.15) of the farmers. This again is in consonance with the findings of Ike, (2008); who identified some of the advantages farmers derived from mixed farming as stability of income, better utilization of the land, reduced risk against total crop failure and flexibility in the use of labour.

These benefits undoubtedly contributed to the high rate of respondents' involvement in mixed cropping. Majority (72.8%) of the respondents weeded their farms at most

three times while 82.1 percent did not pack the weed out of the farmland. None of the farmers use herbicides while they generally practiced the use of pesticide (60.3) and fertilizer (74.8). These findings are in line with Ayoola, (2008); that the usage of chemical inputs by farmers in the tropics is minimal.

Table 1: Distribution of Respondents by farming practices employed

Farming Practices	Frequency		Percentage
Clearing and Burning of farmland:	Yes	329	96.2
	No	13	3.8
Period allowed for land Fallow:	2-3 years	276	80.7
	> 3 years	66	19.3
Type of tillage:	Zero	302	88.3
	Complete	40	11.7
Cropping pattern:	Mixed	291	85.1
	Sole/Mono	51	14.9
No of weeding/annum:	< 3	236	72.8
	> 3	106	27.2
Wedding pattern:			
Weeding and packing		41	17.9
Weeding without packing	281	82.1	
Use of pesticides;	Yes	206	60.3
	No	136	39.7
Use of Herbicides:	-	-	-
Use of fertilizer:	Yes	256	74.8
	No	86	25.2

Source: Field survey; 2015

Test of hypothesis

Ho: Farming practices employed by farmers have no significant effect on soil degradation

This hypothesis looked at the effect of various farming practices employed by arable crop farmers on soil degradation. The findings show that continuous bush burning/clearing by arable crop farmers encourages soil degradation; also their cropping pattern (mixed cropping) depletes the soil nutrient and makes the soil prone to degradation. The fallow period observed by the arable crop farmers and the use of pesticides and fertilizer are major contributors to soil degradation.

Table 2 shows the probit multiple regression parameter estimates of the effect of farming practices on the soil. Coefficient of determination of the model was 0.487 indicating that up to 49% variation in the dependent variable were explained by the set of explanatory variable of the model. As shown in the table, only three of the explanatory variables (use of pesticide, cropping pattern and use of fertilizer demonstrate statistically significant effect on soil degradation, with use of fertilizer showing a higher probability of contributing to soil degradation, based on the farmers perception.

Use of pesticides was significant at 1% level, while cropping pattern and use of fertilizer was significant at 5% level of probability. Fallow period was positively related to degradation showing that reduction in it may cause degradation. Most of the farmers (80.7%) left the farm land fallow for 2-3 years; in other words, increase in fallow period encourages conservation while reduction to two years encouraged degradation. Cropping pattern is positively related to degradation because mixed cropping practiced on a continuous manner depletes the soil nutrients and makes the soil prone to degradation.

Number of weeding per annum did not encourage degradation because there is a negative relationship between it and degradation. This is because majority of the farmers (72.8%) weeded for less than three times per annum. The implication is that high frequency of weeding which leaves the soil bare can induce degradation. Weeding without packing practiced by the majority of the respondents (82.1%) was negatively related to degradation. This implies that weeding without removal of the trash tends to conserve soil surface and serve as manure on decay.

The use of pesticide increased degradation because it had positive relationship with degradation. Based on the result, the null hypothesis that the farming practices employed by arable crop farmers have no significant effect

on soil degradation was rejected, meaning that there is a significant relationship between farming practice employed and soil degradation, hence, cassava farmers should adopt soil conservation practices to conserve the soil and not just planting improved varieties.

Table 2: Probit Multiple Regression Parameter estimates of the effect of farming practices on soil degradation

Explanatory Variables	Coefficient	Standard Error	Z-value
Constant intercept	3.593	4.469	0.804
Fallow period	0.976	0.592	1.650
Use of fertilizer	0.067	0.278	2.393**
Tillage type	-2.425	1.437	-1.688
Cropping pattern	1.328	0.567	2.343**
Weeding pattern	-0.171	4.316	-0.041
Number of Weeding	-0.188	0.251	-0.752
Clearing and burning of farmland	-1.932	1.873	-1.032
Use of herbicides	-0.0248	1.352	-0.184
Use of Pesticide	1.944	0.467	4.159***
Psedo R^2 (R^2) = 0.487			
Goodness of fit = 325.95			
Significant at 1% level = ***			
Significant at 5% level=**			

Source: Field Survey; 2015

Types of soil degradation experienced

Table 3 indicates that almost all the respondents (96.9%) and (93.8%) observed urbanization (loss of arable land) and water logging. The result also shows that more than three quarter (88.8%, 83.3% and 83.2%) observed water erosion, deforestation and wind erosion. This shows that the most observable type of soil degradation in the area despite loss of arable land and water-logging are water erosion, deforestation and wind erosion. Earlier studies indicated that the most common, harmful and observable type of soil degradation is erosion (water and wind) Igbozuruike (1978), Anosike (2002), Mailumo *et al.,* (2011), NEST (2007), Umahi (2011).

The result further reveals that more than half of the respondents 61.9%, and 55.2% observe bush encroachment.More than one-third of the respondents as indicated by the table observe chemical deterioration (35.6%) the observation of chemical deterioration may be due to the littering of polyethylene bags from sachet water and other bio-degradable trash like plastics. Finally, salinization (26.0%), silting (23.0%) and acidification (18.7%) were least observed by the respondents, this findings agree with the work of Kichei and Akeredolu (1991); who were of the view that acidification potential is less and rarely observed in the Nigerian environment as compared to other tropical countries.

Table 3: Distribution of respondents according to type of soil degradation experienced

Type of soil degradation	Frequency	Percentage
Water erosion	304	88.8
Soil salinization	89	26.0
Deforestation	285	83.3
Bush encroachment	212	61.9
Loss of biodiversity	121	35.3
Wind erosion	284	83.2
Water-logging	321	93.6
Chemical deterioration	122	35.6
Silting	79	23.0
Acidification	64	18.7
Loss of arable land (urbanization)	314	96.9

Multiple responses recorded
Source: Field Survey, 2015

Type of cassava cultivated by farmers

Information was sought on the type of cassava varieties that was cultivated by the respondent farmers. According to Table 4, 71.64% of the respondent's farmers cultivated the improved varieties while 28.36% still cultivate the non improved varieties. This indicates that majority of the farmers have adopted the improved varieties as disseminated to them by the research institutes through

the extension agents and therefore are expected to have a better yield.

Table 4: Distribution of respondents according to type of cassava cultivated

Type of cassava	Frequency	Percentage
Improved cassava variety (60444, 60447, 60504, TMS Species, UMUCASS Species)	245	71.64
Non improved variety (Oloronto, Nwanyi ocha, etc)	97	28.36

Source: Field survey, 2015

Perceived effects of soil degradation on yield of cassava

Table 5 presents numerous effects of soil degradation on cassava production activities as perceived by the respondents. Out of the fifteen suggested effects of soil degradation, the respondents agreed that twelve were evident in their farms. Using the discriminating index of ≥2.5 for agreement and <2.5 for disagreement, they strongly agreed that there is increase in poverty rate of farmers ($\bar{x}$=3.15), general reduction in family income ($\bar{x}$=3.11), increase cost of cassava production ($\bar{x}$=3.09), increase weed infestation of cassava crops ($\bar{x}$=3.09), soil fertility has been reduced generally ($\bar{x}$=3.08), cassava yields have reduced significantly ($\bar{x}$=3.05), increase cost of agricultural land due to loss of available land for developmental projects ($\bar{x}$=2.9).

The respondents also accepted that there is increase loss of available agricultural land due to erosion ($\bar{x}$=2.85), stunted growth of cassava crop ($\bar{x}$=2.89) and increase pest and disease incidence in cassava plant ($\bar{x}$=2.81).

This findings show that arable crop farmers in Southeast Nigeria are already facing the menace of soil degradation. This is revealed in the level of effects the degradation is already having on them. In the last decade an overwhelming consensus emerged among scientist that soil degradation is taking place at a much faster rate, therefore, not leaving enough time for the soil to recover and regenerate, (Osabuomen and Okogie, 2011); Anosike, (2002); Canter (1975); Duru (2003); Igbozuruike (1978), Karim and Igbal (2000); NCF (2003), and NEST (2012). This increase in soil degradation affects cassava production by causing shift in soil quality and fertility. This expectation can be seen to be a reality today as the effects of soil degradation is already manifesting in different forms and degrees. This is evident in the findings of this study as well as in many researches conducted all over the nation and beyond, (Foster and Magdoff, 2000; Ike, 2008; Johnson and Lewi, 2007; Eswaran *et al,* 2011; Van Den Ben and Hawkins, 1997 and Zia and Rashid, 1995).

Table 5: Distribution of respondents by perceived effects of soil degradation on yield of cassava

Attributes/Statements	SA (4)	A (3)	DA (2)	SDA (1)	Total	Mean	Remarks
Cassava yield reduced significantly	139 (40.6)	110 (35.5)	62 (18.1)	31 (9.1)	342	3.04	Accept
Stunted growth observed	119 (34.8)	101 (29.5)	86 (25.1)	35 (10.5)	342	2.89	Accept
Rate of poverty increased	158 (46.2)	106 (31.0)	51 (14.9)	27 (7.1)	342	3.15	Accept
Increased wind destruction of crops	123 (39.0)	148 (43.2)	54 (15.8)	17 (2.0)	342	3.10	Accept
Increased destruction of crops by rain	125 (36.6)	144 (42.1)	48 (14.0)	25 (7.3)	342	3.17	Accept
General increase in cost of production	140 (40.9)	125 (36.5)	47 (13.7)	30 (8.8)	342	3.09	Accept
Increased loss of agricultural land due to erosion	128 (37.4)	116 (33.9)	63 (18.4)	25 (10.2)	342	2.85	Accept
Reduction in family income	164 (48.0)	91 (26.6)	49 (14.3)	38 (11.1)	342	3.11	Accept
General reduction in soil fertility	145 (42.4)	112 (32.7)	52 (15.2)	33 (9.6)	342	3.07	Accept
Increase in weed infestation	151 (44.2)	110 (32.2)	42 (12.3)	39 (11.4)	342	3.09	Accept
Increase in disease and pest incidence	106 (31.1)	119 (34.8)	63 (18.4)	54 (15.8)	342	2.81	Accept
Increase in family income	27 (7.11)	51 (14.9)	106 (31.0)	158 (46.2)	342	1.84	Reject
Yield increased significantly	45 (13.2)	74 (21.6)	88 (25.7)	135 (39.5)	342	2.07	Reject
General reduction in cost of production	38 (11.1)	62 (18.1)	151 (44.2)	91 (26.6)	342	2.20	Reject
Total	**1739**	**1604**	**1006**	**781**	**5130**	**2.83**	**Accept**

Source: Field Survey, 2015

SA = Strongly Agreed; A = Agreed; DA = Disagreed; SDA = Strongly Disagreed

Conclusion and Recommendations

Soil degradation has reached a high level stage in the South eastern states of Nigeria. The consequences especially the negative effects on the yield of improved cassava are enormous. Based on the findings of this research work, it was concluded that most arable crop farmers in the study area are still practicing those methods that are prone to degradation irrespective of the variety of cassava planted.

Based on the findings, the following recommendations were made;

1. Nigerian government with the help of research institutes should concentrate more on ways to conserve the degraded soil of the south east than carry out research on more improved varieties as the degraded soil is affecting the yield of the improved varieties.
2. Since the most experienced type of soil degradation in the area is erosion, conservation techniques that can control this should be disseminated to farmers.
3. Farmers should be educated on the best farming method to use in order to conserve the soil.

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