ADAPTATION STRATEGIES AGAINST SOIL DEGRADATION AMONG ARABLE CROP FARMERS IN ATISBO LOCAL GOVERNMENT AREA OF OYO STATE, NIGERIA

Abstract

Environmental effects of drought, flooding and erosion of agricultural land results to soil degradation. Sustainable soil conservation practices are inevitable for agricultural production, food security, farmers' well being and rural economy. This study therefore, investigated adaptation strategies adopted by arable crops farmers to combat soil degradation in Atisbo local government area of Oyo State, Nigeria. Multi stage sampling procedure was used to select 128 arable farmers. Data were collected through the use of structured interview schedule. Descriptive and inferential statistics were used to summarize and analyze the data. Bush burning, soil erosion, soil compaction and deforestation were presumed by the arable crop farmers to be the causes of soil degradation in the area. Majority (60.2%) of the arable crop farmers perceived the effect of soil degradation to be disastrous and the most often used strategies against soil degradation are mulching, manure application and bush fallowing. The challenges in the adoption of soil conservation strategies are the inadequacy of finance, land tenure system, incentive, information, and technical knowhow and soil conservation skills. The perception of soil degradation among arable crop farmers is irrespective of their age and marital status, but depends on their educational level and religion. However, the higher the farmers' presumption of the causes of soil degradation, ($r= -0.02$, $p=0.825$) the lower they adopt soil conservation strategies. It is recommended that farmers should be educated on the need for adequate use of soil without hampering the soil and there should be a cross fertilization of ideas between research, extension and farmers' groups on sustainable use of soil.

Keywords: conservation agriculture, soil conservation, soil erosion, ecosystem, land use

Introduction

Mankind is faced with a catalogue of environmental problems that seem to threaten its supportive ecosystem. Yahaya and Olajide (2002) stated that Nigeria is faced with a vast number of environmental problems such as flood, drought, soil erosion and water pollution; many of which has been blamed on climate variation. Unchecked drought, flooding and erosion of agricultural land cause soil degradation. The soil loses some of its chemical, physical and organic qualities and thereby becomes less productive. The demise of soil structure, texture and fertility diminishes the ability of soil to nourish and support optimum crop growth (Uzokwe, 2000).

Soil degradation can either be as a result of natural factors or due to inappropriate soil conservation practices by humans. Natural factors are steep slopes, frequent floods, blowing of high velocity wind, high intensity rain, strong leaching in humid regions and drought in dry regions. Deforestation of fragile land, over cutting of vegetation, shifting cultivation, overgrazing, unbalanced fertilizer use, non-adoption of soil conservation practices, over-pumping of ground water (in excess of capacity for recharge) are some of the human factors that causes soil degradation.

The different forms of chemical degradation of soil include salinization, acidification and soil pollution. Physical degradation of soil occurs through soil erosion, use of heavy machinery and trampling by cattle. The heavy reliance on agrochemicals and neglect of manure application has also caused organic degradation of soil. Soil erosion is the predominant cause of soil degradation (Wickama and Nyanga, 2009). It is the washing away, transportation or impoverishment of top soil by water and/or wind. It is as a result of erodible soil, strong winds and high annual total rainfall characterized by high intensity. Prevalence of overgrazing, deforestation and quarrying also worsen the situation. In Atisbo Local Government Area, soil degrading practices are mono-cropping, continuous cropping, livestock grazing, over-tilling, no/little irrigation system, over-dependence agrochemicals, removal of tree shades and bush burning among many others.

In the face of these numerous soil degrading challenges, intentional efforts should be made towards effective soil conservation. Several strategies have been devised to combat soil degradation. Among them are cover cropping, agro-forestry, intercropping, terracing, no-till farming, contour plowing, crop rotation, controlled soil pH, soil water maintenance, manure application, salinity conservation and appropriate change in planting pattern/time.

The dense canopy of cover crops prevents rain drops from detaching soil particles and this keeps soil loss to tolerable limits. Cover crops also positively influence physical soil properties such as the infiltration rate, moisture content and bulk density. They increase the organic matter content, nitrogen (N) levels and hence crop yields. Agro-forestry is the integration of woody perennials with crops and/or animals on the same land. Intercropping systems include different kinds of annual crops planted in alternating rows and reduce soil erosion risk by providing better canopy cover than sole crops. Planting pattern, plant density and time of planting also play an important role in soil conservation. Crops planted at close spacing provide a higher canopy during periods with high rainfall intensities and hence protect the soil from erosion. Additional advantages are a decreased risk of total crop failure and the suppression of weeds.

Terracing is the leveling of a section of a hilly cultivated area to prevent rapid surface runoff of water. Terracing gives the landmass a stepped appearance thus slowing the easy

washing down of the soil. In addition, no-till farming is a way of growing crops without disturbing it through tillage, which could lead to compaction of soil, loss of organic matter in soil and the death of the organisms in soil. Contour plowing helps in the percolation of water into the soil. Plowing across the contour lines of a slope also helps in slowing the water runoff and prevents the soil from being washed away along the slope. However, some pathogens build up in soil if the same crops are cultivated consecutively. Continuous cultivation of the same crop leads to an imbalance in the fertility demands of the soil. Crop rotation, which is a method of growing a series of dissimilar crops in an area sequentially, is therefore used to prevent these adversities from taking place.

Nigeria's population explosion has put significant pressure on the natural resource base available for human sustenance with resultant decrease in fallow period of land. Land use intensification, reduction in land productivity, rapid soil losses and disruption of water resources is therefore common (Kuponiyi, 2001). The rapid increase in population means a reduction in the available land space for farming and consequently reduced food production. In agrarian communities where most arable crops come from, soil erosion and degradation of agricultural land pose a threat to food security (Oladeji, 2007). Avoidance of soil degradation by improved soil conservation is therefore important to maintain the functions of the soil and contribute to food security today and for future generations (Etui and Pender, 2005). In order to sustain agricultural production, food security, farmers' well being and rural economy, sustainable soil conservation practices are inevitable. Therefore, this study seeks to determine strategies adopted by arable crops farmers to combat soil degradation in one of the food basket area of Oyo State, Nigeria

Specific objectives

The specific objectives of the study are to determine the:

1. Personal characteristics of the farmers
2. Farmers' presumed causes of soil degradation in the area
3. Arable crop farmers' perceived effect of soil degradation
4. Soil conservation strategies adopted to control soil degradation
5. Trend of arable crops' yield of the farmers
6. Challenges in the adoption of the soil conservation strategies

Null Hypotheses

Ho_1: There is no significant relationship between farmers' presumed causes of soil degradation and their adaptation strategies

Ho_2: There is no significant difference in farmers' arable crop yield in 2009 and 2011

Methodology

The area of study is Atisbo Local Government Area of Oyo State. It is found within Oke Ogun area of Oyo state which has an area of 2,997 km² and a population of 110,792

(NPC, 2006). Atisbo Local Government consists of seven towns. The name of the LGA is an acronym for Ago-Are, Tede, Irawo, Sabe, Baasi, Ofiki and Owo communities. It falls between derived savannah zone with tropical wet and dry season and annual rainfall between 100mm-200 mm. Primary occupations of the people is farming. The population for this study constitutes arable crop farmers in the seven towns. Multi stage sampling procedure was used in this study. One hundred and twenty eight experienced farmers were selected for the study. Data were collected through the use of structured interview schedule. Descriptive and inferential statistics were used to summarize and analyze the data.

Results and Discussion

Personal characteristics of the arable farmers

Table 1 shows that the largest proportion (28.1%) of the arable farmers fell between 51 and 60 years of age, with mean age of 55 years. This implies that farm labour strength is diminishing as it constituted mainly of aged population. However, farming experience is likely higher with older farmers. Also, males dominated farming activities in the area, negating the findings of Baba (2002) that more females are into arable crop farming while more males are into cash crop farming. More than three-quarter of the farmers were married, implying that household labour might complement farming activities. It also indicates that there is a demand for steady arable crop production to maintain household food security. The fact that largest proportion (35.9%) of the farmers had between 11 to 20 years of farming experience (mean = 16 years) implies that they are equipped to overcome their farming challenges to a considerable extent. It is important to consider the religious bias of people, especially because some farming practices and systems are religious sensitive. Most (47.7%) of the farmers were Christians, 34.4% were Muslims while only 18.0% were traditional worshippers. According to Akegbejo and Aromolaran (2000), dwindling farmers' household size has reduced the significance of household labour, farmers now have to hire labourers to meet up with farm labour demands. This conclusion is in tandem with the result in table 1 that shows that most of the farmers had a household size of between four and six; an indication that farm household labour is diminishing. On the other hand, Oladeji (2007) opined that large household size means that there are more dependants to be fed and has negative implication for household food security. Lastly, the educational level of farmers is expected to boost their understanding and facilitate favourable perception of the harm of soil degradation (Baba, 2002). However, the largest proportion (35.(%) of these arable crop farmers have no formal education.

Table 1: Distribution of the arable farmers' personal characteristics (N=128)

Variables	Categories	Frequency	Percentage
Age in years	21-30	7	5.5
	31-40	23	18.0

	41-50	26	20.3
	51-60	36	28.1
	61-70	28	21.9
	Above 70	8	6.3
Mean = 55 years			
Sex	Male	117	91.4
	Female	11	8.6
Marital status	Single	4	3.1
	Married	103	80.5
	Divorced	10	7.8
	Widowed	11	8.6
Years of farming experience	1-10	26	20.3
	11-20	46	35.9
	21-30	34	26.6
	31-40	12	9.4
	41-50	8	6.3
	51-60	2	1.6
Mean = 16 years			
Religion	Christianity	61	47.7
	Islam	44	34.4
	Traditional	23	18.0
Household size	1-3	22	17.2
	4-6	56	43.6
	7-9	42	32.8
	Above 9	8	6.3
Educational level	Non formal	46	35.9
	Primary	31	24.2
	Secondary	35	27.3
	Tertiary	16	12.5

Source: Field survey, 2012

Farmers' Presumed Causes of Soil degradation

Table 2 shows that bush burning, soil erosion, soil compaction and deforestation are presumed by the arable crop farmers to be the causes of soil degradation in the area, while flooding is presumed to be the lowest cause of soil degradation in the area. This little significance of flooding was because of the absence of water bodies that could overflow their banks in the area. The significant detriment of heavy rainfall is thus soil erosion. The result is in tandem with the assertion of Wickama and Nyanga (2009) that running water is the main agent of soil degradation.

Table 2: Distribution of farmers' presumed causes of soil degradation (N=128)

Agent of degradation	Frequency	Percentage	Rank
Soil erosion	98	76.6	2nd
Deforestation	95	74.2	3rd
Bush burning	108	84.4	1st
De-vegetation	92	71.9	5th
Soil compaction	95	74.2	3rd
Flood	33	25.8	7th
Acidification	88	68.8	6th

Source: Field survey, 2012 *Multiple responses

Perceived effect of soil degradation

Table 3 shows that majority (60.2%) of the arable crop farmers perceived the effect of soil degradation to be disastrous while 39.8% of the respondent perceived the effect of soil degradation not to be worthy of concern. This implies that most of the farmers had the understanding of the economic detriments of soil degradation and would probably adopt measures to stop the trend. The 39.8% that do not appreciate the adversity might not take measures to address the challenge and this is a major source of concern.

Table 3: Distribution of the level of perception of soil degradation in the area (N=128)

Level	Frequency	Percentage
Favourable	51	39.8
Unfavourable	77	60.2

Source: Field survey, 2012

Soil conservation adaptation strategies

Table 4 shows that the more often used strategies against soil degradation were mulching (77.3%), bush fallowing (45.3%) and manure application (41.4%). No-till farming and agro-forestry are the less adopted strategies among arable crop farmers. On the average, manure application, mulching, planting of cover crops and crop rotation is practiced by most of the farmers. Some of these strategies might be an incidental or intentional part of the farmers' farm practices, whichever the case; they strategies are good for soil conservation. This implies that soil degradation would have been worse if not for the indigenous farm practices of the farmers and with more motivation from all agricultural stakeholders; soil degradation will not be a problem in this area.

Table 4: Percentage distribution of strategies against soil degradation (N=128)

Strategies adopted	No	Yes		
		Often	Sometimes	Rarely
Crop rotation	6.3	53.9	28.1	11.7

Agro-forestry	89.8	1.6	3.9	4.7
Shifting cultivation	58.6	14.8	11.7	14.8
Planting of cover crops	5.5	35.2	44.5	14.8
Mulching	4.7	77.3	14.8	3.1
Intercropping	23.4	33.6	31.3	11.7
Planting pattern	58.6	15.6	11.7	14.1
Planting indigenous crops	52.3	12.5	18.0	17.2
No-till farming	88.3	3.1	1.6	7.0
Bush fallowing	16.4	45.3	28.1	10.2
Manure application	3.9	41.4	26.6	28.1

Source: Field survey, 2012

Arable crop yield in 2009, 2010 and 2011

Table 5 shows that there is little difference (0.3) in the yield of maize and sorghum in 2009, 2010 and 2011. In the case of cassava and soybean yield, there was an increase in 2010 and a decline in 2011. The yield of soybean in 2009, 2010 and 2011 has a negative difference (- 2.1). This reduction in the yield of a crop that increases soil fertility suggests a reduction in soil fertility in the area. However, there is a continuous increase in the production of yam in the area. The result reveals that crop yields in the area are relatively stable. It might be inferred that the farmers' soil conservation practices had helped the soil to maintain its productive ability.

Table 5: Mean distribution of yield of major crops from 2009 to 2011

Crops	2009	2010	2011	Difference
Maize (bags)	23.0	24.3	23.3	0.3
Cassava (baskets)	79.1	89.2	86.5	7.4
Yam (tubers)	5111.4	5338.0	5929.4	818.0
Sorghum (bags)	4.6	4.8	4.9	0.3
Soybeans (bags)	11.7	12.1	9.6	- 2.1

Source: Field survey, 2012

Challenges in the adoption of soil conservation strategies

Table 6 reveals that the challenges in the adoption of soil conservation strategies are the inadequacy of finance, land tenure system, incentive, information, and technical knowhow and soil conservation skills in descending order. The arable crop farmers believe that adoption of soil conservation strategies requires more expenditures and incentives should be provided to encourage them. Also, land tenure system constitutes another challenge because land is not always a free use item and makes fallowing difficult. This implies that farmers would not assume the responsibility of soil

conservation alone; they would therefore not make much effort at it without the contribution of all land management stakeholders.

Table 6: Percentage distribution of challenges in the adoption of strategies

S/N	Constraints	Very severe	Severe	Not severe
1	Unfavourable land tenure system	68.8	7.8	23.4
2	Lack of incentive	77.3	13.3	9.4
3	Cultural barrier	35.9	26.6	37.5
4	Inadequate finance	82.0	16.4	1.6
5	Unavailability of information	62.5	32.8	4.7
6	Population pressure on land	43.8	25.8	30.5
7	Lack of technical knowhow	68.0	25.0	7.0
8	Inadequate soil conservation skills	61.7	23.4	14.8
9	Little road access to lands	52.3	33.6	14.1
10	Insufficient farm labour	53.9	27.3	18.8

Source: Field survey, 2012

Test of hypotheses

Hypothesis 1: There is no significant relationship between arable farmers' presumed causes of soil degradation and their soil conservation strategies

Table 7 shows that there is no signification relationship between arable farmers' presumed causes of soil degradation ($p>0.05$) and their soil conservation strategies. However, the relationship is negative ($r= -0.02$), implying that the higher the presumption of the causes of soil degradation by the arable crop farmers, the lower they adopt soil conservation strategies. This may be because they presume that the causes of soil degradation are beyond them and so, they do not bother to adopt strategies to reverse the trend. This is one of the reasons why USDA (1999) concluded that farmers alone do not have to pay the price for soil conservation. Also agreeing with the result of analysis on table 7 that lack of incentive is a very severe constraint to adopting soil conservation practices.

Table 7: PPMC test of relationship

Variable	r-value	p-value	Decision
Causes of soil degradation *versus* Soil conservation strategies	-0.02	0.825	NS

Source: Field survey, 2012

Hypothesis 2: There is no significant difference in farmers' arable crop yield in 2009 and 2011

Table 9 shows that there is no significant difference in the yield of maize, sorghum and soybeans in 2009 and 2011 because the p-value for each is greater than level of significant which is 0.05. This implies that there is a reduction in the yield of maize, sorghum and soybean in 2011 compared to 2009. However, there is a significant difference in the yield of cassava and yam in 2009 and 2011 because the p-value is less than level of significant which is 0.05. This implies that there is a remarkable increase in the yield of cassava and yam in 2011 compared to 2009. Cassava and yam are tuber crops, and tuber crops are known to be rugged enough to grow and develop well even in adverse environmental situations. Therefore, the reason why there is a reduction in the yield of the non-tuber crops might be because of adverse environmental circumstances like soil degradation.

Table 9: t-test of difference

Variables	Mean	SE	df	t-value	p-value	Decision
Maize yield in 2009	23.0315	0.6191	126	-0.103	0.918	NS
Maize yield in 2011	23.2835	0.9791				
Cassava yield in 2009	79.1231	0.5139	64	-2.529	0.014	S
Cassava yield in 2011	86.4769	0.2307				
Yam yield in 2009	5111.3934	0.6282	121	-2.307	0.023	S
Yam yield in 2011	5929.4262	0.3196				
Sorghum yield in 2009	4.5795	0.4277	43	-0.661	0.512	NS
Sorghum yield in 2011	4.9091	0.2814				
Soybean yield in 2009	11.7000	0.5771	29	0.927	0.361	NS
Soybean yield in 2011	9.6333	0.4493				

SE-Standard Error, df-degree of difference, t-value - t-test coefficient, p-value – probability coefficient, NS-Not Significant at $p \geq 0.05$, S-Significant at $p < 0.05$
Source: Field study, 2012

Conclusions and recommendation

Bush burning, soil erosion, soil compaction and deforestation were presumed by the arable crop farmers to be the causes of soil degradation in the area. Majority of the arable crop farmers perceived the effect of soil degradation to be disastrous and the most often used strategies against soil degradation were mulching, manure application and bush fallowing. Also, there was little difference in the yield of maize and sorghum in 2009, 2010 and 2011, while there was a continuous increase in the production of yam in the area. The challenges in the adoption of soil conservation strategies were the inadequacy of finance, land tenure system, incentive, information, and technical knowhow and soil conservation skills. The arable crop farmers believed that adoption of soil conservation strategies requires more expenditures and incentives should be provided to encourage them. In addition, the perception of soil degradation among arable crop farmers was

irrespective of their age and marital status. However, the perception of soil degradation among arable crop farmers was culturally and literacy inclined. The higher the presumption of the causes of soil degradation by the arable crop farmers, the lower they adopted soil conservation strategies. There was a reduction in the yield of maize, sorghum and soybean in 2011 compared to 2009. However, there was a remarkable increase in the yield of cassava and yam in 2011 compared to 2009. It is inferred that only rugged tuber crops increased in yield between 2009 and 2011. In order to increase the practices of soil conservation techniques and increase the yield of all crops; governments, nongovernmental organizations, and private institutions should support agricultural research and extension to motivate farmers to conserve the productive ability of the soil.

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