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Assessment of the effects of soil fertility management technologies on the yield of selected food crops in Oyo State, Nigeria

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This study assessed the effect of soil fertility management technologies (SFMTs) on food crop production in Oyo State, Nigeria. It specifically examined the socio-economic characteristics of the food crop farmers, identified the various SFMTs practiced and assessed the yield of selected food crops under the identified SFMTs. The results of the study showed that 70% of the respondents used at least one out of the seven (7) identified SFMTs. Highest proportion (36.9%) of the respondents used cover crops while 17.9% applied inorganic fertilizers alone. To assess yield, the technologies were reclassified into three. Empirical results showed that yam and maize had the highest yield (3354.80kg/ha and 1093kg/ha respectively) under inorganic SFMT while cassava had the highest yield (5534.72kg/ha) under non-usage of technologies. It was concluded that there is no significant difference in the yield of yam under the identified SFMTs, but there was for maize and cassava. The study therefore recommended that yam production be done under any of the technologies, while both maize and cassava production should be carried out under the technologies which gave the highest yields.

Key words: assessment, soil conservation, food crops, yield

Introduction

Food insecurity is a central concern and a fundamental challenge for human welfare and economic growth in Africa. Low agricultural production results in low incomes, poor nutrition, vulnerability to risks and lack of empowerment. Land degradation and soil fertility depletion are considered the major threats to food security and natural resource conservation in Sub-Saharan Africa (SSA). Countries in SSA are among those with the highest rates of nutrient depletion (Stoorvogel and Smaling, 1990). Investments in technology development and uptake and both policy and institutional reforms are needed to increase agricultural productivity to ensure food security and sustained national

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economic growth. Past studies have generated numerous soil fertility management technologies (SFMTs) which if adopted, could propel the agriculture-dependent African continent out of the poverty trap (Bationo *et al*, 2007). The International Centre for Soil Fertility and Agricultural Development (IFDC) estimated that Africa loses 8 million metric tons of soil nutrients per year and over 95 million ha of land have been degraded to the point of greatly reduced productivity (Henao and Baanante, 2006). According to Bationo (2009), the extent of such losses is of sufficient importance that action, such as recapitalization of soil fertility, increased use of inorganic fertilizer, and more efficient recycling of biomass within the farming system are being taken. As a result of the above problems, Sanchez *et al*. (1997) have concluded that soil-fertility depletion in smallholder farms is the fundamental biophysical root cause of declining per capita food production in Africa, and soil fertility replenishment should be considered as an investment in natural resource capital. The situation in Nigeria is not different from the average African picture. Henao and Baanante (1999), in their assessment of soil nutrient depletion, reported that Nigeria and Guinea Bissau experienced the highest annual losses of nitrogen and potassium and that the highest rates of potassium depletion occur in these two countries in West Africa. Ruthernberg (1980) and Adesimi (1988) made assertion that the increasing rate of population growth at 3% in Nigeria and the consequent pressures from competing demands for land over time have resulted in cultivatable land being drawn from its traditional agricultural uses, with resultant reduction in the land-man ratio and this has drastically reduced the average size of farm land and invariably leads to soil fertility depletion through continuous or intensive cropping along with short, unfertilized fallow. Under these short fallow systems, Plucknett (1993) and Adebayo (1997) observed that nutrient availability from natural sources alone become inadequate and soil fertility and productivity can be maintained only through efficient and increasing use of intensification technologies. These include alley farming, tree planting, organic manure and inorganic fertilizers that have direct effects on soil fertility maintenance and improvement (Kang *et al.*, 1986; Polson and Spencer, 1991).

To ensure that an agricultural system is sustainable, it is often necessary that a large land area be managed appropriately. Measures to increase the productivity of both presently cultivated and new land are urgently needed. To meet the rate of population growth, yields must grow at a rate considerably greater than today, even to maintain present low nutritional standards. The extra yield must also be obtained without causing further degradation of the soils, and indeed the fertility of the soils will have to be raised. First and foremost, the farmers (men and women) will need to make the necessary changes, and

governments must assist them in developing their farming practices in such a way that production is increased on a sustainable basis (FAO, 2001). Past research has generated numerous SFMTs that can be used by farmers to improve soil productivity. Assessment of their use formed the basis on which this study was carried out. Specifically, the study examined the socio-economic characteristics of farmers in the study area; identified various SFMTs in use; assessed the yield of arable crops under various SFMTs identified and examined the constraints encountered in the use of the various SFMTs.

Materials and methods

The study was carried out in Oyo State, Nigeria. Oyo State is located between 7^{o} 3′ and 9^{o} 12′ North of the equator and longitudes 2^{o} 47′ and 4^{o} 23′ East of the Meridian. This location confers on the State the equatorial climatic conditions. The study made use of primary data which were collected through a well structured questionnaire and interview schedule. A multi-stage random sampling technique was adopted for this study. Four out of the 33 Local Government Areas (LGAs) in Oyo State notable for growing food crops in large quantity and where various types of SFMTs were in use were purposively chosen for this study. These LGAs were Akinyele, Oluyole, Iddo and Ibarapa East. From each LGA, two (2) communities were randomly selected from a list of food crop communities provided by the Oyo State Agricultural Development Project (ADP). From each community, fifteen (15) food crop farmers were selected making a total of 30 respondents in each LGA. In all, 120 food crop farmers were interviewed for this study. Data analytical tools included descriptive statistics such as tables, percentages, frequency distribution, mean, and Analysis of Variance (ANOVA).

Results and discussion

The socio-economic characteristics of respondents are shown in Table 1. The table revealed that majority of the respondents was male and a larger proportion of them were between ages 41 and 60years with the average age being 46years. Following Ringe-Metzger and Diehl (1993), who classified respondents into four categories, children (0-9years), youth (10-15years), adult (16-60years) and old people (61years and above) as basis for explanation, the study revealed that 81.7% of the sampled food crop farmers were adults. The implication of this is that majority of the sampled farmers had the capability and strength needed for farming operations. The most of the respondents (80.0%) were married; only 33.3% had no formal education and the majority which constituted 39.3% of the respondents, had household sizes of between 1

and 5 members. Analyzing the year put into farming practices showed that most of the respondents (37.5%) had up to 10 years experience. Going by Olayide *et al* (1982), most of the farmers were small scale holders as they had farm size range of 0.1 - 5.99ha. The predominant method of land acquisition in the study area as revealed by the table was through inheritance. From the table, 62.5% of the respondents acquired their land through this land tenure system. The types of labour employed on the farm by the respondents were mostly family and hired labour (55.0%) and majority (32.5%) of them practiced cassava/maize mixed cropping system.

The type of SFMTs practiced by the respondents was shown in Table 2. Result showed 30% of the respondents did not practice any of the SFMTs identified. Out of the remaining 70% that practiced a SFMT, 36.9%, which constituted the highest proportion, used cover crops only to manage soil fertility. Notably, most (63.0%) of those who practiced these SFMTs, had been using the practice for up to 10 years.

The assessment of the yield of food crops under the SFMTs was shown in Tables 3 and 4. In assessing the yield of food crops, the three major food crops cultivated by the respondents in the study area were used. These crops were yam, maize and cassava. In addition, for computational simplicity and easy results interpretation, the seven SFMTs identified were re-classified into three groups: organic alone (application of manure, alley cropping and planting of cover crops), inorganic alone (application of inorganic fertilizers) and combination of organic and inorganic (application of manure and or planting of cover crop with application of inorganic fertilizers). The grouping of respondents is shown in Table 3 below. From the table, 39.2% used organic method alone while 12.5% used inorganic means. Another 18.3% used both organic and inorganic means while 30% did not use any of the SFMTs.

Table 1. Socio-economic characteristics of respondents.

Variable		Frequency	Percentage
Gender	Male	99	82.5
	Female	21	17.5
Total		**120**	**100.0**
Age	18 – 40	39	32.4
	41 – 60	59	49.3
	> 60	22	18.3
Total		**120**	**100.0**
Mean		**46**	
Marital status	Single	24	20
	Married	96	80
Total		**120**	**100.0**
Level of education	None	40	33.3
	Primary	19	15.8
	Secondary	17	14.2
	Diploma/NCE	27	22.5
	B.SC/B.A/B.ED	16	13.3
	S75	1	0.8
Total		**120**	**100.0**
Household size	1 – 5	47	39.3
	6 – 10	45	37.4
	11 – 15	21	17.5
Total		**120**	**100.0**
Farming experience	1 – 10	45	37.5
	11 – 20	18	15.0
	21 – 30	21	17.4
	31 – 40	22	18.3
	41 – 50	14	11.7
Total		**120**	**100.0**
Total farm size	0.1 – 5.99	109	90.9
	6.0 – 9.99	10	8.4
	≥10	1	0.8
Total		**120**	**100.0**
Method of land acquisition	Inherited	75	62.5
	Inherited + Purchased	8	6.7
	Inherited + Leased	7	5.8
	Purchased	17	14.2
	Purchased + Leased	1	0.8
	Leased	12	10.0
Total		**120**	**100.0**
Type of labour employed	Family	7	5.8
	Hired	47	39.2
	Both	66	55.0
Total		**120**	**100.0**
Food crop grown	Yam	3	2.5
	Cassava	22	18.3
	Maize	5	4.2
	Yam + Cassava	17	14.2
	Yam + Maize	19	15.8
	Cassava + Maize	39	32.5
	Yam + Cassava + Maize	15	12.5
Total		**120**	**100.0**

Source: Survey Data (2009)

Table 2. Identification of SFMT practices and duration of use by farmers.

		Frequency	Percentage
Usage of SFMTs	Yes	84	70.0
	No	36	30.0
Total		**120**	**100.0**
SFMTs identified	Planting of cover crops only	31	36.9
	Application of manure only	4	4.8
	Application of Inorganic fertilizer	15	17.9
	Alley Cropping	8	9.5
	Cover crop + Manure	4	4.8
	Cover crop + Fertilizer	16	19.0
	Manure + Fertilizer	6	7.1
Total		**84**	**100.0**
Duration of use of SFMTs	1-10	53	63.0
	11-20	13	15.5
	21-30	5	6.0
	31-40	8	9.5
	>40	5	6.0
Total		**84**	**100.0**

Source: Data Survey (2009)

Table 3. Classification of respondents based on SFMTs used**.**

Major group of SFMTs	Frequency	Percentage
Organic Alone	47	56.0
Inorganic Alone	15	17.9
Organic and Inorganic	22	26.1
Total	**84**	**100.0**

Source: Authors computation from survey data (2009)

The average yield of selected food crops per hectare under the three classes of technology groups are presented in Table 4. The table showed that respondents who did not make use of any technology had the lowest yam and maize yields, but the highest yield of cassava. The respondents who applied inorganic fertilizers only, had the greatest yield of maize and yam crops, an average of 1093kg/ha and 3354.80kg/ha respectively. The table also revealed that respondents who applied only inorganic fertilizers had the least cassava yield of 2766.73kg/ha.

Table 4. Average yield of selected food crops under identified SFMTs groups.

Group	Yam Quantity harvested/ hectare (in kg)	Maize Quantity harvested/ hectare (in kg)	Cassava Qty. Harvested/ hectare (in kg)
Organic	2252.94	484	4230.49
Inorganic	3354.80	1093	2766.73
Organic + Inorganic	3261.85	739	3916.64
None	1734.06	401	5534.72

Source: Authors computation from survey data (2009)

The problems encountered by the respondents in the course of using the various SFMTs was shown in Table 5. The majority of the respondents of 17.5% had problems in obtained fertilizers, 5.8% had problems with unstable market prices of cover crops while only 0.8% of the respondents had problems with the tree crops they planted alongside the food crops. The tree crops, after a stage, form shade thus preventing sufficient insolation from reaching the food crops.

Table 5. Problems encountered in the usage of the soil fertility technologies identified.

Problem	*Frequency	*Percentage (%)
Unstable market price of cover crop	7	5.8
Stunt growth/poor yield of cover crops and tree	6	5
Flooding/Irregular rainfall	6	5
Competition of cover crops with food crops	2	1.7
Transfer of manure from poultry to farm	2	1.7
Bulkiness of poultry dung	2	1.7
Scarcity of fertilizers	21	17.5
Tree crop forming shade	1	0.8

* Multiple responses

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