



ADOPTION OF INTEGRATED SOIL MANAGEMENT AND WATER CONSERVATION PRACTICES AMONG VEGETABLE FARMERS IN JOS METROPOLIS OF PLATEAU STATE, NIGERIA

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ABSTRACT

This study examined the adoption of Integrated Soil Management and Water Conservation Techniques (ISM and WCT) among the vegetable farmers in Jos North and Jos South LGAs of Plateau State, Nigeria. Multi stage sampling techniques were used to select 312 vegetable farmers. Primary data were collected using a structured questionnaires and analysed using descriptive statistics and adoption index (AI). Result showed that 64.2% of the respondents were male with mean age of 44years. Also, majority (68.6%) of them were married with average household size of 7 persons. Findings indicate that mulching (3.7), irrigation (3.7), organic farming (3.6) and crop rotation (3.6) were the highly adopted practices by the vegetable farmers with their mean scores greater than 3.00. The result also indicate that vegetable farmers were low (50%) and medium adopter (50%) of ISM and WCT, respectively. The study concluded that the vegetable farmers adopted mulching, organic farming, crop rotation cover cropping, irrigation and drainage as ISM and WCT in the study area. To increase level of adoption it is recommended that, agricultural practitioners should mobilize smallholder farmers and train them for successful implementation of ISM and WCT practices.

Keywords: Adoption, Conservation, Soil, Management and Water

INTRODUCTION

Agriculture plays a huge role in Africa's economy with about 70% of the continent's population practicing subsistence farming for their livelihood while they equally live in the rural areas. Hence, the significance of this sector in providing employment and motivating economic growth in a developing nation such as Nigeria cannot be undermined. Agriculture mainly hinges on environmental factors and any prolonged variations in average weather conditions can have significant impacts on production. Additionally; agriculture as practiced in the continent, is highly characterized by land tenure insecurity which continues to hamper agricultural growth for millions of smallholder farmers; while poor soil fertility, degraded ecosystems and climate variability are among other problems associated with agriculture in Africa (USAID 2016). Consequently, additional sustainable agricultural technologies such as improved agricultural technologies remain an important part of the efforts to boost food availability, crop production and improve soil quality in a bid to reduce food and nutrition insecurity which is currently threatening humans' right to food accessibility in developing countries (Sennuga and Fadiji, 2020).

Soil and water are indispensable for the existence and survival of all terrestrial life. These are the basic resources to the requirement for food, feed, fuel, and fibre of human beings. Soil supports plant life by providing a medium for their growth and development (Manivannan *et al.*, 2017). It is a non-renewable natural resource and susceptible to rapid



degradation through various forms of erosion processes. Worldwide, around 52% of total productive land has been degraded by various kinds of degradation processes and almost 80% of the terrestrial land is affected by water erosion (Yousuf and Singh 2019). Enormous quantities of soils are lost inconspicuously but leave devastating effects on land quality and the environment; soil erosion may pass unseen in onetime rain yet the associated soil loss ranges between 35 to 75 t/ha/year (Nearing *et al.*, 2017). Food production on limited land necessitates efficient use of the resources to ensure sustainable productivity and food security for growing populations. SWCPs contribute to the reversal and reduction of erosion and land degradation rates and increase soil and crop productivity (Nearing, *et al.*, 2017).

Water conservation includes all the policies, strategies and activities to sustainably manage the natural resource of fresh water, to protect the hydrosphere, and to meet the current and future human demand (thus avoiding water scarcity). Most of the farming systems lacks adequate information on the various conservation techniques in terms of farmland and water use toward improved food security, generate more income, increased well-being, reduced vulnerability and encourage sustainable use of the natural resource base. Household decision to invest in soil-water conservation is based on anticipated benefits

ISWM ensures that productivity and ecological integrity of soil resources are maintained over time. It is key for improving land resource productivity and resilience and is critical in coping with devastating effects of climate change and environmental degradation. Soil conservation techniques are a set of management antidotes needed to prevent the topsoil from being eroded or the soil from being degraded chemically or structurally due to overuse (Lal, 2015).

Soil undoubtedly plays pivotal roles in the agricultural production systems. As a medium that physically supports crop and animal growth, the sustainability of crop productivity also depends on the quality of soil. Though a fixed asset, soil is primarily essential to guarantee food security, industrial crop production and improved household financial status (Agboola *et al.*, 2020). In the tropics (Nigeria inclusive), soil fertility deterioration is a common form of degradation, which is increasingly threatening the sustainable agricultural production of smallholder farmers whose livelihoods partly or wholly depend on soil. Smallholder farmers' goal of production is gradually moving away from pure subsistence to commercial. Hence, much more than the preservation of the environment and soil, issues generally perceived to guarantee household's daily survival form the basis of soil conservation practices. According to Ajayi (2017), adoption of land, soil and water conservation practices has become a key concern in the development policy agenda for Sub-Saharan Africa. The adoption of soil, and water conservation practices that comprise mulching, intercropping, etc. has been considered as part of the agenda of agricultural development policy (Mango *et al.*, 2017). It is no longer possible to ignore the impact of depletion of soil and water resources that has led to the deterioration and loss of resources.

The adoption of agricultural innovations is crucial to increase incomes and food output in developing countries to meet the needs of the continuing growing population (Pingali, 2017). Increasing agricultural productivity is critical to meeting the continuous rising demand for food. Agricultural technologies play immense role in increasing food productivity. As a result, it is useful to examine the adoption of technologies among farmers. According to Thomas *et al.*, (2017) the most common areas of technology development and promotion for crops include new varieties and management regimes; soil as well as soil fertility management; weed and pest management; irrigation and water management.

Furthermore, agricultural production and productivity growth depend on a mixture of factors such as the use of sustainable soil management techniques (SSMT), agricultural



ecological, micro and macro-economic policies, and trade at the international level etc. Other important factors include; land, labour and capital (Osuji, 2017). Although the issues of soil and water conservation have been subject to extensive research worldwide. In Nigeria, these could be witnessed in the various land reclamation projects, irrigation schemes, use of organic manure/fertilizer instead of the inorganic which destroys the soil structure, afforestation, landscaping, crop rotation, planting of wind breaks, cover crops and efficient and effective resource management among other strategies.

Since the introduction of these innovations (past and present) in many parts of Nigeria, few study has been undertaken to know their status in many farming systems and their spread or whether they are still confined to the initial original adopters. This is important as one of the ways of assessing the success, acceptability and adaptability of any technology (ies) or innovation(s) in an area to know the rate and extent of spread of integrated soil management and water conservation techniques. Despite the economic importance and nutritional value of vegetables, farmers in Jos North and South were faced with serious land degradation problems which affects their productivity and livelihoods. To fill this gap this study was undertaken to assess the adoption of integrated soil management and water conservation techniques among vegetable farmers in Jos North and South L.G.A of Plateau State.

This study focused on:

- (i) Describing the socio economic characteristics of vegetable farmers in the study area
- (ii) Describing the adoption level of some ISM and WCT practices among vegetables farmers in the study area

METHODOLOGY

Study Area

The study area was Jos North and Jos South Local Government Areas (LGAs) of Plateau State. Jos North LGA is bordered by Bassa, Jos East and Jos South LGAs and part of Bauchi State while Jos South is situated at the North Western part of the State with its headquarters at Bukuru, which is about 15km from the State capital. Jos North Local Government area of Plateau State lies between Latitude ($9^{\circ} 56' 51.81''$ and $9^{\circ} 55' 42.6''$) N and Longitude ($8^{\circ} 50' 47.72''$ and $8^{\circ} 53' 31.6''$) E while Jos South Jos South Local Government Area is located between Latitudes ($9^{\circ} 34' 22''$ and $9^{\circ} 54' 40''$) N and Longitude ($8^{\circ} 39' 55''$ and $8^{\circ} 59' 13''$) E. Jos is located in Northern Guinea Savannah and has an elevation 1,200 meters (3937 feet) above sea level. (Olowolafe and Dung 2000). Jos North is made up of several districts, towns, and villages which include Tudun wada, Ahwol, Gangare, Kabong, Naraguta, Tafawa Balewa, Mazah and Jenta Adamu while Jos South LGA has four districts: Du, Gyel, and Kuru and Vwang districts. Jos North LGA covers a total land area of 291km^2 with estimated population of 489,277 (NPC, 2022) while Jos South LGA has total land area of about 510km^2 with estimated population of 489,827 (NPC, 2022). The areas is hosting members of diverse ethnic affiliations due to its cosmopolitan nature and it has an average daily temperature of 28°C . The areas witnesses two major seasons which are the dry and the rainy seasons with the total precipitation level in the area put at 1750 mm per annum (Olowolafe and Dung ,2000)

Sampling Techniques

A multi stage sampling technique was adopted for the study. In the first stage, four (4) wards from each of the 2 LGAs were purposively selected based on the farmer's engagement in intensive dry and rainy season vegetable farming. The wards are: Jos Jarawa, Naraguta A, Naraguta B and Tudun wada-Kabong in Jos North while Bukuru, Du, Kuru A and Kuru B from Jos South. In the second stage, vegetable farmer's associations were used in getting the



total number of farmers in the two Local Government Areas as the sampling frame. The third stage involves the use of simple random sampling techniques in selecting 5% of vegetable farmers from sampling frame (Table 1).

Table 1: Selection Procedure

LGA	Wards	Population(N) (vegetable farmers)	Sample size (n) 5%
Jos North	Jos Jarawa	399	20
	Naraguta A	609	30
	Naraguta B	670	33
	Tundunwada- kabong	597	30
Jos South	Bukuru	899	44
	Du	1009	50
	Kuru A	1040	52
	Kuru B	1064	53
Total		6287	312

Source: Vegetable Farmers Association, 2023

Methods of Data Collection and Analysis

Primary data were collected using a structured questionnaires. The questionnaire consists of information on socio economic characteristics of vegetable farmers, adoption variables various ISM and WCT practices among vegetable farmers. Trained enumerators were employed to carry out pre-test of questionnaire and data collection. Testing of the questionnaire was done in the actual study area in order to cross check the relevance of its contents, reliability and validity among others.

Method of Data Analysis.

Data collected were subjected to descriptive statistics such as the means, frequency counts and percentages. Similarly, adoption index (AI) formula adapted from Sani *et al.*, (2018) and Yusuf (2016) were adopted to determine adoption level of ISM and WCT among the farmers. The model/formula is specified as:

$$AI_i = 1 / N_p \sum (ISM + WCT) \dots \dots \dots (1)$$

Where;

i-1,2,3.....n and n= total number of farmers

N_p = Number of practices – 8

AI_i = adoption index of ith farmers

ISM= Integrated soil management

WCT= Water Conservation technique.

RESULTS AND DISCUSSIONS

Socio-economic Characteristics of the Farmers

The socio-economic attributes of the respondents as presented in Table 2 gives a clear picture of the calibre of farmers in the study area. The result shows that majority (64.2%) were males while 35.8% were female. This implies that males are more into vegetable farming in the study area. It can be said that males are more involved in agriculture in order to improve the economic conditions of their household. This agrees with Adebayo and Ojogu (2019) who said that in most rural areas, families gain a living by producing both cash and food crops. The results also revealed that, majority (68.6%) of the respondents were married while 16.8%, 10.8% and 2% were single, widowed and divorced, respectively. This finding implies that majority of the respondents were married with families to fend for. The high



proportion of married respondents according to Eleme (2014) could be related to socio cultural factor where land is only handed over to individuals who are married. The result further shows that 32.4% of vegetable farmers were within the age bracket of 41-50 years while 23.6%, 21.3%, 14.8% and 7.7% were between 31-40, 51-60 below 30 and 61 years, respectively. .

The result also indicates that more productive persons formed the greater percentage of the respondents in the study area with an average age of 44 years. This suggests that respondents were still within their productive years and should be well energized and innovative. Echebiri and Eriogun (2018) also found similar results in their study. Also, majority (85.1%) of the respondents had farming as their occupation while 7.8% and 7.1% were into trading and civil servants, respectively. This implies that most respondents in the study area are farmers and likely aware soil conservation practices. This reiterates the fact that farming remains the major occupation in the study area. Similarly, 53.1% of the vegetable farmers had secondary education while 25.3%, 17.2%, 4.4% had tertiary and primary education respectively. . This result reveals that majority of the respondents were predominantly literate. This high literacy level among farmers usually speeds up communication and information flow and the transfer of innovations or technologies like ISM and WCT. (Agube and Ogbonna, 2018).

Similarly, more than half (52.0%) of the respondents had household size of between 6-10 persons while 34.8%, 11.1% and 2.0% had 1-5, 11-15 and above 16 persons, respectively. The implication of this is that larger households tend to consume more and therefore have more needs to cater for. This large number of household size is in line with Ajunwa *et al.*, (2016) who posited that a large family size could entail many hands in family labour supply, typical of Nigerian agriculture which requires so many hands for labour supply. Also the findings revealed that, 46.6% of the respondents had farm size 1ha and below while 28.7%, 11.8%, 9.2% and 3.4% had 1.1-2ha, 2.1-3.0, 3.1-4.0, and 4.1-5.0, respectively with average farm size of 1.5 hectares. The implication of this finding is that majority of vegetable farmers operate small holdings. Fragmentation due to land tenure systems, nearness to farms and resource endowment of farmers may be responsible. This finding agrees with that of Adebayo and Ojogu (2019) that small farm holdings constitute most of the farming activities in Nigeria.



Table 2: Socio economic Characteristics of Farmers (n=296)

Variable	Frequency	Percentage	Mean
Sex			
Male	190	64.2	
Female	106	35.8	
Marital Status			
Single	55	18.6	
Married	203	68.6	
Widowed	32	10.8	
Divorced	6	2.0	
Age (Years)			
30 and Below	44	14.8	
31 – 40	70	23.6	
41 – 50	96	32.4	44
51 – 60	63	21.3	
61 and Above	23	7.7	
Occupation			
Farming	252	85.1	
Trading	21	7.1	
Civil servant	23	7.8	
Educational level			
No formal	13	4.4	
Primary	51	17.2	
Secondary	157	53.1	
Tertiary	75	25.3	
Farm size (hectares)			
1 and below	138	46.6	
1.1-2.0	85	28.7	
2.1-3.0	35	11.8	1.5
3.1-4.0	27	9.2	
4.1-5.0	10	3.4	
5.1 and above	1	0.3	
Household size(persons)			
1-5	103	34.8	
6-10	154	52.0	7
11-15	33	11.1	
16 and above	6	2.0	

Source: Field Survey, 2023

Level of Adoption of Integrated Soil Management and Water Conservation Techniques

The choice of adopting a technology is preceded by a number of certain mental processes which include: Awareness, Interest, Evaluation, Trial, and Adoption (Fawole *et al.*, 2021). Table 3 reveals that farmers are mostly engaged in mulching and irrigation with mean score of 3.7. This implies that respondents adopted mulching as ISWM practice because mulching reduces evapotranspiration and increase water holding capacity of the soil. According to Aminu and Monday (2022), mulching improves soil nutrients and sustainability in crop production. Farmers were also engaged in organic farming and crop rotation with both having mean score of 3.6. This implies that farmers wish to maintain the fertility of their farm land by using these practices. According to Ouèdraogo *et al.*, (2019), organic farming



was widely adopted, this preference was attributed to its ability to enhance crop productivity, improve soil fertility and minimize the risk of crop failure. Other practices engaged by the farmers are intercropping, drainage and cover crop with a mean score of 3.3, 2.9 and 2.8 respectively. The use of inter cropping may be attributed to the advantage of planting and reaping multiple crop from same piece of land simultaneously. According to Akinnagbe and John (2023), erosion control is the prevention of wind and water, planting cover crops helps to achieve this benefit and enhances biological activity by producing food for microbes which reduce the risk of lower yield by improving soil nutrient status and the modification of soil temperature.

Similarly, conservation tillage, agroforestry and strip cropping were not used by farmers as their mean scores are less than 2.5. The non-utilization of agroforestry by the farmers may be because trees are permanent and may take up large portion of farmland and also that it may not give immediate return on investment. This agrees with the findings of Saliu *et al.* (2017) that farmers though exposed to tree planting. Farmer prefer planting crops that generate economic benefit in the short run like mangoes, oranges commonly preferred by farmers for economic reasons. Therefore, training on agroforestry practices need to be encouraged to create awareness and enhance farmer's knowledge on the benefit of planting forest and agricultural crops on the same piece of land.

Table 3: Level of Adoption of Integrated Soil Management and Water Conservation Techniques

Practices	Aware	Interest	Evaluation	Trial	Adoption	Weighted Score	Mean Score
Mulching	950	60	18	26	43	1097	3.7
Organic Farming	850	96	24	58	35	1063	3.6
Agroforestry	85	200	99	130	104	618	2.1
Cover Crop	360	308	33	40	85	826	2.8
Inter Cropping	725	88	45	58	56	972	3.3
Crop Rotation	885	84	15	30	49	1063	3.6
Strip Cropping	95	260	36	130	106	627	2.1
Conservation Tillage	120	284	72	86	105	667	2.3
Irrigation	950	76	9	26	42	1103	3.7
Drainage	440	268	18	70	71	867	2.9

Mean \geq 3.0 =High adoption, mean<3.0=Low adoption

Source: Field survey, 2023

Adoption Indices of Integrated Soil Management and Water Conservation Techniques

Table 4 shows the adoption index of Integrated Soil management and water conservation techniques (ISM and WCT). The results revealed that half of the respondents (50 %) were found to be medium adopters while the other half (50%) were of low adopters. The implication of the results is that integrated soil management and water conservation technique adoption and practice rate is very low, as all (100%) the farmers could be classified medium and low in their practice of ISM and WCT in the study area. The reason for the low level of adoption may be due to their year of farming experience (1-5years) using ISM and WCT practices and were yet to understand or derived the full benefit of these practices. It can be deduced from this result that the adoption of ISM and WCT is still low among the household heads despite policymakers and scientists' advocacy for more adoption of ISM and WCT to mitigate the effects of climate change on agricultural productivity and improved farmers' livelihoods (Saliu *et al.*, 2017)



Table 4: Adoption Index of Integrated Soil Management and Water Conservation Techniques

Adoption Category	Adoption Index (%)	Frequency	Percentage
High Adopters	67 – 100	-	-
Medium Adopters	34 – 66	148	50.0
Low Adopters	1 – 33	148	50.0
Total		296	100.0

Source: Field Survey, 2023

CONCLUSION AND RECOMMENDATIONS

It is concluded that Mulching, irrigation, organic farming and crop rotation were widely adopted practices among farmers in the study area. There is still low level of adoption of ISM and WCT among farmers despite advocacy on various soil and water management practices that could help mitigate the effect of climate change hence increasing productivity of farmers.

To increase level of adoption it is recommended that

1. Agricultural practitioners should mobilize smallholder farmers and train them for successful implementation of ISM and WCT practices.
2. Organisation of awareness and capacity building training by both government and non-governmental organisation to enlighten the farmers of the benefit of soil and water conservation practises.

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