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IMPACTING ARABLE FARMERS' PERCEPTION OF PROCESSED ORGANIC FERTILIZER USE THROUGH FARM DEMONSTRATION: EVIDENCE FROM MAIZE FARMERS IN OGUN STATE, NIGERIA

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ABSTRACT: *Fertilizer use supports productivity in arable farming. However, improper use of inorganic fertilizers can harm the environment, accelerate climate change and slow down the achievement of the 13th SDG. This study examined the use of farm demonstration in improving maize farmers' perception of organic fertilizer use in the five major towns in Ikenne LGA of Ogun state. Sixty-five maize farmers were selected for the study using multistage sampling technique. Demonstration plots were established near the farmers to observe the agronomic impact of organic fertilizer use. Results showed that respondents' average farm size was less than 1 hectare, 58% had undulating or sloppy lands which are vulnerable to degradation. Only 22% of the farmers mostly use organic fertilizers which they source from unprocessed animal waste. Only 32% of the farmers are aware of commercially processed organic fertilizers. Using the pair-sample t-test, the perception level of the farmers at the end of the demonstration was significantly higher than before the demonstration ($t = 14.87$, $p < 0.05$). The study recommended that perception enhancing intervention be introduced to farmers in order to increase the use of clean and safe commercially available fertilizers.* .

KEYWORDS: Commercial organic fertilizer, Perception level, Maize farmers, Nigeria.

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INTRODUCTION

As a result of the diminishing fertility status of the soil due to shorter fallow periods, smallholder farmers no longer produce a surplus sufficient food to feed the ever-increasing population. Apparently, application of fertilizer is inevitable for the replacement of soil nutrients that are being mined through harvest annually and sustaining productivity in the global agri-food system (Liverpool-Tasie, Omonona, Sanou & Ogunleye, 2016). This is particularly important to the cultivation of arable crops like maize (Kamara et al., 2020). Fundamentally, in order to meet the first three United Nations Sustainable Development Goals (SDGs) of poverty alleviation, zero hunger and healthy living, there is the need to accelerate and sustain global agricultural production. The use of fertilizer to support productivity hence is imperative to the achievement of this goal, thus it is of policy relevance. However, heavy or improper use of inorganic fertilizers can harm the environment, accelerate climate change and slow down the achievement of the 13th SDG. Past studies have suggested that exploring organic fertilizer alternatives or as complimentary manure is imperative to environmental conservation and public health management hence its importance to the achievement of the SDGs (for example Mgbenka, Onwubuya & Ezeano, 2015; Babalola, Isitor & Kio, 2015; Babalola & Olayemi, 2014). Most arable farmers in the African agrarian economies like Nigeria depend on the inorganic fertilizers to support crop growth (Babalola et al., 2015).

It has been established in literature that inorganic fertilizer use in Africa generally is low due to low availability, poor education on how to use it by farmers and credit constraint (Liverpool-Tasie, Omonona, Sanou & Ogunleye, 2017). Although, there is an increase in fertilizer use in some African countries where farmers enjoy some form of fertilizer subsidy such as Malawi, Zambia and Nigeria. However, despite this, fertilizer use is still generally low. There is the general opinion that increasing inorganic fertilizer use can increase agricultural productivity; however, there is no clear evidence to substantiate that continuous use of inorganic fertilizer at an increasing rate will birth sustainable growth in agricultural productivity. In fact, studies have shown that continuous and improper application of the inorganic fertilizers, even when available, may lead to reduction in productivity of clay soils which dominates Africa (Liverpool-Tasie et al., 2015; Babalola et al., 2015; Jote, 2023). The need to demonstrate and encourage the use of cheaper, environmentally friendly and more available organic fertilizer to supplement or even replace inorganic fertilizers motivated this study. Furthermore, there is scanty empirical information in literature on the profitability assessment of organic fertilizer use by arable crop farmers especially in Nigeria.

The need for sustainable management of arable land through use of organic manure is multidimensional in terms of benefits and of policy relevance (as highlighted in the Sustainable Development Goals). Besides the fact that it stabilizes the soil and prevents degradation, it is also environmentally friendly (Jote, 2023). The usual challenge crop farmers face with the use of organic manure is its agronomics (in terms of nutrient release and yield response), ready availability, bulkiness (especially as it adds to transport costs), and the odor in storage. Some interventions through research and development have been conducted to ameliorate these limitations and to provide farmers with information on how to compose organic manure from farm wastes and some farmers have embraced this innovation in Nigeria (Falola & Mukaila, 2022). There are however, processed organic fertilizers available at commercial scale for farmers to use

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in Nigeria. Commercially produced organic fertilizer obtained from a company in Lagos state producing bagged organic manure made from municipal waste in the state was used in this study.

Besides creating awareness and linkages for farmers to access research proven, commercially produced organic fertilizers, the goal of this study was to improve farmers' knowledge and perception about the benefits of organic manure through our formulated intervention model. This we hope will enrich the existing policy framework for technology transfer to farmers especially as related to organic farming. Furthermore, as a valuable contribution to the body of knowledge, we aimed at evaluating the influence of the selected fertilizer on productivity and profitability. Maize farmers were targeted for the study. This is because maize farmers are among the high users of fertilizers in Nigeria. Our *a priori* expectation was that more farmers will adopt the use of organic fertilizers to replace or complement inorganic fertilizers at the end of our experiment (intervention).

METHODOLOGY

The study was carried out in Ogun state, Nigeria. As hitherto stressed, maize farmers around Ikenne Local Government were targeted for the study. The multi-stage sampling method was used to select the farmers. Out of the 5 major towns in Ikenne LGA, 2 towns were purposely selected (Irolu and Ilishan) based on existence of clusters of maize farms, availability and accessibility to maize farmers and their willingness to allow setting up of experimental plots on farm locations. A total of 65 farmers were finally randomly selected for the study. Demonstration plots were established and replicated at 6 locations, 3 in each selected town where respondents can access, participate, receive training and ask questions. Unfortunately, we experienced crop failure in one of the locations in Ilishan and severe unforeseen rodent attack in one other location at Irolu. Thus, final data was collected from 4 demonstration plot locations. Besides on-farm agronomic data collection, a well-structured questionnaire was administered to the farmers to collect information needed for the study. The step-by-step activities carried out in the course of data collection include:

1. **Enrolment and Baseline Survey:** This involved the selection and enumeration of the farmers. Information was collected from these farmers on their agronomic practices, fertilizer and other input used (quantity and costs), output (volume and value) from maize grown, tenure status, vulnerability of farm holdings to degradation, conservation methods and other fertility management employed, their perception about organic fertilizer etc. This was achieved by administering structured questionnaires as instruments for data gathering. The questionnaire was carefully designed and standardized to ensure that it is reliable enough to enable information retrieval on the factors highlighted.

2. **Training/Diffusion of Technology:** Farmers were stratified into 4 groups based on identified locations for the field demonstration plots. Farmers in each location who agreed to give portions of their land for the experiment were recruited and exposed to training especially on the application of the organic manure. Periodic seminars, farm demonstrations and group evaluation were done with the general sampled farmers. The theme of discussions

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centered on fertility management using organic fertilizer and conservative agronomic practices. The organic fertilizer used was sourced from Earthcare Nigeria Limited. The fertilizer is an all-purpose compost produced from municipal solid waste (Municipal Waste Compost, MWC). It is environmentally-ozone-health friendly. It is odorless and non-toxic containing materials helpful in sustainably correcting imbalances in soil like pH balance physical properties, water holding capacity and aeration. The choice of this fertilizer was based on its accessibility to farmers and user-friendly procedure for application. The inorganic fertilizer used was NPK (popularly used by the target respondents).

3. **Cultural Practices:** Land clearing was done at about the same time the farmers were clearing their farms for cultivation of maize. The rainfall pattern was a bit anomalous, so we experienced slight delay in land preparation as compared to the budgeted timetable. In order to remove ambiguity, all agronomic practices on the demonstration plots were done the same way the farmers do it. This was to increase our confidence level that any variation observed must be due to the treatment introduced (the organic material used). The size of each demonstration plot was 60 meters by 41 meters. Each plot was divided into 2, one treated to NPK and the other to MWC. The plots were made accessible to all the selected farmers to observe and compare.

4. **Impact Assessment:** Impact was assessed by measuring the difference in the perception of the farmers with respect to fertility management practices, productivity and profit efficiency at the baseline and endline. Yield parameters were also assessed from the demonstration plot so as to compare the impact of MWC and NPK on yield to ascertain whether MWC can effectively replace NPK even in the first season of use (however, some of the agronomic details are not included in this paper). The *a priori* expectation was that the technology introduced will create significant improvement in farmers' perception and pass as replacement for inorganic manure even in the short run.

Data gathered were analyzed using the descriptive statistics and the t-test analysis to know if there is a significant increase in the level of perception of the farmers after exposure to the intervention.

RESULT AND DISCUSSION

Personal & Enterprise Characteristics of Respondents

This section presents the result of the demographic characteristics (Table 1) of the respondents, farm level (Table 2) and institutional factors (Table 3) relating to the maize enterprise. The result of the demographic characteristics as presented in Table 1 shows that the average age of farmers as the time data was collected was 40 years indicating that the farmers are still in their active labor age and can contribute significantly to maize production in Nigeria. Besides this, the farmers' average experience in maize farming is 14 years while their average years of experience in farming generally is 15 years indicating that maize cultivation is a predominant motivation for their investment in farming enterprise. Furthermore, their experience in maize farming is relatively long enough for them to have gained mastery of the enterprise having passed through more than ten

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production cycles. However, only 43% of the respondents actually practice farming as a major occupation and 57% are civil servants. The huge investment cost and the exploitative tendencies of the middlemen in the agribusiness in Nigeria may be responsible for farmers seeking other sources of income. Most of the farmers are literate having up to secondary education (54%). This is expected to positively influence their attitude towards innovations, production technologies and adoption of conservation measures (Isitor, Babalola & Obaniyi, 2014; Babalola & Olayemi, 2014).

Table 1: Personal Characteristics of Respondents

Characteristics	Descriptive statistic			Freq (n = 65)	%
	minimum	maximum	Mean (±STD)		
Demographic factors:					
Age (years)	30	62	39.5 (9.26)		
Years of farming Experience	6	25	15.3 (7.00)		
Years of exp in maize farming	5	25	13.7 (7.98)		
Household Size	4	7	5.43 (0.97)		
Educ Level (years/class)	0	16	10.8 (4.92)		
None				8	12.3
Primary				7	10.8
Secondary				35	53.8
Tertiary				15	23.1
Marital status: married				44	67.7
Farming as major source of income				28	43.1
Other occupation:					
None				21	32.3
civil servant				37	56.9
Artisan				7	10.8

The result in Table 2 shows that farmers cultivate less than 1 hectares of maize however they have potential for expansion if assisted. Fawole and Fasina (2005) and Ajewole (2010) observed that the bigger the farm size, the more likely that the farmers will adopt and use more commercially produced organic fertilizer which have been found to be environmentally friendly. area.

The adoption of environmentally friendly agronomic practices, like use of organic manure, is particularly imperative in the study area because most of the farmlands are vulnerable to degradation (Babalola & Olayemi, 2014). Most of the farmers (59%) reported that their farmlands are sloppy or undulating, this can trigger soil degradation. Average quantity of fertilizer (NPK) used by the farmer was 215 kg/Ha which is within the range of recommendation of 200-300 kg/Ha

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given by ICS-Nigeria (2002). Therefore, increasing the quantity of fertilizer may not significantly improve yield. This result corroborates the observation of Liverpool-Tasie et al. (2017).

Table 2: Farm Level Characteristics of Farmers

Characteristics	Descriptive statistic minimum	maximum	Mean (±STD)	Freq (n = 65)	%
Farm size (Ha)	0.13	1.20	0.62 (0.36)		
Topography of farmland					
Undulating				29	44.6
Flat				27	41.5
Sloppy				9	13.9
Fertilizer input (Kg)	25	250	133.46 (81.76)		
Fertilizer cost (₦)	2500	250000	13346.15 (8176.24)		
Maize qty harvest (Kg)	450	5000	1700 (1466.82)		
Gross profit (₦)	10000	420000	144953 (132516.09)		
Net income:					
less than 10 000				7	10.8
21 000-30 000				16	24.6
31 000-40 000				7	10.8
41 000-50 000				14	21.5
more than 50 000				21	32.3

Furthermore, expected yield per hectare (based on recommended figure) is between 3 and 5 tonnes. Estimated yield of the respondents (calculated from Table 2) is 2.7 Tons/Ha which is apparently below yield expectation despite inorganic fertilization. Although many factors beyond the scope of this study may be responsible for this, however, this result implies that the farmers need to adopt additional or alternative yield enhancing measures to sustain commercial production of maize in the study

Most of the farmers reported that they make less than ₦50,000 (approx. $36 as at 2024) income per season of maize cultivation as the time of data collection. This is low and may be as a result of low yield and small farm holding. While interacting with the farmers during the wrap-up session, we discovered that virtually all the farmers sell their maize fresh because they cannot afford the cost of drying and processing which would have earned them a higher premium for their produce.

The results in Table 3 show that only 45% of the farmers have had any form of contact with an extension agent, only 43% belonged to one form of community-based organization (CBO) or the other and 79% have not participated or benefited from any government programme.

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Table 3: Institutional Characteristics of Farmers

Characteristics	Freq (n = 65)	%
Contact with Ext Agent	29	44.6
CBO Membership	28	43.1
Govt prog participated/benefited		
None	51	78.5
Conservation and land mgt	7	10.8
Credit programme	7	10.8
Other crop grown: Cassava	58	89.2
Ownership status: lease/rent	65	100.0
Labor type:		
Hired only	22	33.8
Hired & family	43	66.2
Source of capital:		
Personal savings	22	33.8
Bank loan	28	43.1
Co-op loan	15	23.1

This will likely affect their perception about efforts made to increase farmers' adoption of organic farming and its contributions to sustainable soil fertility conservation, food safety and economics of production. Most of the farmers (65%) cultivate rented farmland. Farmers' tenancy security on land owned and cultivated could determine the type of technology adopted for increasing agricultural productivity (Gebremedhin & Swinton, 2003; Wachter, 1994).

Result in Table 4 shows that 79% of the farmers use inorganic fertilizers predominantly and most of them (67%) purchase the fertilizers at exorbitant prices in the open market. The few respondents (approx 22%) who have used organic manure used the unprocessed or untreated livestock waste. This practice leads to high soil toxicity, run-off pollutant and floral contamination with pathogens (Akinnifesi & Kwesinga, 2002; Adeyinka et al., 2005; Fukushima et al., 1999; Babalola et al., 2011). Only 32% of the respondents said they are aware of well treated commercially produced organic fertilizer.

Table 4: Distribution of Farmers by Fertilizer Used

characteristics	Freq (n = 65)	%
Type of fertilizer mostly used		
organic	14	21.5
inorganic	51	78.5
Source of purchase of inorganic fertilizer		
none	7	10.8
open market	44	67.7
research institute	14	21.5
Source of purchase of organic fertilizer		

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none	51	78.5
unprocessed livestock waste	14	21.5
Awareness of commercially processed organic fertilizer	21	32.3
Other soil fertility mgt practices apart from use of fertilizer:		
crop rotation	58	89.2
cover cropping	7	10.8

Crop rotation is done by some 89% of the farmers as a way of managing soil fertility besides the heavy use of inorganic fertilizer. High cost of fertilizer is reported by 88% of the farmers as a challenge they face in the production of maize (Table 5).

Table 5: Production Challenges Faced by the Farmers

Challenges	**Freq (n = 65)**	**%**
High cost of fertilizer	57	87.7
Inadequate capital for operation	58	89.2
High cost of output transport	50	76.9
Postharvest losses	36	55.4
Fluctuating output market price	51	78.5

Perception of Farmers with Regards to The Use of Processed Organic Fertilizer (MWC)

Several variables assessing individual farmer's perception were measured to obtain mean scores for both pre and post demonstration/experiment for the selected study group and results are presented in Table 6. The maximum point on scale of measure for the construct measuring perception was 63. Following the Ashur's (1977) measurement scale, proportion of scores greater than 70% is considered as high and adequate level with respect to the variable being measured. Judging by this, the perception scores for farmers, in respect of the use of organic fertilizer before the field experiment was 68% (42.78±5.50) of the maximum point on scale of measure and inadequate or poor.

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Table 6: Pre- and Post-Experiment/Demonstration Result for Farmers' Perception of Organic Fertilizer

Respondent Groups	Max points on scale of measure	Mean	±SD	t-value	Level of Sig
Perception level before experiment	63	42.78 (68%)	5.50	-14.87	0.000
Perception level after experiment		57.92 (92%)	3.97		

However, after the field demonstration and series of focus group discussions, the mean score perception for the same farmers who participated in the experiment increased to approximately 92% of the maximum point on scale of measure (57.92±3.97) indicating adequate level of perception. Furthermore, the result showed that the mean score perception for the respondents after the demonstration was significantly higher ($p<0.05$) than that for before the demonstration. Thus, as a result of the field experimental demonstration, farmers' perception about organic fertilizer improved and the probability of adoption increased.

Assessing the individual statements making up the construct measuring perception, there were marked increases in the perception of the farmers as a result of the demonstration experiment in virtually all the statements.

Table 7: Pre and Post Experiment Result of the Perception of Farmers with Respect to the Utilization of Organic Fertilizer

Perception Statements	Frequency	
	Pre-exp (%)	Post-exp (%)
Using organic manure improve soil fertility just as good as chemical fertilizers	15 (23)	60 (92)
Organic fertilizer can improve the soil and even prevent soil erosion	37 (57)	55 (85)
Application of organic fertilizer is easier than inorganic fertilizer	44 (68)	52 (80)
Untreated Organic manure is generally too bulky and produce foul odor	43 (63)	52 (80)
Using organic manure can help to improve my soil physical properties like texture, structure and water holding capacity etc thus reverse a degraded land	22 (34)	56 (86)
Organic manure can be made to release nutrient to the soil almost as fast as inorganic fertilizers	7 (11)	50 (77)
Treated organic manure can be used to replace inorganic manure effectively	36 (55)	46 (71)
More weed problem occurs with manuring	36 (55)	54 (83)
There is inadequate information on organic fertility management	50 (77)	46 (71)

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Asking farmers to use organic manure is like encouraging them to be more profitable	22 (34)	44 (68)
Using organic manure can sustainably improves my crop yields/ productivity	22 (34)	49 (75)
Sourcing for organic manure is not a limitation to organic farming	29 (45)	45 (69)
Consumers will prefer crops that are grown using only organic manure	23 (35)	52 (80)
Commercially produced Organic fertilizers can be readily accessed	15 (23)	45 (69)
I will prefer organic fertilizer if I have sustained access to it since inorganic fertilizer poisons the soil gradually	29 (45)	51 (79)
land management using organic materials is important for the benefit of sustainable food production and food security	21 (32)	60 (92)
Crops produced using organic materials are healthier than those produced using agro-chemicals	15 (23)	58 (89)
Environmental protection can be better facilitated using organic materials	15 (23)	61 (94)
Using organic manure promotes waste management	37 (57)	58 (89)
Without use of agrochemical agriculture can still be profitable	7(11)	49 (75)
Use of chemicals require much education than organic materials	44 (68)	60 (92)

After the experiment, the result shows that the number of farmers who now agree that using organic manure can improve soil fertility just as good as the inorganic fertilizers increased by 69%; number of farmers who now agree that using organic manure can help to improve my soil physical thereby reversing a degraded land increased by 52%; the number of farmers who now agree that environmental protection can be better facilitated using organic materials in farming increased by 71%. Also, the number of farmers who now agree that commercially produced Organic fertilizers can be readily accessed increased by 46%. This shows the need to improve extension education and creation of appropriate awareness and linkages between processors and manufacturers of organic manure and farmers as demonstrated by this project in order to increase transition of farmers to organic farming.

CONCLUSION AND RECOMMENDATION

The use of organic fertilizer by arable farmers is environmentally friendly and has the potential to sustainably reduce soil degradation by preserving the soil physical properties. The study examined the use of farm demonstration in improving maize farmers' perception of organic fertilizer use in the selected local government of Ogun state. the perception of the farmers regarding the use of commercially available organic fertilizer was done before and after the farm demonstration. Study findings show that farmers' perception was significantly improved by the demonstration of organic fertilization on their farms, hence their willingness to demand for commercially available fertilizers. Based on the research findings, it is recommended that perception enhancing intervention be introduced to farmers in order to increase the use of clean and safe commercially available fertilizers. .

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