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Factors militating against the adoption of organic and inorganic manures among waterleaf farmers in Akwa Ibom state, Nigeria

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Abstract

The research aimed to identify perceived factors militating against the adoption of organic and inorganic fertilizers among waterleaf farmers in Akwa Ibom State. Primary data was collected through a structured questionnaire and analyzed using descriptive statistics and Likert scaling. The study utilized a multi-stage sampling technique to select 120 participants, comprising 60 organic-based and 60 inorganic-based waterleaf farmers. Results indicated that a majority of the participants, 85% of organic-based farmers and 78.3% of inorganic-based farmers, were female. Furthermore, 71.7% of organic farmers and 66.7% of inorganic farmers were married.

The monthly income data for both organic and inorganic farmers shows that a higher percentage of organic farmers (46.7%) and inorganic farmers (50%) reported earnings between N10,000 - N50,000. An examination of Likert scaling further identified several key factors hindering the adoption of organic fertilizer technology. These factors include a negative attitude from the government, inadequate agricultural policy, limited extension services, lack of access to credit facilities, the labor-intensive nature in comparison to inorganic methods, and the conservative nature of rural dwellers. Several factors were found to be inhibiting the adoption of chemical or inorganic fertilizer technology in waterleaf production in Akwa Ibom State. These include the conservative nature of rural dwellers, lack of awareness, insufficient organic manure, absence of appropriate agricultural policy, the labor-intensive nature compared to organic application, and negative attitudes by the government. The study recommends the implementation of capacity building programs for extension agents to enhance their knowledge, skills, and attitudes necessary for training on both organic and inorganic farming practices.

Keywords: Organic fertilizer, inorganic fertilizer, farmers, waterleaf, Akwa Ibom, Nigeria

Introduction

The availability of nutrients is increasingly becoming a limiting factor in crop yield worldwide. It is well established that the efficient use and application of fertilizers significantly impact food production, a vital component of human sustenance (Achim *et al*., 2022, ALnaass *et al*., 2021, Akpan *et al*., 2019a) [2, 4, 6]. Therefore, a thorough understanding of both organic and inorganic fertilizers is imperative (Aryal *et al*., 2021). Organic fertilizers, being naturally occurring mineral sources with a moderate level of essential plant nutrients, offer several advantages over synthetic fertilizers. They can help alleviate issues associated with the reliance on chemical fertilizers by reducing the need for frequent applications to sustain soil fertility. Additionally, organic fertilizers release nutrients slowly into the soil, ensuring a balanced supply for the healthy development of crops. Furthermore, organic fertilizers serve as an energy source for soil microbes, promoting improved soil structure and crop growth. Their gradual nutrient release and trace element content make them valuable for sustainable agriculture practices. Organic fertilizers consists of a variety of plant derived materials that range from fresh or dried plant material to animal manures and litters of agricultural by-products. The nutrient content of organic fertilizers differs greatly depending on source materials, and readily biodegradable materials make better nutrient composition. Overall, organic fertilizers are widely regarded as slow-release fertilizers that contribute to the overall health of soil and plant life. Organic fertilizers offer a safer option compared to chemical fertilizers. Nonetheless, the incorrect application of organic fertilizers can result in soil over-fertilization or nutrient deficiencies. Therefore, employing a controlled release method for organic fertilizers is a sophisticated and beneficial approach to address these issues and promote sustainable agricultural yield.

The utilization of inorganic or chemical fertilizer is prevalent among farmers in developed nations worldwide. Chemical fertilizers play a key role in modern agriculture by replenishing vital nutrients in the soil, promoting plant growth, and enhancing crop yields (Akpan *et al*., 2019b) [8]. These fertilizers consist of synthetic, chemically processed minerals that deliver nutrients such as nitrogen, phosphorus, and potassium in easily accessible forms. Despite their effectiveness in boosting production, excessive use of chemical fertilizers can have adverse effects on soil health and the environment. Inorganic fertilizers provide nutrients rapidly, enabling plants to absorb them immediately, potentially expediting growth and development. By supplying essential nutrients, chemical fertilizers can substantially increase crop yields, thereby contributing to

food security.

The excessive use of inorganic fertilizers may result in soil degradation, water pollution (through run-off), and the release of greenhouse gases (Adisalem and Dinku, 2021) [1]. Prolonged dependence on inorganic fertilizers can harm soil structure, decrease organic matter levels, and reduce the activity of beneficial microorganisms. Without the addition of organic fertilizers or soil amendments, inorganic fertilizers may cause deficiencies in essential micronutrients. It is essential to apply fertilizers at the correct rates, timing, and placement to minimize adverse effects and enhance nutrient efficiency. Both organic and inorganic fertilizers are widely utilized in vegetable cultivation.

Waterleaf (*Talinum triangulare*) is a popular vegetable crop cultivated and consumed extensively in the Southern region of Nigeria (Akpan *et al*., 2019a; Akpan *et al*., 2019b) [6, 8]. The cultivation of this crop brings significant economic benefits to small-scale farmers with limited resources. It serves as a supplemental source of income for families and offers a viable livelihood option for many unemployed individuals, particularly women in the area (Akpan *et al*., 2019b) [8]. Numerous researchers have highlighted the medicinal properties of waterleaf (Mensah *et al*., 2008; Ikewuchi *et al*., 2017) [15, 13]. The nutritional composition of the crop is notable, as it contains carbohydrates, steroids, protein, fat, oil, minerals, crude fibers, and more (Aja *et al*., 2010; Amusat *et al*., 2018) [3, 9]. The cultivation of waterleaf in Akwa has emerged as a promising agricultural enterprise, creating job opportunities for many individuals, particularly women. The crop has a consistent year-round demand and the initial cost of cultivation falls within the budget of many low-income households in the State (Udoh and Akpan, 2007) [20]. It is grown throughout the year and requires soil enrichment materials to restore nutrients depleted by continuous cropping.

The cultivation of crops necessitates the utilization of farm resources that are relatively scarce and face competition from other needs (Udoh and Akpan, 2007) [20]. A large proportion of waterleaf farmers in the area are lacking in resources (Akpan and Monday 2021) [7], and when combined with the competing demands for farm resources from other crop productions, as well as the high population density and rapid urbanization in the region, efficient management of farm resources by waterleaf farmers is crucial for sustainable production. Currently, waterleaf plays a significant role in urban agriculture, and its cultivation has become a popular livelihood choice for unemployed women in the southern region of Nigeria (Uko *et al*., 2019) [32]. The necessity of sustaining small-scale farm enterprises, such as waterleaf production, is paramount in meeting the dietary needs of consumers and achieving food self-sufficiency in the southern region. This is due to the majority of food production in the country being sourced from these small-scale farms.

In order to address the ongoing issue of declining soil fertility and inadequate agricultural output in resource-poor farming communities, it is imperative to increase the adoption of soil-enhancing technologies, such as fertilizers (organic and inorganic forms). Research studies have demonstrated that both chemical/mineral and organic fertilizers are highly effective in improving productivity levels (Liverpool-Tasie *et al*., 2017; Mensah *et al*., 2018) [14, 16]. Therefore, pinpointing the factors that influence the utilization of these fertilizers by small-scale resource-poor farmers is crucial for achieving sustainable food production. Multiple studies (Akpan *et al*., 2012; Sanusi *et al*., 2019; Akpan *et al*., 2019a) [5, 18, 6] have delved into the quantitative aspects influencing fertilizer utilization among arable crop farmers. However, there remains a critical gap in understanding the qualitative factors affecting fertilizer consumption among farmers in the area. Despite a thorough examination of existing literature, there is a noticeable absence of recent research specifically concentrating on waterleaf farmers and their utilization of fertilizers in Akwa Ibom State. This oversight poses a potential threat to the sustainability of waterleaf cultivation in the region. Given the growing significance of waterleaf as a staple in the daily diet of many Akwa Ibom State residents, it is imperative to safeguard its sustainability by implementing appropriate technologies that enhance the efficient use of agricultural resources. Consequently, this study aims to explore the qualitative determinants influencing the adoption of both organic and inorganic fertilizer technologies among waterleaf farmers in Akwa Ibom State, Nigeria.

Theoretical Framework

The study was based on the concept of consumer preferences as a component of utility theory. Although preferences are the conventional foundation of microeconomics, it is often convenient to represent preferences with a utility function and analyze human behavior indirectly with utility functions. To begin, assume that an individual faces a set of consumption bundles. It is assumed that individuals have clear preferences that enable them to rank all bundles based on desirability, that is, the level of satisfaction each bundle shall provide to each individual. This rank ordering based on preferences tells that the theory itself has ordinal utility. It is designed to study relative satisfaction levels. Absolute satisfaction depends upon conditions; thus, the theory by default cannot have cardinal utility, or utility that can represent the absolute level of satisfaction. The theory is based on the assumptions of completeness, more-is-better, mix-is-better, and consumer rationality.

Research Methodology

Study Area

The research was conducted in Akwa Ibom State, a key region within the "oil palm belt" of the Niger Delta area in Nigeria. Situated at latitude $4^{0}33^{1}$ to $5^{0}53^{1}$ North and longitude $7^{0}25^{1}$ to $8^{0}25^{1}$ east, the state covers a total land area of 8,421 square kilometers. Akwa Ibom State experiences two distinct seasons - rainy and dry seasons, with rainfall distributed evenly throughout the year. Rainfall levels range from over 3,000mm in the southern regions to about 2,700mm in the northern areas (Udofia and Inyang, 1987) [19]. According to the National Population Commission (2006), the study area boasts a population of approximately 3,920,203 individuals. The primary economic activity in the region is agriculture, with a focus on rain-fed cultivation of tree and food crops, such as oil palm, as well as livestock farming. Fishing also plays a significant role in the riverine areas of the State.

Sampling Techniques/Analytical Techniques

The study employed a multi-stage sampling approach. In the first stage, three (3) agricultural zones were selected from Akwa Ibom State's six (6) ADP zones using a simple random sampling technique. In the second stage, 12 extension blocks were randomly chosen from each of the selected zones. Additionally, two (2) cells were purposively selected from each of the 12 blocks, resulting in a total of 24 cells. Subsequently, five (5) waterleaf farmers were randomly chosen from each cell, totalling 120 waterleaf farmers (60 organic based and 60 inorganic based) who served as respondents and comprised the sample size.

To identify factors impacting the adoption of both organic and inorganic fertilizer, 10 variables were introduced. A four-point Likert-type scale was utilized, with the options of strongly agreed (4), agreed (3), disagreed (2), and strongly disagreed (1). Variables with mean scores of 2.5 and higher were deemed to have a significant influence, while those below 2.5 were considered to have a lesser impact. The frequency of each rating was multiplied by the respective categorization code.

Likert scale

$$X = \sum \frac{fn}{nr} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where; $\sum$ = summation; f = Frequency of each of the response made; n = likert value
nr = Number of respondents;

(x) = mean = (F x I) + (F x 2) + (F x 3) + (F x 4) = T …… (2)

i.e. = ((F x I) + (F x 2) + (F x 3) + (F x 4)

Mean (x) = T – sample size = (4 + 3 + 2 + 1) = 10/4 = 2.50) …… (3)

Where F = Frequency; T = Total and M = Mean Score

Results and Discussion: The socioeconomic characteristics of organic and inorganic based waterleaf farmers in the study is presented in Table 1. The sex distribution indicated that 15% of the farmers were males while 85% were females for organic farmers while 21.7% were males and 78.3% females for inorganic based waterleaf farmers. This corroborates Udousung *et al.* (2016) [24], which indicated that most arable crops production is dominated by female farmers in Akwa Ibom State. Also, Umoh (2006) reported that females made up the bulk of farming population in Akwa Ibom State. The age distribution among waterleaf farmers, whether organic or inorganic-based, indicates that the majority of respondents fall within the 41-50 age bracket, comprising 41.67% and 38.3% for organic and inorganic-based farmers, respectively. Additionally, farmers aged 31-40 make up 31.67% and 21.7% for organic and inorganic-based farmers, respectively. This suggests that a significant portion of waterleaf farmers are in their prime farming years. The average age of respondents was calculated to be 45.25 years for organic farmers and 44.6 years for inorganic farmers, showing only a slight difference between the two groups. This trend aligns with previous research by Udousung *et al*. (2019) [22], which found that young, energetic individuals are actively involved in farming and are capable of handling the strenuous demands of agricultural work.

The result indicated that the majority of both organic and inorganic based farmers were married, with percentages of 71.7% and 66.7% respectively. This aligns with previous research (Udousung *et al.*, 2015) [21] which found that married individuals were predominant in waterleaf production due to its potential for income generation, employment opportunities, and food provision. The results suggest that marriage plays a significant role in decision-making within waterleaf production ventures, potentially fostering greater family cohesion. Additionally, the monthly income distribution of waterleaf farmers revealed that a considerable proportion of both organic (46.7%) and inorganic (50%) farmers earn between N10,000 to N50,000 monthly.

Table 1: Socioeconomic Characteristics of Respondents in the Study Area

	Organic Farmers		Inorganic Farmers	
Variable	**Frequency (60)**	**Percentage**	**Frequency (60)**	**Percentage**
Gender (binary)				
Male	9	15	13	21.70
Female	51	85	47	78.30
Age (years)		**Mean = 44.25**		**Mean = 44.60**
20 - 30	2	3.4	5	8.30
31 - 40	19	31.67	13	21.70
41 - 50	25	41.67	23	38.30
51 - 60	12	20.0	16	26.70
>60	2	3.33	3	5.00
Marital Status (binary)				
Single	5	8.3	9	15.00
Married	43	71.7	40	66.70
Widowed	7	11.7	7	11.70
Divorced	5	8.3	4	6.70
Monthly Income (naira)				
<10000	22	36.7	18	30.00
10000 - 50000	28	46.7	30	50.00
50000 - 100000	7	11.7	8	13.30
>100000	3	5.0	4	6.70

Farm Size (ha)		**Mean = 1.11**		**Mean = 0.96**
<1	17	28.3	17	28.3
1 - 2	38	63.3	40	66.7
3 - 5	5	8.4	3	5.0
Social Organization				
Yes	15	25.0	11	18.30
No	45	75.0	49	81.70
Farm Experience (years)		**Mean = 2.45**		**Mean = 2.58**
1 - 2	28	46.7	29	48.30
3 - 4	32	53.3	31	51.70
Capital Source (number)				
Personal Savings	48	80	48	80.00
Bank Loan	3	5.0	5	8.30
Friends	4	6.7	4	6.70
Cooperative Societies	5	8.3	3	5.00
Extension Visit (binary)				
Yes	5	8.3	6	10.00
No	55	91.7	54	90.00

Source: Field survey, 2023

In the study area, a significant percentage of both organic and inorganic based waterleaf farmers earned less than N10,000, with 36.7% and 30% respectively falling into this category. Additionally, 11.7% of organic farmers and 13.3% of inorganic farmers reported earnings between N50,000 to N100,000. These findings align with Udousung, *et al*., (2015) [21] which suggests that poverty is prevalent in rural areas, resulting in limited business expansion opportunities due to wealth and social power disparities. The distribution of wealth among respondents indicates that many are near or below the poverty line, particularly in rural and agricultural sectors. Furthermore, the majority of organic (63.3%) and inorganic (66.7%) farmers surveyed owned between 1-2 hectares of farmland. According to Udousung, *et al*. (2019) [22], approximately 28.3% of waterleaf farmers with less than 1ha of land were found to be both organic and inorganic based. Interestingly, only 8.4% of organic farmers and 5% of inorganic farmers had farm sizes ranging from 3ha to 5ha. This suggests that the majority of waterleaf farmers in the area are smallholders, likely due to the prevalent land fragmentation in the region. The mean farm size for organic and inorganic waterleaf farmers was reported to be 1.11ha and 0.96ha, respectively, aligning with the research by Fasina (2016) [12].

According to the distribution of respondents based on their involvement in social organizations, it was found that a large percentage of both organic (75%) and inorganic (81.7%) waterleaf farmers are not part of any cooperative. This suggests that a significant number of waterleaf farmers in the study area do not belong to cooperative groups. Being part of social organizations can provide farmers with valuable information and resources to enhance their farming practices, including production methods, management techniques, fertilizer usage, and access to credit, among other benefits. The lack of participation in cooperative organizations by waterleaf farmers in the study area may indicate that they are missing out on these advantages. Similar findings were also reported by Udousung *et al*. (2022) [31].

The data on farming experience distribution reveals that a significant proportion of waterleaf farmers, specifically 53.3% for organic farmers and 51.7% for inorganic farmers, had between 3 to 4 years of farming experience. Additionally, 46.7% and 48.3% of organic and inorganic waterleaf farmers had between 1 to 2 years of farming experience respectively. This suggests that the majority of the farmers have accumulated several years of experience in waterleaf farming. The average years of farming experience were 2.45 and 2.58 years respectively. Consequently, these experienced farmers are likely more adept at recognizing the negative impacts of pests and diseases, as well as implementing better farm management practices. Udousung and Umoh (2024) [28] have suggested that farming experience plays a crucial role in facilitating the adoption of new innovations in agriculture.

According to the distribution of respondents based on extension visits, it was found that 91.7% of farmers using organic methods and 90% of those using inorganic methods do not have access to extension services. This indicates that a significant percentage of farmers in both groups lack access to any form of extension services. This aligns with the findings of Udousung *et al*. (2018) [23], who suggest that the outreach to these farmers is very limited, potentially negatively impacting their awareness of new innovations.

Factors Militating against Adoption of Organic and Inorganic Fertilizers

The obstacles hindering the adoption of organic manure are outlined in Table 2, while Table 3 present similar factors for inorganic based waterleaf farmers. This indicates that both organic and inorganic waterleaf farmers are knowledgeable about the benefits of using soil enhancing materials for crop growth enhancement. Negative government attitude is perceived as a significant impediment to the utilization of organic manure by organic-based waterleaf farmers (average score = 3.1), while a less significant factor for in inorganic-based waterleaf farmers (average score = 2.6). The research findings suggest that many farmers in the study area encounter negative government attitudes, which may result in a lack of information on the proper use of different types of organic manure. The belief that organic manure is more labor-intensive to apply compared to inorganic fertilizer is considered a factor impeding its use by both organic and inorganic based waterleaf farmers (average scores of 2.75 and 2.72, respectively). This indicates that farmers in the study area perceive organic farming to require

more labor than conventional agriculture. The conservative nature of rural dwellers was seen to hinder the adoption of organic manure among both organic (mean = 2.6) and inorganic (mean = 3.28) waterleaf farmers in the research area. This suggests that farmers in rural regions may be less inclined to seek out new information compared to their urban counterparts, leading to lower involvement in community organizations. Additionally, the perceived lack of governmental support for agriculture was recognized as a barrier to the use of organic manure by both organic and inorganic waterleaf farmers (mean = 3.1 and 2.6, respectively). This challenge was closely followed by the absence of effective agricultural policies, which organic (mean = 3.0) and inorganic (mean = 2.8) farmers identified as a constraint to utilizing both soil enhancing materials in waterleaf production. The apprehension of organic farmers (average score of 2.93) about the limited availability of credit facilities was identified as a hindrance to the adoption of organic manure, consistent with the research of Etim and Udoh (2020) [11].

Table 2: Factors militating against the Adoption of Organic manure among Waterleaf Farmers

Variable	Organic Farmers							
	SA	A	D	SD	Total	Mean	Dec	Rank
Lack of awareness	15	10	10	25	135	2.25	D	6th
Insufficient Extension services	20	25	10	5	180	3.00	A	2nd t
Insufficient organic manure	5	15	10	30	115	2.00	D	7th
Labour intensive compare to inorganic application	20	15	15	10	165	2.75	A	4th
Conservative nature of the rural dwellers	15	15	20	10	155	2.60	A	5th
Negative to change	5	10	25	20	120	2.00	D	7th
Insecure land tenure system	25	15	15	5	180	2.00	D	7th
Negative attitude by government	25	20	10	5	185	3.10	A	1st
Lack of appropriate agricultural policy	30	10	10	10	180	3.00	A	2nd
Non-access to credit facilities	22	20	10	8	176	2.93	A	3rd

Source: Authors Computation, 2024. Benchmark = 2.5SA = Strongly Agreed, A = Agreed, SD = Strongly Disagreed, D = Disagreed, $\bar{x}$ = Mean

Table 3: Factors militating against the Adoption of inorganic manure among Waterleaf Farmers

Variable	Inorganic Farmers							
	SA	A	D	SD	Total	Mean	Dec	Rank
Lack of awareness	20	25	10	5	180	3.00	A	2nd t
Insufficient Extension services	10	10	20	20	130	2.20	D	8th
Insufficient organic manure	28	12	8	12	176	2.93	A	3rd
Labour intensive compare to inorganic application	19	11	25	5	164	2.72	A	5th
Conservative nature of the rural dwellers	31	21	2	6	197	3.28	A	1st
Negative to change	9	12	10	25	121	2.01	D	9th
Insecure land tenure system	6	12	18	24	120	2.00	D	10th
Negative attitude by government	18	16	10	16	156	2.60	A	6th
Lack of appropriate agricultural policy	21	20	9	10	170	2.86	A	4th
Non-access to credit facilities	12	17	16	15	146	2.43	D	7th

Source: Authors Computation, 2024. Benchmark = 2.5SA = Strongly Agreed, A = Agreed, SD = Strongly Disagreed, D = Disagreed, $\bar{x}$ = Mean

For organic based waterleaf farmers, the study reveal the following significant factors militating against the adoption organic fertilizer technology in the study area; negative attitude by government, lack of appropriate agricultural policy, insufficient extension services, non-access to credit facilities, labour intensive compare to inorganic application, and conservative nature of the rural dwellers. On the other hand, the inorganic based waterleaf farmers perceived, conservative nature of the rural dwellers, lack of awareness, insufficient organic manure, lack of appropriate agricultural policy, labour intensive compare to organic application, and negative attitude by government as significant factors militating against the adoption of chemical technology in waterleaf production in Akwa Ibom State.

Conclusion

The study was to identify factors militating against the utilization of organic and inorganic fertilizers by waterleaf farmers in Akwa Ibom State, Nigeria. Data were collected from 120 waterleaf farmers which consisted of 60 organic based farmers and 60 inorganic based farmers cultivating waterleaf crop. The result from the study showed that the majority of the waterleaf farmers in the study area were female, with mean age of 44.25 and 44.60 years respectively for organic and inorganic based farmers. Most of the respondents were married and earned between N10,000 to N50,000 monthly. Furthermore, most of the organic and inorganic based farmers had a farm size between 1 to 2ha, and many of the respondents were not members of any social organization and also did not have extension visits. The mean farming experience of the respondents was 2.45 and 2.58 years for organic and inorganic based farmers respectively. The factors militating against adoption of organic manure include; lack of extension services, labour intensive application compared to inorganic fertilizer, the conservative nature of the rural dwellers, negative attitude by the government, lack of appropriate agricultural policies were considered as constraints to the utilization of organic manure by organic and inorganic based farmers respectively.

The result indicated that both organic based farmers and inorganic based waterleaf farmers in the study area considered certain factors presented as a constraints to the adoption of both technologies. For organic farmers, negative attitude by government, lack of appropriate agricultural policy, insufficient extension services, non-access to credit facilities, labour intensive compare to inorganic application, and conservative nature of the rural dwellers were perceived as significant factors militating against the adoption of organic fertilizer technology among waterleaf farmers in the study area. Conversely, the inorganic based farmers perceived that, conservative nature of the rural dwellers, lack of awareness, insufficient organic manure, lack of appropriate agricultural policy, labour intensive compare to organic application, and negative attitude by government were constraints to sustainable adoption of chemical fertilizer among waterleaf farmers in the State.

Recommendations

- There should be working policies put in place to ensure that farmers have timely access to fertilizer and organic manure sold at subsidized prices to encourage its utilization to increase productivity.
- Insufficient extension services were identified as a significant constraint to the utilization of organic manure, therefore efforts should be made to enhance extension services to waterleaf farmers. This can include training programs, workshops, and provision of extension materials to increase farmers' knowledge on the proper use of organic manure.
- Lack of access to credit facilities was identified as a constraint for both organic and inorganic farmers. Therefore, financial institutions should provide accessible credit facilities tailored to the needs of waterleaf farmers to enable them to invest in soil inputs and technologies.
- Extension education campaign should be maintained on organic Agricultural practices to sensitize farmers on the use and the benefits of organic farming. This will create awareness among farmers as well as sustain interest on those already in the practices.
- Capacity building programme should be organized for extension agents to develop the knowledge, skills and attitude needed for training farmers on organic Agricultural practices.

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