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Farmers Perception of Practices in Crop Production in Relation to Soil Health in Sapele Delta State

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ABSTRACT

This study investigated farmers' perceptions of practices in crop production in relation to soil health in Sapele, Delta State. The results obtained from demographics show that most of the farmers were experienced men and women. In terms of farming experience, they were highly exposed. However, only a few of them had attained tertiary education, which explains their limited exposure to soil management practices and their effects. The study revealed that most crops, such as maize, had a growing cycle of 0-6 months. Cassava, on the other hand, took 12 months to reach full maturity and was predominantly cultivated on 2.5-5 acres of land owned by individual farmers. Mixed cropping was practiced because it allowed farmers to cultivate a variety of plants and crops. The climate, temperature, and vegetation of the Songhai community were conducive to planting. Regarding farming and soil fertility, many farmers relied on bush fallowing as their primary source of income. Weeds and other agents that reduce productivity and profitability were mainly controlled through mechanical methods, traps, and introducing biological pest enemies. To improve crop yield and soil health, organic manure, especially from poultry droppings, was the most used due to its availability and low cost. Farmers understood the importance of good soil health management practices and were open to adopting new methods, such as microbial inputs, to enhance soil health and crop yield. The study suggests that additional research is needed to identify measures farmers are likely to adopt to protect publicly owned natural resources. Furthermore, the government should encourage the development of general guidelines for obtaining indicators and their use to monitor improvements in soil health.

INTRODUCTION

The rapid growth of the global population has led to increased demands on agriculture to produce more food. Over the past 12 years, the world's population has expanded by one billion people, surpassing 6 billion in 2000, and is anticipated to reach 9 billion by 2050 (Brown, 2004). This population growth has primarily occurred in developing countries, in contrast to regions like Western Europe, North America, and Japan, where population growth is minimal or stagnant. Crop production serves as the initial stage in any food chain or network. Essentially, all living organisms in ecosystems rely on crop production for sustenance. Consequently, the growing medium for these crops holds significant importance. One crucial ecosystem service provided by soil is its support for crop production, upon which humans and numerous animals depend for their subsistence (Miner *et al.*, 2020). Healthy soils form the basis of thriving ecosystems and societies and are intricately linked to food and nutritional security, water quality, human health, climate change mitigation/adaptation, and biodiversity (Manter *et al.*, 2017; National Academies of Sciences, 2017). It is essential to prevent land degradation resulting from soil erosion, nutrient losses, and declines in ecological integrity (IPCC, 2019). The widespread adoption of management practices that promote soil health (SH), defined as "the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans," offers hope in countering agroecosystem land degradation (USDANRCS, 2019). Recent reviews have outlined the connections between soil health and human health, highlighting the fundamental role of soil health in food production, nutrition, and food security (Steffan *et al.*, 2018).

Yield outcomes of soil health management are of importance to ensure that future global food demands are met (Grassini *et al.*, 2013). The premise of linking crop productivity (i.e., harvestable crop yield per unit area) to soil health relies heavily on the assumption that improvements in soil health will alleviate growth-limiting factors (e.g., via increased provision of nutrients or water to the crop, increased disease resistance) and hence improve yields (Chaparro *et al.*, 2012). However, no work has been done to elucidate the relevance of soil health and crop production practices in Delta State, Nigeria. Delta State, being an oil and agricultural producing state, requires more studies to be carried out to determine the suitability of the soil for crop production and to promote healthy soil management practices, which should be encouraged by the government among farmers. If farmers are to adopt healthy management practices promoted by governmental institutions such as the Ministry of Agriculture and research institutes, they first need to believe that these practices are indeed useful. The perceived importance of various management practices among farmers differs from one farmer to another and

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is influenced by socio-economic characteristics as well as the information-seeking behavior of the farmers. Since this study explores the different soil practices involved in crop production by farmers and their relation to soil health, it is useful to establish a foundation in this key area. Hence, the primary objective of the study is to determine farmers views on the various practices of crop production in relation to soil health. The specific objectives of the study include to:

1. Explore farmers indigenous knowledge of soil management practices,
2. Ascertain how the various practices, affect the soil health,
3. Ascertain the acceptability of farmers towards organic agriculture.

LITERATURE REVIEW

Soil Health

According to Curiel-Ballesteros (2009), soil health refers to the ongoing ability of soil to operate as a vital living system, recognizing its biological elements essential for ecosystem function within specific land-use boundaries. These functions are crucial for sustaining soil productivity, preserving the quality of nearby air and water environments, and promoting the health of plants, animals, and humans. Karlen *et al.* (1997) defined soil health as the ability of a particular type of soil to function within natural or managed ecosystem boundaries, supporting the productivity of plants and animals, enhancing water and air quality, and contributing to human health and habitation. In a study conducted by Kibblewhite *et al.* (2008), soil health was identified as an integrative property indicating the soil's capacity to respond to agricultural interventions, enabling it to support both agricultural production and the provision of other ecosystem services.

Factors that Control Soil Health

Soil Type

Brevik and Burgress (2012) noted that, soil types are formed in response to various factors such as the nature of parent material, topography, climate, and natural vegetation. Human activities, such as past land management practices, can significantly alter natural soils. This alteration can occur through processes like erosion leading to the loss of surface horizons, artificial drainage affecting soil water regimes, salinization due to improper irrigation methods, and the depletion of natural soil organic matter caused by agriculture or contamination. Therefore, soil health is primarily influenced by land use and management practices. Certain fixed characteristics like texture and stone content, combined with climate, establish a range of possible soil habitat conditions, particularly those related to soil water regimes. Variable factors such as pH, bulk density, and soil organic matter content, which are influenced by land use and management, determine the specific condition within this range for a particular soil. These fixed and variable abiotic factors interact with biotic factors, including the presence or absence of specific organisms, the availability of carbon substrate and nutrients, and the concentrations of toxic materials, to collectively determine the overall condition of the soil system and its associated health (Brevik and Sauer, 2015).

Organisms and Functions

The relationships between community structure and function are inherently intricate and a prominent focus in contemporary soil ecology (Bardgett *et al.*, 2005). These relationships are underpinned by three fundamental principles: repertoire (referring to the available functions or the 'toolkit'), interaction, and redundancy (Ritz 2005). The connection between diversity and function has been theorized to take various forms, but robust experimental evidence on these matters is relatively limited, primarily due to the challenges in manipulating soil biodiversity as the sole influencing factor (Ritz and Griffiths 2000). Some experimental findings suggest the existence of threshold levels of soil biodiversity below which functions decrease (Setala and McLean 2004). However, in many cases, these thresholds are set at unrealistically low levels of diversity that are rarely found in natural environments. Numerous studies highlight the presence of high functional redundancy in soil communities (Setala *et al.*, 2005). However, it can be argued that high biodiversity within trophic groups is advantageous because such groups are likely to operate more efficiently under various environmental conditions, owing to their wider potential. More diverse systems might exhibit greater resilience to disturbances. In cases where certain components are removed or compromised, other prevailing components can compensate for the loss, enhancing the system's ability to withstand perturbations.

Carbon

Carbon serves as the common currency in soil systems, and its transfer, along with associated energy flows, acts as the main integrating factor. This suggests that the quantities and quality of various organic matter pools can indicate the state of the soil system. Additionally, the flows and allocations of carbon among groups of organisms can provide insights into their relationships with ecosystem functions. However, current food web models fail to elucidate how different assemblages utilize carbon to support these functions (Finney *et al.*, 2016). Existing models of soil carbon dynamics, such as those proposed by Jenkinson and Rayner (1977) and Parton (1996), assume the presence of carbon pools with varying turnover rates. Rapid and medium turnover fractions provide immediate and short-term carbon substrates for soil biota, while more recalcitrant forms with slow turnover rates act as long-term reservoirs of energy, sustaining the system in the extended period and providing structural stability. However, these models are not based on measurable carbon pools utilized by groups of organisms, nor are they explicit in terms of allocation to different soil functions. Consequently, their usefulness in assessing soil health appears to be limited (Jenkinson and Rayner, 1977).

Nutrients

Nutrients play a crucial role as inputs in the soil system, significantly influencing soil health and its processes. Among these nutrients, nitrogen and phosphorus cycling within the soil system have a profound impact on its dynamics and the provision of ecosystem services, especially agricultural production (White *et al*., 2017). While carbon substrate availability is commonly considered the primary limiting factor for microbial activity in soils, accumulating evidence suggests that soil microbes might often face limitations in nitrogen supply (Schimel *et al*., 2005). When the demand for nitrogen exceeds its supply, the functional capacity of the soil system is strongly influenced by nitrogen availability. In undisturbed natural soil systems, inputs from the atmosphere are typically low, and losses through leaching or gaseous emissions are minimal due to high biological demand for mineral nitrogen, leading to rapid assimilation of available nitrogen. However, disturbances such as tillage can increase losses through leaching or to the atmosphere because soil mixing accelerates organic matter decomposition and the conversion of organic nitrogen to mineral forms may exceed the biological demand, especially when available nitrogen is poorly managed (Steffan *et al*., 2018).

Furthermore, nitrogen is extracted from agricultural produce, often more than what can be naturally replaced. Without balanced additional nitrogen inputs, and especially without considering the associated carbon (energy) requirements of biomass, soil health deteriorates in agricultural systems due to progressive reductions in the nitrogen pool available to organisms supporting soil functions and plant growth. Similarly, the natural phosphorus pool in soil diminishes through cropping and other pathways like erosion, resulting in declining soil health without adequate balancing replacement that inherent mineralization (weathering) can provide (Wall *et al*., 2015). Agricultural approaches involving animal manure additions and mineral fertilizer use aim to counterbalance nitrogen, phosphorus, and other nutrient losses, aiming to restore and sustain soil health (Simon *et al*., 2013). In well-managed systems with high levels of manufactured, processed, or mechanized inputs, where these strategies are effectively implemented, productivity is maintained.

However, subsistence agriculture may face compromised productivity if nutrient additions are insufficient or absent. In contrast, in industrial agriculture, excessive nutrient additions beyond the soil-plant system's capacity result in damaging leakage from the soil system into other environmental compartments through leaching and gaseous emissions, leading to soil pollution and overall soil unhealthiness (Setala *et al*., 2005).

Soil Management Practices and Crop Productivity

In a study conducted by Miner *et al*. (2020) examining soil health practices and crop productivity on a global scale, it was found that food systems face numerous challenges, including minimizing environmental impacts, adapting to climate change, increasing yields, and maintaining or enhancing crop nutritional quality. Management techniques focusing on soil health (SH) have been considered promising solutions to mitigate environmental impacts and potentially increase economic returns. However, claims suggesting that improvements in SH will directly lead to enhanced crop quality and productivity require scrutiny. Research by Komatsuzaki and Ohta (2006) highlighted the significant challenge posed by doubling global food demand in the next 50 years, emphasizing the need for sustainable food production and environmental preservation. Tatlıdil *et al*. (2009) conducted research in the Kahramanmaras province of Turkey, evaluating farmers' perceptions of sustainable agriculture. The study utilized a sample of 208 farmers from four districts, assessing their attitudes toward 21 selected sustainable agricultural practices. Socio-economic characteristics, such as farming system, farm area, cooperative society membership, and information-seeking behavior, influenced the farmers' perception of the importance of sustainable agricultural practices. The study concluded that policymakers and extension organizations focusing on these factors could encourage farmers to adopt sustainable agricultural practices more willingly.

Similarly, Simon *et al*. (2013) analyzed the awareness of sustainable agricultural land management practices among crop farmers in the northern part of Taraba State, Nigeria. The study, which surveyed 230 crop farmers, revealed that most respondents were aware of sustainable agricultural land management practices. This awareness underscores the need for implementing more sustainable agricultural land management practices to ensure food security and environmental sustainability. Asthana and Kumar (2008) emphasized the importance of maintaining proper soil fertility through balanced nutrient application for sustainable crop production. They highlighted soil testing as a crucial step and identified seven dimensions of soil testing awareness among farmers. Their study, conducted in Uttar Pradesh state, India, assessed the impact of a World Bank-aided project on disseminating soil testing knowledge. The findings indicated that project interventions significantly influenced farmers' awareness and likelihood of adopting soil testing in different districts, suggesting implications for policymakers and researchers aiming to improve crop production and productivity in developing economies.

METHODOLOGY

Description of Study Area

The study was conducted in the Songhai community, located in Sapele Local Government Area, Delta State, Nigeria, which is 7 km away from the center of Sapele town along the Amukpe-Eku Road in the South-South Geopolitical Region. The study area is situated at Latitude: 5° 53' 38.58" N and Longitude: 5° 40' 35.98" E, with an elevation of 11 meters above sea level. The climate in the area is tropical, characterized by two distinct seasons: wet and dry. It features annual rainfall, high temperatures, and relative humidity (Ediagbonya *et al.*, 2014). The daily temperature ranges from 23.00°C to 27.60°C, with an average annual rainfall of 2000 mm, peaking around June, July, August, and September. The mean relative humidity ranges from 72.5% to 95.0% (Aweto, 2009). The vegetation is typical of the rainforest, with swampy areas near drainage streams. The Songhai community primarily consists of forested areas where farming activities are predominant. Approximately 70% of the population is engaged in farming, cultivating main crops such as yams, rice, cowpea, watermelon, cassava, plantain, fluted pumpkin, and okra. The predominant farming system practiced is shifting cultivation, also known as rotational bush fallow (Aweto, 2009). The major soil types in the area range from light to dark grey, fine sand to silty clay (Youdeowei and Nwankwoala, 2011).

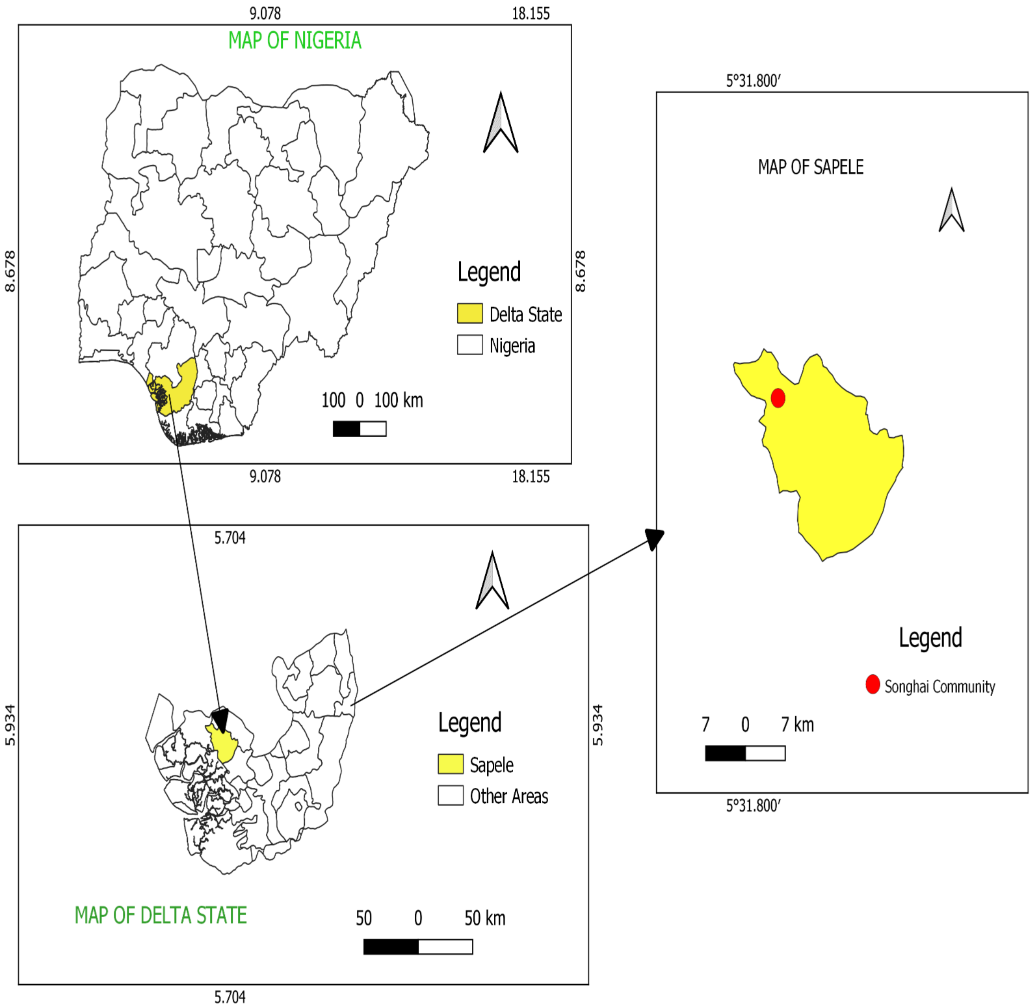

Figure 1: Songhai Community, Sapele Delta State Study Map

Administration of Questionnaire/Sample Size

The main source of data for the study was the questionnaire completed by 42 participants in the Songhai community, Sapele Local Government Area, Delta State. The questionnaires were administered by the researchers to participants through random selection. The target population mainly consisted of farmers living within the central district. The village was selected based on its agricultural potential, location, population density, and its representation of the socio-economic characteristics of rural life in the region. The questionnaires were completed by visiting the farms and meeting with the farmers in shops and fields. Those who could not be reached were replaced with others within the same stratum. It took 15–20 minutes to complete one questionnaire, and assistance was offered to uneducated individuals within the community. Data collection was completed by administering a four-section questionnaire. The first section, meant to assess the farmers' demographics, comprised a list of 11 questions, including gender, age, educational qualification, farming and agricultural experience, most preferred crop, length of time taken for crops to yield, size type, tenement, and cropping system mostly used. For the second section, the questionnaire sought to understand farming and soil fertility practices, focusing on fallow periods, most adopted practices, preferred types of fertilization, organic materials mostly used, reasons for decrease in crop yield, significant increase in crop yield during organic and inorganic application, and the best time for their application. Additionally, the third section aimed to assess farmers' viewpoints on organic agriculture, soil health, and soil fertility, with 12 questions administered to provide near-accurate data. The fourth section was meant to assess acceptance, viability, and sustainability, with 10 questions administered to prospective farmers to determine yearly net income, profitability, amounts usually sold and consumed, willingness to improve organic inputs, views on organic farm inputs, yields, and other challenges they face.

RESULT AND DISCUSSION

Statistical Analysis

Out of the 50 questionnaires administered, only 42 responses were received from the respondents in the Songhai community, Sapele Local Government Area, Delta State. These responses were entered into Microsoft Excel 2019, and the results were presented as descriptive statistics."

Respondents' Demographics

The percentage of farmers falling within the age range of 24-37 years to 50 years and above was determined. Findings from this study revealed that 28.6% of the farmers were in the age range of 24-37 years, 21.4% were between 38-50 years, and 45.2% were 50 years and above, indicating that the larger percentage (38-50 years) represented the most prominent farmers. Regarding educational background, 16.7% of the respondents had primary education, 48.9% had secondary education, and 23.8% had tertiary education. This data indicates that the majority of the farmers in the study area had secondary education, suggesting that their knowledge of soil management practices and its effects on soil health was limited. In terms of farming experience, 9.5% of the respondents had 20 years of experience, 21.4% had 5-10 years of experience, and 45.2% had less than 5 years of experience. Similarly, agricultural experience findings from the study showed that 40.5% of the respondents had less than 5 years of experience, 19% had 5-10 years of experience, 16.7% had 11-20 years of experience, and 23.8% had 20 years of experience. Regarding the prominent crops grown by the farmers, 19% grew Cassava, 7% grew Cowpea, 9.5% grew Plantain, 11.9% grew Yam, 2.38% grew watermelon, 4.8% grew okra, 16.7% grew fluted pumpkin, 4.8% grew amaranth, and 14.3% grew maize (which had the highest percentage). When it came to the growing cycle, 54.8% of the respondents noted that their growing cycle lasted for 0-6 months, 26.2% noted a cycle of 7 – 12 months, and 19% noted a cycle of 36 months, following the typical range required from planting to full growth. The distribution of farm sizes among the 42 sampled respondents revealed that 37.8% possessed between 1-2.5 acres, 9.5% had less than 1 acre/homestead, and 54.8% had between 2.5 – 5 acres of land for operation due to their annual engagement in farming activities. Additionally, based on the type of tenement system, 11.9% indicated their land was leased, 26.2% was rented, 47.2% was owned, and 14.3% were community-owned. Furthermore, 35.7% of the respondents practiced mono-cropping, while 64.3% practiced mixed cropping, where different crops were planted on the same piece of land in the same year. These findings indicate that farming was mainly conducted on a medium scale, and respondents often grew multiple crops alongside their main crop.

Table 1: Depicts the Demographic of the respondents in the study area

Variables	Frequency	Percentage (%)
Gender		
Male	32	76.2
Female	10	23.8
Age (years)		
10 – 23	2	4.8
24 – 37	12	28.6
38 – 50	9	21.4
50 above	19	45.2
Educational Background		
None	3	7.1
Primary	10	23.8
Secondary	22	48.9
Tertiary	7	16.7
Farming Experiences		
<5 years	19	45.2
5 – 10 years	9	21.4
11 – 20 years	10	23.8

20 years	4	9.5
Agricultural Experiences		
<5 years	17	40.5
5 – 10 years	8	19
11 – 20 years	7	16.7
20 years	10	23.8
Major crop grown		
Cassava (*Manihot esculenta*)	8	19
Cowpea (*Vigna unguiculata*)	3	7
Cucumber (*Cucumis sativus*)	4	9.5
Plantain (*Musa x paradisiaca*)	4	9.5
Yam (*Dioscorea cayaenesis)*	5	11.9
Watermelon (*Citrullus lanatus*)	1	2.38
Okra (*Abelmoschus esculentus*)	2	4.8
Fluted pumpkin (*Cucurbita moschatal*)	7	16.7
Maize	6	14.3
Amaranth	2	4.8
How many months does each growing cycle last		
0-6 Months	23	54.8
7 - 12 Months	11	26.2
36 Months	8	19
Above 36 Months	-	-
Size of land holding under operation (Ha)		
Below 1 acre/Homesteads	4	9.5
Between 1 – 2.5 acres	15	37.8
Between 2.5 – 5 acres	23	54.8
Above 10 acres	-	-
Types of Tenements		
Lease	5	11.9
Rent	11	26.2
Owned	20	47.2
Community owned	6	14.3
Type of cropping system		
Mono-cropping	15	35.7
Mixed cropping	27	64.3
Total	**42**	**100**

n=42

Respondents' Response on Farming and Soil Fertility Management Practices

From the findings of the study, 38.1% of the respondents indicated that they leave their field to fallow in less than a month, 28.6% indicated that they do theirs for 1- 6 months and 14.3% of the respondents indicated that theirs is 6 -12 months. In terms of farming practices, 23.8% of the respondents indicated that they adopt tillage system of practice, 16.7% indicated that they adopt making mound/heaps/ridges, 21.4% indicated that adopt bush burning, 7.1% of the respondents indicated that they adopt mulching system, 2.4% indicated that the make use of mixed cropping system, 9.5 % indicated that use different crop varieties,14.3% indicated that they practice cover cropping and 4.7 of the respondents indicated they practiced mixed cropping. Respondents' response on fertilization shows that 57.1% of the respondents make use of organic due to its low cost, 7.1% of the respondents make use of inorganic as result of the cost, 21.4% of the respondents utilise both organic and inorganic and lastly only 14.3% indicated that made use of none because of two reasons; some didn't see the need and others had no money to purchase either. Organic and in organic manure help in improving soil fertility and crop yield (Jenkinson and Rayner, 1977). The findings from the study regarding responses on the reason they make use of organic fertilization indicated that 7.1% of the respondents indicated their reasons due to availability in the community, 23.8% of the respondents indicated low cost of organic fertilization, 52.4% indicated it use due to crop response and 16.7% of the respondents indicated it use due to long term effects. On the other hand, 11.9% indicated that the usage is due to it being readily available in the community, 16.7 % of the respondent indicated usage due to low cost, 23.8% indicated its usage due to the good responses of the soil and lastly 47.6% indicated its use because of the positive long-term benefits. Furthermore, the study also shows the respondents knowledge of organic residue; 19% of the respondents indicated high, 47.6% indicated medium and 33.3% indicated low, while in terms of availability of organic material, 42.9% of the respondents indicated always available, 38.1% indicated that it is available and 19% indicated not available due to the fact they were within the riverine area. The findings on organic material mostly used shows that 14.3% of the respondents make use of plant source, 52.3% make use of animal source and 33.3% make use of both. Response on how plant materials are utilized after harvest shows that 23.8% of the respondents make use of them for mulch, 14.3% of the respondents also burn theirs and 9.5% of the respondent's plough to decompose in soil, 7.1% of the respondents use them for both fodder and firewood and fuel and lastly, 2.4% of the respondents makes use of the for both garbage and other things. In terms of farmer's response on changes in crop yield over the years, 47.6% of the respondents indicated increasing, 19% indicated decreasing and 33.3% of the respondents indicated that it is same over the years. Farmer's response on cause of decrease in yield, 45.2% of the respondents indicated weed/disease/pest infestation as the cause, and 42.9% of the respondents indicated as low yielding varieties as their cause and 11.9% indicated soil degradation/related problems as the cause. Weeds are unwanted plant known to compete with crop for nutrient and essential component so lack weeding leads to low performance of crop. On the other hand, erosion can cause washing of the topmost layer the soil and thus cause soil degradation and depletion (miner *et al*., 2020).

Also, farmer's response on low soil nutrients findings shows that, 28.6% of the respondents indicated continuous cultivation as the cause, 23.8% of the respondents indicated soil erosion as a cause 35.7% indicated has been due to poor adherence to recommended fertilizer as the cause as well, and 11.9% of the respondents indicated burning as another cause which goes to show that soil erosion and continuous cultivation are the primary constraints. However, responses obtained from the data collection on significant increase in crop yield during organic fertilizer application, 54.8% of the respondents indicated high and 38.1% of the respondents indicated slight in their response and 7.1% of the respondents indicated none. In addition, in terms of significant increase in crop yield during inorganic fertilizer application 50% of the respondents indicated high, 40.5% of the respondent indicated slight in their response and 9.5% indicated none. while response on application time, 23.8% of the respondents indicated that they apply before planting and 76% of the respondents indicated that they apply during crop growth.

Table 2: Shows the Farming and soil fertility management practices

Variables	Frequency	Percentage (%)
How long do you leave your field fallow before planting?		
Less than a month	16	38.1
1 – 6 months	12	28.6
6 – 12 months	6	14.3
Above 12 months	8	19
Farming practices adopted		
Tillage	10	23.8
Mulching	3	7.1
Planting hedge crops	1	2.4
Farming under tress	-	-
Use different crop varieties	4	9.5
Cover cropping	6	14.3
Mixed cropping	2	4.7
Kind of fertilization adopted		
Organic	24	57.1
Inorganic	3	7.1
Both	9	21.4
None	6	14.3

If organic fertilization, what is your reason?		
Availability in the community	3	7.1
Low cost	10	23.8
Crop response	22	52.4
Long term effects	7	16.7
If inorganic fertilization, what is your reason?		
Readily available in the community	5	11.9
Low cost	7	16.7
Good crop response	10	23.8
Positive long-term effects	20	47.6
Knowledge in organic residue management		
High	8	19
Medium	20	47.6
Low	14	33.3
Availability of organic materials in the community		
Always available	18	42.9
Available	16	38.1
Not available	8	19
Organic materials mostly used		
Plant source	6	14.3
Animal source	22	52.3
Both	14	33.3
How are plant material (crop residues) utilized after harvest		
Mulch	10	23.8
Burn	6	14.3
Ploughed to decompose	14	33.3
Firewood and fuel	4	9.5
Fodder	3	7.1
Composting	3	7.1
Disposed of as garbage	1	2.4
Other	1	2.4
How would you describe the changes in crop yield over the years		
Increasing	20	47.6
Decreasing	8	19
Same	14	33.3
What do you think is the cause for the decrease in crop yield?		
Weed/disease/pest infestation	19	45.2
Rainfall failure	-	-
Low yielding varieties	18	42.9
Soil degradation/related problems	5	11.9
Perceived reason(s) for low soil nutrients		
Soil erosion	10	23.8
Continuous cultivation	12	28.6
Low fertilizer/manure application rate	-	-
Burning	5	11.9
Poor adherence to recommended fertilizer/manure application	15	35.7
Significant increase in crop yield during organic fertilizer application		
High	23	54.8

Slight	16	38.1
None	3	7.1
Significant increase in crop yield during inorganic fertilizer application		
High	21	50
Slight	17	40.5
None	4	9.5
What is the time of application		
Before planting	10	23.8
During crop growth	32	76
Total	**42**	**100**

n=42

Respondents Awareness of Organic Agriculture, Soil Health and Soil Fertility

The study's findings have revealed the farmers' awareness of organic agriculture, soil health, and soil fertility. Regarding organic residue management, 21.4% of the respondents indicated a high level of awareness due to the majority of farmers recognizing its usefulness. Meanwhile, 28.6% of the respondents had a moderate awareness, and 50% had a low awareness due to limited understanding of its importance. The data also demonstrated the farmers' knowledge of soil organisms' presence in the farm. 28.6% of the respondents indicated that these organisms were always available, 61.9% noted their availability in the soil, and 9.5% stated they were not present. Concerning the awareness of soil organisms contributing to soil health, 54.8% of the respondents were aware, and 28.6% recognized the contribution, which aligns with the findings of Steffan *et al.* (2018). The respondents also shared their views on preserving soil fertility. 23.8% indicated fertilization, an essential method for preserving soil constituents, while 9.5% mentioned crop rotation due to land denudation. Furthermore, 50% of the respondents pointed to intercropping, and 16.7% favoured the tillage system. According to Pankhurst *et al.* (2002), conservation tillage, involving leaving previous crop residues on the soil surface, was practiced by only a small percentage of farmers. Regarding the type of organic fertilizer used, 28.6% of the respondents utilized livestock manure, 42.9% preferred poultry manure, and 23.8% opted for other types without specification.

In terms of integrating legumes with crop rotation, intercropping, and/or green manure, only 9.5% of the respondents practiced it, while 90.5% did not, indicating limited adoption of crop rotation. For pest and disease control, 28.6% of the respondents used biological and organic methods, 11.9% applied integrated pest management (IPM) methods, 47.6% resorted to chemical pesticides like Gammalin, and 11.9% used other methods such as traps.

Non-chemical methods of plant protection were also noted, with 19% employing mechanical means, 73.8% using physical and pheromone traps, and 7.1% utilizing biological enemies of pests. Regarding weed control, 57.1% of the respondents practiced manual weeding, 28.6% employed crop rotation and/or intercropping, and 14.3% used chemical herbicides called uproots. The study findings indicated that 47.6% of the respondents had heard of organic farming, while 52.4% had not. Additionally, 38.1% of the respondents agreed that inorganic inputs lead to soil fertility loss, while 61.9% disagreed. Furthermore, 85.7% of the respondents agreed that earthworms in the soil increase soil fertility, 9.5% believed it reduces soil fertility, and 4.8% claimed to have no knowledge about it.

Table 3: Awareness of organic agriculture, soil health and soil fertility

Variables	Frequency	Percentage (%)
How would you rate your knowledge in organic residue management		
High	9	21.4
Medium	12	28.6
Low	21	50
How would you describe the presence of soil organisms in your farm		
Always available	12	28.6
Available	26	61.9
Not available	4	9.5
Can these soil organisms be seen as contributors to soil health		
Very well	23	54.8
Slightly well	12	28.6
Not at all	7	16.7

How do you preserve soil fertility		
Fertilization	10	23.8
Crop rotation	4	9.5
Intercropping	21	50
Tillage	7	16.7
Other:		
If organic fertilizer are used can you specify the type		
Livestock manure	12	28.6
Poultry manure	18	42.9
Green manure		
Other:	10	23.8
If crop rotation, and/or intercropping and/or green manure are practiced, do you integrate legumes		
Yes	4	9.5
No	38	90.5
How do you control pests and diseases		
Biological and organic control methods	12	28.6
Integrated pest management (IPM) methods	5	11.9
Chemical pesticides (treatment), specify what do you use: Gammalin	20	47.6
Other Methods: Traps	5	11.9
If you use non-chemical methods for plant protection, which of the following do you use		
Mechanical ways	8	19
Physical and pheromone traps	31	73.8
Biological enemies of pest	3	7.1
Other	-	
How do you control weeds		
Mechanical weeding	-	
Manual weeding	24	57.1
Crop rotation and/or intercropping	12	28.6
Chemical herbicides, specify: Uproot	6	14.3
Have you ever heard about organic farming		
Yes	20	47.6
No	22	52.4
Does the usage of inorganic inputs (fertilizer, herbicides, pesticides) lead to soil fertility loss on your farm		
Yes	16	38.1
No	26	61.9
What do you think about earthworms on your farm		
Increased soil fertility	36	85.7
Reduced soil fertility	4	9.5
Nothing	2	4.8
Others	-	-
Total	**42**	**100**

n = 42

Respondents' Awareness of Organic Agriculture, Soil Health and Soil Fertility

The study's findings shed light on farmers' responses regarding the acceptance, viability, and sustainability of their farming practices. Concerning the amount of farm produce sold, 11.9% of the respondents indicated that they sell everything, 33.3% sell most, and 54.8% sell half of their produce, indicating a significant understanding of the importance of farming within the community. In terms of profitability, 85.7% of the respondents stated that their farming business is profitable throughout the year, while 14.3% found their farm produce unprofitable during certain periods. When asked about their annual earnings, 23.8% reported making between 20,000 –

100,000, and 76.2% reported earnings exceeding 200,000, aligning with reports by Al-kaisi (2016). When questioned about their future plans, 57.1% of the respondents planned to continue their business as usual, 33.3% aimed to expand their operations, and 4.7% considered selling or renting their land.

Regarding increasing organic inputs, 81% of the respondents expressed willingness, while 19% were not, possibly due to lack of awareness and knowledge about organic inputs and their impact on soil health. Additionally, 90.5% of the respondents believed that increasing organic inputs would enhance soil fertility and crop yield, while 9.5% held a contrary view. When asked about the comparison between yields from organic and inorganic fertilization, 16.7% of the respondents agreed that organic yields might be lower, 33.3% disagreed, and 50% were unsure. Regarding farmers' awareness of the potential of organic inputs to improve soil fertility and structure, 73.8% responded positively, while 26.2% were unsure. On the willingness to use soil microbial inputs, 78.6% of the respondents agreed, 16.7% disagreed, and 4.7% were uncertain.

Table 4: Acceptance, variability, and sustainability

Variables	Frequency	Percentage (%)
What share of your farm produce do you or your family sell		
Well sell everything	5	11.9
We sell most	14	33.3
We sell about half	23	54.8
Is your farming business profitable during the whole year		
Yes	36	85.7
No	6	14.3
How much income do you receive from your farm in a year		
20,000 – 100,000	10	23.8
200,000 and above	32	76.2
How do you imagine the future of your farm in the next 10 years		
You will continue business as usual	-	-
You will continue and expand farming business	24	57.1
You will allow family member(s) to manage the farm	14	33.3
You will sell/rent it for agricultural purpose	2	4.7
Other	2	4.7
Are you willing to increase organic farm inputs to your farm		
Yes	34	81
No	8	19
Do you think increase in organic farm inputs will help the good soil microbes which would lead to improve soil fertility and higher crop yield		
Yes	38	90.5
No	4	9.5
Do you think yields from organic fertilization are too low compared to yields from inorganic fertilization		
Yes	7	16.7
No	14	33.3
I don't know	21	50
Do you think the use of organic inputs in your farm can improve soil fertility and soil structure		
Yes	31	73.8
No	-	
I don't know	11	26.2
Are you willing to use soil microbial inputs in your farm		
Yes	33	78.6
No	7	16.7
Other: Don't know	2	4.7
Total	**42**	**100**

n = 42

CONCLUSION AND RECOMMENDATION

The results on the demographics of the respondents show that the farmers practice useful and sustainable agricultural methods, such as mixed farming. This approach is influenced by their current farming system, individual experiences, and attitudes and beliefs towards change. For instance, the larger percentage of the population of farms in Songhai, Sapele, Delta State, comprises middle school dropouts, indicating that not all of them are willing to adopt subsistence agriculture. This reluctance stems from the fact that some practices are new to their current farming system and entail changes. Consequently, these farmers perceive these practices as risky and do not consider them important. Values obtained from farming and soil fertility management practices illustrate that the majority of farmers in Songhai Farm, Delta State, understand the importance of organic and inorganic fertilization and the benefits they bring compared to the continuous usage of inorganic manure. Continuous use of inorganic manure can not only decrease soil health but also lead to a reduction in crop yields. Moreover, concerning farmers' awareness of organic agriculture, soil health, and soil fertility, the statistics depict that these farmers welcome the use of microbial inputs and are willing to try out new methods to increase productivity on their farms. The data obtained regarding farmers' acceptance shows that they perceive farm activities as highly profitable, and a significant percentage are open to expanding their business enterprises.

Based on the findings, it is highly recommended that farmers actively participate in sustainable agriculture events and practices. Increased attendance of such events enhances farmers' understanding of the importance of sustainability. Moreover, providing incentives, funding, and raising public awareness, along with empowering institutions to educate farmers about effective soil management practices and their impact on soil health, is crucial. This comprehensive approach can significantly enhance farm yield and soil health. The resulting boost in productivity will not only benefit Delta State but also have a positive impact on the entire country and neighboring developing nations. Therefore, it is essential for the government to promote general guidelines for obtaining indicators and encourage their use to monitor the improvement of soil health.

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