Journal of Agricultural Education Teachers Association of Nigeria
Vol. 10 Number 1, March 2026

FARMERS' AWARENESS AND ADOPTION OF GEOGRAPHIC INFORMATION SYSTEM IN FARM PLANNING, MANAGEMENT AND IMPROVING CROP PRODUCTIVITY FOR SUSTAINABLE FOOD SECURITY IN BENUE STATE, NIGERIA.

Onoriode, O., Ejike, A.A. and Mohammed, H.

Joseph Sarwuan

Tarka University, Makurdi,

University of Nigeria Nsukka,

Modibbo Adama University, Yola.

Abstract

Farmers in Benue state faces persistent challenges such as declining crop yields, inefficient land use, poor farm planning, and vulnerability to climate variability and soil degradation. This study investigated Farmers' Awareness and Adoption of Geographic Information System in Farm Planning, Management and Improving Crop Productivity for Sustainable Food Security in Benue State. Three research questions and hypotheses guided the study. The study population included 1,150,000 registered crop farmers, with a sample size of 400 (232 male and 154 female farmers) selected from the three geopolitical zones of Benue State using the Taro-Yamane formula and a multistage stratified sampling technique. Nine local government areas were purposively chosen for data collection. A 71-item structured questionnaire titled *Awareness and Adoption of Geographic Information System Questionnaire AAGISQ* was developed by the researcher based on a review of relevant literature *and validated by experts. The instrument's reliability was confirmed using the Cronbach alpha method, yielding a coefficient of 0.87. Data analysis involved percentage, mean scores and standard deviation to answer research questions and independent t-tests to test hypotheses at a 0.05 significance level. Findings revealed low awareness, and adoption of Geographic Information System in Farm Planning, Management and Improving Crop Productivity for Sustainable Food Security. The study recommended that agricultural extension agent and stakeholders should create more awareness on the use Geographic Information System in Farm Planning, Management and Improving Crop Productivity for Sustainable Food Security farmers in Benue State.*

Introduction

Technology is undoubtedly revolutionizing agriculture by increasing food production, simplifying farming practices, reducing drudgery in farming, increasing farmer incomes, and ensure effective farm management. Numerous technologies abound in agriculture and the proper application of these technology in precision agriculture can significantly improve efficiency and address major farm management challenges.

Agriculture faces myriad of uncertainty and complex challenges. Many enabling technology are currently stage of development and several are already contributed to in addressing specific limitation within the agricultural industry. For instance, technology such as the geographic information system (GIS) emerges, allowing for the generation of detailed image of the features of the terrain. These tools help to make informed decisions in the agricultural industry leveraging on satellite data, geographic information systems (Chandan, Ajay, Parnika 2024).

According to United States Geological Information (2025), A Geographic Information System is a computer system that analyzes and displays geographically referenced information using data that is attached to a unique location. Similarly, National Geographic (2025) Submitted that GIS is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. Sesrgieieva, (2025) define GIS as a tool that lets users create multi-layered interactive maps that can be used for the visualization of complex data and for spatial analysis. Geograma Digital Map (2025) state that GIS application in agriculture, Agricultural mapping, improved information access to farmers, Increase productivity, efficient water management, enhance research opportunity, hunger mapping, damage Assessment and Precision farming. Jurovich Surveying (2025) highlight several benefits of GIS to include, Improved decision making, costs reduction, increase efficiency, Improved communication across organizations or departments, Easy recordkeeping, and effective geographical Management. Mathenge, Sonneveld, and Broerse. (2022) identity major GIS application in agriculture, included: crop yield estimation, soil fertility assessment, cropping patterns monitoring, drought assessment, pest and crop disease detection and management, precision agriculture, and fertilizer and weed management. This application offer potential for enhance

agriculture sustainability by integrating the spatial dimension into agricultural policies, fostering evidenced based decision making according to Chandan, Ajay, Parnika (2024) GIS enable the generation of detailed terrain image, helping farmers to view, evaluate, and estimate geographic data. This facilitate more accurate and effective agricultural operations and support informed decisions in the agricultural industry.

GIS also in land use mapping, resolving land use conflicts, productivity by allowing better management of land resources (Butora, et al, 2022). Sesrgieieva, (2025) adds that GIS enables farmers to map, organize and analyze field data as well as remotely monitor their crops. These makes GIS a critical tools for effective farm planning.

Farm planning, according to National Open University of Nigeria (2025) involves the optimal allocation of limited farm resources to achieved efficient resource utilization and maximize income. Haveman, (2015) view farm planning as strategic decision making process in the farm management, focusing on the organized use resources to achieved specified goals continuously. Babban,(2025) emphasizes that proper farming planning, increases efficiency, support goals attainment, aids coordination, improve decision making, reduces risks and oversight, encourages innovation and facilitate task delegation.

The National Open University Of Nigeria (2025) further submitted that farm planning enables the farmer examine of the existing resources and efficient allocation of resources. It assist in selecting appropriate enterprise combination, identifying best combination of input to achieving maximum output, determine credit need of farm and forecasting future costs and returns.

Adekunle and Njideka (2024) report that GIS support sustainable land use planning by identifying suitable areas for crop rotation, cover cropping mapping, and agroforestry, thereby improving soil health and biodiversity. The author further noted that GIS also facilitate precision livestock farming by monitoring grazing patterns and optimizing pasture management. Similarly, Dargains, and Cabral, (2021) opined that GIS is used alongside remote sensing techniques for land use and land cover mapping, ecosystem valuation, scenario development, carbon assessment, and forest simulation Modeling using sis software suit.

Farm planning remain an important component of farm management helping farmers to achieve personal and business objectives in more organized manner (National Open University of Nigeria, 2025) the further opined that Farm management applies economic principles to the art of administration farm businesses. The key objectives of farm Management includes, Profit maximization, cost reduction, market leadership, and utility maximization. GIS play significant role Irrigation planning and management, agricultural disaster responds, and sustainable resources management of natural resources, (Idoko 2024: Abbas, and Amanabo, 2017). FAO (2024) notes that (GIS) support poverty appraisals, food security analysis and rural vulnerability mapping.

Food Security According to Worldbank (2025) exists when all individual have consistent physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for healthy and active life. World food programme (2025) emphasize that Food security encompasses the availability of adequate nutritious food for normal growth and development. Adekunle and Njideka (2024) argue that GIS is vital for achieving sustainability agriculture and addressing food demand amidst climate change. GIS base food security assessment is relatively faster, scalable and capable of integration and high resolutions satellite imagery, improving prediction and reliability of the results. Marvel (2023) asserts that GIS enable the observation of geographic variable threaten food supply, which enhanced the identification food globally. Given the increasing impact of climate change on agriculture and food security, integrating GIS in policy and decision making is essential for sustainable agriculture **development. (Mathenge, Sonneveld,** and **Broerse**, **2022)**. The integration of Geographic Information Systems (GIS) in agriculture is pioneering precision farming techniques and promoting sustainable agricultural practices (Adekunle and Njideka 2024).

Problem Statement

Agriculture remains the primary source of livelihood for the majority of the population in Benue State, Nigeria, which is regarded as the “Food Basket of the Nation.” However, the sector faces persistent challenges such as declining crop yields, inefficient land use, poor farm planning, and vulnerability to climate variability and soil degradation.

These issues continue to threaten the state's ability to ensure sustainable food security and agricultural productivity.

In recent years, technological innovations such as the Geographic Information System (GIS) have emerged as critical tools in modern agriculture. GIS enables farmers and agricultural planners to collect, analyze, and interpret spatial and environmental data for informed decision-making in farm management. Through GIS, farmers can identify soil variability, plan irrigation systems, monitor crop health, and optimize resource use — all of which are essential for improving crop productivity and ensuring sustainability. Despite these advantages, anecdotal evidence and preliminary observations suggest that the awareness and adoption of GIS among smallholder and medium-scale farmers in Benue State may be significantly limited.

This apparent lack of awareness and low adoption may be attributed to various factors including inadequate access to training, limited exposure to digital tools, lack of government extension support, and socio-economic barriers such as low income and education levels. Consequently, many farmers continue to rely on outdated and inefficient farming techniques that reduce their productivity and resilience, thereby compromising food availability and agricultural sustainability in the state.

Furthermore, there is a noticeable gap in empirical data regarding the current levels of GIS awareness, the extent of its use in farm planning and management, and the challenges hindering its adoption in Benue State. Without a comprehensive understanding of these issues, stakeholders, including policymakers, agricultural extension agents, and development organizations, may struggle to design effective programs and policies to promote the integration of GIS in agricultural practices.

Therefore, this study seeks to critically examine farmers' awareness and adoption of GIS technology in Benue State, assess its influence on crop productivity, and explore its role in achieving sustainable food security. The findings are expected to guide policy formulation and agricultural interventions aimed at enhancing technological adoption for improved agricultural outcomes in the region.

Purpose of the Study

(1) To determine the level of awareness of Geographic Information System technology among Famers in Benue State.
(2) To assess the adoption rate of Geographic Information System technology among Famers in Benue State
(3) To identify the factors influencing the adoption of Geographic Information System among farmers in Benue State
(4) To examine the benefit of Geographic Information System in Farm Planning, Management and improving crop productivity in Benue state

Research Question

(1) What are the level of awareness of Geographic Information System technology among famers in Benue State?
(2) What is the adoption rate of Geographic Information System technology among famers in Benue State?
(3) What are the factors influencing the adoption of Geographic Information System among farmers in Benue State?
(4) What are the benefit of Geographic Information System in Farm Planning, Management and improving crop productivity in Benue State?

Research Hypotheses

1. There is no statistical significant difference between the responses of the respondents on the level of awareness of Geographic Information System technology among famers in Benue State.
2. There is no statistical significant difference between the responses of the respondents on the adoption rate of Geographic Information System technology among famers in Benue State.
3. There is no statistical significant difference between the responses of the respondents on the factors influencing the adoption of Geographic Information System among farmers in Benue State.
4. There is no statistical significant difference between the responses of the respondents on the benefit of Geographic Information System in

5. Farm Planning, Management and improving crop productivity in Benue state.

Methodology

The study was guided by three research questions and three null hypotheses. A survey research design was adopted, and the study was conducted in Benue State. The target population consisted of 1,150,000 crop farmers, as recorded by the Farmers Association of Nigeria. A sample size of 400 respondents, including 232 male farmers and 154 female farmers, was selected using Taro Yamane's formula.

A 71-item structured questionnaire titled *Awareness and Adoption of Geographic Information System Questionnaire AAGISQ* was developed by the researcher based on a review of relevant literature. The *AAGISQ* contained polycotomous items with four response options: Strongly Agreed (SA), Averagely Agreed (AA), Slightly Agreed (SA), and Not Agreed (NA), assigned nominal values of 4, 3, 2, and 1, respectively.

The instrument underwent face and content validation by three experts: two in Agricultural Education and one in Soil Science, all from Joseph Sarwuan Tarka University, Makurdi, and Benue State. The feedback provided by these experts was used to improve the instrument. Its reliability coefficient was determined using Cronbach's alpha method, yielding a reliability coefficient of 0.87.

The researchers personally distributed the questionnaire to respondents during their meeting days, ensuring it was completed on the spot. For those absent, the questionnaire was sent via Google Drive, email, and WhatsApp, allowing respondents one month to complete it. This approach ensured that only the intended participants completed the questionnaire and allowed the researcher and research assistants to clarify any points of confusion. In total, 386 copies (representing 98% response rate) were filled and returned for analysis.

The collected data were analyzed using both descriptive and inferential statistics. Descriptive statistics, such as mean and standard deviation, were used, while independent t-tests were employed to test the null hypotheses at a 0.05 level of significance. The mean was chosen to answer the research questions because the collected data were on an interval scale. The t-test was used to determine whether there were significant differences between male and

female farmers regarding drought control measures' impact on crop yield and farmers' livelihoods.

The decision rule for hypothesis rejection was based on the p-value and alpha value. A null hypothesis was not rejected for any cluster of items where the p-value was equal to or greater than 0.05 ($p \geq 0.05$). However, it was rejected for any cluster where the p-value was less than 0.05 ($p < 0.05$).

Research Question One

What are the level of awareness of Geographic Information System Technology among Famers in Benue State?

The data for answering the research question is presented in table below

Table 1: Mean Ratings of Male and Female Farmers on the Level of Awareness of Geographic Information System Technology among Famers in Benue State (N = 386: 232 Male And 156 Female Crop Farmers)

NO	ITEM	X	SD	Remark
1	have you heard of Geographic Information System technology(GIS)	1.40	.491	NA
2	heard of Geographic Information System technology(GIS) From extension agents, workshop/media/ friends	2.16	.423	SA
3	Geographic Information System technology(GIS) is use for crop monitoring	2.74	.810	A
4	Geographic Information System technology (GIS) is often uses in soil mapping.	2.90	.980	A
5	Geographic Information System technology (GIS) is often uses in precision farming.	2.59	.600	A
6	GIS technology identify area with specific soil types/PH level /nutrient deficiency.	2.28	.522	SA
7	Do you know you can used GIS technology to predict event like flood/ drought.	2.56	.879	A
8	GIS technology can be used to manage the incident like flood /drought.	2.32	.586	SA
9	GIS can be used to control the incident of flood/ drought.	2.20	.558	SA
10	GIS can be used to analyses factors such temperature/rainfall/soil type.	2.39	.774	SA
11	GIS technology can be used to plan irrigation system.	2.53	.884	A

12	GIS technology can use to manage irrigation system.	2.29	.675	SA
13	GIS technology can be used to provide real-time crop monitoring.	2.30	.723	SA
14	GIS technology can help identify the best areas for different crop based on soil climate.	2.24	.736	SA
15	GIS technology can help identify the best areas for different crop based on soil climate data.	2.10	.673	SA
16	GIS technology can help create detail map of the field highlighting variations in soil property and soil condition.	2.08	.697	SA

The data presented in table 1 revealed that 5 out of the 16 items are had their mean values ranged from 2.53 to 2.74. This showed that the mean value of each item was above the cut-off point of 2.50 which indicates that all the 4 items were Aware of GIS in Benue while the remaining 10 item had their mean values ranged from 2.08 to 2.39. Was below the cut-off point of 2.50 which indicates that all the 14 items are slightly aware of GIS in Benue, 1 item is below the cut of point 1.50 which indicates that they are not aware of GIS in Benue The table also showed that the standard deviation (SD) of the items ranged from 0.43 to 0.98, indicating that the respondents were not too far from the mean and from the opinion of one another in their responses.

Hypotheses One

There is no statistical significant difference between the Responses of the Respondents on the level of Awareness of Geographic Information System Technology among Famers in Benue state.

The data for answering the research question is presented in the table below.

Table 2: T-test Analysis of the Responses of the Respondents on the Level of Awareness of Geographic Information System Technology among Famers in Benue State. (N = 386: 232 Male and 156 Female crop farmers)

	N	DF	MEAN	Std. Deviation	sig	Decision @0.05
malefarmers	232	386	2.3411	.21310	0.00	N.S
femalefarmers	156		2.2476	.25250		

The table 2 also revealed that all the items had their calculated p-values is 0.00 which were less than the alpha value of .05 indicating that there was statistical significant difference in the mean ratings of the responses of the two groups of respondents on the Level of Awareness of Geographic Information System Technology among Famers in Benue State. Therefore, the hypothesis of no significant difference was rejected.

Research Question Two

What is the adoption rate of Geographic Information System Technology among Famers in Benue State?

The data for answering the research question is presented in the table below.

Table 3: Mean Ratings of Male and Female Farmers on the Adoption of Geographic Information System Technology among Famers in Benue State (N = 386: 232 Male and 156 Female Crop Farmers)

NO	ITEM	X	SD	Remark
17	I use Geographic Information System technology (GIS) for crop monitoring in the farm.	2.08	.735	NA
18	I use Geographic Information System technology(GIS) for soil mapping in the farm	1.04	.811	NA
19	I often use Geographic Information System technology (GIS) for precision farming in the farm.	1.08	.880	NA
20	I always use GIS technology to identify area with specific soil types/PH level/ nutrient deficiency.	1.05	.913	NA
21	I always use GIS technology to predict event like flood / drought in the farm.	1.07	.983	NA
22	I always use GIS technology to manage the incident like flood /drought.	1.08	1.057	NA

23	I always use GIS to control the incident of flood/ drought.	1.06	1.075	NA
24	I always use GIS to analyses factors such temperature/rainfall/soil type.	1.07	1.119	NA
25	I always use GIS technology to plan irrigation system.	1.10	1.194	NA
26	I always use GIS technology to manage irrigation system.	1.08	1.230	NA
27	I always use GIS technology to provide real-time crop for monitoring	1.12	1.308	NA
28	I always use GIS technology to identify the best areas for different crop based on soil climate.	1.09	1.333	NA
29	I always use GIS technology to identify the best areas for different crop based on soil climate data.	1.10	1.378	NA
30	I always use GIS technology to create detail map of the field highlighting variations in soil property and soil condition.	1.10	1.429	NA

The data presented in table 4 revealed that 15 out of the 15 items are the uses of GIS, had their mean values ranged from 1.05 to 2.08. This showed that the mean value of each item were below the cut-off point of 2.50 which indicates that all the 15 items that are the uses of GIS were not adopted in Benue state. The table also showed that the standard deviation (SD) of the items ranged from 0.73 to 1.42, indicating that the respondents were not too far from the mean and from the opinion of one another in their responses.

There is no statistical significant difference between the responses of the respondents on the adoption rate of Geographic Information System Technology among Famers in Benue State.

The data for answering the research question is presented in the table below.

Hypotheses Two

Table 4: T-test Analysis of the responses of the Respondents on the Adoption rate of Geographic Information System Technology among Famers in Benue State. (N = 386: 232 Male and 156 Female Farmers)

	N	DF	MEAN	Std. Deviation	sig	Decision @0.05
malefarmers	232	386	1.1124	.17501	0.04	N.S
femalefarmers	156		1.0714	.00000		

The table4 also revealed that the calculated p-values is 0.04 which were less than the alpha value of .05 indicating that there was statistical significant difference in the mean ratings of the responses of the two groups of respondents on the Adoption rate of Geographic Information System Technology among Famers in Benue State. Therefore, the hypothesis of no significant difference was rejected.

Research Question Three

What are the factors influencing the adoption of Geographic Information System among Farmers in Benue State?

The data for answering the research question is presented in the table below.

Table 5: Mean Ratings of male and female farmers on the factors influencing the adoption of Geographic Information System technology among famers in Benue state (N = 386: 232 Male and 156 Female Farmers)

NO	ITEM	Mean	SD	Remark
31	Farmers' awareness/understanding of GIS technology influence GIS adoption in Benue state.	3.07	1.470	A
32	Availability of GIS technology influence its adoption in Benue state.	3.50	1.646	A
33	Accessibility of GIS technology influence its adoption in Benue state.	3.75	1.541	A
34	Lack of institution framework influence its adoption in Benue state.	3.68	1.669	A
35	Cost of GIS technology limits its adoption	3.75	1.161	A
36	Lack of technical know-how on the uses of GIS technology influence its adoption in Benue state.	3.68	1.695	A
37	Lack of technical know-how on the interpretation of GIS data influence its adoption in Benue state.	3.71	1.776	A

38	Inadequate extension services to guide farmers on the use of GIS technology.	3.81	1.779	A
39	Influence of pear group/ other farmers/community leaders influence its GIS adoption in Benue state.	3.48	1.942	A
40	Lack of government support influence the adoption of GIS technology	3.77	1.890	A
41	Inadequate basic amenities to such as internet connectivity/electricity/road to ensure it effectives uses	3.62	1.929	A
42	Farmer's educational level influence the adoption of GIS technology.	3.62	1.980	A
43	Financial status of farmers influence the adoption of GIS technology	3.68	2.094	A

The data presented in table 5 revealed that the 13 items are the factors influencing the adoption of Geographic Information System GIS among farmers had their mean values ranged from 3.07 to 3.81. This showed that the mean value of each item was above the cut-off point of 2.50 which indicates that all the 15 were the factors influencing the adoption of Geographic Information System among farmers in Benue state. The table also showed that the standard deviation (SD) of the items ranged from 1.16 to 2.09, indicating that the respondents were not too far from the mean and from the opinion of one another in their responses.

Hypotheses Three

There is no statistical significant difference between the responses of the respondents on the factors influencing the adoption of Geographic Information System among farmers in Benue state.

The data for answering the research question is presented in the table below.

Table 6: **T-test analysis of the responses of the respondents on the Factors Influencing Geographic the adoption of Information System Technology among Famers in Benue State (N = 386: 232 Male and 156 Female Farmers)**

	N	DF	Mean	Std. Deviation	Sig	Decision @0.05
Malefarmers	232	386	3.2427	.47127	0.00	N.S
Femalefarmers	156		3.6070	.16243		

The table 6 also revealed that the calculated P-values is 0.00 which was less than the alpha value of .05 indicating that there was statistical significant difference in the mean ratings of the responses of the two groups of respondents on the Factors Influencing the adoption of Information System Technology among Famers in Benue State. Therefore, the hypothesis of no significant difference was rejected

Research Question Four:

What are the benefit of Geographic Information System in Farm Planning, Management and improving Crop Productivity in Benue State?

The data for answering the research question is presented in the table below.

Table 7: Mean Ratings of Male and Female Farmers on the factors influencing in Farm **Planning, Management and improving crop productivity among famers in Benue state (N = 386: 232 Male and 156 Female Farmers)**

NO	ITEM	X	SD	Remark
	Benefit of Geographic Information System in Farm Planning			
44	For land use planning identifying suitable areas for different farm activities	3.12	2.361	A
45	For mapping crop suitability location i.e. determine the suitability of different crops	3.60	2.200	A
46	For identifying areas with specific area/nutrient deficiency / soil ph	3.61	2.251	A
47	For planning irrigation practices i.e. identifying area with adequate water resources for irrigation system	3.51	2.346	A
48	Provide climatic data or information to predict future crop yield	3.61	2.343	A
49	Optimizing crop location based data for planting (precision farming)	3.55	2.413	A
50	Optimizing crop location based data for fertilizer application (precision farming)	3.60	2.446	
51	Optimizing crop location based data for harvesting (precision farming)	3.66	2.485	A
52	For climatic change impact assessment to identify area of valuable to climate change	3.67	2.528	A
53	For mitigating risk associated flood	3.66	2.574	A
54	For mitigating risk associated drought	3.67	2.625	A
55	For data-driving insights to inform farming decision	3.69	2.657	A

	Benefit of Geographic Information System in Farm management			
56	For tracking crop health	3.72	2.693	A
57	For tracking crop growth	3.81	2.735	A
58	For identifying type of soil, type, Ph. and nutrient to improve crop yield	3.79	2.783	A
59	For effective management of irrigation system to avoid waste.	3.68	2.849	A
60	For optimizing farm management practice to reduce cost	3.76	2.891	A
61	Developed target management strategies to reduce pest so as to improve crop quality.	3.70	2.931	
62	Developed target management strategies to control disease so to increase yield	3.57	3.035	A
63	Help make effective decision on drought/ flood management strategies for sustainable farming	3.80	3.027	A
64	Provide data-driving information for accurate farm management decision	3.73	3.105	A
	Benefit of Geographic Information System in crop productivity			
65	Provide field data such as soil condition/ crop health / water patter to increased crop yield.	3.88	3.120	A
66	Identify the best area for different thereby maximizing land productivity.	3.71	3.203	A
67	Help in crop monitoring to prevent incident of pest in order to boost crop quality	3.81	3.231	A
68	Help in crop monitoring to control the incident of disease to boost crop quantity	3.36	3.292	A
69	Help manage irrigation system effective to water conservation for sustainable crop growth	3.86	3.346	A
70	providing data to reduce flood incident to reduce destruction of farm	2.79	3.592	A
71	providing data to reduce drought incident to increase crop productivity	3.74	3.454	A
72	Provide evident related to soil type/ PH level of the soil to determine the type of crop to cultivate in order to increase crop yield.	3.50	3.572	A

The data presented in table 4 revealed that 29 items are the benefit of Geographic Information System in Farm Planning, Management and improving crop

productivity had their mean values ranged from 3.12 to 3.88. This showed that the mean value of each item was above the cut-off point of 2.50 which indicates that all the items were the benefit of Geographic Information System in Farm Planning, Management and improving crop productivity in Benue. The table also showed that the standard deviation (SD) of the items ranged from 2.20 to 3.57 indicating that the respondents were not too far from the mean and from the opinion of one another in their responses.

Hypotheses Four

There is no statistical significant difference between the responses of the respondents on the benefit of Geographic Information System in Farm Planning, Management and improving crop productivity in Benue state.

The data for answering the research question is presented in the table below.

Table 8: **t-test analysis of the responses of the respondents on the benefit of Geographic Information System in Farm Planning, Management and improving crop productivity in Benue state (N = 386: 232 Male and 156 Female Farmers)**

Respondent	N	Df	Mean	Std. Deviation	sig	Decision @0.05
malefarmers	232	386	3.2925	.67093	0.00	N.S
femalefarmers	156		3.7814	.19567		

The table revealed that the calculated p-values ranged is 0.00 which less than the alpha value of .05 indicating that there was statistical significant difference in the mean ratings of the responses of the two groups of respondents on the benefit of Geographic Information System in Farm Planning, Management and improving crop productivity in Benue state. Therefore, the hypothesis of no significant difference was rejected.

Discussion of Findings

The results from table 1 revealed that 16 items indicated farmer's level of awareness of Geographic Information System GIS Technology among Famers in Benue State. Of these, five items show high level of awareness. 10 items indicate slightly awareness and 1 item showed that famers are not aware of GIS Technology among Famers in Benue State.

This finding was further was further confirmed by the test of corresponding hypothesis in table 2, which indicate a statistical significant difference in the mean ratings of the responses of the two groups of respondents on the Level of Awareness of Geographic Information System Technology among Famers in Benue. This align with the finding of Yunus (2016) who report that low GIS awareness among precision agriculture in the Cukurova region of Turkey. This finding is alignment with Shehrawat, Sube-Singh, and Arulmanikandan, (2024) identified low awareness regarding the use of advanced technologies like GPS, drones, and precision agriculture tools for crop production.

Table 2 also revealed the adoption rate of GIS Technology among Famers in Benue State. The 14 items show that GIS has not been adopted by Famers in Benue State. The study was further confirm by the test of corresponding hypothesis in Table 4, which stated that a statistical significant difference in the mean ratings of the responses of the two groups of the respondents on the adoption rate of Geographic Information System Technology among Famers in Benue State. The finding is consistent with the finding of Mitchell, Weersink, and Erickson, (2018). Who reported low adoption rates for precision agriculture technologies in Ontario crop production? This finding is alignment with Shehrawat, Sube-Singh, and Arulmanikandan**, (2024)** who observe similarly low Adoption rates for advanced tools, primarily due to cost, lack of training, and complexity. Similarly, Oladeji O.O., Okoruwa V.O., Ojehomon V.E.T., Diagne A., and Obasoro O.A. (2015) opined that access to credit, media, farm size, gender, household size, and agricultural income significantly influence both the probability and intensity of adoption in their study area

Table 3 revealed the factors influencing the adoption of GIS among Farmers in Benue State. The 14 items show that they are the factors influencing the adoption of GIS. The study was further confirm by the test of corresponding hypothesis in Table 6, which show that a statistical significant difference in the mean ratings of the responses of the two groups of respondents on the factors influencing the adoption of Geographic Information System among Farmers in Benue State. Batizi, et. all (2021) found that factors such as gender, age, district, farm size, staple food production and knowledge influence the

Adoption of Climate-Smart Irrigation Technologies for Sustainable Crop Productivity by Smallholder Farmers in Arid Areas of South Africa. Similarly, Similarly, Oladeji, Okoruwa, Ojehomon, Diagne, and Obasoro, (2015) opined that access to credit, media, farm size, gender, household size, and agricultural income significantly influence both the probability and intensity of adoption in their study area.

Table 4 revealed the factors influencing the adoption of Geographic Information System among Farmers in Benue State. The 14 items show that they are the factors influencing the adoption of Geographic Information System among Farmers in Benue State. The study was further confirm by the test of corresponding hypothesis in table 6, which state there was statistical significant difference in the mean ratings of the responses of the two groups of respondents on the factors influencing the adoption of Geographic Information System among Farmers in Benue State. Batizi, et. al (2021) that factors such as gender, age, district, farm size, staple food production and knowledge influence the Adoption of Climate-Smart Irrigation Technologies for Sustainable Crop Productivity by Smallholder Farmers in Arid Areas of South Africa. similarly Oladeji, Okoruwa , Ojehomon, Diagne, and Obasoro, (2015) opined that Access to credit, access to media, farm size, gender, household size and agricultural income significantly influence the probability and intensity of adoption in the study area

Table 4 also highlight the benefit of GIS in Farm Planning, Management and improving crop productivity. The 29 items affirmed that they are benefit of GIS in Farm Planning, Management and improving crop productivity. This findings was further supported by the test of corresponding hypothesis in Table 8, which revealed that a statistical significant difference in the mean ratings of the responses of the two groups of respondents on the benefit of Geographic Information System in Farm Planning, Management and improving crop productivity among Farmers in Benue State. Mathenge, Sonneveld, and Broerse, (2022) noted the major GIS application areas includes crop yield estimation, soil fertility assessment, cropping patterns monitoring, drought assessment, pest and crop disease detection and management, precision agriculture, and fertilizer and weed management. This is in an agreement with Adekunle et al (2024) who emphases that

GIS aids in identifying suitable areas for crop rotation, cover cropping, and agroforestry, enhancing soil health and biodiversity.

Conclusion

The study examined the awareness, adoption, influencing factors, and benefits of Geographic Information System (GIS) technology among farmers in Benue State, Nigeria. The findings of the study shows that there is a moderate level of awareness of GIS among farmers and full awareness is yet to be achieved. Adoption of GIS technology is ongoing, but still relatively low, this may due to factors such as lack of training, high costs, and limited access to resources.

The study also identified multiple factors that influence the adoption of GIS, including lack of technical know-how, access to credit, availability of GIS technology, lack of institution framework, cost of GIS technology, and inadequate extension services. Importantly, the study confirmed that GIS provides significant benefits in farm planning, resource management, and crop productivity, as supported by both empirical data and existing literature.

Furthermore, while GIS technology holds great potential for transforming agricultural practices in Benue State, its effective adoption remains limited due to several factors and challenges. Strategic interventions from government, agricultural stakeholders and Non-governmental organization are needed to enhance awareness, build capacity, and remove adoption barriers among farmers.

Recommendations

1. Government agencies, Agricultural Extension Officers, and NGOs should implement awareness programs to educate farmers on the potential and benefits of GIS technology in agriculture.
2. Government agencies, Agricultural Extension Officers, and NGOs should provide regular training workshops and practical demonstrations should be organized government and agricultural stakeholders to build farmers' technical capacity to use GIS tools effectively.
3. Government Agencies and Policymakers should consider subsidizing GIS-related hardware and

4. software, making it more affordable and accessible to smallholder farmers.
5. Financial institutions and agricultural support programs should facilitate easier access to loans or grants for farmers interested in adopting precision technologies such as GIS.
6. Extension officers should be well-trained in GIS technology and tasked with regularly supporting and mentoring farmers in its application on the field.
7. Partnerships between universities, research institutions, and local farming communities should be encouraged to develop context-specific GIS solutions tailored to local needs.

REFERENCES

Abbas, A.M and Amanabo,U H (2017) Geographic Information System (GIS) And Its Nexus To Agriculture: Making Improved Technology Accessible To Farmers In Nigeria. *International Journal of Advanced Research and Publications ISSN: 2456-9992* http://www.ijarp.org/published-research-papers/oct2017/Geographic-Information-System-gis-And-Its-Nexus-To-Agriculture-Making-Improved-Technology-Accessible-To-Farmers-In-Nigeria.pdf

Adekunle, S .T and Njideka, R .C (2024) GIS-driven agriculture: Pioneering precision farming and promoting sustainable agricultural practices. *World Journal of Advanced Science and Technology*, 2024, 06(01), 057–072. DOI: https://doi.org/10.53346/wjast.2024.6.1.0047

Alagbe, O.D, and Adefowope, D.E. (2022) Geographical Information System (GIS): A panacea for Food Insecurity in Nigeria (A review). *International Journal of Recent Research in Interdisciplinary Sciences (IJRRIS)*, Vol. 9, Issue 2, pp: (1-8), April - June 2022. Available at: www.paperpublications.org

Babban. G,(2025) *Planning in Agribusiness the Importance.* Retrieved from https://babbangona.com/the-importance-of-planning-in-agribusiness/

Batizi, S, Salmina M, Christian, D.P, Sylvester.M, Luxon, N, and Grany, S (2021) Factors Influencing the Adoption of Climate-Smart Irrigation Technologies for Sustainable Crop Productivity by Smallholder Farmers in Arid Areas of South Africa, *11(12), 1222;* https://doi.org/10.3390/agriculture11121222

Butora, A, Soloniewicz, B., Schwartz, C., Aziz, C., Sichang, S., and Mohammed, M. (2022) The Practical use of GIS in Agriculture. *International Conference on Computational Science and*

Computational Intelligence. DOI: 10.1109/CSCI58124.2022.00270

Chandan K. M., Ajay K., & Prusty, P. S. (2024) *Application of GIS in Agriculture.* Retrieved from https://www.researchgate.net/publication/380360753_Application_of_GIS_in_Agriculture

Dargains, A., & Cabral, P.A. (2021) GIS-based methodology for sustainable farming planning: Assessment of land use/cover changes and carbon dynamics at farm level. *Land Use Policy, 111*, 105788. https://doi.org/10.1016/j.landusepol.2021.105788

Food and Agricultural Organization (2024) *Remote Sensing and GIS for sustainable agriculture and food security*. Retrieved from https://openknowledge.fao.org/server/api/core/bitstreams/38db939a-7a59-45ab-ada5-b4ab3afe75bf/content

Geograma Digital Map (2025) ***8 applications of GIS in agriculture***. Retrieved from https://www.geograma.com/en/blog/8-applications-of-gis-in-agriculture/.

Haveman, R (2015), *Farm Planning.* Retrieved from https://www.linkedin.com/pulse/farm-planning-rene haveman#:~:text=Farm%20planning%20is%20a%20decision,from%20among%20all%20possible%20alternatives.

Idoko, N.T (2024) GIS *Applications in Nigerian Agriculture.* Retrieved fromhttps://disciplines.ng/gis-applications-in-agriculture/

Jurovich Surveying (2025) *What Is Gis*? Retrieved from https://www.jurovichsurveying.com.au/faq/what-is-gis

Mathenge, M, Sonneveld, B.G. J. S and **Broerse**, **J E. W. (2022)** Application of GIS in Agriculture in Promoting Evidence-Informed Decision Making for Improving Agriculture Sustainability: *A Systematic Review. 14*(16), 9974; **https://doi.org/10.3390/su14169974**

Marvel, G (2023) GIS for Food Security. Retrieved from**https://geomarvel.com/analyze-food-security-with-gis/**

Mitchell, S., Weersink, A. and Erickson, B. (2018) Adoption of precision agriculture technologies in Ontario crop production. *Canadian Journal of Plant Science*. https://doi.org/10.1139/cjps-2017-0342

National Geographic (2025) *GIS (Geographic Information System).* Retrieved from https://education.nationalgeographic.org/resource/geographic-information-system-gis/

National Open University of Nigeria (2025) *Farm Business Organization. Aex310 lecture.* Retrieved from https://nou.edu.ng/coursewarecontent/AEA310.pdf

National Open University of Nigeria (2025) *lecture note on AEC 401: farm management records and accounts.* Department of agricultural Economics and Extension. Retrieved from

https://nou.edu.ng/coursewarecontent/AEC401.pdf

Oladeji O.O., Okoruwa V.O., Ojehomon V.E.T., Diagne A., and Obasoro O. A., 2015, Determinants of Awareness and Adoption of Improved Rice Varieties in North Central, Nigeria, Rice Genomics and Genetics, *Vol.6, No.7 1-10 (doi: 10.5376/rgg.2015.06.0007)*

Ojo, T. F., **Famakinwa ,M. and Omonijo, O.(2019)**Assessing The Application Of Geographic Information System (Gis) Among Agricultural-Based Researchers In Southwestern Nigeria. *Ife Journal of Agriculture* Vol. 31 No. 1 (2019): Retrieved from https://ija.oauife.edu.ng/index.php/ija/article/view/134

Shehrawat, P.S, Sube Singh, A. and Arulmanikandan, B (**2024)** Farmers' awareness level and adoption regarding usage of ICT for crop production. *International Journal of Agriculture Extension and Social Development***,** Vol. 7, Special Issue 11. https://doi.org/10.33545/26180723.2024.v7.i11Sc.1366

Sesrgieieva, K (2025) *GIS In Agriculture: Best Practices For AgriTech Leaders*. Retrieved from https://eos.com/blog/gis-in-agriculture/

United States Geological Information (2025), *What is a geographic information system* (GIS)? Retrieved from https://www.usgs.gov/faqs/what-a-geographic-information-system-gis

World bank (2025) *What is Food Security*? https://www.worldbank.org/en/topic/agriculture/brief/food-security-update/what-is-food-security

Yunus E S. (2016) Awareness And Adoption of Precision Agriculture In The Cukurova Region Of Turkey. https://www.academia.edu/81875869/Awareness_and_adoption_of_precision_agriculture_in_the_Cukurova_region_of_Turkey?utm_source=chatgpt.co